9345

ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

MAY 15 1920
U. S. PATENT OFFICE

Vol. VIII. Whole No. 85 May, 1920 No. 1

Cutting the Boche Electrified Barbed Wire

SMITHSONIAN
FEB 28 1995
LIBRARIES

By VAN LOUIE MARTIN

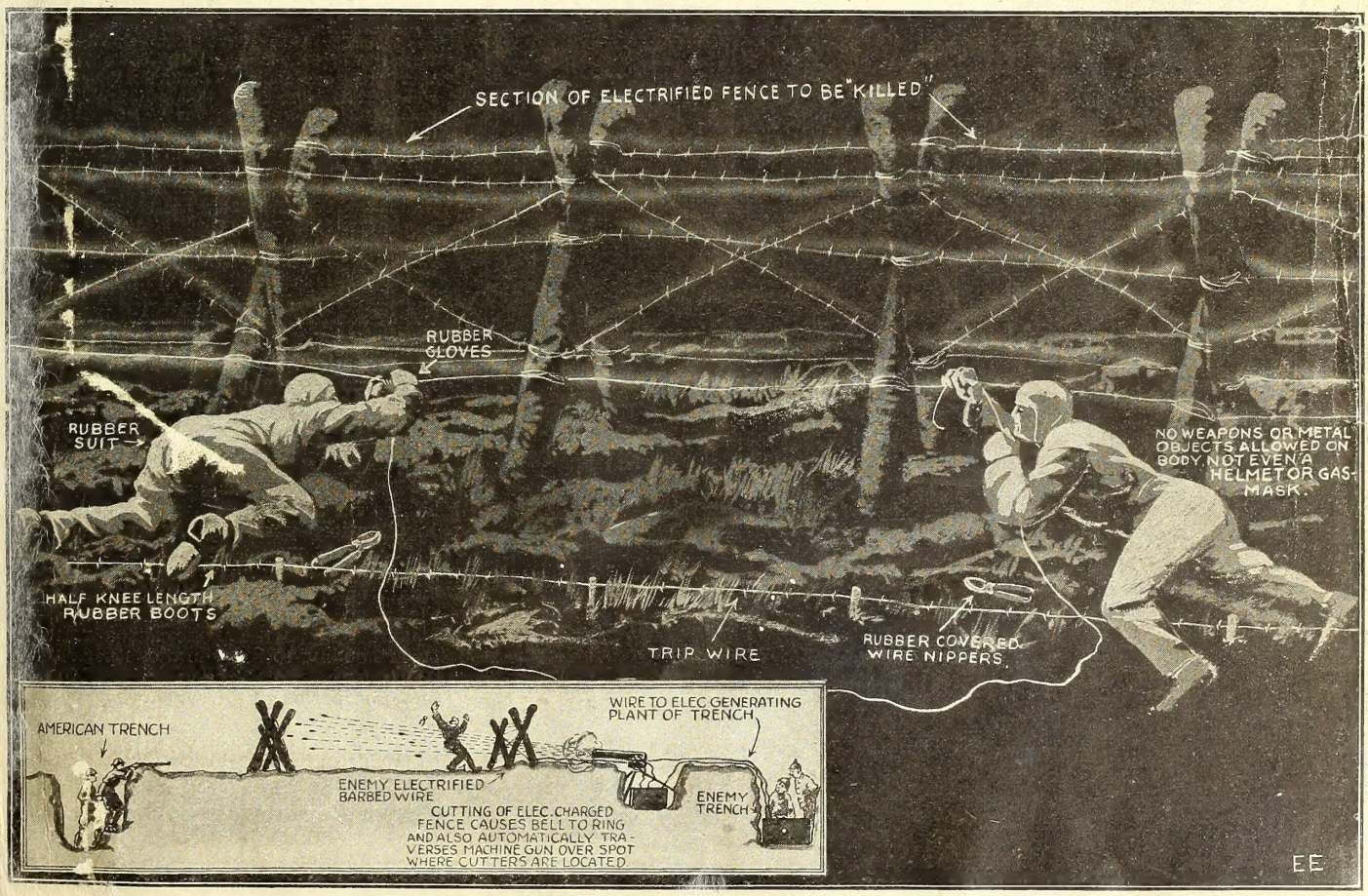
51st Inf., 2nd Bat. Scouts, U. S. A.

It was in the fore part of September, 1918 and we were in reserve at the famous Schluct Pass in the Vosges Mountains, province of Alsace, and near the French, Germany and Switzerland boundary line. We were overlooking the little city of Münster and were quartered amongst batteries of French mountain guns that had been firing, undetected, upon the enemy front lines, six kilometers away, from these same positions for about four years.

One afternoon, at about the close of day, when the cold rain was pouring down,—and it rained in France 330 days out of a possible 365 during 1918 (Brest Official Report)—and they call it "Sunny" France,—we started our weary hike to a point in the front lines about ten kilometers away, overlooking the little village of Orbey. We were not allowed to stop for a rest on this hike as we were, of course, well within enemy artillery range all the way, and we were to relieve the French troops before daybreak the following morning. We had no mishap until arriving at Las Noir; (Black Lake) here we were led by a French guide down the bed of a diverted mountain stream camouflaged on both sides and overhead. The guide, knowing the terrain so well, naturally led us faster down this rocky stream bed than we could follow, and altho each man was trying to hold onto the pack of the man stalking along in the dark in front of him,—we were from necessity taking it "Indian" fashion, or single file—several platoons became disconnected from the main body.

In spite of delays one o'clock found us all stationed at our designated places in the front line trenches and by three o'clock

(*Continued on page 76*)



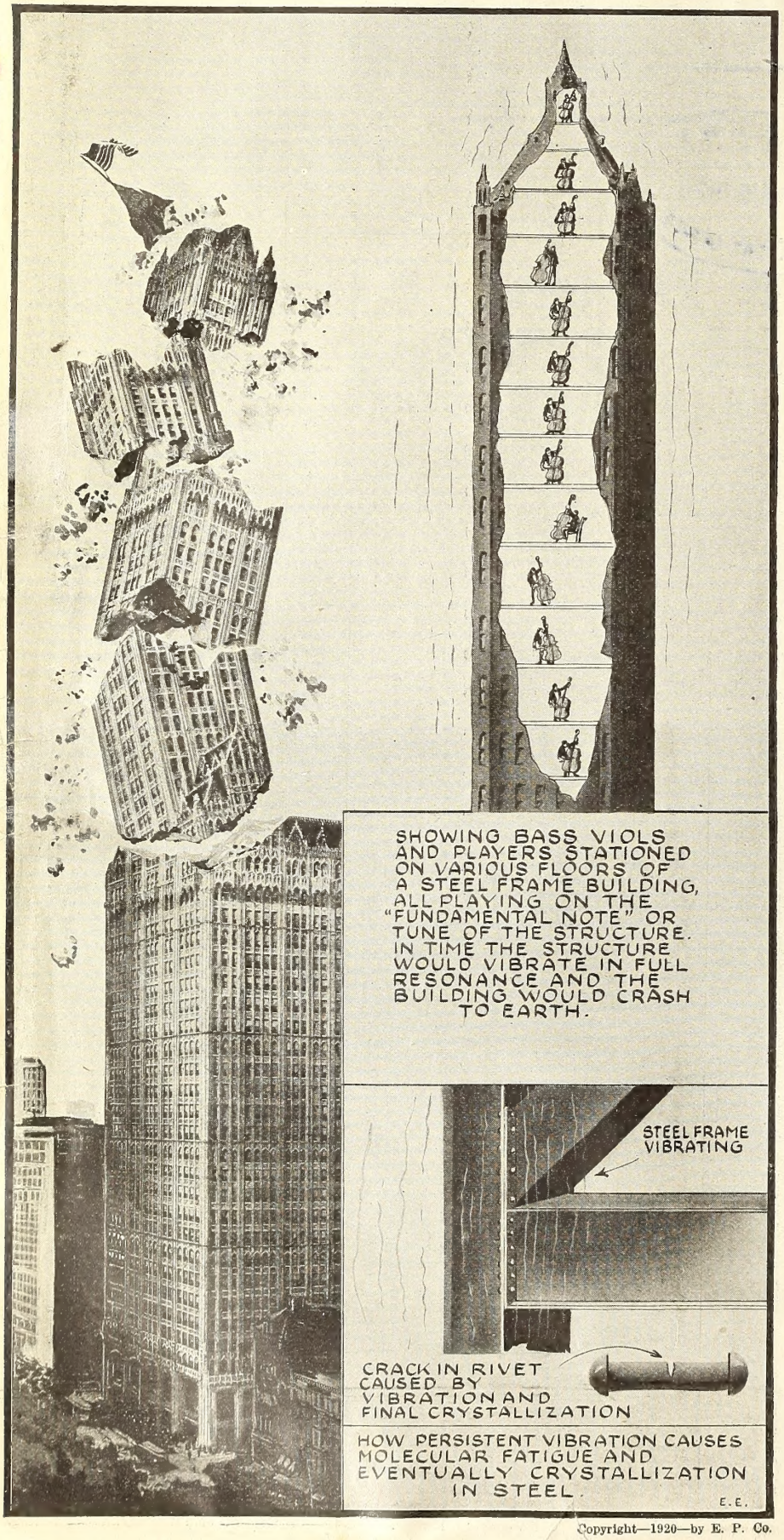
The Exciting and Life-Risking Business of Cutting Boche Electrified Wire Fences Is Here Narrated for the First Time by a Man Who Actually Did It.

Copyright, 1920, by E. P. Co.

Oddities of Sound

By H. WINFIELD SECOR

Some of the marvelous things that sound or vibration can accomplish are here described. For example, do you know that it is possible to "play down" a steel skyscraper by placing a bass-viol on certain floors? Do you know how to tell how far a train whistle is, by timing it? What causes an echo? How the phonograph talks?



Copyright—1920—by E. P. Co.

THE subject of *Sound* is one of the most entrancing in all the ramifications of pure and applied science today. Quite a little has been written on sound from time to time, and yet, all in all, really very little has been told concerning it. There are several excellent works, including those of Tyndall, Miller and other authorities, which cover the usual physics of sound, a subject with which we are all concerned, and about which we know so little. The study of the human ear, for example, is one of the most absorbing studies in all medical science,—not the dissecting or analyzing of the ear structure itself, but the complete study of "just how we hear." We will not concern ourselves here, however, with the orthodox aspects and physical studies of sound, which can be found in the text-books treating on the subject, but will confine our present introspections to the outstanding oddities of the science of sound, or what is the same thing,—*Vibration!*

Fig. 2. What's This! The 100,000 Ton Woolworth Building Broken to Bits and Falling into Broadway?—and We Never Read It in the "Squeedunk Herald"!! Well, It Hasn't Happened Just Yet, but It Might. Every Steel Frame Structure Has a Vibrant Musical Note of Its Own. If You Once Ascertain This Fundamental Note of the Structure and If You Can Set It Vibrating at Full Resonance on This Tune, the Structure Will Vibrate so Powerfully Eventually, That It Would Fall to Pieces. A Scientist Some Years Ago, Calculated That If We Could Place a Bass Viol on Certain Floors of a Skyscraper, and If All of These Istruments Were Played for a Considerable Period Persistently on the Fundamental Note of the Building, Say "B. Flat", That the Structure Would Eventually Disintegrate and Fall Apart. The Inset Figure Shows Another Little Known Phase of Vibration and What It Will Do. Experience Has Shown That Where Vibration Exceeds a Certain Limit, the Very Best Steel Will Start to "Crystallize." Other Materials Are Similarly Affected, and Crystallization Will Cause Cracks to Develop in Rivets and Other Members, as Experience Has Shown. At the San Francisco Fire and Earthquake Catastrophe Some Years Ago, the Power of Vibration Was Wonderfully Illustrated. Some of the Tall Skyscrapers Were Shaken Until Every Stone and Piece of Mortar and Flooring Was Shaken to the Ground; but the Steel Framework Held Its Head Aloft Thru It All. Of Course, In This Case the Vibration Was Much More Severe Than Would Be Produced by Any Ordinary Means.

A sound of a certain pitch has a different corresponding frequency in vibrations per second in the air, or solid body in which it originates, also as is well known, there are certain well defined limits above and below which the human ear will not interpret sound as such. Normally, the human ear does not recognize sounds below 16 vibrations per second, nor those above 25,000 vibrations per second. The lower the pitch of the sound, such as a bass note, the lower the vibration period; while the higher the pitch, the higher the vibration rate. Middle "C" on the piano has a vibration corresponding to 259 vibrations per second. The fourth octave above middle "C," has a vibration period of 4,138 vibrations per second, while the fourth octave below middle "C" or low "C," has a vibration frequency of 16 per second. Practically all of our music is written in between these limits.

DEMONSTRATING THE POWER OF MUSICAL VIBRATION.

It is very easy to demonstrate the great power of musical vibration or vibrations in general, by the aid of two tuning forks.

ery high-school student has performed s experiment, but it is not so well known that it will bear repeating here, espe- lly in the demonstration here described. appreciate just what this experiment is, should, if possible, procure two small ing forks, four to five inches long. e tuning forks are usually placed on onant wooden bases, preferably open at e end, and the two openings of the nsmitting and receiving forks arranged face one another. In the laboratory, the ing fork is usually struck on one of the e prongs with a felt hammer, so as to e the maximum vibration at the natural quency of the fork, without interfering h the degree and period of the sound en forth by the fork when struck. If of the forks is now struck smartly on edge of the table or else hit with a all hammer, it will sound its natural note, "A," and if the second tuning fork is the same identical pitch, then it will be rtained that the two forks can be placed a considerable distance apart, in some ances placed across the room; and the rations set up in the air by the first fork, be transmitted and caused to act upon second fork, which will then start rating and give forth a sound of its own. ibration (probably not always but ally within the range of audibility,—that etween 16 and 20,000 vibrations per sec-) has often caused much mischief in gineering and other structural work. A le vibration is a dangerous thing, not in elf perhaps, for the originating source ay be very small as to magnitude, but this ay cause a larger structure to start vibrat- ng—and once a large structure, such as the frame of a building or bridge has started to vibrate at its own natural period or funda- mental note, (and every building or bridge structure possesses its own fundamental note), there may be trouble brewing, once the vibration has reached a fully resonant state and the amplitude of the various members has attained a maximum.

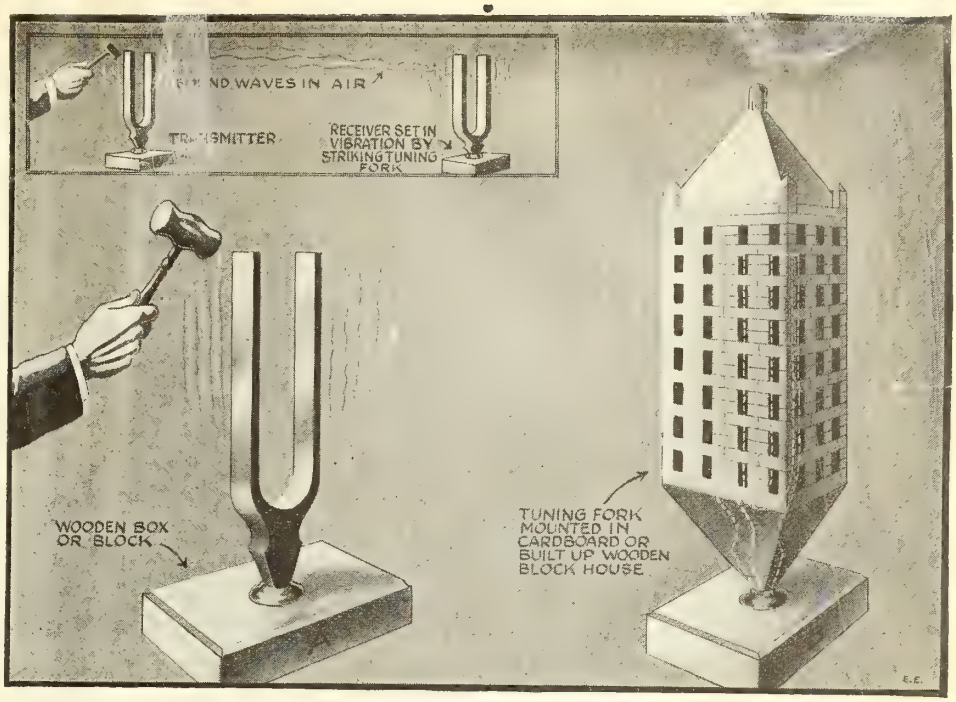


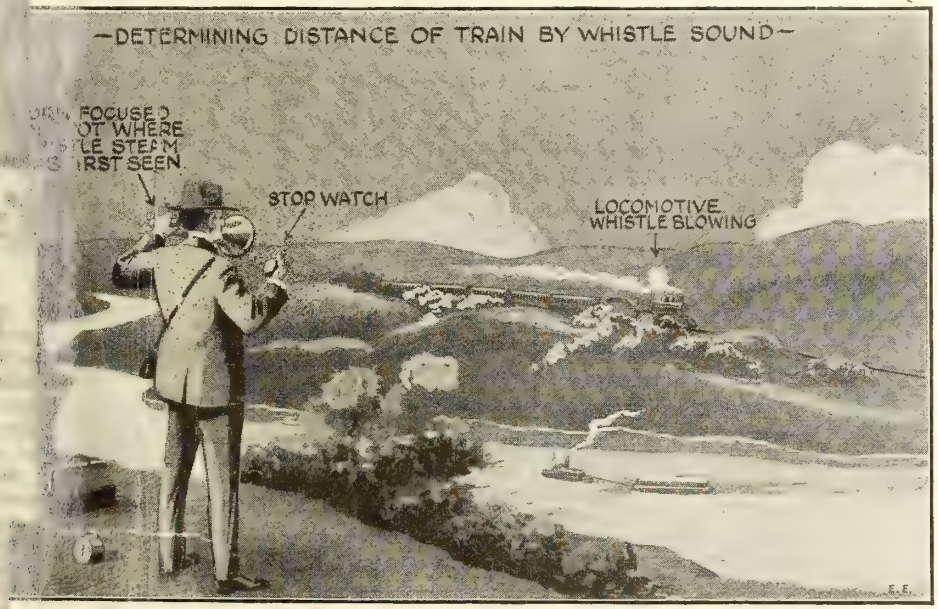
Fig. 1. The Small Inset Cut Shows How Two Tuning Forks of the Same Pitch Can Be Used to Demonstrate the Wonderful Phenomenon of Acoustic Resonance or "Sympathetic Vibration." If the First Tuning Fork Is Struck with a Felt or Other Hammer, the Second Tuning Fork Will Be Set Into Vibration. Mounting the Tuning Fork on Hollow Wooden Boxes Will Give Much Greater Sound, and in Most Cases the Ends of the Boxes Are Open. For This Experiment the Open Ends Should Face Towards One Another. The Larger View Shows How the Same Experiment Can Be Performed in a Very Interesting Manner, to Show in a Small Way, How a Steel Building Structure Can Be Vibrated by Sound Only, Until It Falls Apart. The Tuning Fork Is Mounted In a Free Wooden Base so as to Rest on the Box as Shown. On This Base a Miniature Building May Be Constructed of Small Wood Blocks and When the First Tuning Fork Shown, Is Struck the Second Fork Inside the Building Will Start Vibrating. When It Reaches Full Resonance, the Building Will Collapse and Fall Over. A Very Beautiful Experiment!

SKYSCRAPERS COULD BE DESTROYED BY SOUND ALONE!

A very interesting experiment which is nothing else but a demonstration on a small scale of the undreamt of power of vibra- tional force, is illustrated at Fig. 1. To form this experiment, a small cardboard scraper may be mounted on a wooden of the shape shown, with the sec- ing fork mounted inside of it. The ork is mounted firmly in the wooden e, and this base rests in a free position on the receiving block or resonant chamber as shown. Now, when the tuning fork at the left is struck with the sounding hammer or otherwise vibrated, the second fork will start vibrating, the amplitude of vibration depending upon the distance from the originating fork, and eventually the miniature building will topple over. In some ways this is perhaps but a crude illustration of vibrational force as applied to a large building, but it at least gives us some practical idea of this phenomenon.

Several years ago, one of our greatest experts on musical sounds and the tremendous forces of vibration, stated that he could "play down" a skyscraper such as the Singer tower, or the Woolworth building, in New York City, simply by placing musical instruments, such as bass-viols, on each floor or on certain floors, and in certain parts of the building. The theory of this action is as follows: He would first determine by calculation or otherwise, the fundamental note of the entire structure, which would probably be very low in the tonal register. Then the musicians would all start playing their instruments on this fundamental note, and keep it up. Of course, this really is a theoretical consideration but under certain conditions the main possibilities of such an experiment are very logical and plausible. It might take quite a little time to get the whole structure vibrating at its natural frequency, once it did, it would be high time for the tenants on the fifty-fourth floor and the lower floors of the Woolworth building to scuttle earthward, for there would shortly be a shower of bricks, stones and mortar from the entire structure into the street. At this juncture a very startling and parallel incident comes to mind and shows what vibration really can do. At the time of the San Francisco fire and earthquake, the author remembers having seen photographs of the tall buildings, one of about sixteen stories, which had been shaken by the earthquake or *vibrated,* until all of the stone work, floors, etc., had been shaken free from the steel frame, leaving absolutely nothing but the steel frame complete—stretching upward in the air like a Martian giant ready to stalk over the world, à la H. G. Wells.

All of these vibration stresses are taken into consideration by engineers and architects who design tall buildings, particularly skyscrapers, especially where the ground is vibrated under them constantly by subways, as in our large cities. In the ordinary building structure, where the steel frame is covered with stone and other building materials, these all help to absorb any vibration set up in the metal framework, in the same manner as the hand or any other part of the body touched against a vibrating tuning fork absorbs the vibra-



g. 4. A Very Interesting Phenomenon of Acoustics or Sound Is That Here Illustrated. By Knowing the Time When e Steam from a Locomotive Whistle is First Seen, and the Time When the First Sound Is Heard, the Distance of e Whistle Can Be Readily Calculated by Simple Arithmetic. The Velocity of Sound in Feet Per Second Is Multiplied by the Number of Seconds Elapsed, Between Seeing the Steam and Hearing the Sound.



Fig. 6. The Un-Musical Parlor: If You Have Heard Any Strange Noise Which Jarred on the Ear When Your Piano Is Being Played, Look Around for Glass Vases, Metal Picture Frames, or in Fact Anything Made of Metal or Other Hard Materials such as Brass, Porcelain, etc., All of Which Have a Fundamental Vibrating Note of Their Own, Altho You May Not Think So. In Some Cases, the Object Will Vibrate So Strongly That It Has to be Removed from the Piano or from in Proximity to the Piano.

tion of the fork, and brings it to a stop very quickly. The arrangement of the musicians and their bass-viols for vibrating a steel structure according to this theory is shown at Fig. 2.

VIBRATION IN BRIDGES.

As just pointed out the building materials which cover the steel frames of our office and factory structures serve to absorb the majority of any ordinary vibrational forces set up in the steel framework, and thus prevent anything approaching a disastrous collapse of the building; but when it comes to *bridges* there is no such absorption of the vibration and you will always note a great deal more free movement in all of the various steel members of a bridge no matter of what size.

In some cases, especially on large bridges like the Brooklyn Bridge over the East River in Greater New York, the vibration may take on the nature of a long, slow swing, which might be so gradual as to pass unnoticed by the human senses. However, you will often notice the vibration in a bridge distinctly, even where the bridge rests on properly spaced piers, every time a wagon or automobile goes trundling across the planking, and oftentimes in this connection you will become aware of a certain peculiar note, which if you had the correct apparatus to check it up with, would tell you what the exact register of this note is; which might possibly be the fundamental note of the whole bridge structure, or again it might be simply the fundamental note of a certain part of the structure, depending upon the conditions.

This matter of vibration and the tremendous forces which may result from rhythmical repetition of certain vibrational or musical notes, if you want to call them that, is always kept in mind by military men. Every soldier who has ever marched across a pontoon or in fact any bridge will undoubtedly recollect the method and the orders given for carrying out this procedure. The first and most important thing in marching a body of troops across a bridge, especially a small or lightly constructed bridge, is to have them *break step*. If the soldiers are marched across such a bridge in their regular step—tramp, tramp, tramp—the result will be that the rhythmical wave of vibrational force will travel along the length of the bridge, and grow stronger and stronger as the steady beat of the marchers persists—and eventually, perhaps in a few minutes, the bridge will be heaving up and down like a teacup on the ocean and break up or collapse. Fig. 3 illustrates this phenomenon very vividly. At "A" we see how the bridge sways as the troops march across *in step*. At "B" the successive and constantly increasing amplitudes of the vibrational waves creeping along the length of the bridge is clearly depicted, while at "C" the proper method of marching soldiers across a bridge is shown under the command of *break step*.

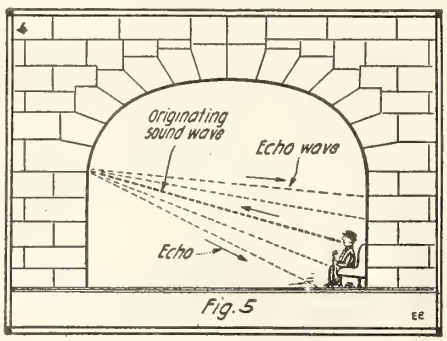


Fig. 5. The "Echo," with Which We Are All Familiar, Is Caused by a Sound Wave Being Reflected. We Often Notice This Effect in Stone Archways in Public Parks, or Wherever There Is a Hard Resonant Surface Against Which the Sound Can Impinge and Then Be Reflected.

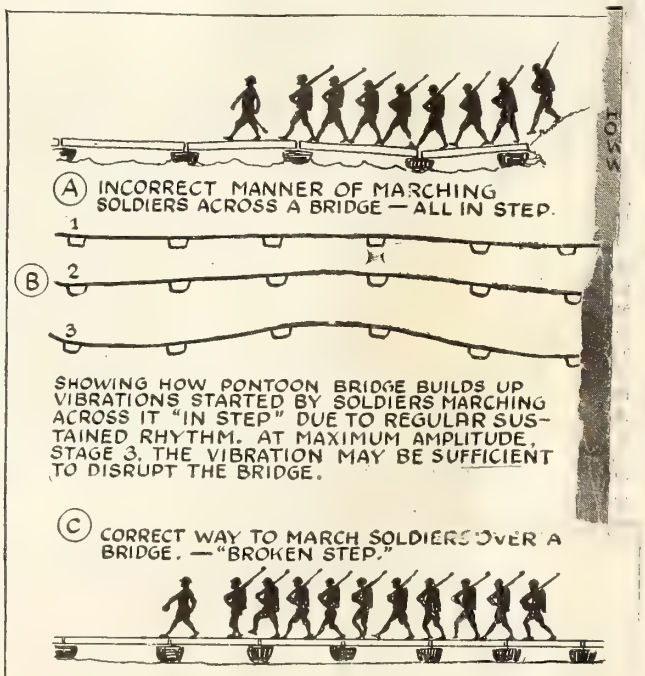


Fig. 3. This Shows the Various Stages of Vibration as Set Up in a Bridge, When Soldiers Attempt to March Over It with Each File of Men "in Step." The Order Is Always Given to "Break-Step," When Soldiers March Over Bridges, Whether Large or Small, to Prevent the Chance of a Regular Rhythmic Vibration Being Set Up Which Would Eventually Attain Such an Amplitude as to Cause the Bridge to Break Into Sections. Every Military Man Is Made Thoroly Familiar with This Vibratory Effect Early in His Career.

It is of course evident that with t *broken step*, i. e., the successive files soldiers taking their steps at differe moments precludes the possibility of rhythmical vibration being set up and pr vents it from becoming of dangerous pr portions. Another peculiar result of su tained vibration, even tho it may be mo slight in nature and almost not noticeal even to an inspector of steel building a bridge structures is *crystallization*.

Several years ago the writer had opportunity of seeing just what crystal zation really can do under the lashwhip sustained but minute vibrational forc Referring to one of the detailed illustr tions at Fig. 2 we see how crystallizati caused by vibration will crack iron riv and not only rivets, but even steel bea which are subject to such action as w as shafting and other metal members.

In one case, which the writer saw at fi hand, an electric motor armature of co siderable size had all of the lead wires co necting the coils to the commutator brok off every two weeks. They would not be broken off at once, but a great many them would be severed, and upon examin tion by a chemical expert he pronounc the cause as due to severe and persiste vibration which had caused *crystallizatio* of the copper conductors. The ends these conductors where they broke off o parted were crystallized just like balls o fine glass, even under the microscope. This trouble was finally remedied by changing the toothed gear drive from this armature to a smooth and less vibrational chain drive. Also the electrical experts finally decided on replacing all of the *solid* copper wire leads connecting the coils to the commutator by stranded conductors made of many fine wires or small cables.

DETERMINING DISTANCE BY VELOCITY OF SOUND.

The velocity of sound in air, when the temperature is 70° Fahrenheit, is 1,132 feet per second. At the freezing temperature the velocity of sound is 1,090 feet per second; that is, at 32° Fahrenheit. The velocity of sound in salt sea water, as used in submarine signaling, is approximately 4,000 feet per second. Musical sounds different pitches are all propagated in open air with the same velocity. Ex sive sounds and sounds confined as in tu are propagated with different velocitiun as

(*Continued on page 72*)

A Bullet-Proof Searchlight Reflector

By EDWIN F. LINDER, M.E.

MANY ingenious contrivances have been produced under the stress of the unusual circumstances which have always accompanied the wars waged by nations during the various periods of history. The recent great conflict was no exception to this natural tendency in stimulating the inventive traits of the scientific members of both the civil and military groups opposed to each other. It can therefore be safely assumed that the great magnitude of the last military campaign, in which so many millions of people were engaged, presented a much larger field for the development of suggestions for military use than any other previous war. Perhaps, at the close of actual combat, more than *one hundred thousand schemes* were under consideration by the officials of the allied governments and by engineers and other private professional enterprises engaged in the production of supplies and equipments for the armies in the field. Thousands of experiments were made along heretofore unknown lines of military action; a number of these efforts were crowned with success, yet the vast majority proved of little use when put to the terrific test of the battlefield. However, the benefits gained by the opportunities presented to observe the deficiencies of the countless number of devices will serve to build up better and more effective equipments for future protection.

THE SEARCHLIGHT IN WAR.

During the early stages of the war the searchlight was found to be of great service in sweeping over the territory beyond the front trenches, known as "No Man's Land." Here it was found extremely difficult to protect the apparatus from the alert marksman stationed behind the enemy's line. Every imaginable ruse to hide the location of the searchlights was resorted to, such as shifting them from place to place; using several close together, operating one—then shutting off the light by shutters and putting the others into action—yet it would not be long before the enemy range-finders would find the mark and finally a well placed shot would end its career.

METALLIC MIRRORS NO BETTER THAN GLASS

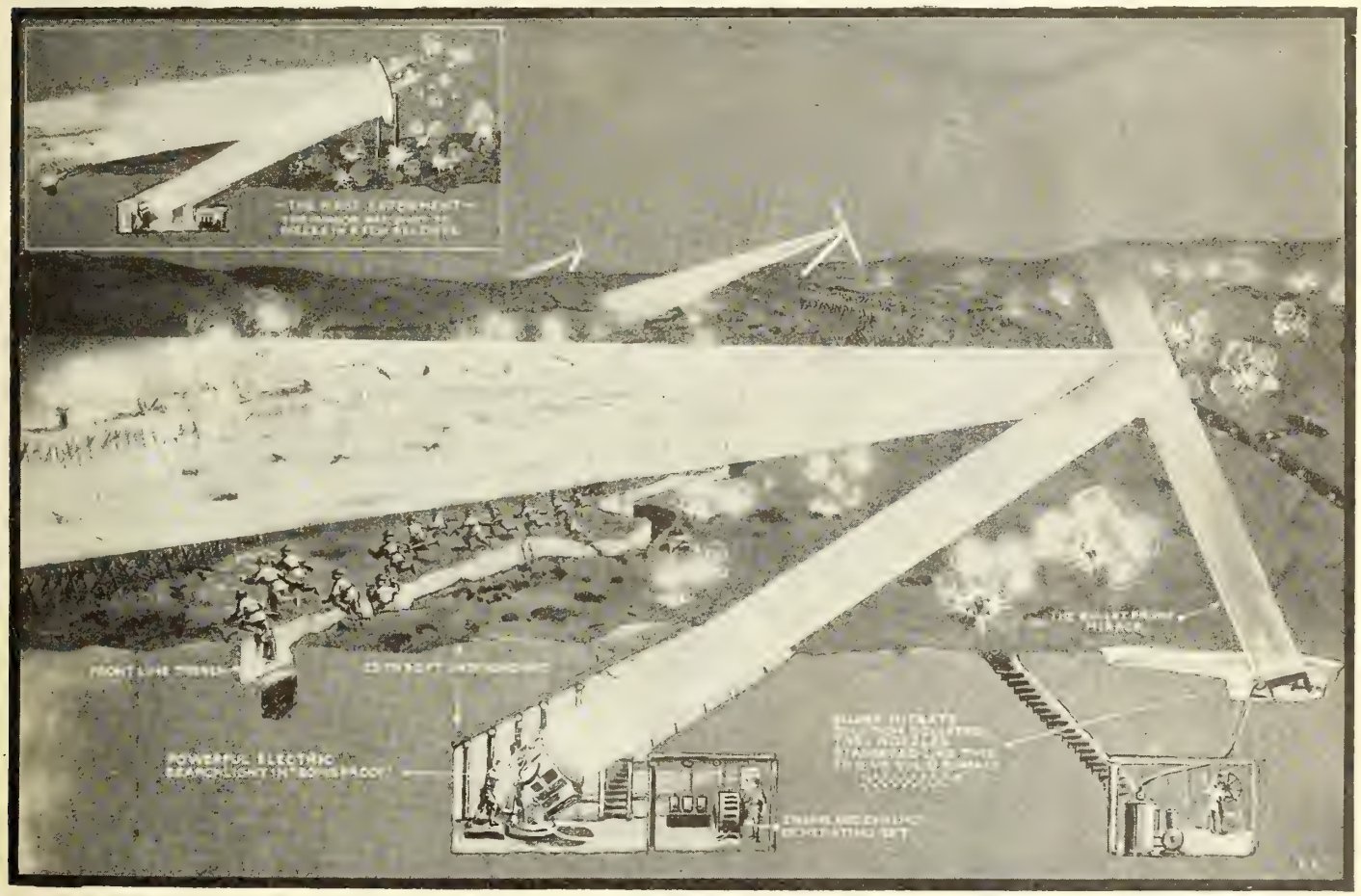
Metallic parabolic mirrors were substituted for the more delicate glass types, but fared very little better at the hands of the enemy, who had become exceedingly skillful in quickly demolishing searchlight stations.

When this country entered into the conflict a new source of genius was brought to the assistance of the Allies, and among the most useful and much needed branches, the staffs of experts in the searchlight industries of several of the largest establishments in the world, were the first to whom was detailed the difficult problems of devising means to fill the requirements of the wrecked equipments of the Allies' forces and also to furnish better devices for our own army.

The then existing models of searchlights, which had proved to be defective, were replaced by many new types of design. Experience of the staff officers in the field pointed out that what was required to improve this branch of the service were designs that would produce searchlights that could be operated under cover of some kind of overhead protection, and at the same time enable our army experts to direct the beam at will toward the enemy. This type of light was sought for trench use where the beam was to be usually rotated on a horizontal plane.

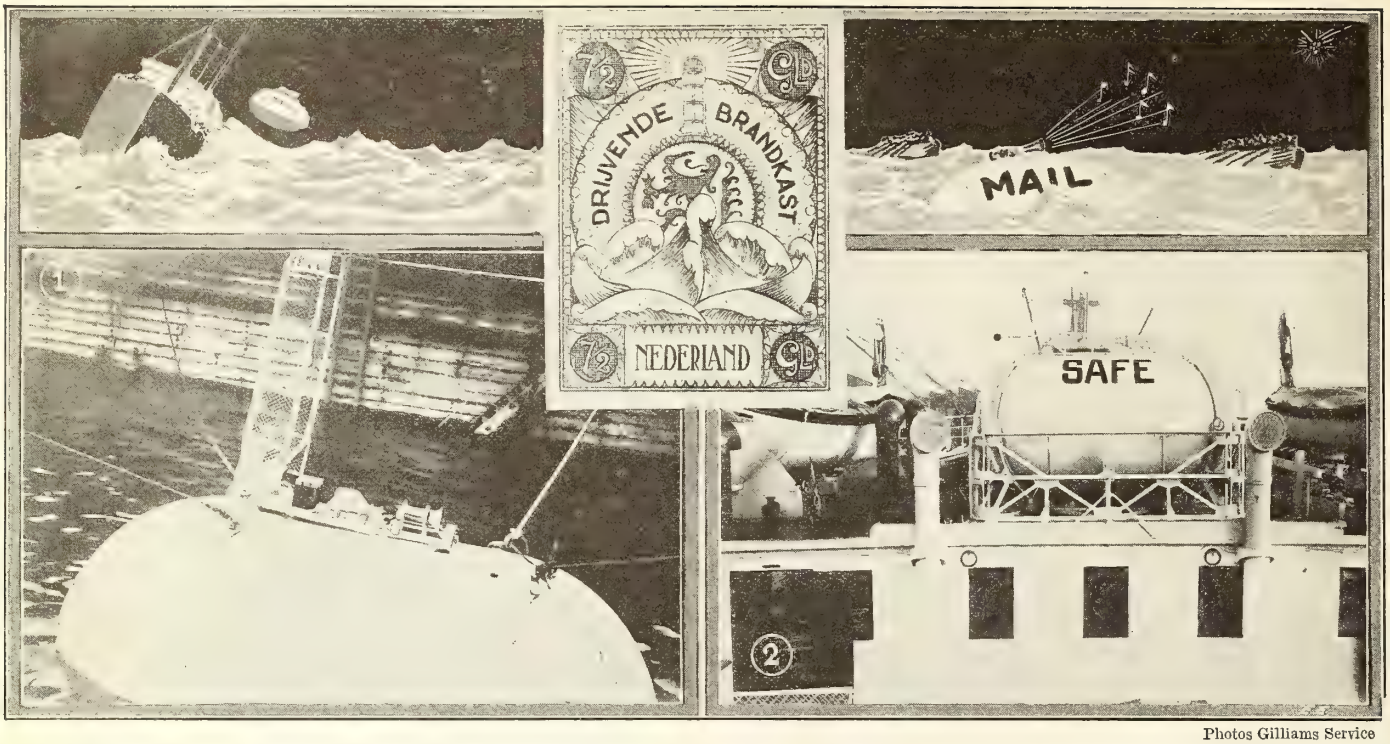
After much study a type was actually constructed by an American concern in which the chief improvement was the mounting of a plain glass reflecting mirror that could be pivoted to the desired angle on a long tube. When in use, the only parts exposed to the gun fire and snipers of the enemy was the plain mirror. This scheme of course protected the major part of the apparatus from damage to a greater extent than the former models—but soon was discarded, as the exposed position of the second reflector served as an excellent target, and once shattered placed the plant out of commission. (The insert in the illustration gives a very good idea of what happened every time the plain mirror would be raised above the top of a trench.

(*Continued on page* 66)



Copyright, 1920, by E. P. Co.

A Bullet-Proof and Shell-Proof Mirror by Means of Which It Becomes Possible to Reflect Searchlight Beams Across "No-Man's-Land" into the Enemy Territory Has Become a Reality, Thanks to the Invention of the Present Liquid Mirror. The Searchlight Is Placed Well Under the Ground in Such a Position That It Is Very Difficult to Destroy, Even by Shell-Fire. The Mirror Is Composed of Fine Jets of Mercury or Other Suitable Liquid, Overlapping Streams of Which Are Squirted Skyward in the Manner Apparent from the Illustration and Which Tests Have Shown to Act as an Efficient Mirror for the Purpose.



Photos Gilliams Service

A Floating Safe: An Ingenious Invention for Use Aboard Ships. The Safes Are All Equipt With a Complete Signal Apparatus Giving Light Every Fourth Minute. One Minute a Sound Signal (Horn) Every 9 Minutes, One Minute Duration, During 3 Months and a Rocket Every Hour During 12 Hours. The Signaling May Be Set to Commence One Half Hour After the Safe Floats. Every Safe Is Provided With Means by Which When Floating It May Easily Be Picked Up. It Also Has On It a Brass Plate On Which the Name of the Ship and the Cable Address of the Safe Company Is Stamped. It Is Also Thought That the Safes Will Prove of Value In Saving Life In Case of Ship Wreck, by Providing a Clear Beacon for the Lifeboats to Remain Close By, Thus Enabling the Rescuers to Find Them More Quickly.

Floating Safe For Ship Mail

OF the many recent inventions and devices recently invented to save life on high sea, all being more or less a direct result of the efficient, however ruthless, manner in which Germany carried on her undersea attack in the recent war, none has so far proved as practical as an ingenious invention known as a *Floating Safe* that has just been put into use by the Dutch Postal Service. This new device is being used on the mail steamers of the Netherlands Steamship Company, carrying mails to and from the East Indies and other parts of the world.

Because of its being a very efficient protector of valuable mail during the imperiling transit at sea, this new device is very likely to prove of most vital importance to the commerce of the entire world.

Great financial distress has often been caused as the result of important and highly valuable mail which it was impossible to duplicate, being lost following a wreck at sea. The loss at sea of valuable mail, containing drafts, checks, money orders, stocks and bonds, always results in serious delay in the straightening out and settling of affairs occasioned by their loss. There is not the least doubt that such accidents and losses have a retarding effect on international commerce along certain lines.

Considering all this, it is rather remarkable that no previous attempt of any account has been made to thoroly safeguard the mails in case of shipwreck. Now, however, that the thing has been done and a suitable device has been perfected by the Dutch Postal Service, it seems almost certain that other countries will follow the example of Holland, and that it will not be very long before all steamships carrying transatlantic mails will be equipt with floating safes built along similar lines.

The floating safe that the Dutch Postal Service is now using so successfully is very different in appearance from the ordinary combination safe such as we know it. Instead of being square, it is oval in shape, painted a glistening white, with the word "Safe" emblazoned in large letters on either side. These letters can be seen at a considerable distance.

The device itself consists of a safe proper and a cradle. The latter is made of a frame work of iron with stout wire netting. It will hold the safe under all circumstances, except when the ship with the deck on which the cradle is fastened sinks to a considerable depth below the water. In this case the safe is released automatically!

The safe during the voyage of the mail steamer is located on the deck of the ship in full view of the bridge, so that the officer on duty can constantly keep a watchful eye upon it, in the event that anyone on board the ship should attempt to break it open. As a further safeguard, it is connected with the dynamo of the vessel, so that any person not knowing the wiring and touching the outside will either start a signal or be unpleasantly surprised. At no time are passengers on the ship allowed near it, being warned constantly by the crew and printed orders to keep away from it.

The safe is oval in shape to prevent wreckage from attaching itself to it; also to give it greater strength and buoyancy. It is designed to float on the bulkhead principle, and the greatest of care is taken in its manufacture to prevent any possible leakage of sea water. In the manufacture no riveting is involved, all of the joints being welded and hammered. It is practically fireproof, being able to stand tremendous heat without melting or causing injury to the contents. It is constructed of three different sheets of especially prepared steel, each built inside the other, which add to it strength as well as buoyancy. While they are made in different sizes to suit the carrying capacity of the ship, most of the safes measure 4,000 millimeters (about 13 feet) in length, with a diameter of 2,000 millimeters (about 6½ feet), and a carrying capacity of 3,000 kilograms (about 3¼ tons), which is more than the average volume of really valuable mail shipt at one time on most transatlantic steamers.

At the time of a shipwreck, when the safe and its contents is cast adrift on the sea, it is by no means a helpless floating object, as on the top or deck of each safe there is a complete signaling apparatus, which, when the safe is thrown overboard and cast adrift from its cradle, starts to work automatically, thirty minutes after the safe starts to float. This apparatus flashes a bright light every fourth minute for the duration of a minute as a miniature lighthouse. In addition a signal horn is sounded every ninth minute. *These operations will be kept up for three months* should the safe not be picked up by that time. Besides these precautionary measures, hourly for twelve hours after the safe is released from the ship a rocket is automatically set off.

When the ship is about to leave port, the safe is closed with two or more covers provided with special locks and keys. Then it can only be opened by the use of a secret code. Every safe in addition is provided with a special compartment which automatically destroys all the contents should an attempt to force it be made by an unauthorized person.

In order that the Dutch public may profit by the use of the floating safes, special stamps (see photo herewith) have been issued by the Government. These stamps are now on sale at post-offices all over Holland, and when placed on a letter or package entitles it to be placed in the safe during the sea voyage.

The keys to the safe during the voyage are carried by the captain of the ship. On the payment of a small fee while at sea, passengers who desire to do so may entrust their valuables to the safety of the new device.

One-Man Car Versus The Jitney Bus

By L. H. ROSENBERG

AFTER the happenings at Toledo last fall when the city was without street car service for twenty-seven days, it will take something more than mere argument to convince the public that the auto bus will be able to replace the present street car systems in our largest cities. It did not take the citizens that length of time to determine that street cars were indispensable to their best comfort, and the only reason that service was not restored in a few days was due to a dead-lock in political circles. Altho numerous "jitneys" were imported into Toledo and private cars and motor trucks were utilized to transport the people during this time, the persons in the residential districts of the city found it well-nigh impossible to obtain means of getting to town without paying an exorbitant price.

In addition, the jitneys and auto buses increased the congestion in the downtown streets to an alarming extent. If this was the case when inadequate transportation facilities were available, it is not hard to visualize what the result would be if the number of automobiles was increased to take care of the situation.

Such a congestion is bound to increase the number of accidents because it is only natural to assume that the number of accidents varies as the number of machines on the street. Furthermore, the fact that auto buses have no definite lane of travel greatly increases the danger. Children playing in the streets (there is no other place to play in the large cities) are more than likely to stay off of the tracks where they are sure that cars will run with certain regularity. If, however, accidents do occur with street cars, the injured are certain to obtain some compensation because they deal with a responsible corporation. This is usually not the case with the auto bus or jitney because the owners are more or less of a fly-by-night character.

The general thought that auto buses take less time because they make fewer stops is not really correct, for this condition is not an advantage to the rider since auto buses are limited as to passenger capacity, and the reason that few stops are made is because they are loaded to capacity shortly after leaving their terminal. For instance, the Fifth Avenue buses in New York City, operating during the evening rush hours, run about two hundred feet apart, and they are usually filled to capacity shortly after leaving their starting place. Of course, if additional lines were placed in service, the situation would be somewhat relieved but any home-goer would rather stand up in a crowded street car than be delayed for his dinner.

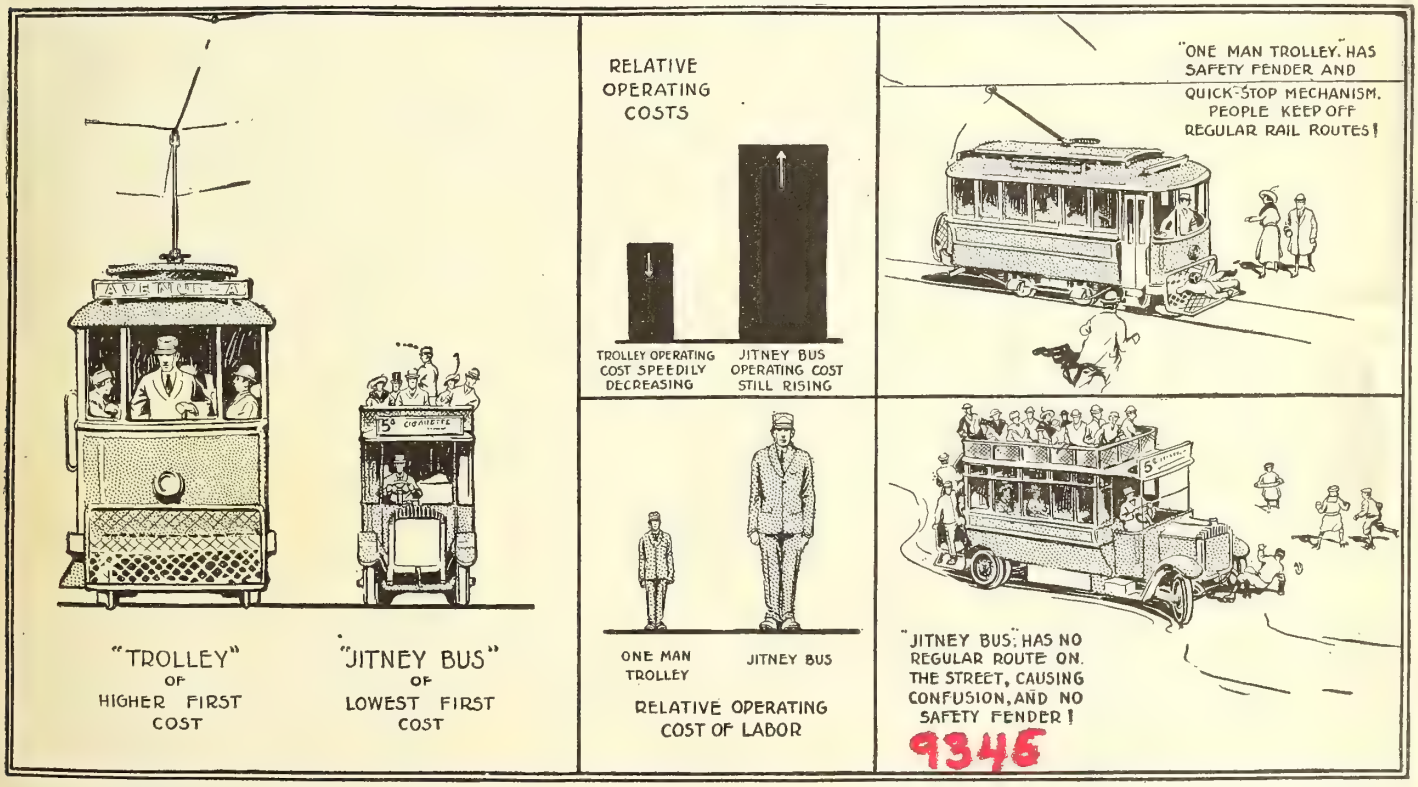
The possibility of auto buses replacing electric street cars has been still further lessened by the introduction in the last few years of the one-man safety car. About three hundred traction companies in the country have already installed these cars in order to reduce the headway between cars and to obtain increased operating speed. Since the cars are of smaller capacity, fewer stops are made, and they can operate at higher schedule speeds than the larger double truck cars. Their lighter weight permits a definite saving in power consumption.

Thus both of the so-called advantages for the auto bus frequency of operation and greater speed are equalled in the one-man safety car.

From the labor standpoint the safety car is comparable to the auto bus; in fact, it is better in some cases where two men are needed to operate the bus. More safety is obtained with the electric vehicle as adequate precautions are taken to make the safety features inherent in the design. Some of these features are: Car cannot be moved or the brakes released until the door is closed; the door cannot be opened until the brakes are applied and the controller moved to the "off" position, and the controller is equipt with a device which requires a conscious effort on the part of the operator to properly perform his various duties. These features actually prevent accidents.

After all the basis for determining which is better, the one-man car or the auto bus for transporting the people in large cities is the economical consideration. It is true that the first cost of the auto bus is less than the trolley installation when the entire investment of track, overhead, substations, etc., is considered, but the operating cost of the trolley installation is much less. This statement, of course, is based on the cost per passenger handled. With gasoline constantly rising in price there is no doubt but that this item is to become a greater and greater factor in the cost of auto bus operation. On the other hand, the cost of producing electrical energy is becoming less as large super-power stations are built. The water power bill just past by Congress guarantees that this cost will remain somewhere near its present value.

The apparent superiority of the auto bus is seen, therefore, to be really an inferiority, due to several factors, which are usually lost sight of by the layman.



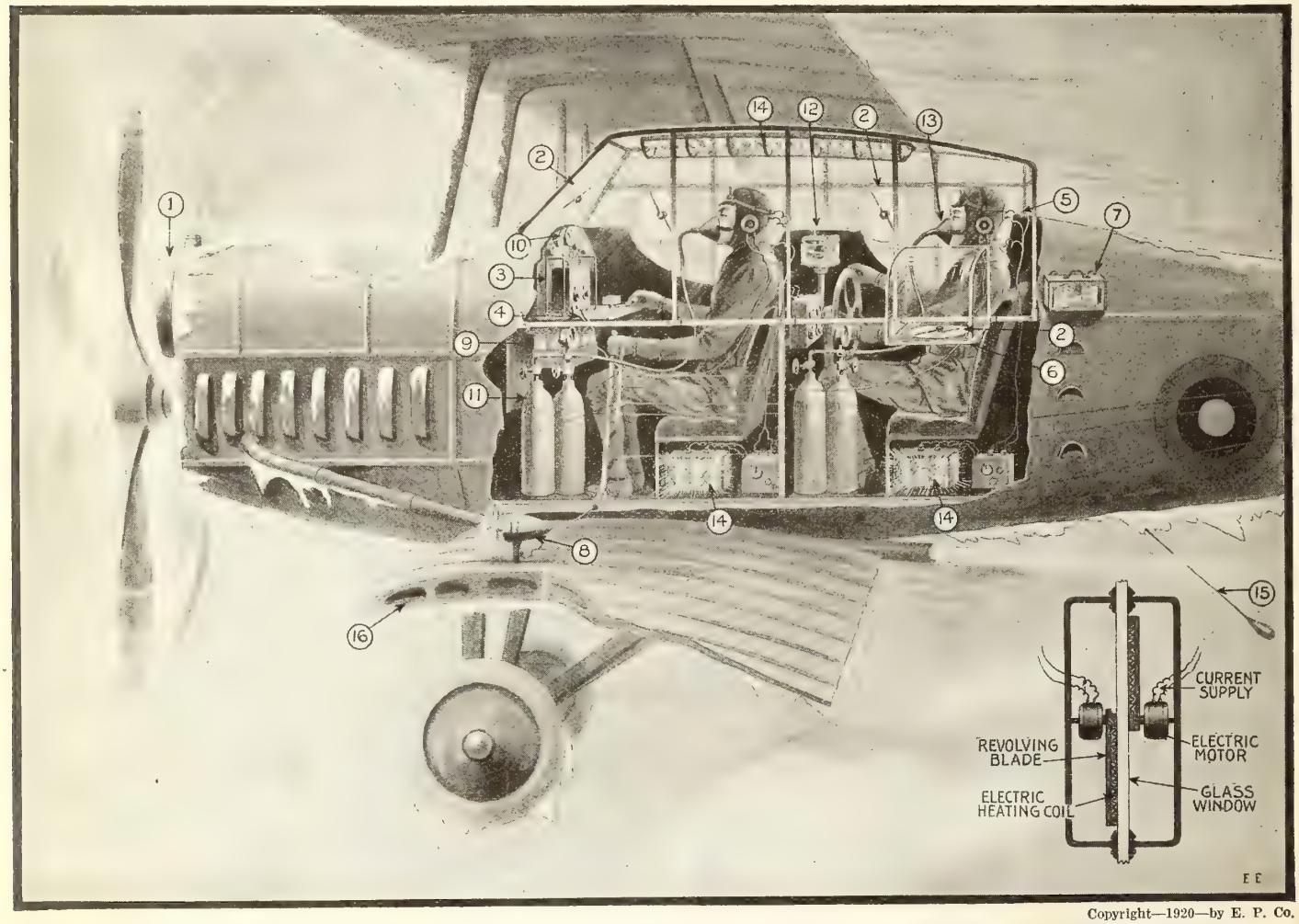
In View of the Numerous Articles Which Have Appeared in Various Enthusiastic Newspapers and Certain Journals Concerning the Wonderful Merits of the "Jitney Bus" as Compared to the "Electric Trolley," Our Readers Will No Doubt Like to Learn a Few Real Facts Concerning the Relative Values of the Trolley and the Bus as Analyzed by Mr. Rosenberg, an Engineer With the Westinghouse Electric and Manufacturing Company.

Flying In A Vacuum

What Happens to an Aviator Flying at 36,000 Feet Altitude and Higher

AVIATION fans have recently had reason to become greatly enthused over the marvelous high altitude climbed by Major Rudolph Schroeder, Air Service, U. S. A., when he forced his "La Pere" airplane, fitted with a 400 H. P. Liberty motor, to a height of 36,020 feet, smashing all world records in high flying, for any class of machine. Last year, Roland Rohlf set a new world's record in high altitude flights at 34,610 feet. Major Schroeder has kept persistently at it, and has now established his new record surpassing that of Rohlf's by 1,410 ft.

his senses numbed by the severe cold of 67° below zero, his airplane covered with frost and ice, even to the red-hot exhaust pipe of the Liberty motor, and with his eyes partially frozen, Major Schroeder lost control of his machine and plunged earthward at terrific velocity. His plane fell like a plummet for a distance of 5 miles (his caused it to glide to a graceful landing. When the plane finally landed on the field, the spectators who had been watching it and who had thought that it was a comet or some other meteorological freak, rushed toward it and found the intrepid flyer sitting erect in the cock-pit, apparently lifeless. The terrific strain on the human body, especially the face and eyes, caused by riding thru the air at 100 miles per hour or more in a frigidly cold atmosphere, is here demonstrated vividly. On the surface of the earth it is generally understood, that the humors inside the eye-balls never freeze, but they apparently have a freez-



Copyright—1920—by E. P. Co.

1. Supercharger comprising Air Compressor and Oxygen intensifier for carburetor System of the Liberty Motor, so as to Develop the Same Horse-Power at High Altitudes as at Sea Level.
2. Electrically Heated, Motor-Driven Ice and Water Scrapers on Glass Windows.
3. Wireless Telephone Transmitter and Receiving Set Mounted in Springs.
4. Wires From Radio Set to Microphone and Receivers in Helmet.
5. Electric Wires From Battery to Heating Coils in Helmet, Suit and Shoes.
6. Glass Window Electrically Cleaned for Looking Downward.
7. Barograph for Recording Altitude Automatically.
8. Wind-Driven Dynamo Supplying Electric Current for Radio Set.
9. Auxiliary High-Tension Battery for Radio Set.
10. Usual Flying Instruments,—Gasoline Gage, Etc.
11. Oxygen Tanks.
12. Gyroscopic Airplane Compass.
13. Oxygen Mouth-Piece, Including Microphone mounted therein.
14. Electric Heaters to Warm Glass-Enclosed Cab.
15. Radio Antenna Wire With Stream-Line Weight.
16. Section Thru Airplane wing.

Detail in Lower Righthand Corner, Shows Cross-Section of Electrically Heated and Driven Window Scraper.

Men today, especially aviators, are making history,—history more entrancing and exciting than the wildest tales of romanticism and adventure written by our greatest novelists. When Major Schroeder establisht his new world's record of 36,020 feet, at Dayton, Ohio, on February 27, he had one of the most miraculous adventures that any person possibly ever had or will have for some time to come. With his supply of oxygen low or nearly exhausted, highest altitude having been nearly 7 miles; 5,280 feet per mile). The instruments on his machine indicated that it had fallen a distance of more than 5 miles in less than two minutes, that is, at the rate of one mile in .4 of a minute.

Having recovered his flying senses owing to his vast experience in piloting airplanes, at a distance of about 2,000 feet above the ground, Major Schroeder managed to get his machine out of the diving angle, and ing point, and it would seem that Major Schroeder was so unfortunate as to have found it, for he landed with his eyes partially frozen, and spent several days under expert medical care in a hospital, before he was able to see properly.

Even before the rapidly falling airplane itself became visible, observers on the ground saw that which closely resembled the tail of a comet, which was caused by

(*Continued on page* 93)

Flashlighting Animals

By HOWARD TAYLOR MIDDLETON

PHOTOS BY THE AUTHOR.

THE little folks of wild life land (even those that travel by day) are often encountered in localities where the light conditions are very bad, and if the camera man would procure good pictures under these conditions



Photograph of a "Grey Fox" Digging for Meat. Photographed with a Flashlight Gun By the Author and One of the Finest in His Collection. A Very Unusual Picture!

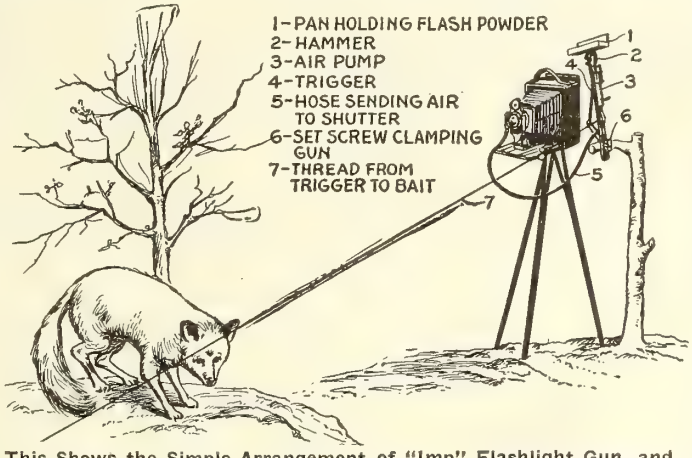
it is essential that he resort to the *flashlight gun*. This little instrument, actuating on the principle of the toy cap pistol, and loaded with magnesium powder, will supply the necessary illumination to produce fully exposed negatives in a dark forest, either by day or by night.

For our work Mrs. Middleton and I have found the "Imp" gun, costing a nominal sum, the most practical, as it works synchronously with the camera shutter, but the Eastman flash pistol, or an ordinary cap pistol, will suffice, as they can be synchronized with the camera by careful adjustment.

I think it very likely that the average person who wishes to enter the fascinating field of Nature Photography by flashlight will prefer the apparatus which is already synchronized. Therefore, I will explain in detail how pictures may be procured by an ordinary hand camera working in unison with the "Imp" gun. As you will note from the rough sketch of the "Imp" in action, it is composed of a pan in which the flash cartridge is placed, of a hammer that comes in contact with the powder when the trigger is pulled, and of an air pump which sends a current of air, by way of a rubber hose, to the camera shutter—operating the same at the instant when the explosion of the magnesium powder occurs.

There is also an attachment upon the gun for operating a camera furnished with cable release. This being the case, it is quite possible to operate two cameras at one time in connection with the "Imp" gun, one equipt with rubber hose, the other with cable—thus doubling the opportunities for a picture.

Let us assume that the sunset is a flaming pageant in the western sky, and that the first of the evening stars are winking overhead. It is time for us to take our way forestward in quest of night portraits. As we are in a good game country buried beneath a heavy blanket of snow, we will look for the tracks of Reynard, Odoriferous Sammy, the skunk, and, perhaps, for the bloody circle inscribed with an "X" in the centre where an owl has not only made his "kill," but left us his autograph as well. Expecting to find these denizens of the woods, we are well supplied with bait to tempt our prospective sitters to our outdoor studio. Patience is a necessary virtue.



This Shows the Simple Arrangement of "Imp" Flashlight Gun, and Camera Operated By Air Pump On Gun, Set to Photograph Animals Automatically By Flashlight.



Guess Who This is? Yep, Foiled Again! It's None Other Than "Br'er Skunk" Nibbling On Some Cheese Used As Bait and Flashlighting Himself.

First of all, we discover where a fox has been digging for mice beside a rotten log. We set up our camera and flash gun there, running a thread from the trigger of gun across the point in the snow where we have burried a delicious morsel of raw meat. Later in the night when Reynard catches a whiff upon the breeze which speaks of an appetizing meal in the vicinity, he will hurry to the banquet at his best lope. Digging frantically, his paws soon encounter the thread; the trigger of the gun releases the hammer which falls upon the powder. A great white light spreads out fanwise in front of Reynard, frightening him mightily. He yaps with terror and flees away thru the forest, leaving the feast behind him—but we have our first animal self-portrait.

Odoriferous Sammy is exceedingly fond of cheese, and, if a succulent piece is left upon the top of a stump in a neighborhood where Sammy abounds, he will be glad to present you with his portrait in return for the sumptuous repast.

A dead bird, used as bait, will eventually bring an owl to our studio, and, if Fate is kind, even that monarch of the night, the great *horned owl* may condescend to sit for us.

A thread strung with corn and laid upon a fence post near a crow roost, will result in a self-portrait of Black Jim.

By way of finale, let me say that nature photography by flashlight is such good fun that it is my earnest wish to have the many readers who are "Camera Bugs" give it a trial. I will be only too glad to give all the aid in my power to those who ask for it.

There are many other ways of rigging up a camera to photograph animals. Those electrically inclined will find it quite simple to work out an arrangement whereby an electro-magnet or solenoid circuit is energized by battery current when the animal trips a thread connected to a switch or light spring contact.



Flashlight Photo of a "Crow", Caught in the Act of Eating Corn Fastened to a String.



An Exceptionally Clear and Remarkable Flashlight Photo of the "Great Horned Owl."

Newton's Less Popular Laws

By PROFESSOR JAMES S. STEVENS

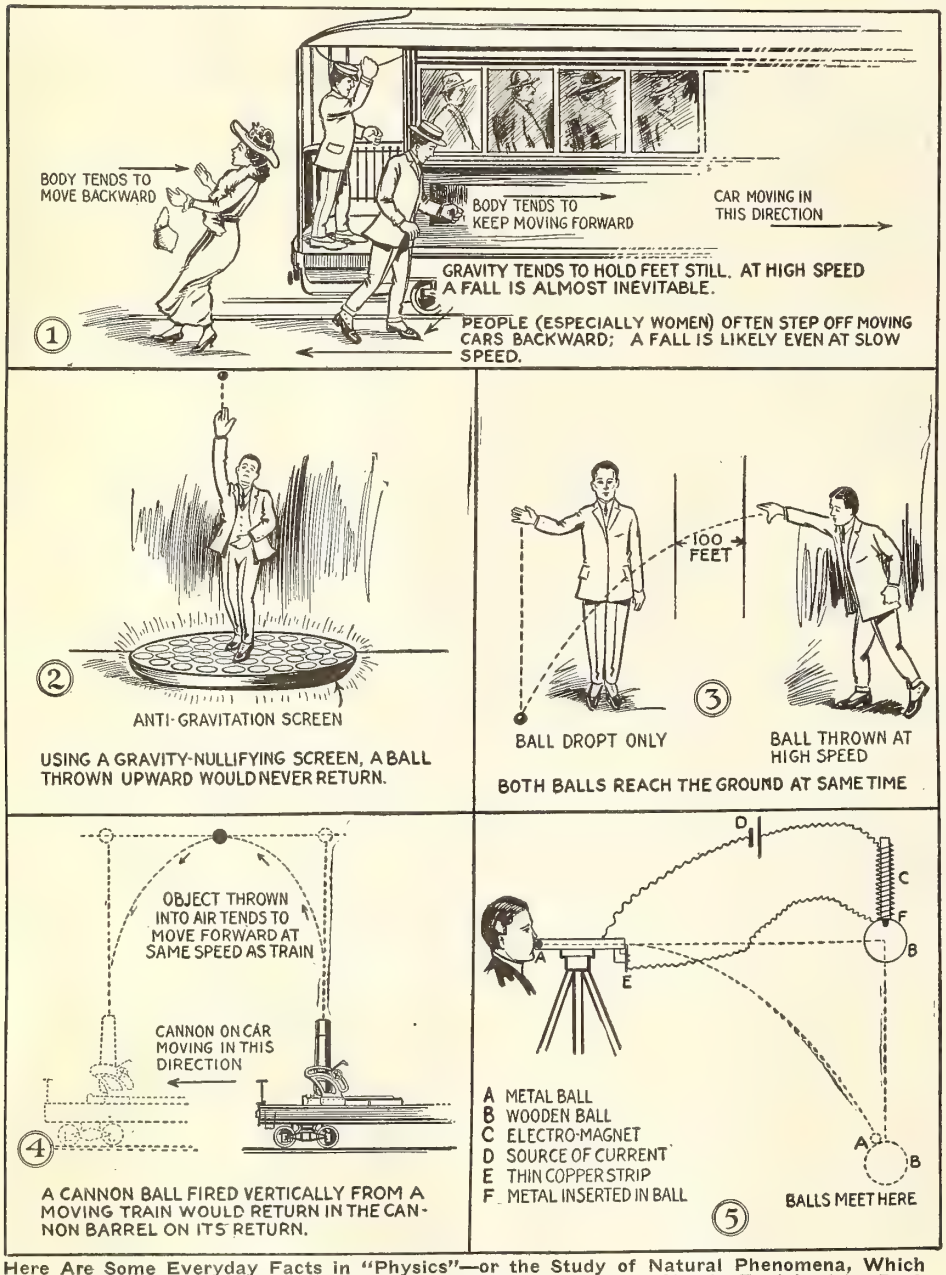
JUST now the great law of gravitation which was discovered by Sir Isaac Newton is very much in the limelight on account of certain proposed modifications which have been suggested by Einstein. We are in danger of forgetting that modern mechanics is very largely based upon three other laws laid down by Newton, called the *laws of motion.* These laws are, indeed, closely connected with the law of *universal gravitation,* and it is difficult to understand one without the other. Put in popular form these laws are as follows:

1. *If a body is in motion it will continue to move forever in a straight line, and if a body is at rest it will continue to be at rest forever, UNLESS some external force is applied to change these conditions.*

2. *If several forces act upon a body the resulting motion will be the same as if each force acted independently.*

3. *Action and reaction are equal in opposite directions.*

The first law is not capable of mathematical demonstration. Its truth appeals to our sense of fitness of things rather than to any experiment which has been made. The doctrine of relativity might, if completely understood, throw a light on the statement that a body tends to move forever in a straight line. On the other hand it completely destroys whatever lingering hope we may have had of being able to prove that a body at rest would rest forever.



Here Are Some Everyday Facts in "Physics"—or the Study of Natural Phenomena, Which You Probably Have Not Thought of. The Underlying Laws Are Clearly Explained by Prof. Stevens, So That You Can Readily Grasp the "Why and Wherefore" of These Seemingly Paradoxical Actions.

Certain rather interesting results follow from this law: It is due to this that a horseback rider is thrown headlong over a stone wall when the horse refuses to make the leap but stops abruptly when he reaches the wall. It is also due to this law that we fall down when alighting from a street car in motion if we are not careful. The motion of the car tends to cause us to move in a straight line in the direction of the car, while gravitation causes our feet to strike the ground and their motion is stopt while the motion of the upper part of the body continues. Hence the fall; see Fig. 1. It will be seen that the first and second laws act together, and the gravitation law has a part in the procedure. If it were not for the fact that gravitation acts constantly we would not reach the ground when getting off the car but remain traveling along beside the car at the same rate of speed. This first law of motion would make it impossible for a *gravitation screen* to be of much material advantage. If the rope of an elevator were to break and the gravitation were instantaneously screened off, the elevator would continue to fall due to the first law of motion. If we should toss a ball into the air we would never see it again if we made use of a gravitation screen; see Fig. 2. The same would be true with our own body if we gave a jump away from the earth. If we headed towards the moon and jumped at the rate of ten feet a second we would reach the moon in about four years. If, however, we had not taken the precaution to screen the gravitation effect of the moon we would land on the surface of the moon with the velocity of about two miles a second, which would doubtless render us incapacitated for lunar explorations.

The following illustration of Newton's second law will interest baseball fans. If a catcher had an arm sufficiently powerful so that he could throw a ball in a *perfectly* straight line from his hand to the foot of the second baseman, it would reach this point at exactly the same instant that a ball dropt directly downwards from the pitcher's hand would strike the ground; see Fig. 3. Strange as it may seem, a cannon ball fired vertically upward from the top of a train moving with constant speed *would fall into the mouth of the cannon on its return;* see Fig. 4. These illustrations, of course, take no account of certain modifications which might be made due to atmospheric friction, etc. A remarkably striking experimental illustration of the second law may be set up as follows: A metal tube about two feet long and three-fourths of an inch in diameter is clampt in a horizontal position in such a manner that upon looking thru it, we can exactly see the center of a croquet ball into which an iron screw or iron plug has been fastened, and this screw is held up by an electro-magnet as in the figure; see Fig. 5. A thin strip of copper touches the end of the tube and extends about a quarter of an inch above the bottom. An electric circuit is made including the tube, the copper strip, and the coils of the electro-magnet. When all is properly arranged we blow a metal ball thru the tube as swiftly as possible. When the ball strikes the copper strip the circuit is broken and the croquet ball begins to drop. Somewhere in mid-air the metal ball will strike the wooden ball. The experiment rarely fails to succeed if proper precautions are taken. The distance between the tube and the ball will depend upon the strength of the experimenter's lungs. Twenty feet is a distance which gives good results. The metal ball should be almost as large as the internal diameter of the tube in order that it may receive the entire force of the wind when it is blown thru.

There are few experimental illustrations of Newton's third law which are at all striking. It may be questioned whether in its net results this law is a benefit to humanity or otherwise. If it were not for this law we could bump our heads against a stone wall with perfect safety if we were

(*Continued on page* 106)

9345

Electricity Gone To The Dogs

THE very latest in "Dog-land" is the canine clinic recently established for these intelligent quadrupeds in Berlin, Germany. The laboratory in which the clinic is located, is fully equipt with the most up-to-date technical apparatus for the cure and treatment of diseases peculiar to the canine. The photographs herewith, show the *artificial sun* treatment, comprising a powerful electric light in a highly polished reflector, and also a specially devised electrical *hot-air* apparatus.

One photo shows a sick dog being treated with what is known as the artificial *high-sun* rays, and it will be noted that the dog's eyes are covered with a bandage, so as not to injure them by the extreme brightness of the light rays here brought into play.

One of the most troublesome and frequent ailments of dogs in general, is skin disease, and the second photo shows a noble canine suffering from this affliction, being treated with the electrically heated hot-air applicator, to remedy this ailment. At this dog clinic, all kinds of operations are performed on dogs, for broken bones, nasal, throat and mouth troubles, et cetera. Many ailments among animals, and particularly in dogs, are of a rheumatic or similar nature, and often yield to intensified heat treatment such as that produced by the artificial high-sun device shown, or else by placing damp cloths over the injured member or over the entire body, and then placing the "patient" into a special electrically heated oven. These ovens have been developed very remarkably both in this country and abroad, and have proven their worth many times over, especially for cases of stiffened muscles, whether caused by direct injury, or from rheumatism. The temperature of these electrical baking heaters often reach a point as high as 400° Fah. This, of course, must be a perfectly dry heat, and the injured animal is carefully and tightly wrapt in dampened cloths, before it is placed in the treatment oven. This dampness soon dries out, and thereafter a steady dry heat is applied for a half hour or so, until the temperature rises to a considerable height, and in doing so, develops an extreme penetrating power which reaches to the bone itself.



At Left: Dog Receiving Treatment from Artificial Electric Sun in New Dog Hospital in Berlin, Germany.

At Right: Here We See a Faithful Canine Being Treated with Electrically Heated Hot Air for Scalp Ailments.

X-Rays Of Unprecedented Hardness

By DR. ALFRED GRADENWITZ

EVER since the gamma-rays of radium were shown to be essentially of the same nature as X-rays, the only difference so far being their greater hardness or penetrative power (or in other words, their shorter wavelengths), the attention of physicists and practitioners alike has been engrost by the problem of how X-rays of sufficient hardness to exert the same therapeutical effects as radium, how "artificial radium rays," as it were, could be produced.

Inasmuch as the hardness of X-rays is the greater, as the cathode rays by the stopping of which they are produced move with higher velocity—that is to say, as the voltage applied to the X-ray tube is higher, the solution of the problem from the very outset was sought in an unceasing increase of this voltage. A considerable advance toward the final goal was made by the invention of different types of glow cathodes allowing the electrons generated on the

(*Continued on page* 112)

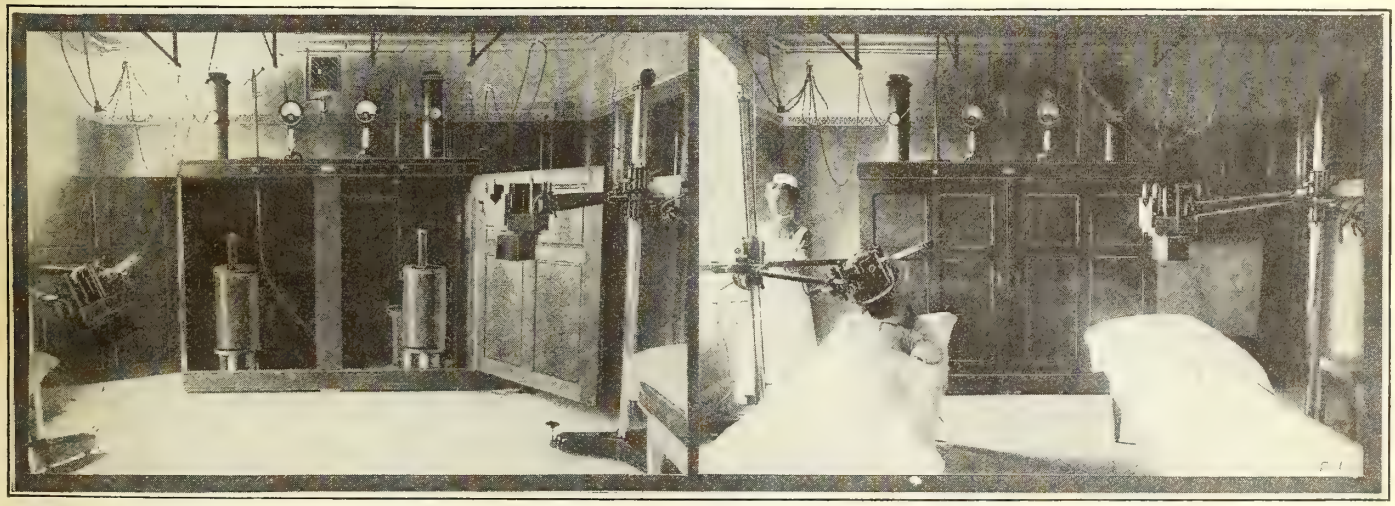


Photo at Left Shows the Ultra-High Potential Transformers and Cabinet with X-ray Tube Holders in Foreground, for Producing Extremely Hard X-rays Which, It Is Believed, Will Replace "Radium."

View at Right Shows Patient Being Treated by Extra Hard X-rays for Therapeutic Treatment. Potentials of Several Hundred Thousand Volts Have Been Successfully Used in This Special Work by Dr. Dessauer, of Frankfort-on-Main.

The "Lodestone" or Natural Magnet

By EUGENE S. TODD, Mineralogist



The First Law of Magnetism Is That Like Poles Repel, and Unlike Poles Attract. When Two Lodestones Are Held Side by Side in This Manner, the Iron Filings Link Across Between the North and South Poles at the Top and Bottom, Illustrating "Marriage."



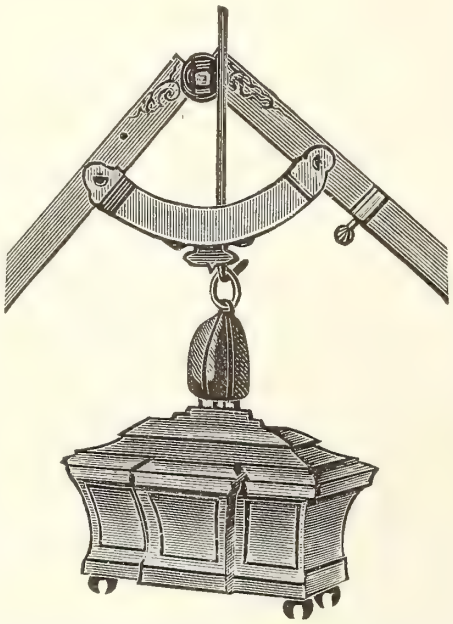
The Fact That "Like Poles" Repel, Is Here Clearly Demonstrated. When the Two North Poles and Two South Poles of a Pair of Lodestones Face Each Other, the Iron Filings Are Repelled, and Illustrate "Divorce," to Quote Mr. Todd.

I WANT to show you the "Lodestone"—perhaps you have never seen one, or even heard of one,—and yet it is the most wonderful stone in the world, barring none, and altho it is called a *stone,* it really is not one, but rather belongs to the family of minerals.

Why its name? Let me tell you. Suspended, by a silken thread or floated on mercury or on a circular raft on water, the same end of the stone will always point to the "Lodestar," Pole Star, Polaris, or North Star, as we know it; thus it will be seen that the lodestone is a natural compass, such as the Vikings used to make centuries ago, long before America was discovered, or before the compass as we know it today, was invented. Now after making a compass out of a lodestone, let us make one *with* the lodestone, as the Chinese did years ago, by rubbing a steel sewing needle over a lodestone to *magnetize* it, and then placing the needle very gently on the surface of a bowl of water. The needle, so placed, will float and immediately take a position pointing north and south. When the needle is floating on the surface of the water, the lodestone placed near it on the outside of the glass or bowl, will deflect it, turning it east or west, or for that matter, any way. Released from the influence of the stone, the needle will immediately resume its former position, pointing north and south. If the needle is a good one, you can draw it to the bottom of the glass of water, thus sinking the needle, and draw it up again to the surface of the water without once touching the needle, the lodestone being held flat against the outside of the glass, while moving it upward.

You can also make a compass out of a *steel pen* in the same manner, being careful to rub the south pole toward the point of the pen if you want it to point north, and the north pole toward the point, if you wish to make a south pointing compass as the Chinese do.

The mercury compass is more expensive to make, owing to the high cost of mercury, but it's well worth the price just to see the lodestone floating on its surface; floating, because the lodestone is so much lighter in weight than the mercury it displaces, the specific gravity of the mercury being 1357, and that of the lodestone about 783. In the mercury compass, it is well to paint or mark the north-pointing end of the stone, red or white, leaving the south pointing end, black or the natural color of the lodestone.



This Is Galileo's Original Lodestone, One of the Most Interesting Exhibits in the World, Especially to All Electricians. This Stone, After 300 Years, Holds as firmly as Ever, Its Suspended Weight of 15 Lbs., the Weight of the Stone Being but Six Ounces. This Precious and Historical Lodestone Is Exhibited in the Tribuna de Galileo, Florence, Italy. The Iron Weight Suspended at the Bottom of the Lodestone Is Made in the Form of a Sepulchre.

USES OF THE LODESTONE.

The lodestone is used in colleges in elementary classes, to demonstrate magnetic laws, and is used in preference to the bar or horse-shoe magnet because of its *permanence* and power,—for a good lodestone is more powerful than the average magnet of similar weight.

Lodestones are also used in automobile and aviation schools in demonstrating the principle of the magneto; by amateur experimenters in wireless; and is frequently taken home by parents as a useful and fascinating toy for children. It is a permanent magnet, and its magnetism can only be destroyed by heating the stone "red-hot." Altho the magnetism can be drawn out electrically and restored electrically, once the lodestone is heated as aforementioned, its magnetic life is gone beyond resurrection.

SUPERSTITIONS OF THE LODESTONE.

There are many superstitions about the lodestone, and it is believed by many people that these mysterious stones are always lucky, inasmuch as they attract the good and repel the evil. The circus people were wont to take them south during trips and sell them to the negroes at fabulous prices, and some of our most famous actors and actresses carry them. Paderewski, the great pianist, took one with him to Poland about three years ago, when he went there in the interest of his people.

The writer knows personally, a very celebrated actress, who absolutely refuses to go on the stage, without a lodestone somewhere on her person. She claims when she happens to leave it at home, something unpleasant is sure to occur, and when she has it with her, things run along smoothly. She says that *it makes her more magnetic,* and that she controls her audience with more ease, thus receiving more applause which incidentally increases her salary!!

There is an old saying in Sweden, (where the lodestone is found), "Wear a lodestone over your heart and it will insure you heart's desire; place it under your pillow at night, and your dreams will come true."



This Photo Shows the Jewelled Bearing Magnet Compass and One of the Earliest Forms of a Compass, Formed of a Piece of Magnetized Steel Resting on the Surface of a Glass of Water. A Steel Needle Was Magnetized by a Lodestone and Dropt Gently Into the Water in Early Times, but in This Case a Steel Writing Pen Was Employed. Try the Needle Trick Yourself. We Found It Most Interesting. It Points to the North.

This latter condition may not always be desirable, especially in cases of nightmare.

It is also a betrothal stone. A young man will break a lodestone in two pieces and give his sweetheart half, so that they will always be drawn together by the magnetism of the stone. In fact you can show the *marriage* of a pair of lodestones, viz: when they are drawn together,—but you can also show the *divorce* of the pair, and this occurs when they repel each other, as they undoubtedly will when like poles are placed opposite. You see a lodestone has two poles, one North and the other South; positive and negative, or male and female. Naturally the male end of one stone will only attract the female end of the other, which is called the "marriage of the stones," or the divine magnetic attraction between opposite sexes and unlike poles.

LEGENDS OF THE LODESTONE.

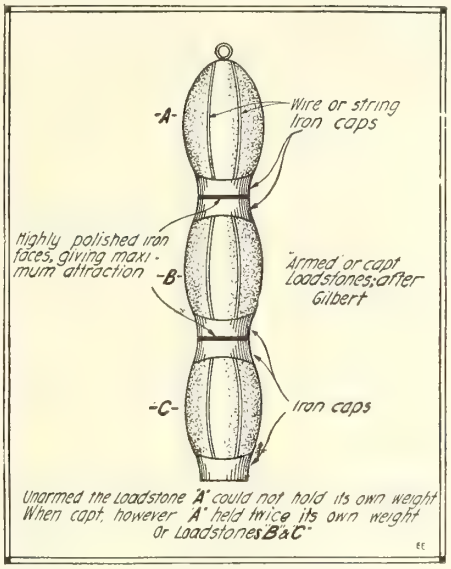
The stone is supposed to impart magnetism to the person carrying one, and many people believe they have been cured of rheumatism by keeping one about their person. Probably marbles would work as well!

Many strange stories of the wonders of the lodestone are told, one of these stories being of the mythical "lodestone mountain," described in "The Arabian Knights," the vessel being drawn toward it, until when quite near, all the spikes and nails were drawn from the ship, and she fell apart,—a total wreck, all the metal (iron or steel) parts of the ship flying towards the mountain, and the ship itself sinking to the bottom.

In Sweden (the most powerful lodestones and those here pictured came from Sweden), they tell how hunters have been unable to pick their guns from the ground, after laying them down near lodestones. They also tell of cases where the person's shoes had to be removed, owing to the nails in their soles, which held them fast. Of course these are only fables, the truth of which I shall not warrant.

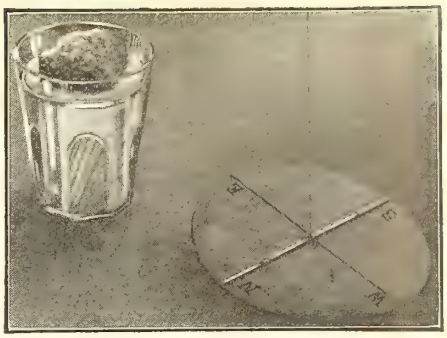
From history we learn about this most mysterious stone, how Mahomet's casket was suspended in mid-air by an immense lodestone, hidden from the view of the faithful.

Plato speaks of magnetic virtue divine. Marco Polo brought the idea of the mariner's compass from China. King Solomon used the stone to guide his mariners when searching for West Indian gold. Sebastian Cabot writes of variation of the needle, or magnetic deviation. Vincenzio Viviani, himself a distinguished mathematician, liked to be known as the last disciple of Galileo and tells us in a biography of his great master, that towards the close of the year 1604, he had completed a long study of the properties of the lodestone, and after



This Diagram Shows an "Armed" Lodestone or Natural Magnet. When the Magnets Are Armed or Capt With Iron Pole-Pieces in the Manner Shown, Their Lifting Power Is Greatly Intensified, Even Doubled and Trebled.

many and varied experiments, had found a sure way of mounting any given stone so as to make it sustain the weight of iron,



Here We Have the Original Chinese Compass Formed by a Lodestone Floating on Mercury, at the Left. The North-Seeking Pole of the Lodestone, Which Is the Actual South Pole of the Magnet, Is Indicated by the Chalk Mark. Another Form of Compass, Comprising a Magnetized Steel Needle Mounted on a Circular Disc of Wood and Suspended by a Thread, Is Shown at the Right.

80 to 100 times greater than could be supported by the stone unmounted,—a result which had not been discovered by any other investigators up to that time, nor for that matter today—if you exclude electromagnets.

It appears that during the long summer vacation at Padua, Galileo used to spend his vacation in Florence, where from about 1601 he gave private lessons in science, to the young Prince Cosino de Medici; in the summer he had evidently been rehearsing the wonderful properties of the lodestone, and having inspired his pupil with a keen desire to have one, he on returning to Padua, was able to send the prince a specimen, which he had obtained in Venice, and which weighed about one-half pound. It was not elegant in form, but was very powerful. A friend of his, Sagredo by name, nad another fine stone which was beautifully formed, and weighed about five pounds,—and when it was known that Sagredo was disposed to part with it for a price of 400 scudi (about $450.00), the prince desired to obtain possession of this stone, but thought the price excessive. Thereupon, ensued a long haggling correspondence, which ultimately resulted in the prince purchasing it for 100 doubloons or about 100 guineas.

Unfortunately, the Sagredo stone was lost in after years, (also apparently the smaller one from Venice), and neither of them could be found after a careful and thoro search made by the request of Leibnitz in Florence, in 1698.

Dr. Gilbert in his book "De Magnete" publisht in 1600, speaks of a stone (whose weight is not known) which normally could

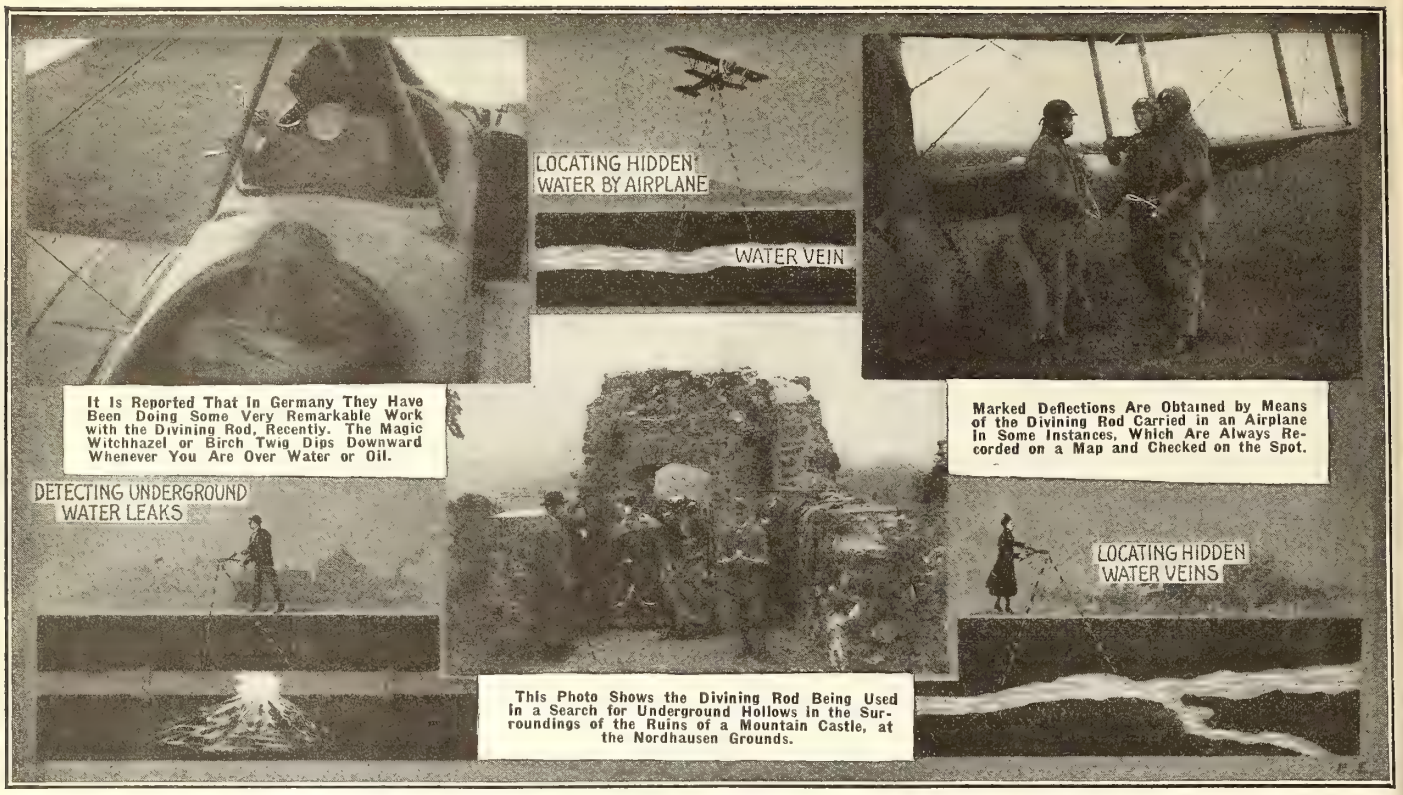
(*Continued on page* 88)



To Illustrate the Underlying Action of the Electric Motor, Two Lodestones May Be Used in the Manner Shown, the Smaller Lodestone Being Placed on a Polarized Steel Dome, Such as Those Placed on Chair Feet.



By Alternately Approaching the Opposite Poles of the Small Lodestone With the North and South Poles of the Large Lodestone Held in the Fingers, the Smaller Stone Can Be Caused to Rotate Continuously, the Same as an Armature of a Motor. A Small Steel Nail-File Was First Magnetized by Means of a Small Lodestone and Then Placed on a Polished Steel Dome, Such as Used on Chair Feet. By Alternately Projecting North and South Poles of a Large Lodestone Held in the Fingers Toward the North and South Ends of the File, It Can Be Caused to Rotate.



Airmen And The Divining Rod

By DR. ALFRED GRADENWITZ

The *divining rod* at present claims unusual interest from a double point of view: On the one hand, a scientific explanation of the enigmatical phenomenon is sought, that a forked twig or wire loop in the hand of a person specially gifted will deflect on passing over running water; on the other hand, endeavors are made to utilize this phenomenon for practical purposes, the more so as the puzzling rod has recently been found not only to deflect over natural, but as well over artificial water courses, especially piping. The Municipal Water Works of Munich, Germany, have, for instance, obtained some most remarkable results in locating pipe ruptures. Tests have also been made repeatedly in connection with ore, salts and coal layers. In the present critical situation due to Germany's having had to give up some of her most valuable ore and coal mines, special hopes are in the Fatherland attached to the help of the *divining rod.*

At the recent Congress of the *Association for Elucidating the Divining Rod Problem,* held at Nordhausen, there were discust these possibilities of application. Another new development dealt with was the possibility of using the divining rod from an airplane. A well-known divining rod specialist, Otto Edler von Graeve, gave a practical demonstration of the way underground water courses are ascertained from the airplane, the deflections of the divining rod being afterwards recorded on a map and checked on the spot.

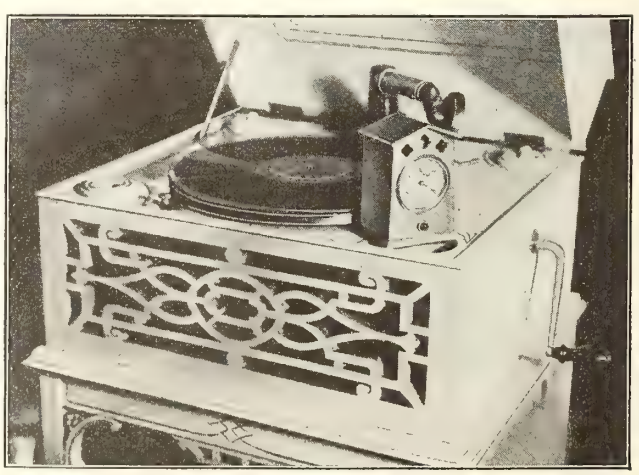
Phono-Clock Wakes You Gently!

Undoubtedly you have heard the story of how to be awakened gently, by nothing less than the sweet music of a string orchestra or the tinkling chimes of Westminster Abbey, in the distance, so specifieth those who know.

Well, friends, here it is at last, and all you need is an alarm clock and a phonograph — puts us in mind of the chap who bought an automobile cap and all he needed then to complete his outfit was an automobile! But this is not as comical or tragical as it might at first seem. In all seriousness we have tried this stunt, and it works to perfection, and all that we have to say in the line of criticism of this interesting and much desired invention is that the world is looking for the "genius" who can put up this combination on a nice little wooden base and sell it for a dollar or two.

We remember a chap who worked night and day on such a contrivance, comprising a little three-inch home-made phonograph disc record, with a "get-up" message suitably inscribed on it, all of which can be fitted to a small shaft protruding thru the top of the alarm clock, and then connected with the alarm spring mechanism within the clock. It worked!

We have often wondered why some one did not think of this idea and develop it to a logical commercial conclusion, which could be on the order of the "talking doll" which has a small, cheap phonograph fitted within it. It seems a capital idea.



Set the Clock at Your Arising Hour—the Phonograph Does the Rest!

In the illustration here shown, the alarm clock rests on the phonograph cabinet and when the alarm rings in the morning, it releases the turn-table brake and before you know it, you are slowly coming back from Slumberland to the tune of the "Anvil Chorus" from *Il Travatore,* if you have a strong mind, or to the lilting strains of the "Merry Widow Waltz," if you are temperamental.

Or if you are one of those hard sleeping hounds, put on "Shimmy With Me."

So we may look forward to the day not far distant when we can purchase at approximately the same sum we now spend for a "Big Ben" alarm clock, one of these new-fangled "do-funny" phono-clocks. Possibly some long-whiskered psychologist or student of mental phenomena may devise a form of music which will serve not to awaken you, but to put you to sleep! When you stop to think about it, you probably will recollect that at the last musicale you attended some of the dreamy selections caused your mind to relax to such a degree that you presently found yourself wandering on the borders of Slumberland.

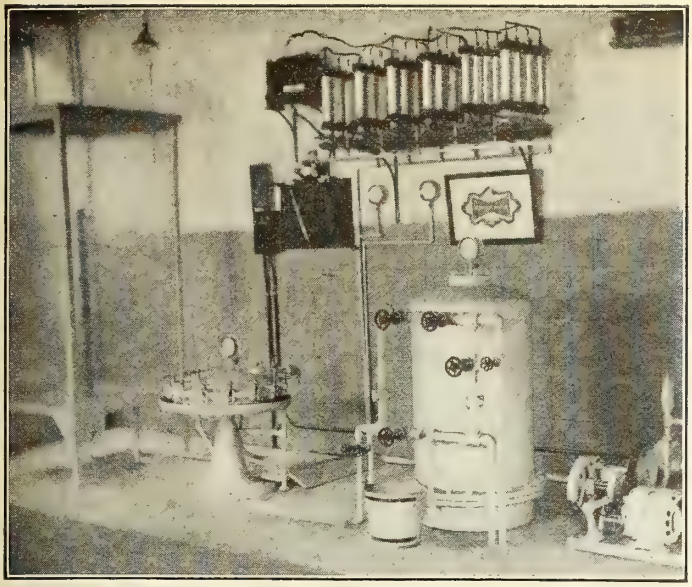
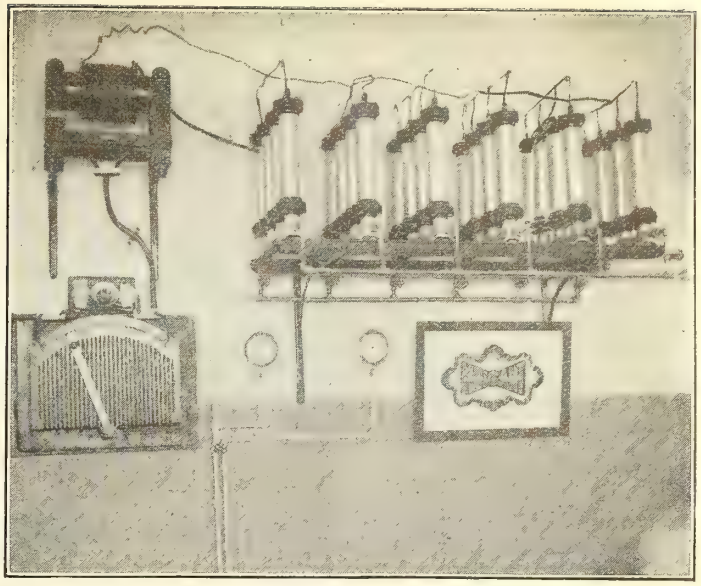


Photo Above Shows the Newest Thing in Electric Water Purifiers, Which is In Daily Use in New York City. It Represents One of the Most Elaborate Filtering and Electric Ozonizing Water Plants Ever Devised.



This Photo Shows a Close-up View of the High Potential Electric Ozonizing Tubes in Which Free Ozone is Liberated, and Eventually Caused to Pass Thru the Water and Destroy All Bacterial or Other Germs In It.

New York Has Ozonized Drinking Water

By Joseph H. Kraus

OZONE as a germicide and deodorant has been dealt with so many times that it is scarcely necessary for us to mention in detail what its action is. All harmful germs and growths in water are positively annihilated when water is purified by ozone. After ozonization it is 100 per cent free from disease germs and at the same time produces a very sparkling drink.

An enterprising New York concern, after having worked for years on the problem, has evolved not only a system of providing and filtering water, but has also obtained patents on an improved form of silent discharge ozone generator. Essentially, ozone consists of three atoms of oxygen bound together in the form of one molecule. It is produced by pumping air thru these silent discharge tubes between the electrodes, the oxygen of which is made to combine by the action of a high frequency current. Thus the oxygen comes into a nascent formation more active and powerful as an oxidizing agent than pure oxygen of the air.

The apparatus developed by this company first allows the water to filter thru a regular sand filter. The water then passes under 45 pounds of pressure thru a silk filter, and thence onward to a large glass tank. Before its entrance into the tank, however, it unites with the ozone supply pipe coming directly from the discharge tubes whence the ozone and water continue onward to a large glass chamber. Here they squirt out in the form of fine sprays of water, the ozone thoroly acting on every droplet. In this way ozone action is absolutely thoro, and not nearly as long a time of exposure is necessary as with the ordinary ozonating apparatus.

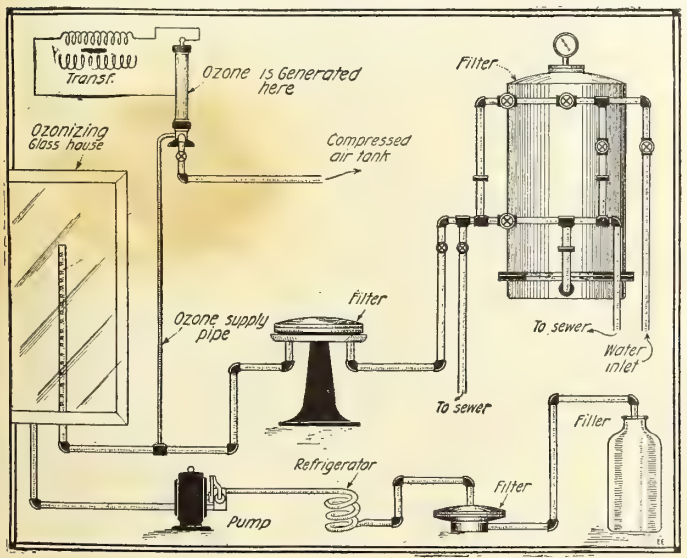
The ozonized water then passes into a refrigerator where it is cooled and goes onward to the final filter. From here it goes to the supply pipes and it is bottled according to the latest style—namely, in Thermos vacuum bottles. This company supplies the water daily in bottles of any size for office use. The water is always cold and sparkling, being tasteless at the same time. There can be no doubt as to its purity and utter absence of bacteria, as bacterial plate cultures prove negative.

The entire system is electrical; pumps, transformers, and in fact even delivery is carried on by the use of electric current.

The silent discharge chamber consists of two aluminum tubes fitted at the top and bottom to Bakelite ends made to fit these tubes accurately.

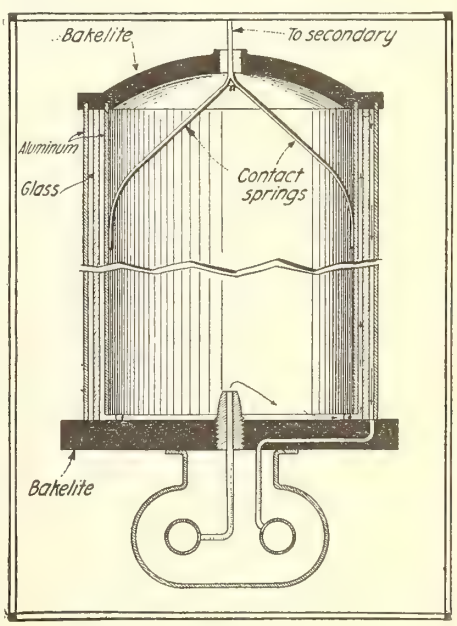
Separating the tubes is a thin-walled glass cylinder. The air passes thru a pipe from a compressor, travels thru the space between the glass center and inside aluminum chamber. Thence down between the glass and outside chamber and out again. During its passage the air is under continuous action by minute electric sparks, which cause its oxygen content to form into its very active state of O_3, or ozone.

Connection to a 15,000 volt transformer is effected by means of a spiderleg-like spring inserted into the top of the discharge chamber, making contact with its inner wall, while a connection also goes to the outer wall. Insulation is so perfect that the jars may be grasped while the apparatus is in operation without a shock being felt.—*Photos courtesy The Moissant Company.*



Left: Diagram Shows the Various Stages Thru Which the Water is Past Before It is Eventually Filled Into Vacuum Bottles, in Which It is Distributed Daily to People in All Parts of the City. The Water is Not Only Filtered and Ozonized, But It is Also Cooled By a Refrigerating Plant.

Right: A Detailed Diagram of One of the Ozonizing Tubes Shown in the Photos of the Complete Installation. The High Potential Electric Current is Connected to the Inner and Outer Aluminum Cylinders. This Causes An Electric Brush Discharge to Take Place Around and Thru the Glass, Thus Producing Ozone.



Church Service By Phone



Church Service Via Telephone Is One of the Latest Innovations, In the Realm of Applied Science. The Above Picture Shows the Microphone Mounted Just In Front of the Church Pulpit and Also the Sick Man With the Receiving Head Gear for Reproducing the Words of the Pastor, as Well as the Choral Music.

Mr. Sam Pritchard, a miner of Penycas, Ruabon, Wales, injured by the fall of a rock a year ago in a colliery, now hears church service regularly at the local Baptist Chapel by means of a telephone rigged up by three of his friends. One of the photos shows the injured man listening to the service going on at the chapel some distance away.

The second photograph shows a close-up view of the pulpit in the church, with the telephone microphone arranged so as to gather its quota of the preacher's vocal waves. This idea brings to mind a scheme which may be found useful in many diversified instances, i.e., this idea should prove a valuable one on Sundays when the weather is extremely inclement and when deep snows cover the country as in the northern and western part of the United States, so that the Sunday church service could be enjoyed just as well over the telephone, as not.

In the present instance, the apparatus required is not very expensive and comprises a simple telephone transmitter or microphone button, together with a few cells of dry battery, a sufficient length of twin conductor telephone wire and a telephone receiver, or two, of the 75 ohm watch case type, which are worn on a headband by the gentleman shown in the photograph.

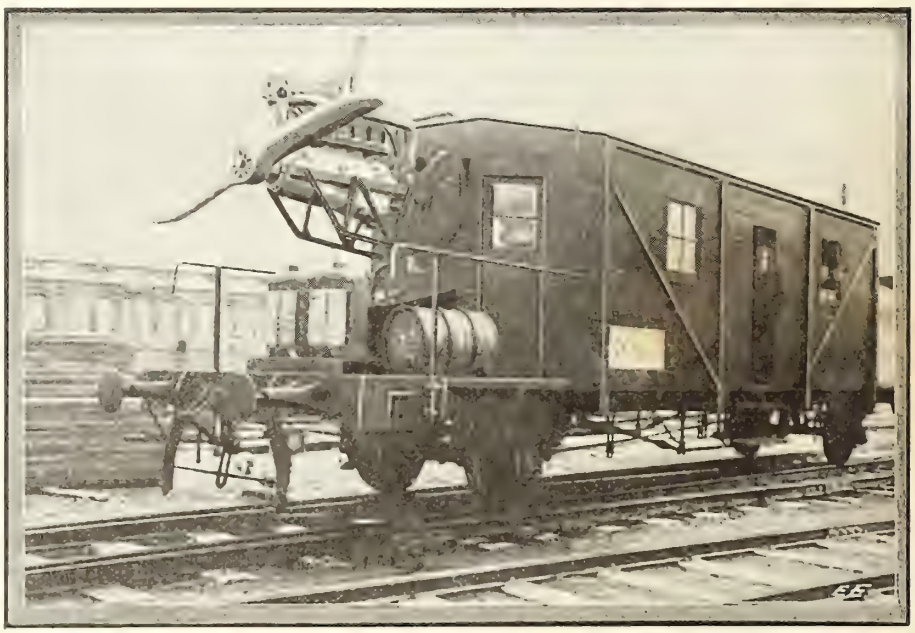
Car Propelled By Air Screw

Owing to the great shortage of coal as fuel for trains in Germany, an inventor of that country has rigged up the unique air driven railroad car shown here. He has simply adopted a powerful type of airplane engine to one end of the railroad car, which altho it may not seem so efficient as a regular motor-driven car, resulted in a speed of 60 miles an hour.

The motors used on these German air-propelled cars are rated at 160 horsepower. The usual gasoline fuel tanks and cooling water radiators are seen mounted on the platform of the car, at the left.

This gives us another idea, viz., that as the Germans have a great many thousand airplane motors on hand which they have no use for just now, they will probably find quite an extensive field for their application to railway cars, etc.

This novelty would also seem to lend itself very well to the utilization of second rate engines or airplane engines which do not come up to the "top notch" test such as required by the rigid rules laid down by the aviator. If a second grade engine or one that is somewhat worn is adapted for this service on railway cars, no one will be injured if the engine should happen to misfire now and then,—while the aviator demands the very highest degree of efficiency in performance; and recent tests have shown that even the far-famed "Liberty Motor" is good for only 100 flying hours' service on an airplane. But it would undoubtedly be good for several hundred, or very possibly several thousand running hours, for such service as that here shown. The idea is worth trying.



How the Germans Have Found a Use for Thousands of Airplane Engines Which They Have on Their Hands. Also on Account of the Great Shortage of Coal in Germany, These Wind-Driven Cars Have Found Much Favor in the "Vaterland."

Electricity in the "Movie" Studio

By CARL M. HEINTZ

ELECTRICITY has played no little part in this great industry, working its way into every phase of the motion picture work. The principal use of electricity is in the stage lighting. In general stage lighting is a combination of what is called "hard" and "soft" light. The mercury vapor lamp, which is very largely used, possesses the actinic qualities that make it very excellent for this work. The mercury vapor lamp gives a soft light and in order to bring out the high lights in a picture or to emphasize contrasts in a picture, arc lights are employed. These arc lamps which throw off a "hard" light are very generously used and consume a considerable amount of current.

While the mercury vapor lamp is supplied for either A. C. or D. C. current, it is generally considered that its operation on D. C. is more satisfactory.

It is generally known that an arc lamp operates better on D. C. than A. C. or when operating on A. C. it changes its intensity of illumination slightly with every alternation, and since it is possible for this to synchronize with the shutter operating on the "movie" camera, one can readily see why D. C. is more satisfactory for stage lighting.

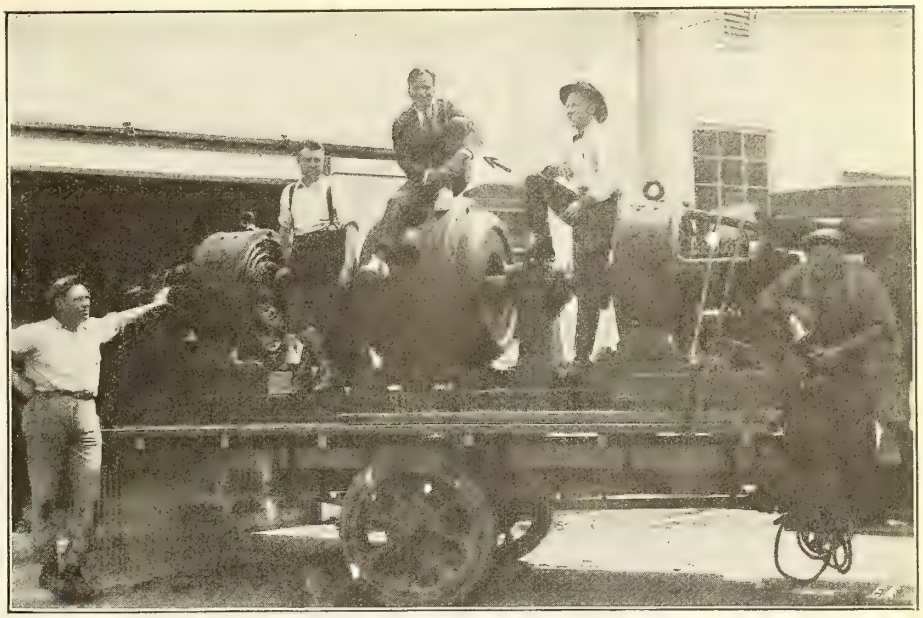
It might be interesting to briefly outline the electrical equipment at some of the studios. Take the *Metro Studio* for instance. The Southern California Edison Company's incoming high voltage line of 15,000 is stept down in a bank of 3-250 K. V. A. Transformers to 2,200 volts. They also have another bank of 3-100 K. V. A. Transformers stepping down from 2,200 volts to 110 volts 3 phase. These supply the stage-lighting circuits. The A. C. lights being mostly used for overhead lighting.

The Chief Electrician at this studio uses a very novel scheme to secure constant voltage regulation on his A. C. lighting circuits. It is most desirable to maintain a constant voltage regulation for two reasons, one that it produces better photography, the other it increases the life of the mercury vapor lamps.

The Metro Studio has installed a 3-phase, 60 K. V. A., 2,200-volt Induction Regulator, which controls the bank of 3-100 K. V. A. Transformers on the lighting circuits.

Then when the director calls for the lights and a very few seconds later calls for the camera to "shoot," the regulator has compensated for the additional load which amounts to a great deal on large settings. The voltage under this arrangement never varies over a volt and a half at the point of distribution. At this same studio the D. C. current for the stage lighting is supplied by a 300 K. W. Motor Generator Set.

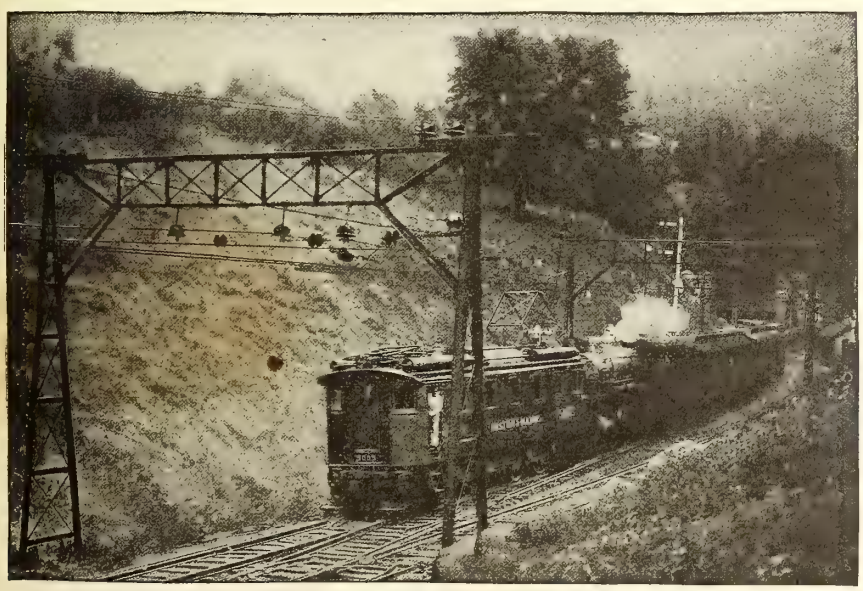
Outside of using electricity for stage lighting the studios use a great deal in their carpenter shops, laboratories and projection rooms, etc.—*Photo Courtesy Westinghouse E. & M. Co.*



Of Course the Editors Couldn't Pass This Photo Up, With "Doug" Fairbanks Sitting On One of the New Motor-Generator Units For His Studio. It Is Hard To Determine Which Is the Most Alive, the Dynamo or "Doug," Especially When He Does Those Mexican Athlete's Stunts Down in "Sunny California."

Railroads are Electrifying

SINCE the United States has an abundance of coal, railroad electrification here has been determined solely by local conditions. Passenger terminal problems caused the electrification of the New York Central at New York and the Pennsylvania at New York and Philadelphia. The limitations of the steam locomotive determined the electrification of the Baltimore Tunnel on the Baltimore & Ohio, the Cascade Tunnel on the Great Northern, the St. Clair Tunnel on the Grand Trunk, the Hoosac Tunnel on the Boston & Maine (see photo herewith) and the Detroit River Tunnel on the Michigan Central. Examples of electrified railroads with freight as well as passenger service are the Norfolk & Western, the Chicago, Milwaukee & St. Paul and the New York, New Haven & Hartford.



The American Railroads Are Fast Awakening to the Fact That "Electrification" Means Dollars and Cents to Them, Altho It May At First Seem of Tremendous Initial Expense. Here We See a Boston and Maine R.R. Electric Locomotive and a Steam Locomotive.

While the other electrifications are successful and interesting, the last three are more properly representative of general railroad electrification. The Norfolk & Western is an example of electrification under the heaviest conditions of freight traffic on a mountain grade. The Chicago, Milwaukee & St. Paul has in operation the longest continuous mileage in the world, and when completed will cross five mountain ranges. The New York, New Haven & Hartford has a very large movement of both freight and passenger traffic. All three installations are successful and profitable, and when financial conditions are stabilized and the American railroad question settled, it is expected that all three will extend their electrified service.

Differing from America, European and South American countries, with the exception of England alone, lack an adequate supply of fuel, but many of them, including Norway, Sweden, Switzerland, Italy, Spain and Brazil, have large amounts of water power, while France has a moderate amount. These resources combined with the high cost of fuel make extensive railroad electrification in these countries inevitable sooner or later. *Photo W. E. & M. Co.*

New York Aero Show

THE second annual Aeronautical Show was held in New York City, at the 71st Regiment Armory, from March 6th to the 13th inclusive, under the auspices of the Manufacturers' Aircraft Association. Many new innovations and novelties of design were shown and brought out in the aircraft exhibit. In some and in fact in most cases, the larger and outstanding trend of design at the present time, is clearly along the lines of comfort and practically nothing of a military nature was exhibited at the show.

This is as it should be perhaps, for we have had enough war to last us for a while, and the airplane which people are today interested in, is quite naturally that which will carry them the most comfortably and the most safely from place to place. Airplanes as well as gas filled dirigible balloons were shown at the exhibition, and ranged in price from $2,500 to $15,000 and more.

The family aerial runabout known as the *Butterfly Sport,* has been developed to sell by the thousands just like *Fords,* for the flying public who have not the desire to invest more than $2,500, and yet who can obtain from this machine all of the thrills of flying, besides the advantages of rapid travel—for this little machine can skim thru the air at a 72-mile-an-hour clip, with a single passenger.



The Latest Addition to the Flying World is the "Butterfly Sport" Monoplane, Which Has Just Been Brought Out for Family Use at Popular Prices. The Makers Claim They Are Going to Turn Them Out by the Thousands, Just Like "Fords" and the Price is $2,500. They Have Got the "Flivver" Beat, However, when it Comes to Speed, for They Skim Thru the Air at 72 Miles an Hour and Better, With a Single Passenger. This Plane and Another Similar Plane at a Slightly Higher Price, Capable of Carrying Two Passengers, Were Exhibited at the Recent New York Aeronautical Show.

The United States Army and Navy exhibited at the show, but the regular commercial airplane manufacturers had the greatest number of devices and machines on exhibition.

ELECTRIC AIRPLANE NOVELTIES.

Electricity is finding its way into the realm of aeronautics more and more each year. While nothing startling was shown in electro-aeronautic developments at the show, one thing was noticeable, and that was that more planes than ever before are being fitted with *electric self-starters.* The Curtiss planes are invariably fitted with electric self-starters, and this is particularly noticeable in the seaplanes, which many readers have probably seen in actual flight at Atlantic City and other locations. Thanks to the electric self-starter and other features, the seaplane of this type rambles thru the air and up and down off the water, just like a regular *Ford* on land.

The seaplane has it on the land plane in that if you should happen to drop a few hundred feet and land in the water, the chances are you will not spoil your disposition very much, but if you take chances on landing inadvertently on a church spire or on some one's nice iron picket fence in the heart of a city, you ought to wear a barrel or two of shock absorbers in order to minimize the "kick" of the sudden stop; —as the Irishman remarked, "he didn't mind the going up, but it was the 'sudden stop' in coming down, that slightly jarred his nerves."

The famous *bubble-sextant* which had a great deal to do with the successful navigation of the famous N. C. planes in their flight across the Atlantic Ocean, was exhibited at the Navy booth and explained by naval officers, to the interested public. The bubble on this sextant is electrically lighted. There was also exhibited and explained by the naval officers, an improved form of rapid range-finder for aircraft.

It was noticeable at the show that aircraft builders are beginning to fit them out regularly with electric *tail* and *wing-tip* marker lamps, red and green, etc., and they are also developing tiny wind driven generators for supplying current to various navigating instruments, for operating the wireless set, (when carried on board), etc.

There are, of course, a host of other distinct electric novelties in the world of flying, which are not very common, such as electrically heated uniforms for high altitude flying, electric foot warmers, electric searchlights for landing at night, and, of course, the wireless telephone and telegraph, which have been developed considerably since the close of the war.

An interesting feature observed at one of the airplane radio exhibits, was an audion detector and amplifier cabinet, containing two bulbs, and the wooden cabinet of which was resiliently mounted on four strands of one-half inch diameter heavy rubber bands, stretched between the sides of a metal frame, so that no vibration whatever could reach the cabinet.

A radio *direction finder* with revolving loop antenna for use on planes, was also exhibited. By means of this apparatus, the aviator can quickly determine in what direction radio transmitting stations are located, and thus he will be able to quickly find his own bearings.

CANNON FIRES THRU SHAFT OF NEW ENGINE.

The Wright Aeronautical Corporation exhibited the powerful new "Wright-Hispano" airplane engine, fitted with a 37 mm., rapid fire cannon—get that!—cannon we said!—which fires a one-inch projectile directly thru the center of the hollow shaft of the engine. This spells *good-bye* to armed flying tanks such as those developed near the close of the war, by the Germans. To aim the gun, the aviator has to jockey the plane of course, until the axis of the machine and the engine are in direct line with the target or enemy plane. This beautifully built motor is also arranged to fire synchronously, two machine guns mounted on either side of the engine.

Many other interesting things aeronautical were exhibited. A new comer in the spark plug world was in the form of a mica plug, for which it was claimed that an original set of these were flown in a Martin bombing plane by Col. R. S. Hartz, in his "round-the-rim" flight of 9,823 miles along the entire border line of the United States. Very remarkable indeed, in view of the fact that not one of the plugs was removed during the entire trip from July 24th to November 13th.

An interesting gyroscopic *turn indicator* was demonstrated at the show, and this contained a white disc driven by an air-propelled gyroscope which tended to pop up before right or left hand windows, whenever the aviator attempted to make a turn. This was pointed out as a very valuable new instrument, as it is impossible for an aviator to tell from his compass when he is making a turn at night or in a fog, and he often gets lost and all mixed up in his bearings when such a turn indicator is not before him, under these conditions. The white dial of the *turn indicator* is treated with a radio-active substance so that it glows in the night time.

AIRPLANES WITH PARACHUTES.

At least one airplane exhibited at the show was supplied with an independent parachute, which is said to work effectively and to take up but very little room. It can be readily put into action at any instant.

All in all, the airplane show appealed equally to everyone—men, women, and children. The great strides made in providing comfort in the planes, both large and small, proved a great drawing card. Some of the planes looked really more "comfy" than our finest automobiles, and give the effect when looking down into their passenger compartment, of the highest class railroad Pullman cars.

Electric lights were fitted in the same manner as those in Pullman car berths, and their glass bulls' eyes nestled in the leather upholstery of the ceiling, in some of the machines.

The handling of the machines has been greatly simplified so as to greatly resemble the driving of a modern motor car, and it was noticeable that the "joy-stick" has given way to foot control levers and steering wheels, the same as on automobiles.

The handling of a plane today, is far different from what it was a few years ago, and one can hop into the seat of one of these up-to-date aircraft—throw on the gas and the self-starter, and in half a minute be rolling over the ground at from 40 to 50 miles an hour, ready to glide up into the air.

A gigantic transcontinental aerial flier was exhibited by the Thomas-Morse concern, but the "grandaddy" of them all, was a whooping big plane which almost scared you to death to look at it—with its 105 feet of wing spread and its three 400-horsepower Liberty motors, which was exhibited by the L. W. F. Engineering Company.

(*Continued on page* 68)

Aladdin's Lamp

By CHARLES S. WOLFE

AN average chap, average if there ever was one, was Johnny Hartman. That old saw about the gods making mad those whom they are about to destroy is probably true. Usually they make very commonplace those whom they are about to exalt.

Hartman had been to college; but it had been a flying trip. In his capacity as driver of a wholesale drug house dray, he had once delivered a load of laboratory apparatus to the local "prep" school. His career as a student had stopt short in his freshman year at the high school, and it cannot be truthfully said that up until the day of his leave-taking had he given any promise of becoming good in any particular branch of study.

His very best work had been done in the creek, and this, unfortunately did not figure on his monthly report card, except indirectly under the head of "Days Absent." His parents, glancing over these report cards, had discovered startling discrepancies, or more correctly, perhaps, startling *regular* discrepancies, in the number of days per month that Johnny was supposed to have been at school and the number of days which the card showed he had actually been there.

At the impromptu court-martial presided over by his father that followed the arrival of a particularly bad report card, Johnny had been unable to present any evidence of a consequential nature in rebuttal. Sentence was duly past, and Johnny joined the ranks of the toiling millions. No great industrial upheaval followed the arrival of this recruit into labor's army. He did not set the world on fire. For that matter, he didn't even strike a tiny spark.

A semi-technical article in a Sunday Supplement started Johnny on his amazing career. Becoming, Heaven alone knows why, mildly interested in the matter set forth in the article, Johnny began verifying some of the statements made by the writer. Like the chap who read Webster's Unabridged from cover to cover, he found them correct. But in his experiments he had used a dry cell and a simple electromagnet. His interest piqued, he began to hunt down the "why" of that dry cell, and from that day on he became a confirmed dabbler.

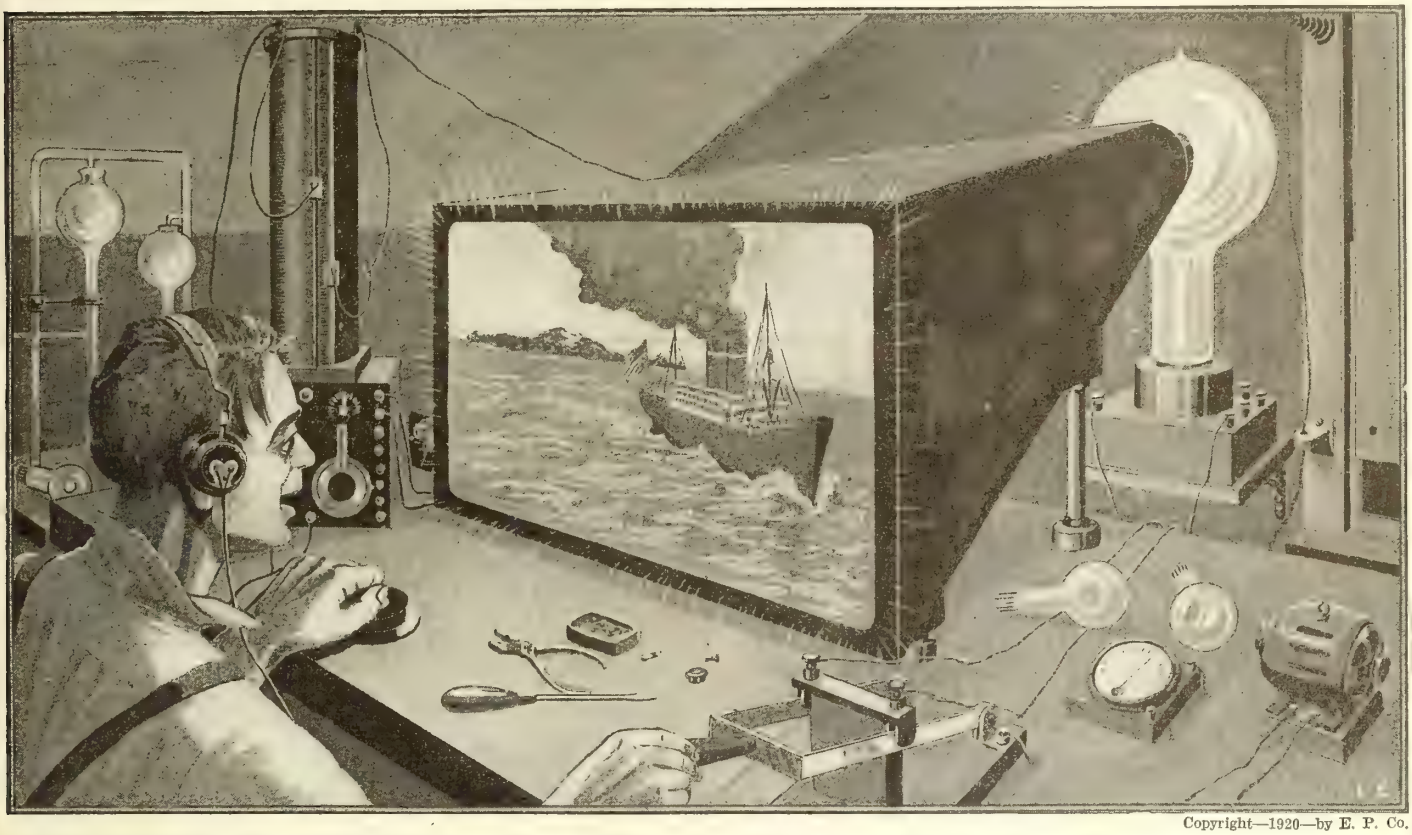
As the years went by they did to Johnny what they do to most of us. The average number of ups and downs; mostly downs. First his mother past into the Great Beyond, and by the time the poignant misery of this loss had become a dull ache, his father had also solved the Great Riddle. Johnny was now alone in the world.

Rooming house after rooming house followed, each move effected with more difficulty than the last because of the ever-accumulating bunch of junk that he was gathering together. As a compensation for his trouble along these lines, came his increasing knowledge of things electrical and mechanical, and he had long since wished his dray off on another unfortunate, having secured a fairly lucrative and admirably steady position with a firm of electrical contractors. Johnny will never know just how much he was valued by that firm. His knowledge of the things with which he worked extended beyond the practical into the theoretical, and as a consequence, he was unconsciously applying his superior knowledge to his daily installations. He was known to his employers as a man who met and mastered the emergencies of his business with unusual skill. And so he stood—all unknowing—at the age of twenty-eight on the brink of the Great Discovery, passing his days among motor installations and house-wiring parties and his nights in his little room and laboratory among Oudin and Tesla coils and high frequency phenomena.

On this particular evening, a goodly portion of an unfortunate steer safely tucked away in his stomach, he entered his laboratory for his customary night's recreation. Of late he had been dabbling in an aimless sort of fashion with vacuums. Meandering serenely thru many hours, he had succeeded in turning out electric incandescent lights that performed creditably, and had logically followed it up by duplicating the work of Fleming and De Forest. It requires only a brief paragraph to record these facts, but it had taken Johnny many an evening of hard and patient labor, accompanied by more failures than successes to reach that stage.

Working with hot glass is quite a trick, and when you have to dig out the processes for yourself it is terribly hard. From the

(*Continued on page 78*)



Copyright—1920—by E. P. Co.

". . . . A Queer Flickering Light Hovered Over the Whole Front of the Big Mysterious Box. . . . It Grew Brighter. . . . Vague, Shadowy Blotches Filled the Screen, Where That Weird Light Played. Hartman Was Tuning Frantically. . . . And Then, Suddenly, It Was There on the Screen—the Moving Picture!"

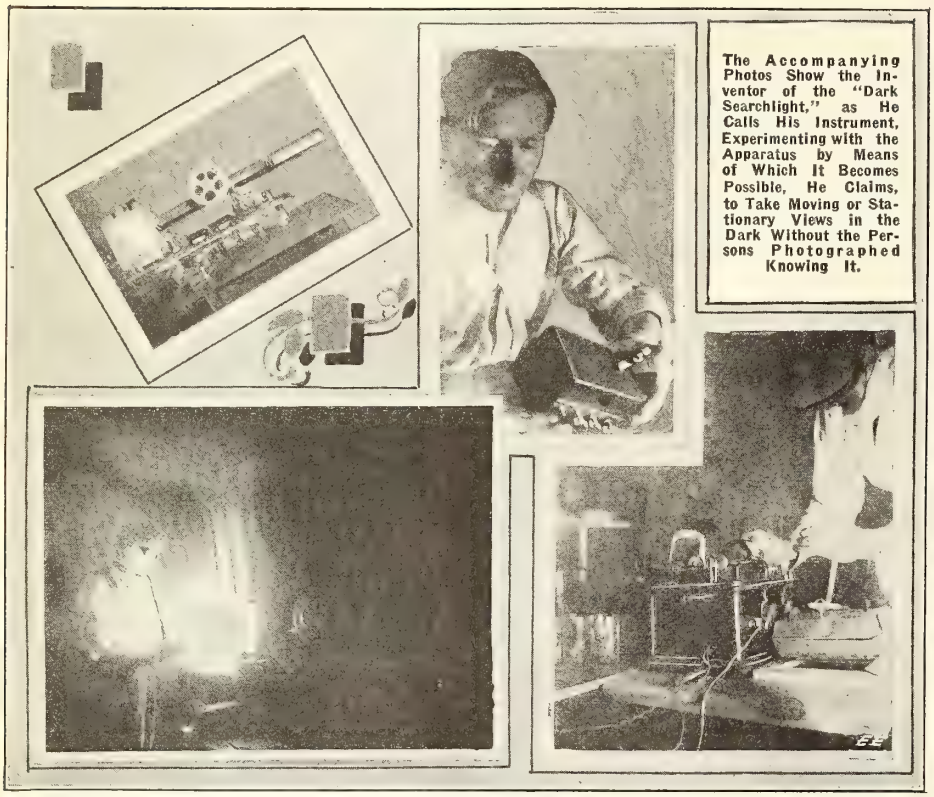
MARTIAN STUDENTS

FOR THOSE WHO READ THE ARTICLE, "HELLO MARS" IN THE APRIL NUMBER

GOUKA = CAT

The Dark Searchlight

By LEWIS YEAGER



The Accompanying Photos Show the Inventor of the "Dark Searchlight," as He Calls His Instrument, Experimenting with the Apparatus by Means of Which It Becomes Possible, He Claims, to Take Moving or Stationary Views in the Dark Without the Persons Photographed Knowing It.

The Two Top Photos Show the "Dark Searchlight" Camera and the Inventor With One of the Instruments, While the Two Lower Photos Show Mr. Yeager and the Powerful Light Used in Taking the Pictures, and at the Extreme Right an Experiment with the New Device.

JUST as wireless was designed to aid the human ear, the dark searchlight was evolved to make it possible for the human eye to see in the darkness without being seen. It is for the purpose of answering many questions asked me and for stimulating others to do research work in this line that I submit this non-technical description. The machine was suggested as a defensive weapon for this country during the war. This article will also allude to the use of the device as a police weapon and sporting apparatus. First, we will consider the needs of such an improvement, then we will consider descriptions of simple contrivances used in testing out the system.

The dark searchlight suggestion was made to the consulting board before the war ended in order to safeguard the Americans against the enemy contrivances. Having followed some of the foreign inventors in their systems of transmitting photographs by wire and in the process of photographing speech, I knew it was possible they had perfected the process without the knowledge of the Allies. The consulting board suggested that I send samples of the work after the device passed from one committee to another. This letter reached me shortly before the close of the war.

As the layman knows a searchlight cannot be used in war-time at night without giving away a position to the enemy. The ideal soldier would be one who had the power of night vision or could see in the darkness without being seen. As the schoolboy would term it, the soldier needs "cat's eyes."

THE DARK SEARCHLIGHT.

The dark searchlight is based on the principle that the photographic plate is quicker than the human eye in catching an impression. The ordinary section of moving picture film is made with successive exposures. The ordinary film is made at the rate of sixteen exposures per second. This does not mean that the sixteenth of a second is required for the exposure if we wish to split hairs on the point. It must be remembered that the film must be jerked in front of the lens barrel of the camera between the exposures.

With the dark searchlight we illuminate a spot and make the exposure so quickly it escapes the nerves of the eye, and the observer is able to use a searchlight without being seen.

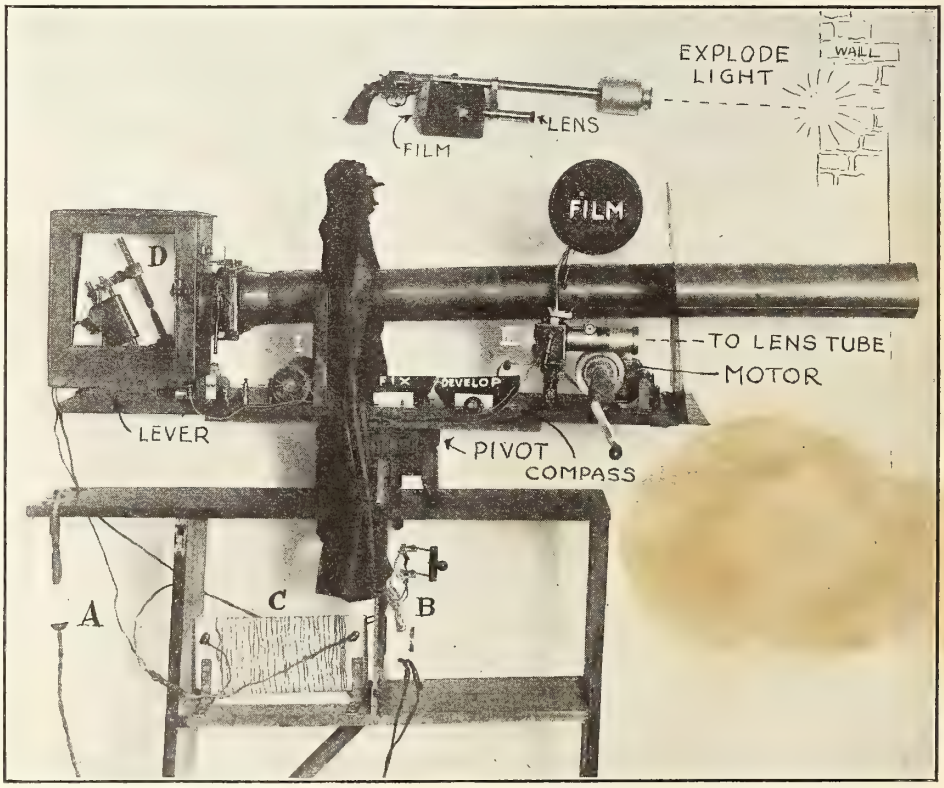
We must use an actinic light for the searchlight proper and a special sensitized plate for the observation fixation. After the plate or film is exposed it may be prepared as in ordinary photography. It will be understood by the layman that the idea is for the camera used in connection with the light of actinic value to catch an image in so brief a period the eye of the individual observer did not see the light beams.

We must not only have a light source, but must have it under control to the extent it may be projected upon a spot for the fraction of a second, while the telephoto lens is directed on the same spot. We must also have equipment or the camera proper for capturing the reflection the instant the light is uncovered.

THE SIMPLEST APPARATUS.

We will now take up the simplest apparatus which could be tested, then discuss more complicated plans:

The simplest form of apparatus which may be considered is shown in sketch (Fig. 1). This scheme provides a hand contrivance. A camera is used with a special flashlight torpedo and gives a range as far as the observer can throw the illuminating device. The camera, in the hands of the observer, with the shutter



The "Dark Searchlight Gun" Is Shown Above—It Projects or Fires a Magnesium or Other Cartridge While the Camera Takes the Picture. The Large Machine Shown Below Is the One On Which the Inventor Has Spent Most of His Time. The Principle of This Startling Invention Is to Project a Spot of Light From the Arc, of Such a Short Duration that the Eye Will Not Perceive It, Which, However, Will Enable the Person to be Photographed by the Extra Sensitive Film of the Camera.

open, is directed on a certain spot. The torpedo is thrown and explodes the percussion cap and ignites the actinic powder for the observation.

The second step in the evolution and a small machine which proved interesting and successful is illustrated in Fig. 2. This was a combined firearm provided with a silencer for the sound and a damp fabric to eliminate the flame from the weapon. The bullet included a spindle nose with a percussion cap at the tip and the spindle surrounded by the actinic powder. The camera attached was left open when the arm was discharged. As soon as the nose of the projectile struck a solid body, it exploded the magnesium charge. Of course this only hid the observer; the light at the point where the charge exploding giving away the fact an observation was being made. This machine has the advantage of great range with less weight than where electric light sources are used. The disadvantage of the machine is that it does not conceal the fact photos are being taken. The observer is in no danger, however, as the sound and light from the firearm is eliminated.

I am giving space to descriptions for the same reason that the instructor in radio tells his pupils how corks bob up and down when a stone is tost into the water. Much of the material in this article is for the purpose of instruction and to encourage the amateur.

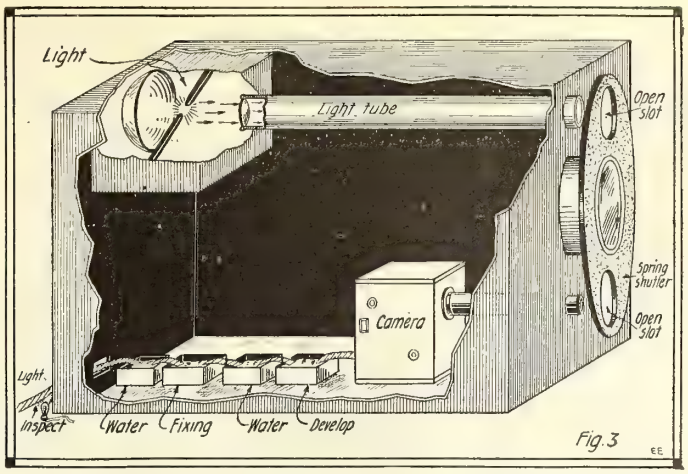
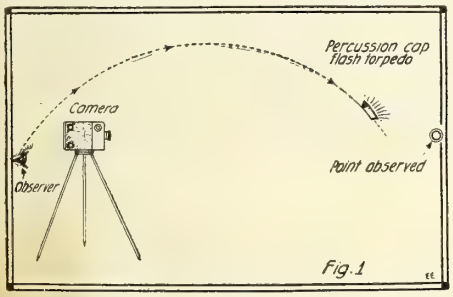


Fig. 3, Above, Shows a Simplified View of the "Dark Searchlight" Camera and Light Projector, Together With the Successive Developing, Washing and Fixing Solution Trays Thru Which the Film From the Camera Passes, So that the Photographic Images Are Very Quickly Available for Inspection.

GENERAL PLANS FOR THE MASTER MACHINE

The dark searchlight plans offered to the government in order to give the experts the idea consisted of:—The light source proper; the projecting lenses and tube to prevent fogging of film; the motor-driven camera mechanism and camera, and the developing and fixing bath. The apparatus mounts much on the order of a machine gun.



The Above View, Fig. 1, Shows How the Magnesium Cartridge or Other Form of Illuminant Operates in Conjunction With the Camera—the Observer and Position Where the Camera Is Located, or the Person Projecting the Flash Cartridge Being Unknown to the Victim.

A number of materials may be used in obtaining a light source where the light will have actinic value. Magnesium wire, mercury and the ordinary electric arc are among the light sources rich in actinic qualities. Lenses must be used which will not kill this value.

Reflectors, projecting lenses and the like will not be discust here, as they are well known.

A good spring motor will drive the camera gears if it is desired to take a number of exposures. The gear must be such that only one picture is made with several seconds of time intervening. The film is fed from an upper reel to a lower toothed gear if the observation is made by an ordinary movie camera.

When the film is exposed it is fed into the bath for developing, then fixt, after which it may be inspected. The human eye, with the aid of the machine, has been able to make it possible to see in the darkness without being seen.

Methods of photographing a compass to give the exact direction in which the picture was taken and means for revolving the machine will not be described here.

I found it easy to synchronize the shutter of the light by using an electric circuit. The shutter of the camera closed a contact completing a circuit when the exposure was made. This energized a magnet at the searchlight and opened the shutter for an instant. (Two slots in a shutter.)

HOW THE DARK SEARCHLIGHT IS USED

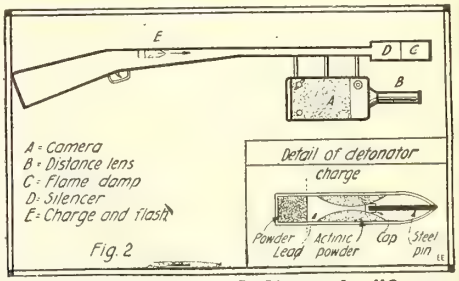
To take an observation the operator starts the motor after the machine is directed where a territory is to be scanned. The light is in operation but is concealed by the shutter. As the film shutter opens for the exposure, the shutter in front of the light source is tript and the light is released for the fraction of a second. A fraction of a second later the lens shutter opens the circuit and the searchlight shutter cuts off the light. The machine is directed onto another spot and the operation is repeated. The film is fed into the bath for developing and fixing.

OTHER USES

Other than military uses I will suggest some freak use or uses of value for the process. When the machine is adopted for commercial use, the hunter may count the ducks on the lake before the sun rises. He will photograph them without so much as the possibility of disturbing them while he arranges for a "pot" shot. Now for a use which I fear will shock some younger readers of the ELECTRICAL EXPERIMENTER. Like all inventions the dark searchlight will meet with opposition. I realize that park "cops" who meddle in the affairs of lovers and have the anti-spooning bug, may use it for unworthy purposes. For the sake of readers of this journal who may be the victims of the machine I will give them a secret process for detecting the light by machinery.

If the Germans had been using the dark searchlight, it would have been possible for the Allies to have detected it. Now, readers, get this big idea as it may save you being the victim of the anti-spooning "cop" who makes use of the dark searchlight! If you fear being watched, use a head set in circuit with a battery and suitable detector such as a selenium cell. The detector must be sensitive to light. Now just as soon as a man or lady "cop" begins to take snapshots, hang out the detector and be prepared to beat it with the girl. She will admit right there you are worthy of being taken into partnership and you may form a "close corporation" just as soon as you have escaped.

If you are building your own selenium cells or using mercury, be careful about breathing too much of the fumes, and if using the arc light use enough resistance wire to absorb the heat, as you may burn out the wiring in the house.



This Illustration, Fig. 2, Shows the "Camera Gun" Devised by Mr. Yeager, Also a Detail Sketch of the Special Flashlight Cartridge Projected by the Gun. The "Gun" Is Fitted With a Flame Damper and Noise Silencer, So That the Person or Persons Photographed Cannot See Nor Hear the Gun When It Is Fired.

Experimenting with the dark searchlight process will certainly make you a "master experimenter."

(Note: Due to patent reasons several fine points of the dark searchlight's mechanism are not disclosed.—EDITOR.)

German Papers To Depend On Radio

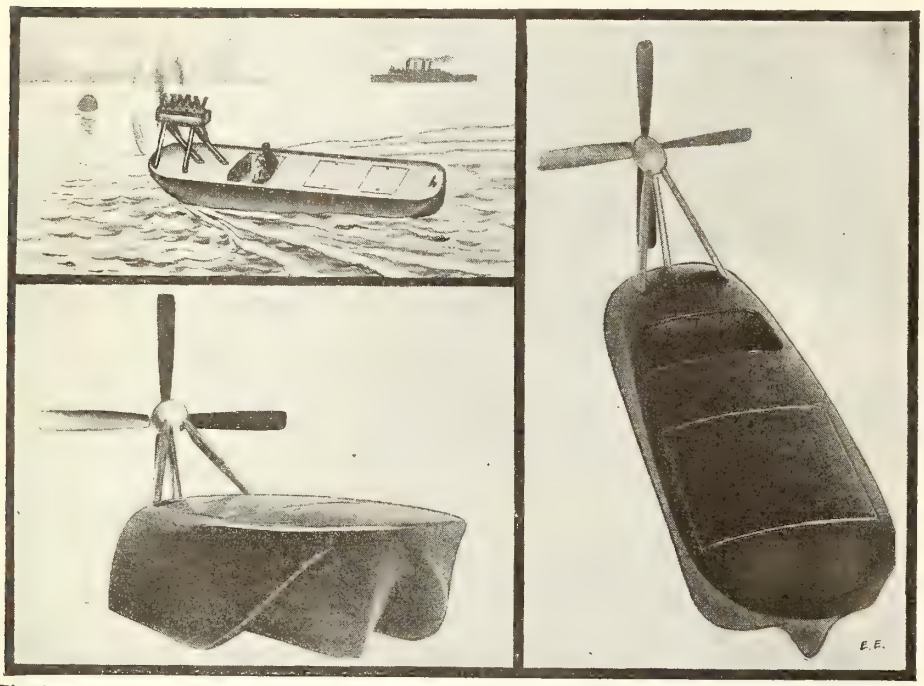
Wireless is to be widely extended in Germany, in especial for the press, if the plans of the ministry of posts and telegraphs mature. It is proposed to establish a collateral central in Berlin, and wireless plants in various wireless districts into which the empire will be apportioned. For this year the construction of 35 wireless stations and 50 receiving stations situated in important trade centers is planned.

Germany needs such an arrangement, for its telegraph service is severely criticized, and in addition to greatly increased prices, it is now necessary to telegraph the simplest, shortest message urgent—at three times the ordinary rate. The wireless will be expensive, but it will be worth it to the newspapers and business houses to be sure of speed.

The German papers that comment on the innovation are hopeful, but call attention to the unreliability of the wireless and raise the objection that anyone may pick up a message, so that a paper having an apparatus might easily steal the news of another paper.

This is partially controlled by the fact that the wireless for the present is subject to the Imperial Ministry of Posts and Telegraphs, and no one may have a wireless without official permission. A private plant that misuses its apparatus will be suspended immediately—if the owner is caught. The press message thefts could be prevented, it is suggested, by the proper publicity regarding the offender. Circular dispatches will be a feature of the plan, whereby the same bit of news can be sent to any number of stations at once.

100 M. P. H. Air-Propelled Boat



The Latest Thing in Speed-Boats! By Means of an Air-Propeller and a High-Powered Engine, Together with Quadruple Convex Bottom, the Inventor Has Successfully Tested a Model Which Seems to Point to a 100-Mile-per-Hour Speed of To-morrow.

The Loudy Hydroplane here illustrated is an aerial propelled, quadruple convex bottom, speed boat, capable of 90 miles per hour in a calm. It is powered with a 400 horsepower Liberty 12-cylinder airplane engine, located aft of the pilot, and driving an 8-foot four-bladed propeller thru a shaft, bevel gear transmission. When the motor turns at 1700 the propeller turns at 1000 revolutions per minute. The boat is 24 ft. (between perpendiculars). It weighs 2000 pounds fully loaded, in racing trim, including pilot and mechanic.

The model shown in the accompanying photographs is one-twelfth actual size. It was tested in the Naval Tank at the University of Michigan in order to determine its hydro-dynamic resistance. The aero-dynamic resistance was computed from reliable data and added to the hydro-dynamic resistance, from which the horse-power required was computed. The "horse-power required" curve intersected the "horsepower available" curve at 90 miles per hour.

Several trial runs were made in order to determine the trim. The pitching moments due to the position of the thrust and resistance necessitated placing the center of gravity well aft. When this was determined the boat did not nose up or under, but maintained an even keel at all speeds. The boat planed perfectly at 18 m.p.h., at which speed the bow wave disappeared. The wake was clean and low. There was absolutely no spray. In coming to a stop, the boat settled rapidly and pocketed the water at the bow, coming to rest in a very short distance.

Rudders are placed on either side of the step and work in conjunction. The boat turns readily due to the out-curving water-lines at the bow, banking into a turn instead of out of it, as most boats do. This boat is non-capsizable due to its shape.

With a 700 H.P. Fiat airplane motor, a boat of this same type would make 104 miles per hour.

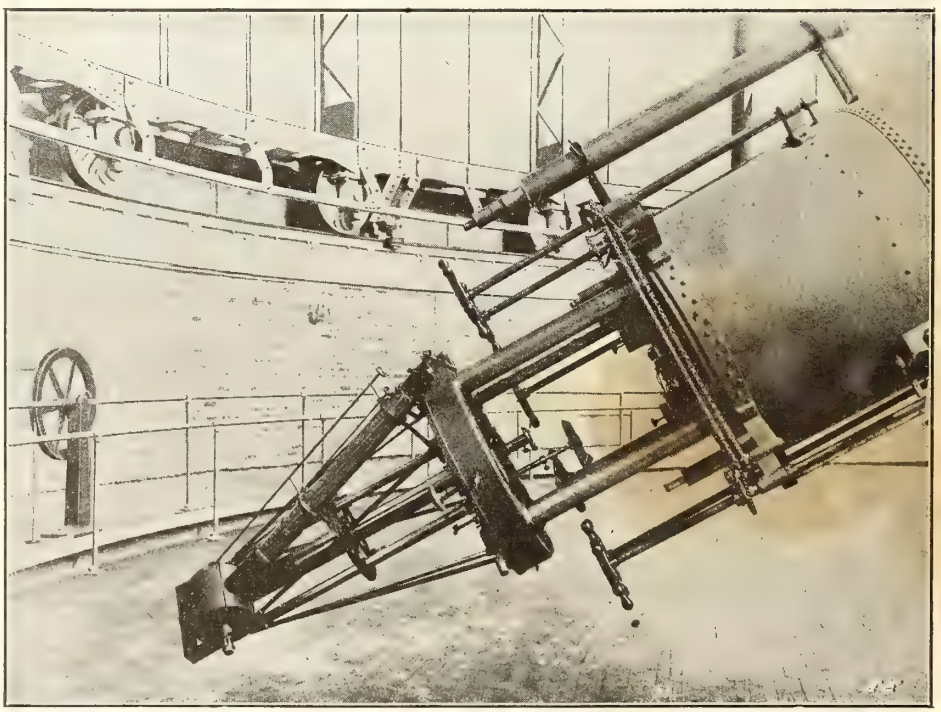
The Astronomical Spectrograph

By FLOYD L. DARROW

HERE we see the Bruce spectrograph attached to the eye-end of the 40-inch reflector at the *Yerkes Observatory*. The essential parts of a spectrograph are: (1) A very narrow slit thru which passes the beam of light, (2) a small telescope called a collimator, at the focus of which the slit is placed, (3) a prism to disperse the light into its component colors, and (4) an observation telescope to produce a magnified image of the spectrum. To be used as a spectrograph for photographing the spectrum, three prisms are usually employed, so as to obtain a greater degree of dispersion, and a plate holder is substituted for the eyepiece.

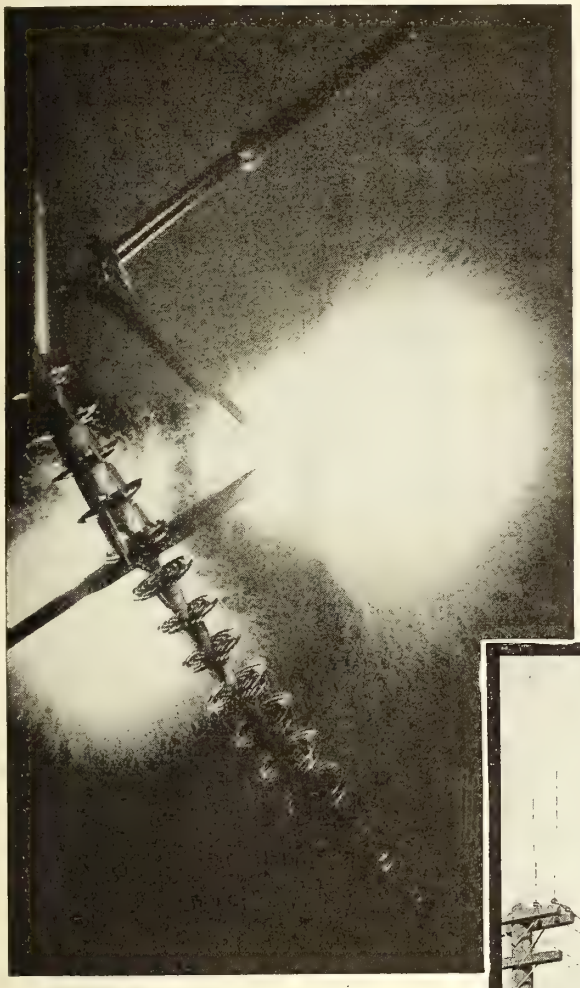
In the photograph we can see the collimator centrally placed, which receives the light gathered by the huge lens and transmits it to the three prisms contained in the circular case at the bottom. The light from the sun falling upon the first prism at the proper angle is dispersed into the colors of the rainbow and passing thru the other prisms undergoes further dispersion, emerging as a broad band of color, which is focust by the observation telescope upon the sensitive plate. In this photograph the eyepiece and not the plate holder appears.

Light is an electromagnetic wave motion in the ether of space, the waves differing from those that produce wireless and heating effects only in length. Wireless waves are very long and of low pitch; light waves are very short and of high pitch. Color itself is simply pitch (or frequency), the red waves being long and the violet waves short. Within certain narrow limits the human eye is sensitive to these waves. On one side of the spectrum, however, we have the invisible or infra-red and on the other the ultra-violet. Now it is due to this inequality in wave length that light undergoes dispersion. The shorter the wave length the more the velocity of light is retarded in passing into a dense medium like glass. Therefore the violet waves are retarded most and the red least. This results in the emergence of the light separated into its colors with red and violet at the ends and the other colors lying between. (*Continued on page* 111)



This Photo Gives an Excellent Idea of the "Solar Spectrograph" as Fitted to the Eye-End of the 40-Inch Telescope at the Yerkes Observatory. The Spectrograph Enables Us to Analyze the Structure of the Stars and Nebulae of the Heavens, for Every Incandescent Vapor Has Its Own Characteristic Spectrum Color.

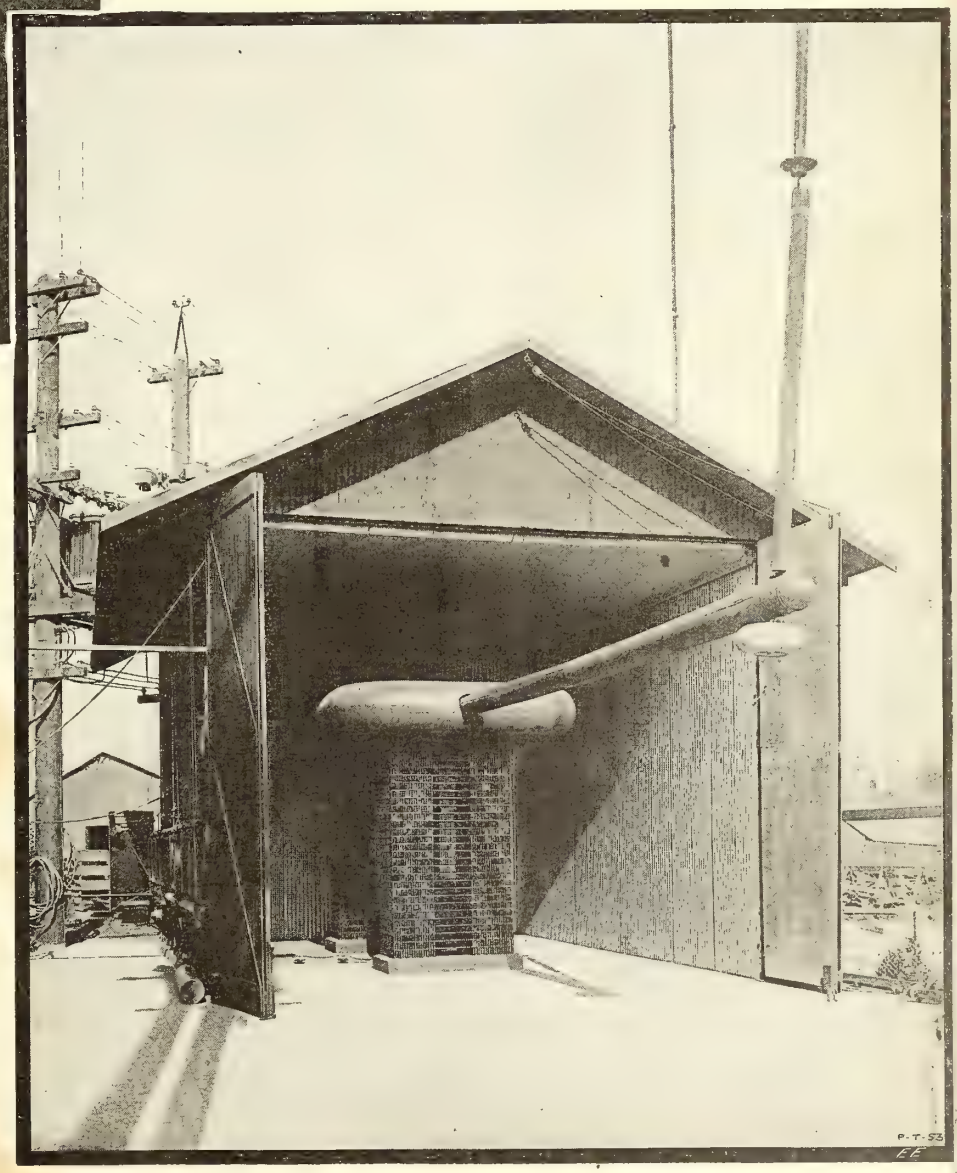
Largest High Frequency Laboratory



Photograph at Left Shows a Test Being Made at High Voltage and High Frequency on a Chain of Suspension Insulators of a well known type. The voltage on this test was 150,000,—the Corona Having Been Started by a Potential of 207,000 Volts, the Corona Always Being Maintained by a Lower Voltage Than the Initial Potential Required to Start It,—While the Frequency Was 48,000 cycles Per Second.

THE insulating of apparatus for voltages of from 100,000 to 150,000 at sustained frequencies varying from 15,000 to 500,000 cycles per second, such as used in radio telegraphy, is a far more difficult problem than that of insulating for the same voltages at "commercial" frequencies, such as 60 cycles per second.

To study this problem, the Federal Tele-



Photograph at Right Shows Large Building Containing High Frequency Apparatus, Erected and Used for Testing Purposes by the Federal Telegraph Co., at Palo Alto, Cal. The Exciting Current for the High Frequency Apparatus Is Supplied to the Air Condenser from a Poulsen Arc, of the Type Used in Long Distance Radio-Telegraphy. This Laboratory Is Unique, and So Far as Known, Is the Largest of Its Kind in the World. It has Sufficient Power to generate a Potential to Earth, of Half a Million Volts, at a Frequency of 50,000 to 100,000 Cycles Per Second.

graph Company built at its plant at Palo Alto, California, a great high voltage laboratory, in which it is possible to duplicate the high voltage and high frequency phenomena which have to be met with in operating a high power radio station.

The building which constitutes the high-voltage laboratory is shown in the large photograph herewith. This building consists of a wooden framework lined with corrugated iron. It not only acts as the shelter for the apparatus but forms the grounded plate of the air condenser. The high potential plate of the condenser, which has somewhat the appearance of a life raft, is mounted on top of the porcelain supports. This plate corresponds to the antenna of a radio station. Beneath the high voltage plate is the loading inductor (not shown in the picture) sometimes known in radio stations as the "loading coil." Current is supplied to the air condenser from a Poulsen arc, such as is used in the arc radio transmitters manufactured by the Federal Telegraph Company.

The laboratory is unique in that it is capable of generating a potential *to earth* of half a million volts, which is about as high as is obtainable in any of the 60-cycle, high-voltage laboratories of the country, and at the same time this voltage is generated at a sustained frequency of 50,000 to 100,000 cycles per second. Thus this laboratory is the largest of its kind in the United States, and, as far as is known, the largest in the world.

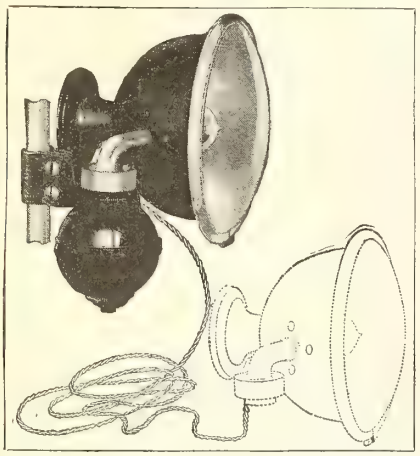
The smaller photograph shows a test being made on a string of suspension units, such as used on high-voltage transmission lines, which are, in this case, equipt with a corona shield. The photograph shows corona plumes two to three feet long maintained by a potential of 150,000 volts at a frequency of 48,000 cycles per second. Corona first appeared at 207,000 volts.

(*Continued on page* 114)

...Automobile News...

AUTO REEL LIGHT.

The Autoreelite is a combination of three lamps in one—Spot Light, Trouble Light and Portable Light. Inside of the ball casing is a reel containing 12 feet of elec-



This Auto Light is Something Quite New and Should Meet with Great Favor Among Motorists Everywhere. It Combines a Spotlight, Trouble Light, and Portable Light with Twelve Feet of Flexible Cord.

tric cord which permits the light to be carried anywhere within 12 feet of the windshield.

When you wish to inspect any portion of your car at night, simply remove the lamp from its support and the 12 feet of cord permits you to carry the light anywhere round the car. The cord reel winds and unwinds like a curtain roller.

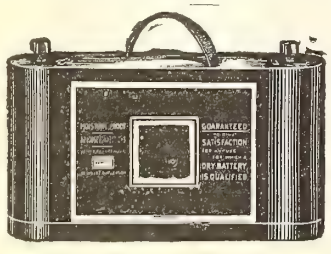
This lamp is the only one manufactured, it is claimed, that combines a windshield spot light, a trouble light and a portable light, and the cost of the Autoreelite is no more than that of an ordinary high-grade windshield spot light.

The 12-foot extension cord and reel are contained in the small, neat ball casing attached to the bracket.

DRY CELL IGNITER BATTERY.

The dry cell igniter battery illustrated is simple in construction, strong and durable. A specified number of dry cells, properly and permanently connected together are put into a moisture proof container. The cells are perfectly insulated from one another and hermetically sealed in the container, so that only the two terminal binding posts and the carrying strip protrude thru the sealing compound.

The terminal nuts on the binding posts are embedded in a square shaped knob of insulating material so that a wrench or



A New Compact Form of Dry Cell Ignition Battery for Auto Requirements.

strip of metal accidentally in contact with both binding posts will not cause a short circuit. The size and shape of the insulated terminal nut permits sufficient pressure to be exerted to insure a perfect and permanent contact without using pliers. The carrying handle is of strong webbing, having the ends securely anchored in the interior of the battery. The positive and negative posts are indicated by the proper symbol stamped on the sealing compound alongside the binding posts.

The method of construction, necessarily eliminates all trouble from moisture, loose terminals, broken or improper connections and is a time saver to the user. The space occupied is no more than that which would be taken up by an equal number of standard dry cells, so that these batteries will fit standard size battery boxes in any case.

The carrying handle is a convenience that will be appreciated by everyone who wants to use the battery for different purposes: for example—a farmer could use it on his tractor, his automobile, his pumping engine, as circumstances require, by simply disconnecting it from one and connecting it to the other. This general utility feature of the sparker unit should appeal to every user because of the saving in time, as well as for its convenience and economy.

$50.00 In Prizes

Beginning with our July issue, we shall print on this page a new automobile department entitled "Automobile Stunts", and we will pay $50.00 in prizes for the three best articles received each month.

A great many of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. Almost every other automobilist some time or other invents a little device or does something to his car to make it better than it was before. "Experimenter" readers want to duplicate these stunts, and that is just what this new department will be for. In other words an exchange of ideas. Note that the idea does not necessarily have to be electrical in any way. You may have a new stunt or trick how to patch a blown tire that was not described before. You may have a new idea how to prevent your spark plugs from carbonizing, and thus short circuiting. You may know of a new stunt how to refill or charge a storage battery. If you have a town car, you may have thought of some simple trick how to signal to your chauffeur, so he will know where you will want to go.

There are hundreds of such ideas, and we will pay $50.00 a month to get them. Of course, we would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. If no photograph can be furnished—altho we would like to have it—a simple sketch will do showing the essential parts, etc.

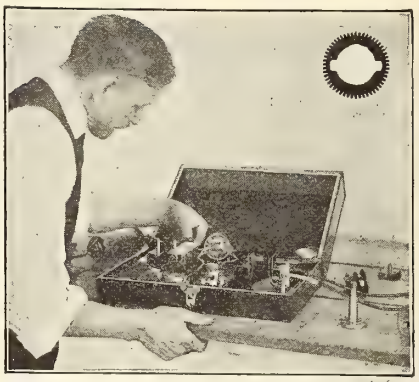
We will pay the following prizes:

FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes will be paid for at the rate of $2.00. Articles submitted should not be long ones. About the size of the ones shown on this page will do. Address all manuscripts to "Editor, Automobile Stunts," care of this publication.

MAGNETO DEFECTOMETER.

For use by electrical repair men in locating magneto troubles, the outfit shown in the accompanying illustration is now being made by a Chicago concern. By means of this outfit, it is said that it is possible to determine whether a condenser is out of condition, whether a collector is defective or whether an armature is dead. The arrangement of the outfit is such that the condition of the armature can be determined by the action of a vibrating spring. Directions accompany the instrument outlining the indications for a perfect armature and also indicating how faults on damaged armatures show up.



This Instrument Quickly Locates Defects Or Trouble in the Various Parts of Automobile Magnetos. By Means of This Instrument, You Can Quickly and Accurately Locate Trouble in the Condenser, Collector, or Armature.

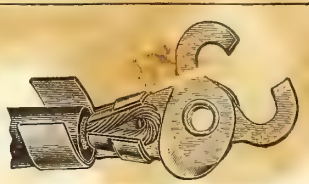
AUTO JOTTINGS.

As a matter of fact, it is only in certain parts of the country that we see many electrics running about, but among certain people there has always been and is now a profound respect for the clean and noiseless electric auto. The field of electrically driven cars has recently become enlivened to a greater extent than ever before by the advent of a number of new features and developments. Principal among these, we find the new light weight and rigidly built storage batteries and first and foremost in recent inventions,—the new Steinmetz automobile. In the Steinmetz machine, twice the horsepower is developed with the same motor and battery weight, by causing both the field and the armature to rotate, in opposite directions. The armature drives one wheel and the field the other, thus acting as its own differential.

CLEVER BATTERY TERMINAL.

These terminals are suitable for both primary and secondary winding and are claimed to insure perfect connection at all times, and in view of the fact that the contact blades or jaws of the terminals are of spring brass, bent in opposite directions, they prevent the possibility of being jarred loose by vibration.

It is not necessary to remove the thumb nut on spark plug or battery terminal in order to place these connectors into or out of service; all you have to do is simply to loosen the binding nut, open the jaws of the terminal clip, close them around the screw of the terminal base, and tighten up the nut.

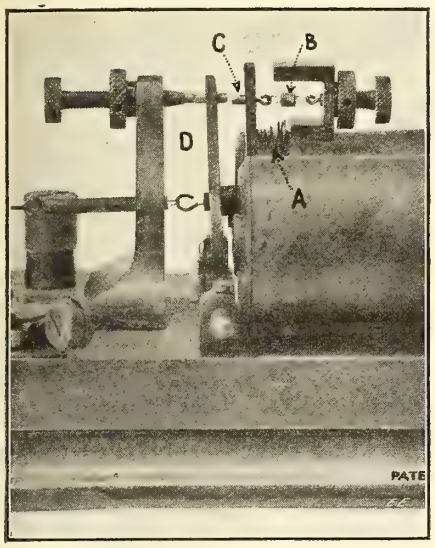


Detachable Spark Plug and Battery Terminal Combining Excellent Electric and Mechanical Principles. All You Have to Do is to Simply Loosen the Nut and Insert or Remove This Hinged Lug in a Jiffy.

110-Volt D. C. or A. C. Telegraph Relay

By Donald McNicol

This new universal relay for single line Morse telegraph or other signal circuits operates on 110-volt alternating or direct current. The relay is in appearance the same as an ordinary main line 150-ohm. telegraph relay. The adjustments are the same as with ordinary relays; that is, by movement of the electro-magnets relatively to the armature, and by means of a retractile spring attached to the armature. The relay will operate satisfactorily on any current strength from 10 to 200 milliamperes, and the current may be from a direct-current source or from an *alternating-current* source, of *any commercial frequency and voltage*. The view of the construction of the relay herewith shows a spring cushion contact in place of the solid contact heretofore used in signal relays. This cushion contact *C* is so designed that it is substantial and introduces no trouble-making complications. It involves a properly balanced floating contact supported by retractile and expansive springs, *A* and *B*.



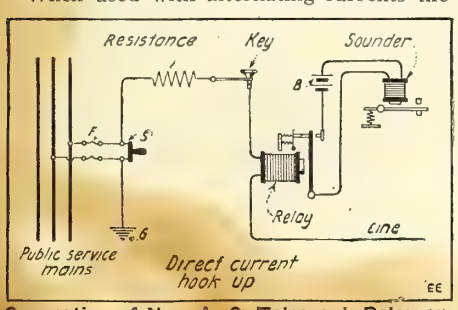
The Alternating Current Telegraph Relay —the Problem of Problems, Solved at Last by the Use of a "Floating Contact" Which Follows the Vibrations of the Armature.

When used with alternating-currents the relay armature remains in *floating contact* with the relay front-stop as long as the relay circuit is closed. A sounder operated by the relay is actuated faithfully and exactly the same as with direct current.

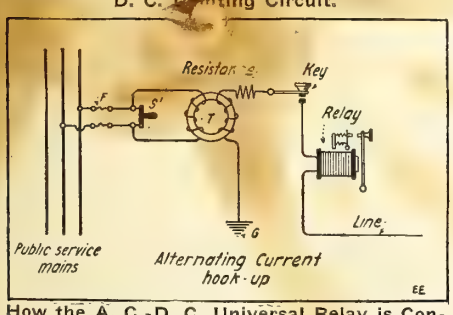
The main advantage in using this relay is that to operate telegraph lines there is no necessity for the setting-up of motor-generators, primary batteries, or storage batteries; a lamp-socket connection to the public service 110-volt, 60-cycle mains is all that is required. In case the public service system is an ungrounded one an inexpensive transformer may be used and one terminal of the secondary grounded as shown in the A. C. hook-up.

The relay is now in use as a district-service relay in New York City and has been tested on lines 200 miles long operated by a Vibroplex transmitter, the received signals being exactly as clear as if direct-current had been used.

Alternating-current sounders are now on the market and may be used in connection with this relay. In case a. c. sounders are not desired an ordinary d. c. sounder may be used, or a dry-cell sounder of a type which uses current only when the relay is open. See D. C. diagram. Ordinarily a telegraph circuit is closed at least two-thirds of the time; if, therefore, current is used to withdraw the sounder armature, and a spring used to close the sounder armature, it is clear that the life of the dry cell local battery will be proportionately prolonged.



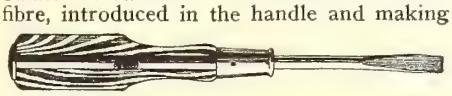
Connection of New A. C. Telegraph Relay on D. C. Lighting Circuit.



How the A. C.-D. C. Universal Relay is Connected up to Alternating Current Lighting Circuit.

AN INSULATED SCREW-DRIVER THAT PREVENTS SHOCKS.

A distinguishing feature of the new insulated screwdriver is the insulation of hard fibre, introduced in the handle and making it shock-proof under all conditions (rupture point 10,000 volts) and serving as part of, what is in effect, a continuous shaft, with a heavy rivet head. This makes it especially useful in work on automobiles and all electrical installations.



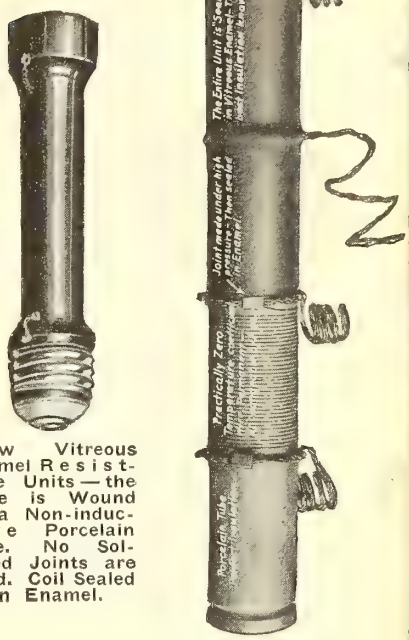
An Essential Tool for All Electrical Workers —an Insulated Screw-driver.

The form of the handle has been carefully planned to combine grace of design with these practical advantages.

NEW VITREOUS ENAMEL RESISTANCE UNITS.

A new departure in enamel resistance units is incorporated in the type here shown. It is built on a porcelain tube, giving perfect insulation. Grounding is impossible. No iron core with attendant self-induction is used, also no mica or asbestos. The wire used has practically zero temperature. The wire will not change its molecular construction thru service at rated temperature, and will not age and offer a different resistance in ohms. Joints between fine wire resistance and heavy terminal leads are made while parts are clean and bright under high pressure—then sealed in enamel at high temperature. There are no soldered joints that are uncertain and hazardous, and that cause disintegration of resistance wire during the process of soldering.

The insulation is vitreous enamel, one of the best insulators known. The entire unit is "sealed" in enamel, insuring against electrical, mechanical and chemical depreciation. No cement, japan or black paint, nor mixture of cement, sand, asbestos chips and powders—no porous insulation, either with or without a spotted skin effect are used, the makers claim. Flexible terminal leads of copper braid of any length desired are furnished. No limit as to location or length of leads. No moisture can reach the resistance wire. The units are rugged, permanent, compact and practically non-inductive. Any resistance or capacity desired is available.



New Vitreous Enamel Resistance Units—the Wire is Wound on a Non-inductive Porcelain Core. No Soldered Joints are Used. Coil Sealed in Enamel.

(So enthusiastic are the makers that they will send a sample free of charge to all interested parties. A self-enclosed envelope to our "Technical Information Bureau" is all that is required.—Editor.)

THIS STEP-DOWN BELL TRANSFORMER SCREWS IN SOCKET.

The step-down A. C. bell transformer here shown strikes a new note in the construction of bell transformers, in that it is of the socket type, and may be connected to the line by simply screwing into any Edison base socket or receptacle. This permits even the inexperienced to connect it. Also the method of connection permits the easy removal from one house to another, should the family move. All bothersome soldering is done away with in the installing of this transformer. The complete weight is only one-half pound, and the 10-volt type will ring four 2½-inch bells, while the 16-volt type will ring seven 2½-inch bells.

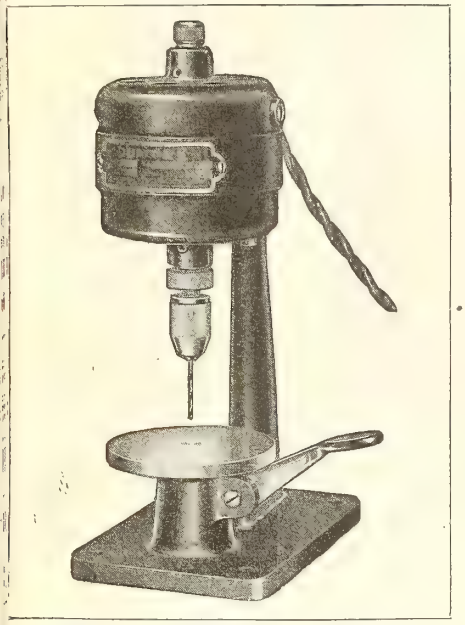
The transformer is enclosed in a neat black enameled shell, with the secondary terminals brought thru a porcelain block, conveniently placed. The transformer is well made, and impregnated, and does not depend on any filling compound to exclude moisture. The device will not burn out on short-circuit of the secondary terminals, and has an input of only 10 watts on short-circuit. This form of transformer is being more widely adopted every day to serve instead of batteries for ringing bells and operating annunciator systems.



Attachment Plug and Transformer Combined.

NEW 10,000 REVOLUTION ELECTRIC DRILL.

A new electric motor driven drilling tool is being put on the market by a western concern. The machine is adapted for use by manufacturers and jewelers for light,



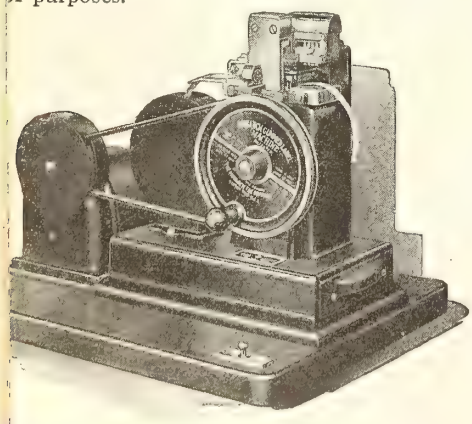
Electric Motor Drill Which Is Capable of Drilling at Speeds of from 500 to 10,000 Revolutions Per Minute.

sensitive work. The illustration shows the machine equipt with a direct-connected, variable speed type of motor, together with a spring chuck and a six-speed controlling unit, affording speeds varying from 500 to 10,000 revolutions per minute. The controller is mounted on the floor and is regulated by a foot pedal.

A wide range of operations may be very conveniently handled with this drill as it may be used with entire satisfaction on steel, cast iron, brass, aluminum, fiber, hard rubber, etc. The table is adjustable and gives the drill a stroke of ½". The capacity of the machine is for drilling holes up to 1/16" in diameter in steel and ⅛" in diameter in soft alloys. Holes can be drilled to the center of a 5" circle. The motor and chuck are in perfect dynamic or running balance, thus assuring smoothness of operation and accurate results.

MOTOR-DRIVEN GUM LABELER PRINTS SEVEN SIZES OF LABELS.

Designs of motor-operated labeling machines, such as shown in the accompanying illustration, have recently been developed by a Dayton, Ohio, concern, for a variety of purposes.



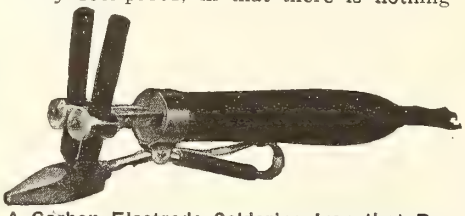
Operated Machine that Will Make and Print Seven Different Sizes of Gummed Labels.

This machine will make and print seven different sizes of labels without change in adjustment. It is only necessary to change the roll of paper in order to secure the size of label desired. From 14 to 40 characters can be printed on tags, the number varying with the size. It should find a wide field of application in stores of all kinds, especially where the hand-written tag or label is rapidly being obliterated.

SOMETHING NEW IN ELECTRIC SOLDERING IRONS.

A new and highly unique, as well as efficient electric soldering iron has recently been perfected.

It differs from others, in that the current does not flow until the twin terminal touches the work to be heated. The terminals are of carbon, which almost immediately develops a very high temperature—up to 3,300 degrees C. As soon as the operation is completed and the tool taken from the work the current, of course, ceases to flow, as the circuit is open. The same company manufactures a copper-pointed iron which is heated on the same principle—that is the circuit is closed by allowing the iron, operated by a spring, to come in contact with the two carbon points. When this contact has been made it is said to take less than a minute to heat the copper ready for work. This iron can also be used as two-prong soldering tool by simply removing the tip. These tools are practically fool-proof, in that there is nothing



A Carbon Electrode Soldering Iron that Develops a Heat of 3,300 Degrees Centigrade.

to burn out and that the only parts requiring to be renewed are the carbon contacts.

ELECTRICAL RECORDER AND ALARM FOR BOILER WATER-LEVEL.

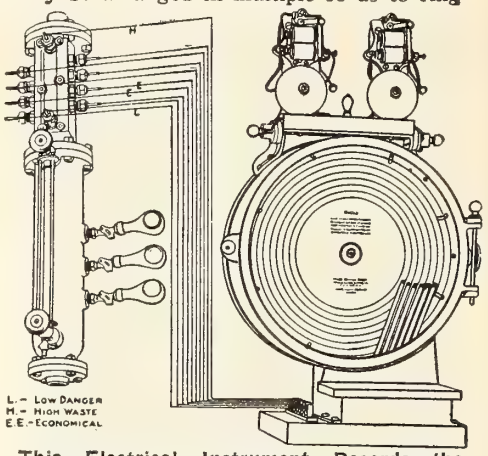
How often do unreasonable disputes arise between the chief engineer and the firemen as to the water level in boilers? A new clock driven water level recorder and alarm has been perfected to facilitate the maintenance of boiler room routine. This instrument *records* the level of your boiler water at all times. It shows where it is and has been, and the exact time it was at that level.

By its use the engineer and fireman can, if he will, guard against danger and loss from the extreme of too little water. He can learn to prevent all the losses and inefficiency arising out of a condition of too much water.

Moreover, surplus water in a boiler over the economical level destroys the proportions of its design and reduces the ability of the grate area to evaporate as fast or to as high a pressure. It also reduces the steam storage space provided besides calling for a given heating surface to handle more water than possible. The product is wet steam or foam, and the result is loss.

The makers of the new electrical water-level recorder seek to correct all this by helping to carry the level always at the economical line.

The instrument shows the level on a recording dial every moment, and when high or low is reached, alarms ring and signal lights flash. When on the economical line there is a white light constantly burning. It might be thought that the apparatus is quite a refinement for the boiler room, but such is not the case, as practise has demonstrated. The recorder itself is usually placed in the engine room. The alarm bells and lights are placed in the boiler room so that the boiler attendants can watch the boiler properly. The signals may be arranged in multiple so as to ring



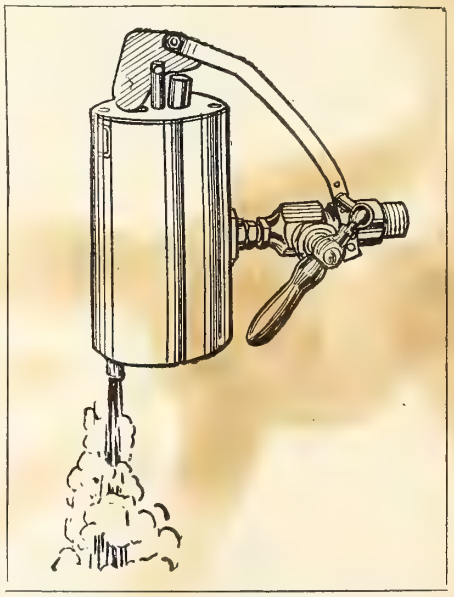
This Electrical Instrument Records the Water Level in a Steam Boiler at All Times, and Gives a Low-water Alarm. It Prevents Disputes in Boiler-room Operation.

or light up in two or more locations. Also the water gauge attachment and the recorder can be separated any distance desired.

ELECTRIC HEATER FOR RUNNING WATER.

The interior of this electric water heater consists of two compartments, the upper one of which holds the electric switch, and the lower one contains the heating element, consisting of a highly resistant metal alloy. The water passes thru this lower compartment, and as it is submerged it cannot be subjected to a heat temperature sufficient to injure it.

The heater may be attached to any ordinary water supply, and hot and cold water may be drawn from the same spigot as desired, the hot water being furnished only by the throwing on of the electric current, which is done automatically. The water being heated as wanted, there is no waste of electricity and 1¼ gallons a minute may be brought to a temperature of 115 degrees. Sufficient water for a bath may be heated in from 10 to 20 minutes.



This Electric Spigot Heats Cold Running Water at the Rate of 1¼ Gallons a Minute.

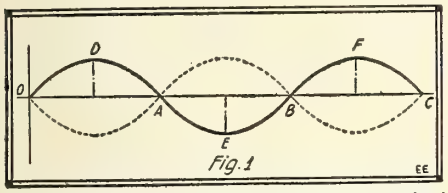
Experiments in Physics

By JOHN J. FURIA, A. M.

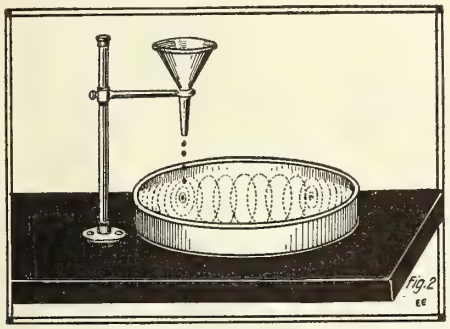
Department of Physics, N. Y. University

LESSON VI—INTERFERENCE

THE phenomenon of *interference* is a very important one in Physics and is usually misunderstood or not well understood at all by the elementary student. The reader should bear in mind that interference does not have the meaning of prevention which it commonly has. It means the combination of two



If a Rope About 20 Feet Long Is Attached to a Rigid Support, and Then the Free End Is Caused to Move Up and Down in Rapid Succession, Stationary Waves Are Set Up in the Manner Shown.



By Placing a Layer of Mercury in an Oval Dish, as Shown, and Pouring Some Mercury Into a Funnel, the Latter Dropping Into the Dish, Sets Up Waves in the Liquid Which Expand at the First or Originating Focus—and Converge at the Second Focus. The Second Focus in Turn Acts as the Origin of Waves and This Interferes With the Set of Waves From the First Focus, Producing Bands of "Interference."

waves which reinforce and neutralize each other alternately at regular intervals. A train of waves may be reflected so that the original train of waves and its reflected train may interfere or two trains of waves from different sources may meet and interfere.

PRODUCING STATIONARY WAVES.

If a rope about twenty feet long is attached to a rigid support and then the unattached end caused to move up and down in rapid succession *stationary waves* are set up (see Fig. 1). The rope is attached at

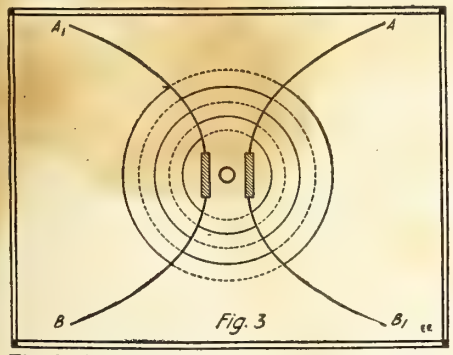


Fig. 3 Shows the Top View of the Ends of a Vibrating Tuning Fork. Each Prong Sets Up Waves of the Same Pitch and Points of Silence Will Be Found Along the Line AOB1 and A1OB, as a Test With a Second Tuning Fork Will Demonstrate.

O; the heavy line represents the original wave, and the dotted line the *reflected wave*. Each particle in the advancing wave is met by the returning wave tending to cause it to move in the opposite direction. For an advancing particle moving upward, the reflected particle moves downward and vice versa, leaving the particle undisturbed as at A, B and C. At D, E, and F, however, the particle of the original and reflected waves would both be in their lowest or highest positions and would double the effect of each wave, giving a displacement from the axis twice that of either wave. Because of the state of rest of each individual particle the combination is known as *stationary waves*. The incoming and reflected waves alternately reinforce and neutralize each other. This is an example of *interference* from a wave and its reflected wave.

Another excellent example of interference by reflection can be obtained by a liquid in a shallow dish. Construct a shallow dish elliptical in shape. Cover the dish with a thin layer of some heavy liquid, preferably mercury. Place a funnel with a fine opening over one focus of the ellipse and pour mercury into the funnel. The striking of the drops upon the liquid surface sets up waves in the liquid in the form of circles, expanding at the focus where the drops fall, and converging at the other focus. The second focus in turn acts as the origin of waves, and these interfere with the set of waves from the first focus, producing bands of interference (see Fig. 2).

SOUND IS A WAVE MOTION.

By *interference* waves can reinforce and neutralize each other. It follows then that two sounds can combine to reinforce each other and also produce *silence*. The pro-

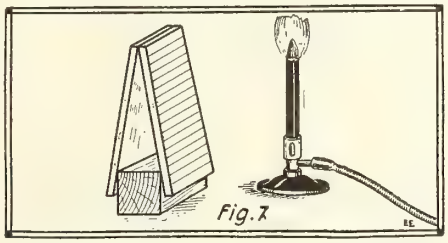


Figure Seven. In This Experiment Two Pieces of Plate Glass Are Separated at One End So as to Form a Wedge. With a Bunsen Burner Having a Little Sodium in Its Flame, a Series of Black and Yellow Lines Will Be Seen Across the Plates. This Experiment Must Be Performed in a Fairly Dark Room.

duction of silence by two sounds can be shown in many ways, the simplest being by the use of a tuning fork. So far we have considered only waves coming from one source. As stated before we can produce *interference* by waves from different sources. If a wave from one source arrives at a certain point in a phase of condensation and another from another source arrives at a phase of rarefaction, the effect of the two will be to produce no disturbance at all. If the waves in question are sound waves of the same pitch (frequency) this point will be one of continuous silence.

Fig. 3 shows an end view of a vibrating tuning fork. Each prong sets up a train of waves of the same pitch, causing the air between the prongs to alternately condense and rarefy while behind the prongs the air is alternately rarefied and condensed. The series of waves proceeding forward is represented in the figure by heavy lines (condensations) and the dotted lines (rarefactions). At all points along the lines AOB′ and A′OB rarefactions and condensations come together at the same instant (four points for each circle). Therefore at these points there will be *silence*. If a vibrating tuning fork is held near the ear and slowly rotated, it will be found that four distinct positions will give silence, all others sound.

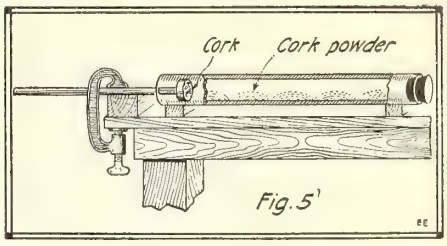


Figure Five. A Simple Experiment With a Glass Tube and Some Cork Powder. The Formation of Little Heaps of Cork Powder, When the Rod at the Left Is Rubbed and Vibrated, Demonstrates the Production of "Interference by Reflection."

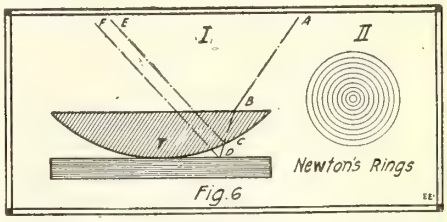


Figure Six. Showing How Interference Rings Are Produced in Light or Optics When the Eye at EF Receives Two Different Images From an Impinging Light Beam AB, Falling on a Lens T. In This Case, the Eye Will See Alternate Bands of Brightness and Darkness in Monochromatic Light—or Alternate Bands of Colored Light in White Light.

A piece of glass tubing is bent into the shape shown in Fig. 4 and two funnels are attached by means of rubber tubing at C and D. At A and B another piece of glass tubing is attached of diameter large enough to permit it to slide back and forth freely. When the tube ABF is adjusted so as to make the right and left sides of the apparatus equal in length, the ear placed at D will distinctly hear the sound of the tuning fork vibrating at C. As the tube AFB is

(*Continued on page* 85)

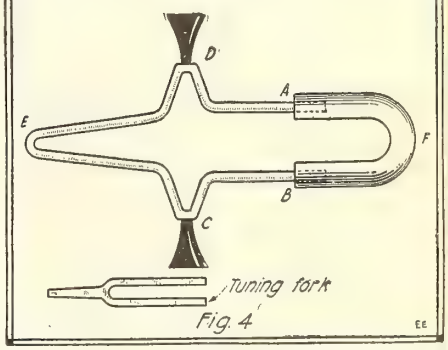


Figure Four. A Tubular Acoustic Device for Demonstrating the Effect of Interference of Sound Waves. The Ear Placed at D Will Hear Nothing When the Adjustable Tube F Is Moved to the Point Where the Waves Coming in From Each Side of the Tube Are Opposite in Phase and Neutralize Each Other.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

of U. S. Naval Observatory

The Earth's Interior

UP to comparatively recent times the opinion was universally held that matter within the earth's interior existed in a *fluid state* at a tremendously high temperature. The flow of molten lava from volcanoes and the occurrence of hot springs and geysers testify to the fact that intense heat prevails beneath the surface crust of the earth as also the well-known fact that there is, on the average, an increase of 1° F. for every sixty feet of descent in mine shafts. If this law of increase held from surface to center the temperature would be sufficient to melt and volatilize all known substances at a depth of only sixty miles, while at the center of the earth a temperature of 350,000° Fahrenheit would prevail.

Now modern investigations of the temperature of the sun and the stars have made us more conservative in our estimates of the temperature of the earth's interior. It has been found that the temperature of the radiating layers of the sun are to be placed at only about 12,000° F. It is extremely improbable that any such temperatures would exist generally thruout the earth.

A most important factor affecting the condition of the earth's interior substance, is the pressure due to gravity of the earth material upon underlying strata.

Atmospheric pressure at sea level is fifteen pounds per square inch. A cylinder one sq. inch in cross-section and one hundred and forty-four feet in height contains one cubic foot and if filled with water would weigh 62.5 pounds and therefore exert a pressure of 62.5 pounds on the base of the cylinder. If filled with surface rock instead of water the pressure on the base of the cylinder would be about 165.5 pounds, the average density of surface rock being about 2.65 times the density of water. At a depth of one mile, therefore, the pressure exerted by the surface crust of the earth is about six thousand pounds or *three tons per square inch!* At a depth of one hundred miles the pressure per square inch would reach the tremendous value of three hundred tons per square inch, assuming that the density of the rock remains the same as at the surface and the force of gravity the same as at the surface. As a matter of fact both have changed slightly for a point one hundred miles below the surface but the effect is to increase the pressure rather than to diminish it.

The pressure increases in direct proportion to the depth only for a few miles beneath the surface. The *rate* of increase of both the pressure and the density falls off rapidly for great depths. Yet it has been estimated (by Legendre's Law), that the pressure near the center of the earth is approximately *three million times the pressure of the air at sea level* and the density of the material at the earth's center is about eleven times the density of water.

Now it is well known that pressure raises the boiling point of liquids and the melting point of solids and, therefore, the effect of pressure within the earth is to keep matter in the solid state. It is manifestly impossible to produce experimentally the conditions of pressure prevailing even at moderate depths beneath the earth's surface. Yet it is possible to get indirectly at the condition of matter in the interior of the earth from a knowledge of its surface density and of its mean density, which is found from its known mass and volume.

Direct analysis of surface rocks has establisht the fact that the average density of the earth's surface crust is 2.65 times the density of water. The mean value of the earth's density as a whole is 5.53 times the density of water. Somewhere within the earth's interior, then, its density must exceed this mean value.

Just how the density of the earth material is distributed from surface to center is the question.

According to Legendre's Law, mentioned above, the compression of matter due to the pressure of layers above is computed as for a fluid. This distributes the density so that the earth material has about eleven times the density of water within five hundred miles of the center of the earth, is about as heavy as steel, or eight times as dense as water half way down, and from 2.6 to five times as dense as water within five hundred miles of the surface.

According to another law known as the Roche-Wiechert Law it is assumed that the earth consists of a central nucleus or core composed chiefly of iron, density 8.2, surrounded by a stony shell of less density. The core has a radius that is approximately eight-tenths of the earth's radius. (See Illustration.)

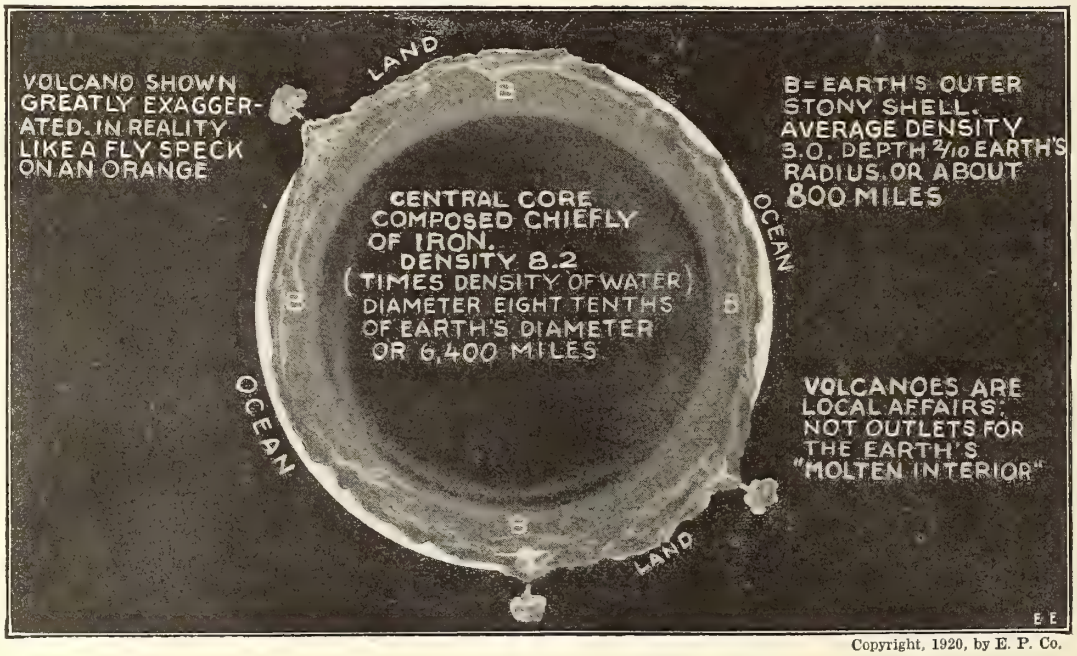
There is strong reason for believing that this theory approximates more closely to the truth. It is interesting in this connection to recall the fact that the meteorites, which are believed by some geologists to be shattered worlds, are either almost pure iron or else stony in their composition.

Whatever theory is held to it is evident that the earth's interior cannot be in a fluid state;—*tho locally at shallow depths and moderate pressures "pockets" of molten matter and gaseous vapors may occur.* Greatly increased pressures at lower depths would probably keep the material in a solid state even tho highly heated.

Further light is thrown on the problem by the important "pipe-tide" experiments of Michelson and Gale performed in 1913, for the purpose of determining how the earth yields to the tide-raising forces produced by the sun and moon. These experiments showed conclusively that the earth acts as an elastic solid and that it is as "rigid as steel"; a fact that is also borne out by various other experiments. This is in flat contradiction to the older theories of a "viscous" interior, the important distinction between a viscous and an elastic body being that the former after being deformed by a force does not return to its original form after the force is removed but remains permanently deformed while the latter returns to its former state when the disturbing force is removed.

Since the earth is shown to be "as rigid as steel" in its response to disturbing forces and moreover, since its highly magnetic state suggests the presence of a considerable quantity of iron in its interior, a substance that the spectroscope also show us exists universally to a great extent in the sun and stars, the theory that there is a *central iron core* to the earth is now very generally held.

Since the heavier metals mercury, gold and platinum, have densities greater than twelve it follows that they cannot occur in



Copyright, 1920, by E. P. Co.

Scientists Now Believe that the Earth's Interior Is Not Molten as Had Been Thought for a Long Time. From Many Scientific as Well as Mathematical Considerations, It Has Been Proven That the Interior of the Earth Is as Solid as Steel. Seemingly, the Inside of the Earth Is Not Hot at All, Most of the Heat Being Contained in the Crust of the Earth. It is Now Thought That This Heat Is Produced by Radio-Activity.

any considerable quantity within the earth's interior.

An interesting point to consider in connection with the constitution of the earth's interior is the *Radio-activity* of matter found in its crust. Owing to the fact that tremendous amounts of heat are released by the disintegration of radioactive substances in the earth's surface crust it has been shown that these substances cannot exist within the earth's interior at a greater depth than about forty miles.

The average quantity of radioactive matter in the earth's surface rocks has been estimated. It is an extremely minute quantity but is so appreciable in its effect upon the heat of the earth that only one-twentieth of the amount found per cubic centimeter in surface rocks, if universally distributed thru the earth's interior, would keep the earth from cooling and lengthen the geological ages beyond reason.

The conclusion is forced upon us that the radio active substances of the earth must be confined to a very thin outer shell, or else, the earth is *gaining* heat.

In fact, the idea has been advanced that the observed heat of the earth's surface layers may be due to the radio activity alone and that the earth's interior may be comparatively cool.

It is the belief of certain scientists that there may be within the interior of the earth *endothermic compounds,* resulting from the union of helium and hydrogen with carbon and the metals, in which the stored up energy may be many thousand times greater, proportionally, than the energy locked up in our most powerful explosives.

Unexpected disturbances or perturbations of our planet from without might suddenly release the energy stored away in such compounds and cause a veritable world explosion such as might conceivably produce a *Nova* (New Star).

"FALLING THRU THE EARTH."

In connection with a discussion of the condition of matter within the earth's interior it may be of interest to consider what would happen to a body falling down a shaft extending from surface to surface, *thru the very center of the earth.*

Three important factors affect materially the consideration of this problem: the *air resistance* within the shaft, the *rotation of the earth* about the polar axis, and the *decrease in the acceleration of gravity* beneath the earth's surface.

It is a well known law of physics that gravity is greatest at the surface and decreases within the earth so as to be always directly proportional to the distance of the point from the center of the earth.

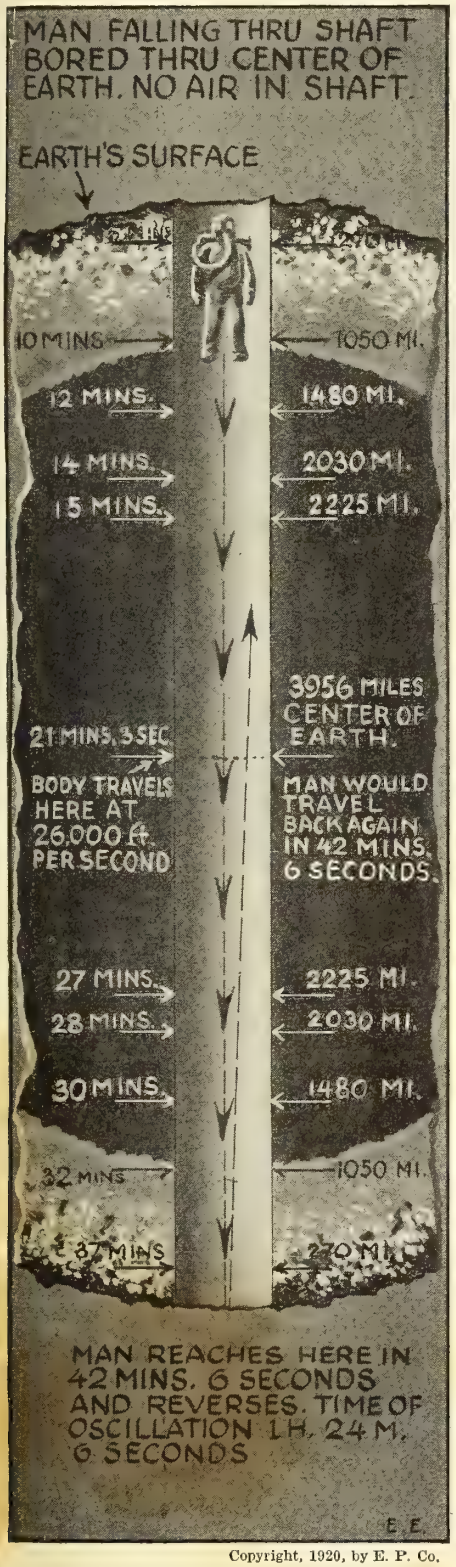
Taking account of this decrease in the force of gravity with depth, we will first consider the case of a body falling in a vacuum, and therefore free from air resistance, along the earth's axis from pole to pole. In such a shaft there will be no deflection of the body arising from the earth's rotation since the rotation of the earth is performed about the polar axis.

It can be shown that a body starting from rest and falling along the polar axis *in vacuo* will reach the earth's center in $21^m\ 3^s$; its acquired velocity at the time it reaches the center will be 26,000 feet per second, or four and nine-tenths miles. With this as an initial velocity it will then pass from the center towards the opposite surface *against* the attraction of gravity, taking the same time that it took to fall from the surface to the center, or $21^m\ 3^s$. By the time the surface is reached its velocity will be reduced to zero and the body will then fall toward the center once more, which it will reach again in $21^m\ 3^s$. It will pass back from the center to the surface at the original point of departure in another $21^m\ 3^s$, and so on indefinitely. The motion of the body in this case is what is known as simple harmonic motion. Unless stopt by external forces a body would oscillate under such conditions from surface to surface, *forever,* the period of the oscillation being $1^h\ 24^m\ 12^s$. The velocity of the body and its distance from the surface can be found for any instant by means of a simple mathematical formula.

Consider now the effect of the earth's rotation on the fall of a body, *in vacuo, along any other axis thru the earth.*

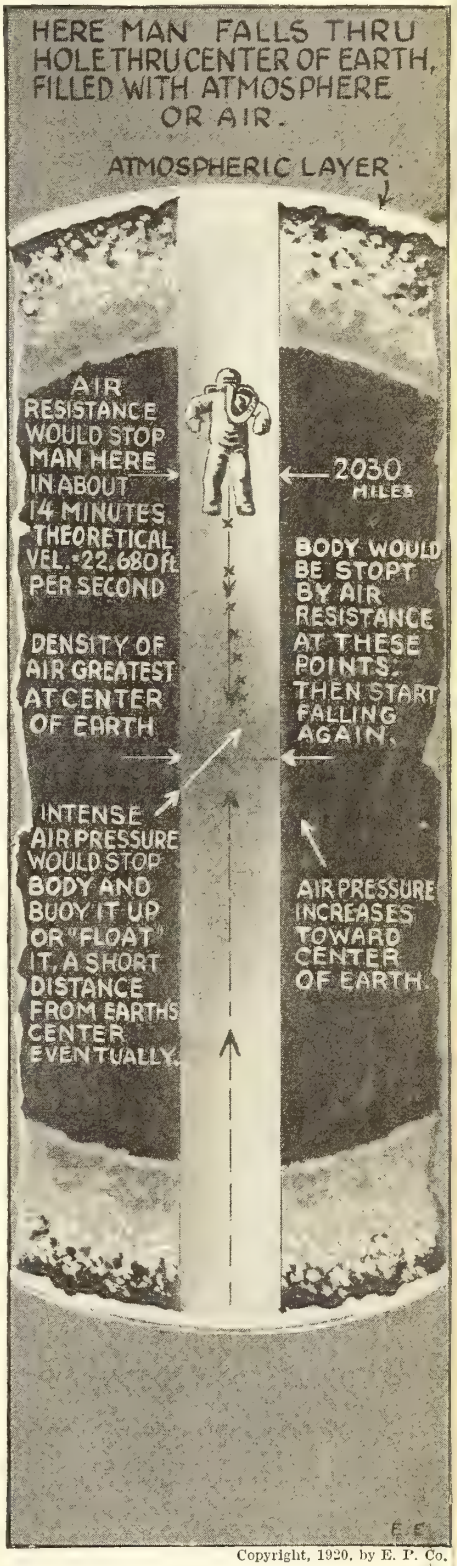
It is well known that at the earth's surface a falling body is deflected by the earth's rotation to the *Eastward* by an amount that is proportional to the square root of the cube of the height of fall and to the cosine of the latitude. This deflection only holds for surface gravity, however, and for great depths we find a com-

(*Continued on page 72*)



Copyright, 1920, by E. P. Co.

This View Shows What Would Happen to You if You Would Fall Clean Thru the Center of the Earth if There Was a Vacuum in the Shaft Instead of Air. If You Carried Your Own Oxygen It Would Not Be at All Impossible That You Would Survive the Trip Because You Would Not Encounter Any Friction. It Would Take You One Hour, Twenty-four Minutes and Twelve Seconds to Make the Round Trip. In Other Words, Coming Back to the Starting Point.



Copyright, 1920, by E. P. Co.

This is a Parallel to the Opposite Illustration, and Shows What Would Happen to You If You Were to Fall Thru a Shaft, Which, However, Contained Air. It is Interesting to Note That You Would Never Be Able to Fall Even Half Way Down for the Simple Reason That the Air at a Distance of About Two Thousand Miles Below the Surface of the Earth, Due to the Ensuing Compression, Becomes Almost as Thick as Molasses.

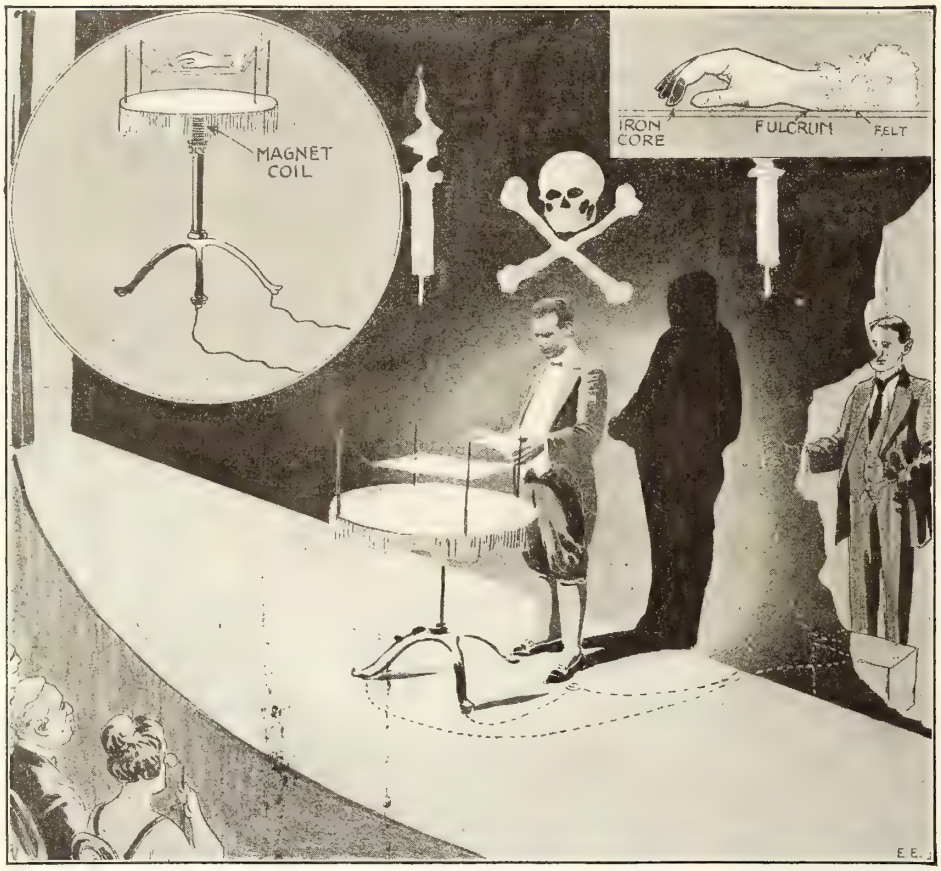
The Amateur Magician

The Rapping Hand

By JOSEPH H. KRAUS

PROFESSOR HARGRAVE had been very busy on some new research for quite a while and I couldn't find opportunity to see him as often as I desired, but as fate would have it we finally ran into each other, so to speak, at a New York playhouse where he had gone to meet an old friend of his, now entertaining the public with a "Magic Act."

A short time after this we were en route to his Long Island home again where he had "something new." "Now, old timer," he exclaimed, after we had made ourselves comfortable, "I have a little device here which has been *killed*, or practically so, by the magical profession. It is very clever and quite undetectable and will come in very handy, particularly now when the *Ouija Board, Spiritual Seances, Rappings*, etc., are being held so severently. Wealth, sport and fun can be obtained from the same. Just to demonstrate," he continued, "you see here we have an ordinary hand made of wax or molded wax composition. Look it over and examine it carefully. You will note that there are no springs, wires, threads or in fact anything connected to it now or at any time.



The Home Magician Will Find the "Rapping Hand" Very Effective as a Mystery Producer. The Hand is "Worked" by an Electro-magnet, the Circuit Being Closed by a Confederate, Usually.

"I take this hand and place it upon this glass plate, I allow you to select any card from the deck, you return it. There, that's fine! By placing the deck into this little black bag I can know the name of your card by only asking the operating hand what it was, using the same code that was used in the *Bell Trick* described some time ago. You will remember that two rings signified YES and one NO. You don't believe it? Well, just to demonstrate."

Professor Hargrave had now placed the molded wax hand upon the glass plate which he held about four inches above the table. Meanwhile adjusting four little wires at the ends of which were small hook-like formations passing thru holes in the corner of the plate so that it was suspended horizontally. At the other end the wires were attached to four posts screwed into the table. Then continuing to address the hand, he said, "Will you tell this gentleman by raps the number of spots which appeared on the card he had just chosen?" Immediately at the word of command the hand tapt out the answer, seven clear distinct raps, on the glass table.

I grasped for the hand, lifted it from the plate. There were no strings, no wires, or anything else connected to it. The Professor laughed at my chagrin in not finding something I had expected and again reached for the hand. Replacing this he readdrest the hand.

"Was that card a diamond?" The answer in the affirmative convinced me that it *was* a pretty good stunt.

I had seen too many of the Professor's tricks, however, to become extremely excited or marvel at the results, although they couldn't be described with the same effect that they have when presented. To see a hand and wrist lying on the table rap out an answer to any question you may ask of it, provided the answer can be given as either "yes" or "no," is an extremely wonderful bit of entertainment. The mystery then continued in the shape of a fortune telling stunt until my strained eyes refused to watch any longer. The Professor then took the hand off the glass plate, disconnected the latter from the suspending wires and placed it on the regular magician's table, where he was demonstrating his trick.

We then stept over to an adjoining library table, sat down and the Prince of Magicians busied himself with a fresh cigar. This tedious operation completed, he opened a drawer and leisurely extracted several sheets of paper and a pencil. Then laying these in front of him he proceeded to sharpen a pencil, another tedious operation, successfully completed after several *bad breaks*. "Well, now," Hargrave ejaculated suddenly, "I suppose you would like to know all about this, wouldn't you?"

Tap—tap—tap. Wheeling around quickly I noticed the hand on the table rapping out a regular rat—tat—tat in time with music with which a phonograph in a distant part of the house was permeating the atmosphere. "Well, I'll be ———. The hand stopt short. "Here, here," the Professor interrupted, before I had gone much further, "you will scare it." It started again; slowly at first, however, then with increasing rapidity until the sound was more like machine gun discharges than anything I have ever heard. "All right, that will do," Hargrave shouted in a commanding voice, and the hand, mysteriously affected, now quieted down.

"Now to proceed with the work in hand. You wanted to know how this was done. Well, here it is. You see it is very simple. That hand is simply an ordinary wax model procured from any store in the largest cities. It is sometimes used for demonstrating the quality of gloves and

(*Continued on page* 74)

In "JUNE" E. E.

How "Cartoon Movies" Are Made.

Psychopathia or Psychics—which? Does the Brain Interpret Radio Signals, or is This a Disease of the Mind? By H. Gernsback and Joseph H. Kraus.

Oddities of Sound—Part II. How the Phonograph Talks. By H. Winfield Secor.

Harnessing Brooks and Streams for Electric Light and Power.

Searchlight and Mirror Mark Aero Field. By Edwin F. Linder, M. E.

A Wartime Radio Detective. Episode II. By Pierre H. Boucheron.

A Miniature Sky—in which the stars and planets may be studied at will. By Robert H. Moulton.

The Aurora—Facts and Theories with exceptional illustrations. By Prof. Lindley L. Pyle, Dept. Physics, Washington University.

Radium—The "Bad Boy" of Science. Another popular article on Radium and its Wonders. By Harold F. Richards, M.A.

Another "scientific story" by Charles S. Wolfe.

Low Voltage Soldering Irons and How to Build Them. H. H. Parker.

Besides all the usual departments, including "Home Electrics"; "Everyday Mechanics"; "Electrical Machinist."



The Above Photographs Show Some of the Work Accomplisht and Also the Work-Shop of Mr. A. M. P. Cowley of St. Paul, Minn. As Mr. Reed Points Out in His Article, Mr. Cowley Has One of the Finest Laboratories in All "Bugdom." You Will Thoroly Enjoy This Story of Mr. Cowley, 66 Years Young, and "Dean of All the Bugs."

Some Laboratory!!

By THOMAS REED

WHAT was the first shop you ever had? Want to hear about mine? All right then, I'll tell you. I don't suppose I had accumulated more tools than a couple of "gimblets" and the family saw (used principally for cutting rings off hambones) before I felt the pressing need of a "shop," or "laboratory"—as you highbrows call it to-day, and began to prospect around the house for a location, like an old "Forty-Niner" looking for gold.

At first glance, the "prospect" looked like an embarrassment of plenty. The house I lived in was a big old house, with a main part, and an ell, and a sub-ell, and a shed, and another shed, tapering off that way to the point where the house ended and the back-yard began; and in all this space, there were many places which would have done admirably for a shop.

But when it came to "staking out" and taking possession of my claim, I found each spot occupied by some domestic object, firmly rooted in possession, and very difficult to dislodge.

For instance, there was a fine tho somewhat angular space under the cellar stairs; but it was stuffed with father's old books, and as to displacing them—well, you could have displaced father's liver with considerably less pain on his part.

Then there was an available corner over behind the furnace, but that was the asylum for discarded "crocks." The collection of crocks came about in this way: sometimes they break, leaving a cover on your hands, and sometimes a cover breaks, leaving you a crock. Now you'd think it was an easy problem, simply to combine the left-over covers with the ditto crocks, like widows marrying widowers—as they sometimes do when susceptible bachelors are scarce; but a widowed cover was never known to fit a bereaved crock. It either tilted up at an angle, or went down thru altogether.

So there those odd crocks were, stacked up in rows, in the forlorn hope that sometime or other a fit would occur. They retarded the growth of Science like anything, by occupying the space I needed for my "gimblets"; but throw them away?—well, you didn't know father, of course. It's true, I proposed the throwing, in loud and distinct tones; but, as I may have said somewhere else, the weight of my suggestions wasn't exprest in tons, or pounds even, but more like these atomic weights, that use up a long string of decimals, such as .000000001. That was about where they stood in the family scale of specific gravities; so the crocks stayed.

Never mind, out under the "sub-el" I have mentioned was a large empty room, with big windows letting in the sun, and even a bench all ready for use. Well, what more did I want? Why didn't I take that? I did, because it was all I could get.

But oh, oh, likewise—ah, ah,—as they say in comic opera, it was the laundry, or "washroom" as we called it; and when Monday arrived—Daddy!—it was no place for "gimblets" and hambone-saws, let alone my "delicate" mechanisms under construction. Clothes-baskets were there, tubs, spattering water and clouds of steam, not to mention the heavy and indiscriminate feet and hands of the big Swede engaged in the separation of dirt from duds. Each Sunday I had to gather up and remove to "zones of safety" all my various treasures, down to the last corset-spring.

But as I advanced in age and sassiness, my shop-requirements obtained a tolerance, and at last a regular standing. Having routed the crocks, my next bold move was on the space over by the window, dispossessing the old packing-case, on which we

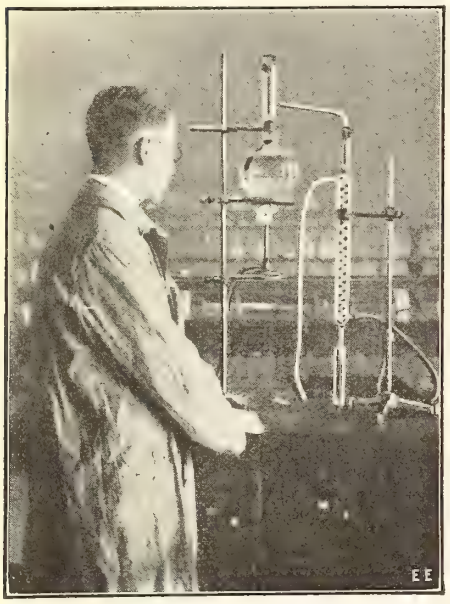
(*Continued on page* 89.)

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

EXAMINATION OF WATER—I.

THE chemical examination of water is a matter of very great importance, both for sanitary and industrial purposes. Is water pure and wholesome to drink? Has it suffered contamination from sewage, sinks, or products of



Using the Vertical Condenser for the Distillation Water in the "Ammonia Test."

organic decay? Is it free from mineral matter objectional to particular industrial uses? Is it hard or soft? Does it contain poisonous metals dissolved from the pipes thru which it has past? These and many more questions of a similar nature must frequently be answered by the chemist, but to be able to give trustworthy advice in these matters he must exercise the utmost skill and thorogoing care at every point.

SANITARY ANALYSIS OF WATER.

Taking the Sample: The first source of probable error comes at the very outset. Very frequently a chemist is asked to analyze water without any knowledge of its source. But this is all wrong. The person who makes the analysis should take the sample and in so doing note very carefully all the surroundings—nearness to buildings, slope of the land, nearby surface conditions, proximity to fertilized fields, etc. Such information is of the utmost importance in interpreting results and without it intelligent conclusions cannot be drawn.

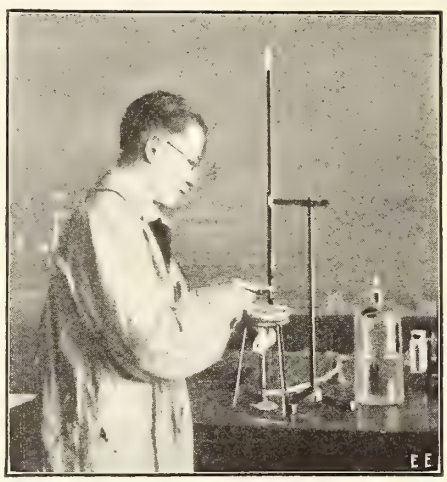


Making the Determination of Total Solids by Evaporation Over a Copper Water Bath. Desiccator Stands at the Side.

In the second place the sample must be taken in a *chemically* clean bottle of at least a half gallon capacity. To cleanse the bottle fill it one-third full of a solution made by dissolving potassium bichromate crystals in concentrated sulfuric acid. Allow this solution to stand in the bottle for several hours, shaking at frequent intervals so as to bring it in contact with every part of the inside of the bottle. Then pour out the solution, preserving it in a glass-stoppered bottle for future use and rinse the bottle thoroly. Go to the place where the sample is to be taken and fill the bottle with the water in question. Empty this out completely and fill the bottle again. Stopper it tightly and take it to the laboratory where the analysis should begin at once.

For all solutions and wherever water is used in this work other than that under examination, distilled water must be had. It will be found very desirable, both for this and subsequent work to have in your laboratory a small *water still.*

Sediment: The presence of sediment will not tell much as to the character of water, yet it is desirable to make this test. Allow a test tube full of the water to stand over night, or if you have a *centrifuge* such as is used in the Babcock milk test, centrifuge the sample. Carefully pour off the clear liquid and if there is a residue examine it with a hand magnifier or better still with a compound microscope. If the sediment should disclose bits of hair and cotton or woolen fibers, it might indicate organic contamination.

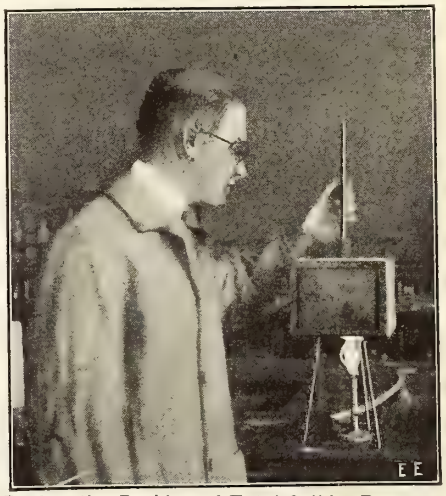


Determining the Quantity of Organic Matter by Titration With Potassium Permanganat, Accompanied by heating and Stirring.

Color: Fill a long test tube, or preferably a Nessler tube, with the water and stand it on a piece of white paper in front of a window giving a good light. Back of the tube place a piece of white paper extending almost to the bottom of the tube. If on looking down into the tube the water is transparent, or shows only a slight bluish tinge, it is normal in color. If, however, there are tints of brown, yellow or green, the water may be polluted.

Odor: Perfectly harmless water may have both odor and taste, while exceedingly dangerous water may be free from both. However, the presence of a positive odor usually indicates contamination. To determine the odor, warm about 250 cc. of the water in a corked flask to 40° C. After shaking well, remove the stopper and smell the contents. If the odor is putrid, the presence of decaying organic matter is indicated. This may be of either animal or vegetable origin.

Total Solids: By total solids is meant the residue of mineral and organic matter left upon evaporating water to dryness. If you have a balance, this determination may be made quantitative. Such a balance, too,

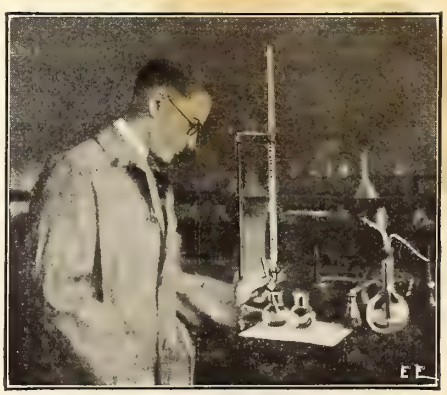


Drying the Residue of Total Solids, Preparatory to Cooling in the Desiccator and Weighing.

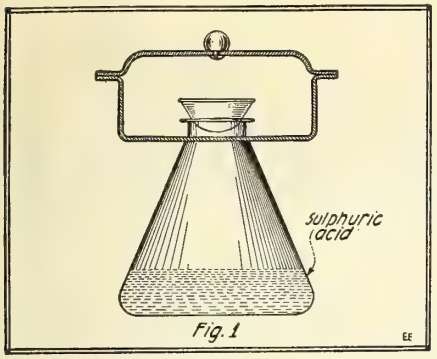
will be found exceedingly useful in many other branches of experimental chemistry work. For many determinations a balance is indispensable. Of course, an analytical balance is desirable, where possible, but a less expensive one, that will weigh accurately to a milligram, will satisfy the requirements of most of this work.

Measure exactly 100 cc. of the water into a clean, dry evaporating dish, which you have previously weighed to the nearest milligram. Evaporate this to dryness over a copper water bath. Dry for an hour at 105° C. in a small drying oven placed on a tripod over a Bunsen burner. Then cool in a desiccator over sulfuric acid and weigh. See Fig. 1. Subtract from this second weight the original weight of the empty evaporating dish and calculate it as milligrams. This number multiplied by 10 will give the number of parts per million of total solids in the water. For drinking purposes water should not contain more than 600 parts per million.

To determine the presence of *organic matter* evaporate to dryness another portion of 50 cc. of the sample in a porcelain dish.



Making the Chlorin Determination by Titration With Standard Silver Nitrate Solution and Potassium Chromat Indicator.



Chemical Laboratory Desiccator Used for Drying Precipitates.

When dry place the dish over a Bunsen burner and heat gently at first, gradually raising the temperature. If the residue chars and blackens, organic matter is present and raises the suspicion of contamination.

DETERMINATION OF CHLORIN.

By *chlorin* we mean combined chlorin. This element in itself is not at all harmful, but if present in more than small quantities, it indicates sewage contamination and is, therefore, tested for with great care.

For this determination a standard *silver nitrat solution* will be required. Prepare this by dissolving exactly 2.394 grams of pure silver nitrat in a liter of distilled water. A solution of 10 grams of potassium chromat in 100 cc. of water will be necessary for an indicator.

By means of a pipette transfer 50 cc. of the water to be tested into each of two small beakers. To each add three or four drops of the potassium chromat solution. Fill a burette with standard silver nitrat solution and mount it over the beakers placed in a good light on a white paper. Now add the silver nitrat a drop at a time, stirring after each addition with a clean glass rod, which must not be removed from the beaker. Continue this procedure until the water shows the first tinge of red. To determine when this occurs, look at the water thru the contents of the second beaker placed at one side. From the readings of the burette find the number of cubic centimeters of silver nitrat solution that have been used. Each cubic centimeter used means 10 parts of chlorin per million parts of water. In exceptional cases the chlorin content of pure water may run as high as 50 parts per million, but it is usually much lower. A large amount of chlorin indicates contamination from sewage or sinks, unless there is some other known source.

DETECTING THE PRESENCE OF AMMONIA.

The presence of nitrogen compounds in water, of which ammonia is one, is always regarded as a sure sign of contamination.

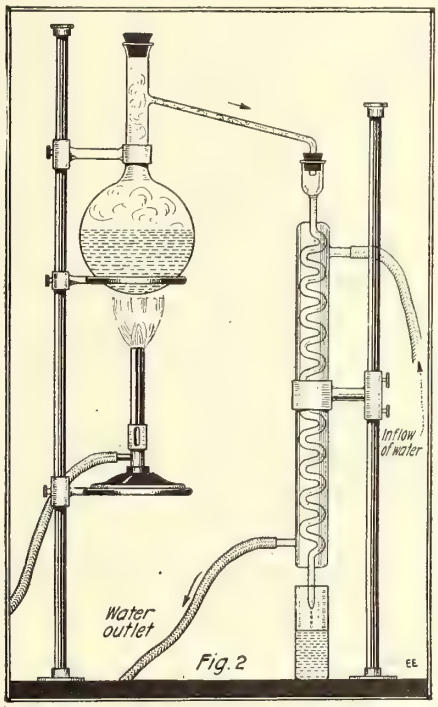


Nesslerizing Water in the Ammonia Determination. Nessler's Reagent Is Being Introduced With a Pipette.

For nitrogen can come only from animal and vegetable sources, and while these nitrogen compounds in themselves are not harmful, they are frequently accompanied by germs of contagion, which breed disease and death.

First of all it must be emphasized *that these tests cannot be carried out in a laboratory containing any ammonia bottles or ammonia solutions.* They are exceedingly delicate tests and the presence of ammonia in the air will give a positive test, when perhaps the water originally contained no ammonia at all.

The solution used in these tests is called *Nessler's Reagent* and is made as follows: Dissolve in 250 cc. of water 62.5 grams of potassium iodid. Pour out 10 cc. of this solution and save for future use. To the remainder add a cold, saturated solution of mercuric chlorid until a permanent precipitat appears. Redissolve this precipitat with the 10 cc. of potassium iodid solution saved out and again add mercuric chlorid very slowly, until a slight precipitat remains after stirring. Add a water solution of 150 grams of potassium hydroxid and make the volume up to a liter. After the precipitat has settled, pour off the clear liquor and preserve in a clean stoppered bottle.



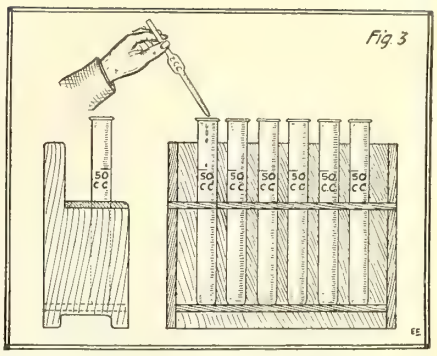
Distilling Apparatus Set Up for Making Ammonia Tests on Water. The Work Is Extremely Interesting and Practical, as It Concerns Our Daily Health.

Making the Ammonia Determination: Ammonia is usually reckoned as "free" and "albuminoid," but for our purposes the test for the total ammonia content is all that will be required.

To liberate the ammonia from the nitrogenous compounds in the water an alkaline solution of potassium permanganat is essential. To make this solution dissolve 100 grams of potassium hydroxid and 4 grams of potassium permanganat crystals in 625 cc. of distilled water and evaporate in a porcelain dish to 500 cc. Preserve this in a stoppered bottle.

Now set up distilling apparatus similar to that used in the distillation of alcohol, or better use a vertical condenser with a spiral condensing tube, like the one shown in the cut, figure 2. If possible use a liter boiling flask and close its neck with a tight fitting cork stopper—not rubber.

First place in the flask 200 cc. of *distilled* water and add 50 cc. of the alkaline potassium permanganat solution. Distil off three successive portions of 50 cc. each to free the apparatus of any traces of ammonia compounds that may be in it. Then add a half liter of the water to be tested and distil off into Nessler tubes, or tall test tubes, six portions of 50 cc. each. See Fig. 3. To each portion add 3 cc. of Nessler's reagent by means of a pipette and after waiting five minutes look down into the tubes. A yellowish brown coloration proves the presence of ammonia. The amount of ammonia may be judged from the depth of color. If considerable amounts are present a brown precipitat will separate out. If more than a faint trace of yellow is observed, contamination is certain. Practically all of the ammonia will be found in the first four tubes.



Rack of Test Tubes, Each Holding 50 C.C., Used in Nesslerizing Water. Nessler's Reagent Is Added by Means of a Pipette.

DETECTION OF NITRITES.

Nitrites represent another form of nitrogen compounds, whose presence also indicates contamination. In fact nitrites are never found in good water. One of the highest authorities on water analysis states that more than one part in 500 million parts of water is looked upon as unfavorable.

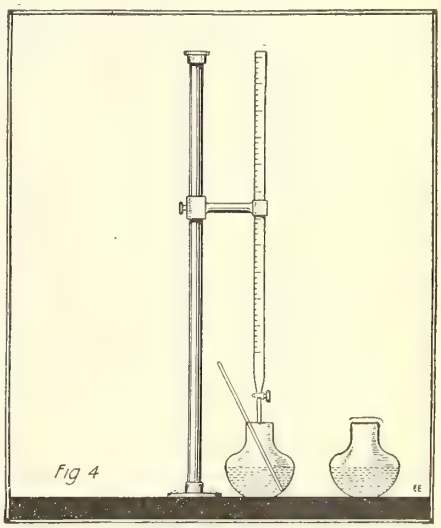
For this very delicate determination two solutions will be required as follows:

Sulfanilic Acid: Dissolve 1 gram of acid in 100 cc. of hot water and preserve in a stoppered bottle.

Naphthylamine Hydrochlorid: Boil one-half gram of the salt in 100 cc. of water for ten minutes, make up to 100 cc. and preserve.

The Nitrit Test: In a Nessler tube place 50 cc. of the water to be examined and add 1 cc. of concentrated hydrochloric acid followed by 2 cc. each of sulfanilic acid and naphthylamine hydrochlorid. Cover with a watch glass and allow the tube to stand for 30 minutes. If a pink color is found either immediately or at the end of the above period the presence of nitrites is proved.

(*Continued on page 77*)



Titration Apparatus Used in Testing Water in the Chemical Laboratory.

A Bench-Lathe From Pipe

By A. NOAH HARRINGTON

HEREWITH present drawings of a hand-made bench lathe made from pipe fittings. I made one several years ago, and it has given such good service that I thought some of the readers of the ELECTRICAL EXPERIMENTER would be interested in constructing such a lathe. The materials required are five one-inch crosses or double tees, five tees, two ells, four feet of one-inch shafting, ten nipples, four floor plates and a small amount of babbitt metal. The drawing needs but little explanation; E and E in Fig. 1, are pieces of one-inch shafting fastened in the fittings with babbitt. Great care must be taken to get the two pieces of shafting *perfectly parallel!* If they are not, the slide rest and tail stock will bind, and you will not be able to slide them along the shafts smoothly.

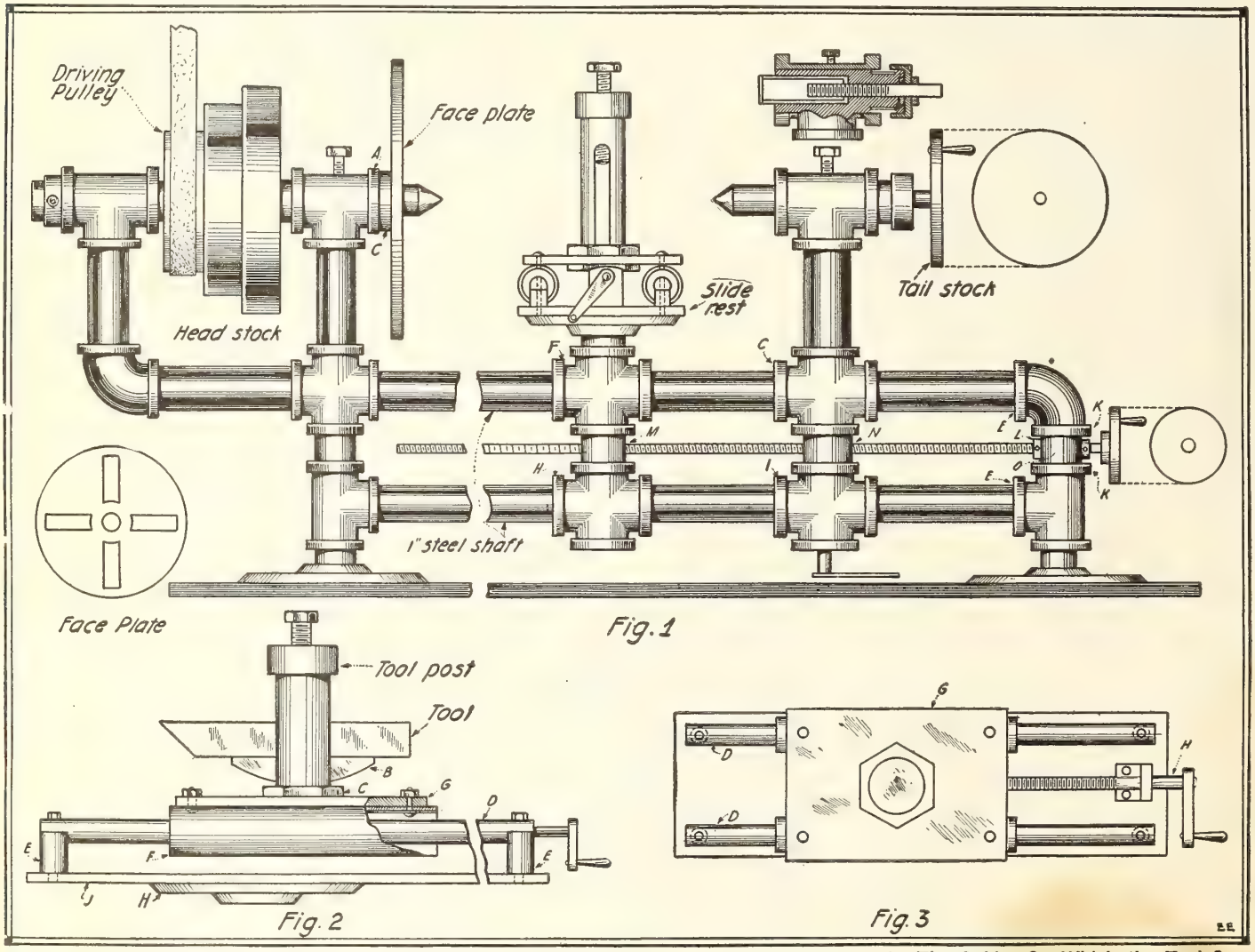
The best way to do this, is to cut two pieces of metal exactly the same length and fasten them between the shafts at dd and ee, Fig. 1. Tie them together with the *slide rest* and *tail stock* in place. Wrap one layer of thin tissue paper around the shafts where they go thru the slide rest and tail stock so they will not bind and babbitt them in the pipe fittings. The nipples should be plugged with wood so the babbitt will not run into them. The ends of the shafts should be *tinned* with solder to hold them firmly in place.

The feed screw is made from a piece of one-half inch shafting threaded its entire length. Holes are bored in the nipples at L and MN. A one-half inch nut is placed in the nipple at M, figure 1, before the babbitt is poured for the feed screw to run in. Two collars can be cut from a piece of ⅜ pipe, and fastened on the feed screw each side of the nipple at LK, figure 1, with pins past thru the feed screw. A handle can be made from a pipe floor plate.

To make a good job of it, the lathe should be completely put together and carefully lined up with the feed screw in place, and then babbitted. The ends of the shafts should be firmly fastened in the fittings. The shaft for the head stock is made from a piece of one-half inch pipe turned smooth. One end is threaded for one inch, a one inch lock nut being screwed on, leaving three-quarters of an inch of thread projecting, to screw the face-plate on. The lock nut is turned down smooth to form the thrust bearing C, figure 1. The iron face-plate was cast from a wooden pattern and turned up in the shop.

But a very good one can be made from a large pipe floor plate or base flange. The slide rest is shown in figures 2 and 3. J is a plate of iron 3½ x 7 inches. A pipe floor plate is fastened to it at H, Fig. 2; DD, are pieces of one-half inch cold rolled

(*Continued on page* 115)



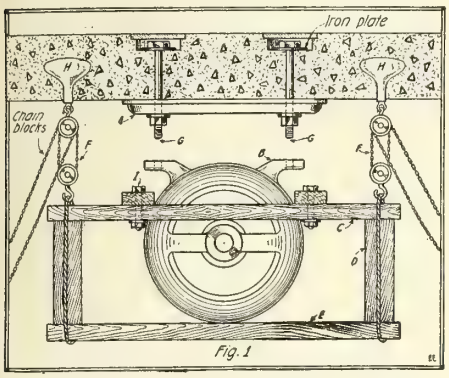
A Surprisingly Useful and Accurate Bench Lathe Can Be Built from Iron Pipe As Here Illustrated. The Guides On Which the Tool Carriage Move Are Preferably Made of Machine Steel, but Iron Pipe, Carefully Polished, Can Be Used for Rough Work.

The Electrical Machinist

By H. WINFIELD SECOR

No. 7—ERECTING MOTORS (Cont.)

IT is comparatively easy to erect and properly secure in place small motors and dynamos, but larger machines are sometimes quite awkward to erect, especially when they are placed on the ceiling. A scheme used in an installation



This Illustration Shows Wooden Cradle in Which Large Electric Motors Were Raised by Means of Chain Blocks, to Their Position Against the Ceiling on Which They Were to Be Mounted. Of Course, There Are Many Other Ways in Which This Can Be Done, but This Idea Worked Out Very Well, and Twenty-four 50 H.P. A.C. Motors Were Raised in This Manner, Without a Single Mishap.

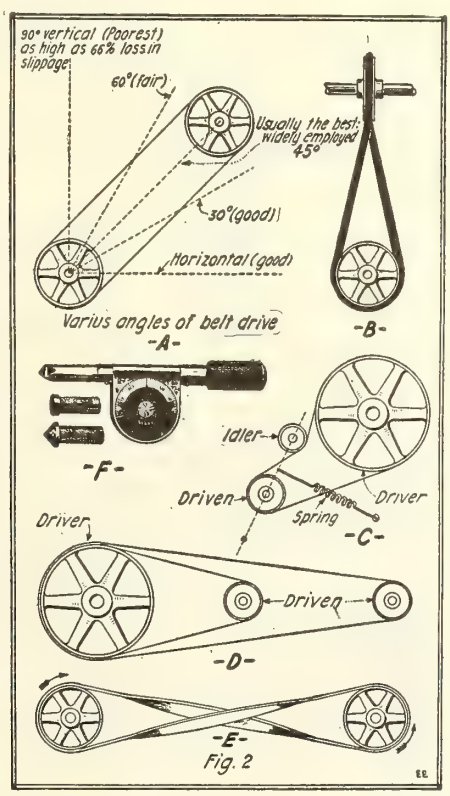
of high-powered motors, comprising twenty-four 50 H.P., two phase, A.C. induction motors, is illustrated at Fig. 1. The conditions for erecting these motors were as follows:

The building was a solid concrete one, with concrete floor beams and at first it looked as if the construction gang would have to build a heavy timber frame or scaffold to support the chain blocks in order to raise the motors to the ceiling so that they could be bolted into position. However, it was presently discovered that the designers of this building had had the forethought to have a series of threaded iron sockets molded into the concrete beams on the ceiling, at intervals of about eight feet, for the purpose of erecting machinery, mounting shafting, etc.

The first step then taken was to have four wrought iron (or steel) screw-eyes made, as shown at H. These were forged by a blacksmith from some 1" diameter stock, the loop of the eye being firmly welded to the shank and the latter threaded, of the proper pitch to screw into the sockets before mentioned.

The next problem met with, and which proved to be not so easy as first appeared, was how to raise the motor in the inverted position. First, of course, the end frames and bearings were inspected to see that they were properly reversed with respect to the oil wells and ring oilers in the bearings, for proper operation in this inverted position on the ceiling. Practically all motors of the small or medium size are reversible by simply removing the bolts holding the bearing frames and rotating these half way around, so that the bearing oil drain comes at the bottom for the new position. Eventually, the problem was solved by procuring several joists of substantial size measuring 4"x4", and a cradle was made as shown at Fig. 1. The oil was emptied out of the bearings if there happened to be any; the motor was rolled over until its base feet turned upward in the air, and by means of a rope sling, secured around the feet or otherwise, the motor was raised by one of the chain blocks and the cradle slipt under it. The motor was lowered into the cradle, and this latter, prepared to be raised by means of the two chain blocks shown. Heavy rope slings about 1½" thick were past around the ends of the cradle, which was bolted together and the chain blocks attached to these ropes in the manner indicated. The iron screw-eyes are shown at HH, the chain blocks at FF, the iron bed-plate of the motor at A, and the bolts to hold the latter as well as the motor passing thru the concrete floor at GG. The frame of the cradle is shown at C, D and E. At II are shown two cross pieces of timber which can be put into place, after the motor is lowered into the cradle, so as to keep it from moving.

Careful measurements have to be taken in any cases such as these, so as to make sure that the chain blocks would always pull up to their maximum extent, i. e., with the two sheave blocks close together, so that the cradle could be raised sufficiently high in order that the feet of the motor will go into position over the bolts. The bolts for holding the motor were made of steel 1½" in diameter, machine threaded on the lower ends, and having extra large heads forged on them at the top. These pass thru the concrete beam 18" thick, and on the floor above, in the pockets in which the heads of the four bolts rested, there were afterward placed pieces of flooring tightly fitted in. The bed-plate A, weighing about 150 lbs., was raised into position and secured by lifting it up on to a heavy scaffold by three men, altho two were able to raise this from the scaffold and lift it up to a height even with their shoulders, and the nuts quickly placed on the bolts, this temporarily holding the bed-plate in position. The scaffold was then removed and the motor prepared for raising, in the cradle shown.



Here We Have Some Useful Wrinkles on Belt Drives. The Relative Efficiencies of Belt-Driven Shafts, Especially in Various Angular Positions Are Shown at A; a Reversed Drive With a Crost Belt Is Shown at E.

When the motor had been raised almost to a level with the ends of the protruding bolts, two of the nuts at one end were carefully removed, and standing on the scaffold which had been pusht up alongside the motor cradle, pressure could be

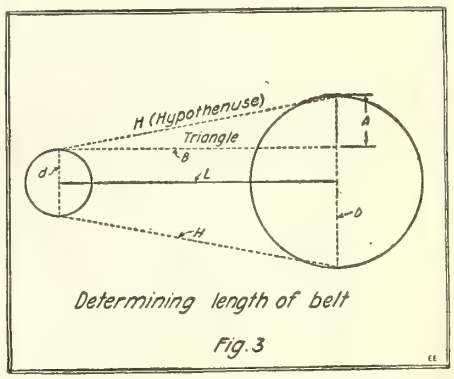


Diagram Showing the Various Mathematical Factors Used in Solving Belting Problems, Particularly That of Calculating the Exact Length of Belt Connecting Two Pulleys, Having Different Diameters.

exerted on the bed-plate, while the nuts were removed and two of the motor feet quickly pulled up over the bolts, by means of the chain block. Pressure could be exerted, if desired, against the bed-plate by blocking placed between the motor and the bed-plate. Behind each nut was placed a powerful spring washer which served to act as a nut lock in order to prevent them from vibrating loose. After two of the motor feet had been slipt over the bolts and the nuts taken up a few threads, the other two nuts were removed from over the bed-plate, and the remaining two motor feet slipt over the bolts. The nuts and spring washers were then placed on the bolts, and now all of the nuts were made up solid by heavy wrenches, locking the motor firmly in position.

After the cradle had been lowered and the chain blocks removed, the pulley was then placed on and the electrical connections from the motor to the controlling compensator box on a nearby concrete column were then installed. Everything was then ready for the connecting of the line shafting by means of a belt to the motor pulley. These motors were all placed safely in position without one accident in this fashion and the height of the ceiling was approximately 18'.

VARIOUS FORMS OF BELT DRIVE.

At Fig. 2, several forms of belt drives are illustrated. Connecting motors with line shafting or separate machines is commonly effected by means of leather, canvas or rubberized fabric belting (usually leather); also there has come into considerable favor in later years the well-known chain drive and various forms of gear and friction drives.

At Fig. 2A several important considerations in applying leather or other forms of frictional belt drives are indicated. Probably the greatest majority of belt drives are installed to operate at an angle of from 45 degrees to an angle of 60 degrees from the horizontal. Those interested can look up some of the efficiencies of various belt drives placed at different angles, in machine shop text-books and manuals. Some prefer the horizontal drive. Here the frictional

(*Continued on page* 82)

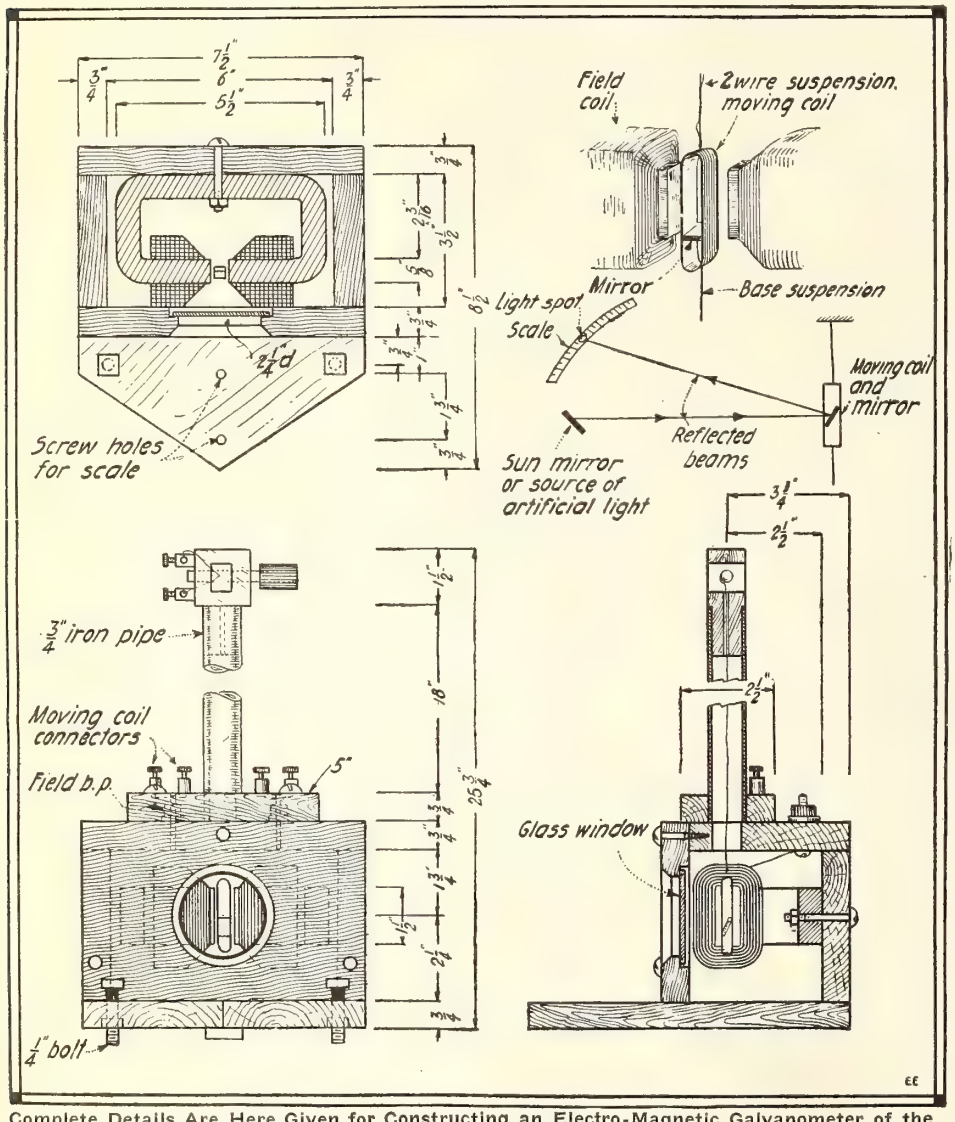
An Electro-Magnetic Galvanometer

By HANS O. STORM

A Moving Coil, Variable Field Instrument of High Sensibility

DRAWINGS are here shown of a D'Arsonval galvanometer constructed by the writer, which has certain advantages from the point of view of the amateur who wishes to make his own instrument. It operates on the same principle as the standard D'Arsonval galvanometer. A light coil, carrying the measured current, is suspended by its own lead-in wires in a strong magnetic field, and is deflected in proportion to the measured current. A small mirror attached to the coil reflects a beam of sunlight or artificial light upon a suitable scale, the observed spot of light being deflected from its neutral position on the scale by twice the angle thru which the coil is turned. The instrument here shown varies from the usual type in having electro-magnets in place of the permanent magnet, for furnishing the field in which the coil is suspended.

This makes for greater ease of construction, since good permanent magnets of the proper shape are hard to make. The use of an electro-magnet also makes possible a stronger magnetic field around the moving coil. Furthermore, both the damping and the sensibility can be changed at the will of the operator by changing the current in the field coils. When using the galvanometer with a Wheatstone bridge, much labor can be saved by making an approximate adjustment without any current in the field coils of the galvanometer, then turning on the field current and making the finer adjustment.



Complete Details Are Here Given for Constructing an Electro-Magnetic Galvanometer of the Moving Coil, Variable Field Type. It Possesses Very High Sensibility, and Is Used in Conjunction with a Beam of Light and a Scale.

The case of the instrument is made of wood, and serves both as a frame for holding the magnet and coil support, and as a cover to protect the moving coil from the disturbing effect of air currents. It is supported on three legs. The rear one of these is a small wood or fiber block glued to the base; the two front ones are bolts which turn in nuts countersunk into the wood of the base. Turning these bolts enables the instrument to be adjusted for level.

The window in the front of the case should be of the thinnest and clearest glass obtainable, for the beam of light must pass thru it twice before being thrown upon the scale.

The magnet core can be forged out of wrought iron, and should be well annealed. No finish is necessary except on the pole faces, which should be filed flat, or even a little concave, to make the flux-density in the air gap more uniform.

The winding of the electro-magnet depends upon the nature of the power supply from which it is to be excited. The best source of power is a storage battery, because it gives a steady E. M. F. Pulsating current from a rectifier will do, if the effective voltage of it remains constant. The coils in the galvanometer illustrated were wound with No. 22 enameled wire, 500 turns on each leg of the core, and all turns in series. It operates well on 15 to 20 volts. If a higher voltage is used, smaller wire and more turns should be wound, and vice versa. The coils are wound as near the air gap as possible, so that unavoidable magnetic leakage shall not weaken the field at that place. They must be tapered toward the air gap, in order that they may not obstruct the path of light from the mirror to the extreme end of the scale.

The suspension column is made of ¾" brass pipe or fiber tubing, firmly fitted and glued into a piece of wood at the base of it.

The coil support shown in the drawing enables the moving coil to be adjusted both for height and for angle. It is made of wood. The lead-in wires from the moving coil are wound around the horizontal wooden pin, which can be turned to adjust the height. The entire block can be rotated in the pipe to adjust for angle. A piece of flat spring steel, bent slightly so that it presses against the inside of the pipe, and resting in a groove in the coil support block, keeps the latter tight in the pipe, but not so tight as to prevent free adjustment. Flexible wires connect the coil support to rigid binding posts on the top of the case. With this arrangement any number of interchangeable moving coils can be used.

To make the moving coil: Bend a thin strip of brass into the shape shown. If a strong damping is desired, solder it together, if otherwise, glue it together with paper insulation between. Wind this frame with about 300 turns of the smallest silk-covered wire obtainable; at least No. 40. Fasten the final turns with a drop of sealing wax, and twist the free ends together. These serve for lead-in wires, they support the coil, and they furnish the controlling torque. Note that the fineness of the wire affects the sensibility in two ways; the finer the wire the more turns can be wound on the coil, and also, the weaker will be the controlling torque. Thus the sensibility will vary about as the square of the cross section of the wire, or as the fourth power of its diameter.

A piece of mirror is cut to fit the inside of the coil frame. This mirror will be about ¼" square. It is pushed in, and should stay there by its own friction, without glue. If this is the case, its angle can be adjusted to reflect the beam of light on to the scale from any desired angle of incidence.

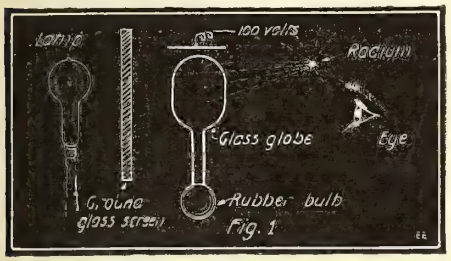
The scale may be of stiff paper on a wooden frame, and held about thirty inches in front of the instrument by a wooden arm, screwed to the base. In this case the

(*Continued on page* 114)

Radium--The Mother Of Ions

By HAROLD F. RICHARDS, M. A.

IMAGINE an insect so small that one-thousand billion of his brothers would have to be collected at one point in order to make a speck visible to the eye. The well-known cootie is as large as a prehistoric mastodon in comparison. Sup-



Apparatus to Show the Condensation of Water Vapor Upon the Ions Produced by Radium Rays in the Air Inside the Glass Globe.

pose further that this insect can move with a speed 3,000 times greater than the muzzle-velocity of shells thrown by the giant Berthas that bombarded Paris at a distance of 70 miles. It seems that it would take more than a Sherlock Holmes to track this elusive fugitive in its flight. Yet it is a task of the same magnitude that scientists have accomplisht in following the path of a *single alpha particle* thru the air. The following experiment, however, is so simple that it can be performed by almost anyone, after a few trials.

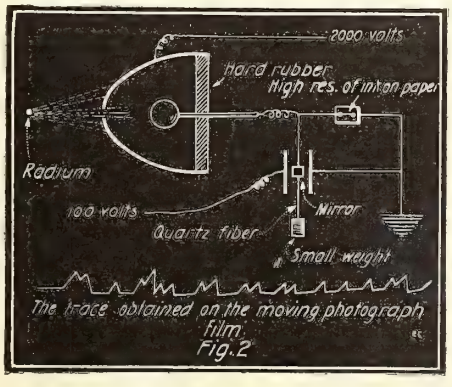
Science has far more sensitive means for detecting electricity than for measuring matter. I have already described, in a former article, (see March number), methods for detecting the particles of matter expelled when the atoms of radium explode. These methods operated by virtue of the electrical charge carried by these minute particles. Now I want to explain a simple experiment which enables us to follow, *by mechanical means,* the path of one lone alpha-particle. The apparatus is indicated in the illustration, Fig. 1. It consists simply of a hollow glass sphere to one end of which is attached a rubber bulb. Behind the glass globe is a ground-glass screen, thru which a powerful electric lamp sends a diffused illumination. When the rubber bulb is comprest and then suddenly released, minute drops of water vapor condense upon any dust particles which may be present, on account of the sudden lowering of temperature due to expansion. After this process has been repeated a number of times, all the dust nuclei have been removed from the air, and no clouds of condensed vapor are seen when the air is allowed to expand suddenly. Now place a bit of radium so as to send its radiation thru the air in the glass, and release the comprest rubber bulb. Fine lines of condensed water vapor are seen threading the air in the bulb. These show the presence of the alpha-particles.

The explanation of the effect is as follows: When the air is bombarded with alpha-particles, some of the molecules of air are broken up into electrified ions, very much as machine gun bullets might knock out individual grapes from bunches hanging on a vine loaded with the fruit. These electrified bits of sub-molecular matter act as nuclei for the condensation of water vapor. As the alpha-particle proceeds thru the air, it leaves a wake of ions in its path, and the vapor which has condensed upon them renders the path visible. Condensation occurs for the negative ions when the volume of air is suddenly increased by 25 per cent, but an increase of 31 per cent is necessary to cause condensation on the positive ions.

The fact that the drops of water are condensed about electrified nuclei is readily shown by placing two charged metal plates near the glass globe. The drops of water are then seen to move towards the plates, impelled by electrical attraction. This simple experiment can also be performed with *uranium,* which is comparatively cheap, or the ionization can be produced by X-rays or ultra-violet rays. The beta-rays and gamma-rays of radium will go right thru the glass wall of the globe, but if it is desired to work with the alpha-particle of radium or uranium, a thin paper window should be fitted in the wall of the globe, in order to let them thru. If a photographic plate is substituted for the eye, an actual trace of the alpha-particle can be obtained. It appears as a jagged line on the film.

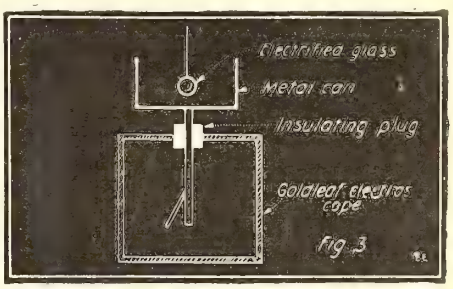
AN ALPHA PARTICLE PUNCHES THE BAG.

In an ingenious experiment it is possible to register the entrance of every alpha-particle, even tho they may enter the counting chamber at the rate of 1,000 per minute. The apparatus is indicated in the illustration. A brass sphere is supported by a metal rod inside a brass hemisphere, and the latter is connected to a set of high-tension batteries giving a potential of about 2,000 volts. The rod supporting the brass ball is connected to a very fine quartz fiber hanging between two metal plates, one of which is charged to 100 volts. Quartz is chosen because it can be made into very light fibers of great strength and elasticity. Since quartz is a non-conductor, the surface of the fiber is coated with a thin film of silver. The alpha-particles enter the vessel thru a small opening. As each one penetrates the air, it produces ions in its path, and the strong electric field of 2,000 volts causes these ions to move so swiftly that they manufacture many more ions by collision with other air molecules. Thus the electric effect due to a single alpha-particle is enormously magnified. The electric charge carried by these ions to the brass ball causes the quartz fiber to become electrified, and it is attracted towards the charged metal plate near which it is suspended. The electricity remains on the fiber just long enough to produce a "kick," and then leaks off to the earth thru a high resistance of India ink on paper. See Fig. 2. A small mirror attached to the fiber reflects a spot of light upon a moving photographic film, so that every time an alpha-particle enters the chamber the kick



Apparatus to Register Automatically a Single Alpha-Particle Emitted by Radium. Every Nick in the Line Indicates the Entrance of a Single Alpha-Particle Into the Counting Chamber. The Portion of the Trace Shown Corresponds to an Interval of Two Seconds. 1,000 Particles Entered the Vessel Per Minute, Yet Each One Is Recorded Separately.

of the quartz fiber produces a nick in the line of light registered on the film, see figure. The effect is thus just as if every alpha-particle dashed up, gave the fiber a good wollop, and then retired to make room for other athletically-inclined particles.



Simple Apparatus to Show How Radium Discharges an Electrified Insulator, Thus Proving That Radium Produces Ions in the Air.

The photographic film upon which the stunts of the particles are recorded moves at the rate of about four miles an hour, when 1,000 alpha rays enter the counting chamber per minute. When it is remembered that a microscope would be required to render visible the quantity of radium which produces only 1,000 alpha-particles per minute, and that the electrical charge carried by each particle is so small that as many of them would be required to light an ordinary incandescent lamp as there are drops of water in the modern swimming tank, the development of science that permits the registration of each alpha ray seems well-nigh unbelievable.

One must have the imagination of a poet to realize fully the wonders revealed by Science. The nearest star is so far away that an imaginary airplane traveling one mile in every second would take 800,000 years to reach it. Two celestial bodies crash together in interstellar space and burst into flames, yet the conflagration is not heralded at our earth until half a century later, altho light travels at the enormous speed of 186,000 miles per second. Terrestrial distances vanish into nothing compared to these astronomical magnitudes which must be measured in light-years. The astronomer calculates the mass of the sun, and we find our earth to be, in comparison, merely a speck of dust dancing in the sunbeam, and we, ourselves, but germs upon a mote. Turning our eyes from heaven to earth, we find that the heat and power of steam are due to the rapid vibrations of molecules which are so small that the highest vacuum we can obtain has fifty millions of them in every cubic inch. Our nearest approach to *nothing* contains fifty million particles in a cubic inch. The sudden drop from the infinite to the infinitesimal is staggering. Yet the experiments with radium show that there is a whole *solar system* in one of these molecules. The imagination refuses to function, but scientific experiments admit of no other conclusion. In order to explain the myriad facts revealed by this wonderful substance we must assume that in the very atom itself there are electrons as planets revolving in majestic orbits about a large nucleus as a sun, and recent experiments which tend to show that even an electron has potential energy, may force us to conclude that these electron-planets are composed of parts.

(*Continued on page* 115)

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

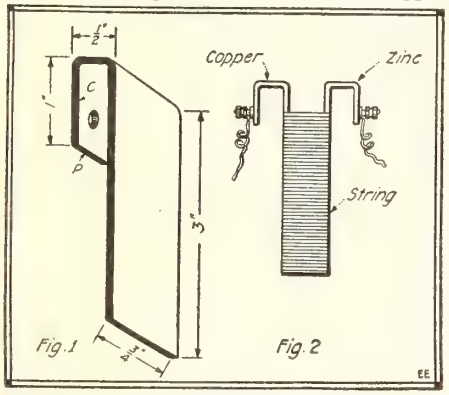
FIRST PRIZE, $3.00

A BATTERY-LESS ARMATURE TESTER.

Many experimenters desire a small device for testing rather than to carry a battery around.

To construct this tester first shape a piece of copper about 1/16 of an inch in thickness and bend at the required lengths.

The hole at (1) is drilled ⅜ of an inch from the edge (c) and 1/12 of an inch up from the end (p). After doing everything as shown in Fig. 1 make a duplicate of this out of a piece of zinc about 1/16 of an inch thick. Next obtain an old dry wick from a lamp, place it between the copper



Battery-less Armature Tester Composed of a Strip of Copper and a Strip of Zinc Bound Together, but Between Which Is Placed a Lamp Wick. The Element so Formed Can Then Be Soaked in Plain Water, Salt Water or Sal Ammoniac Solution. A Telephone Receiver Is Used to Complete the Test Circuit.

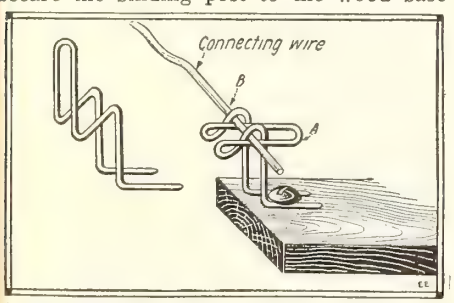
and zinc evenly. Then wind string around as shown in Fig. 2; wind tightly as if winding a tuner.

Connect a telephone receiver with it; when ready for use dampen the wick with water and very distinct sounds can be heard when testing across the segments.

Contributed by THOMAS MOORE.

HAIRPIN BINDING POST.

A good spring binding post can be made from a hairpin. Scratch the enamel off with a knife and bend the pin as shown in sketch with a pair of pliers. Next secure the binding post to the wood base



A One-Minute Binding Post Made from One of Sis's Hairpins.

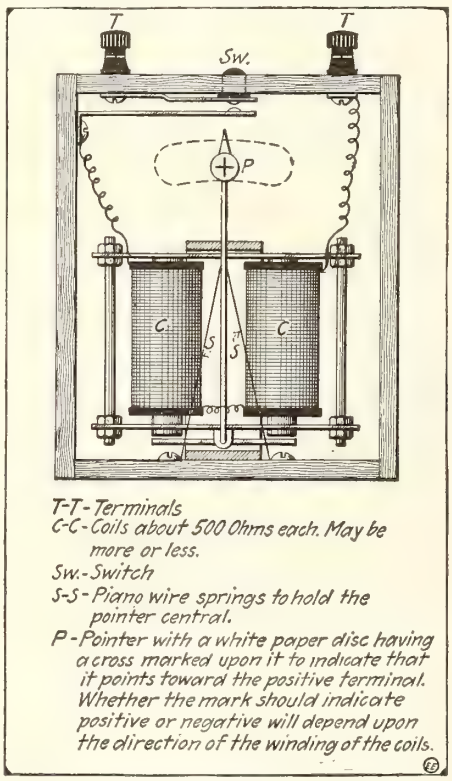
by a tack which is driven between ends of binding post as shown. The wire is inserted thru eyelets B.B. by pressing down on A. This binding post can also be made with a piece of spring brass wire.

Contributed by DAVID RASCON.

SECOND PRIZE, $2.00

MAGNETIC POLARITY INDICATOR

I enclose a sketch of a polarity indicator made from a telephone ringer which seems to be especially adapted for such work.



A Simple and Useful Magnetic Polarity Indicator Constructed from a Polarized Telephone Bell-Ringer.

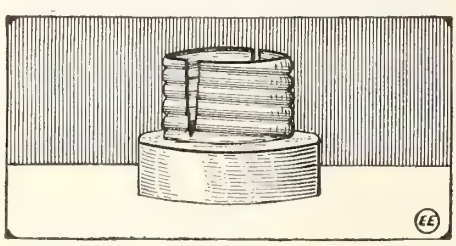
In this case I increased the throw of the needle or pointer by adjusting the armature of the ringer, I added a switch so that the tendency to make connection by touching the wire to the terminal and in time burning it off would be eliminated. The switch also acts as a safeguard against burning the coils out in case the resistance of the coils is small and the potential high. The connection or closing of the switch need be only for a moment.

Contributed by O. B. POORE.

A "QUICK TEST" LAMP SOCKET.

Remove the cover from an ordinary fixt socket and split the lamp-screw shell down opposite sides, forcing the two halves of the shell slightly apart.

Contributed by N. J. SECCOMBE.



To Test Lamp Bulbs Rapidly, Split a Socket Shell in the Manner Illustrated, so That Lamps Can Be Slipt In and Out.

THIRD PRIZE, $1.00

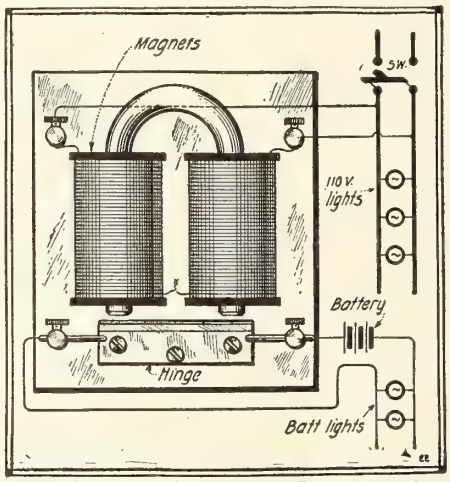
AN AUTOMATIC LIGHT SWITCH.

I herewith describe an automatic switch which will throw on battery current when the 110-volt current gives out.

The necessary parts include: A set of magnets for 110-volt circuit, two single binding posts, two double binding posts, some heavy wire, a hinge and a wooden block for a base.

The action is simple. When the 110-volt circuit is broken, the magnets release the hinge. The hinge strikes the contacts and connects the battery lights. For best results the switch should be placed vertically.

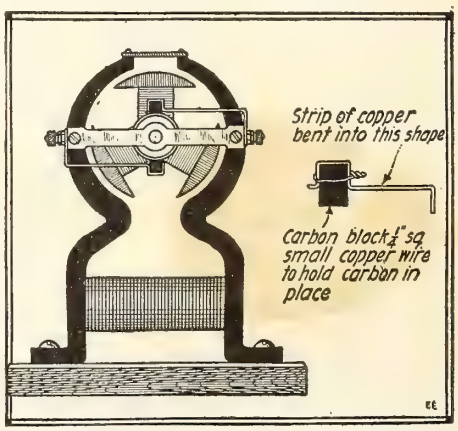
Contributed by F. J. GILLIS.



When the Main Line Voltage Fails, This Automatic Relay Closes the Battery Circuit to the Emergency Lights.

SMALL MOTOR BRUSHES.

Being a reader of THE ELECTRICAL EXPERIMENTER I give herewith a little idea for carbon brushes suitable for a battery motor, which I have tried on small motors and found that it saves the wear and tear on the commutator.



A Clever Way of Making Small Carbon or Better Grafite Brushes, for Battery Motors.

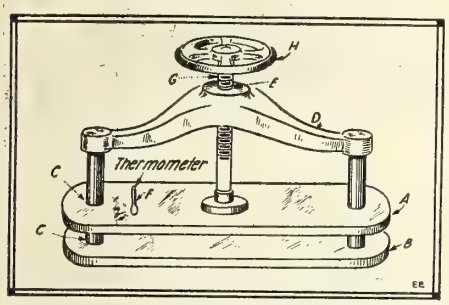
The price of the brushes will suit everyone's pocketbook, the materials used being a piece of carbon from a flashlight battery and a strip of copper.



MACHINE FOR MAKING RUBBER STAMPS.

Here is a simple, easily made machine with which any one can make their own rubber stamps. To construct the same, procure two pieces of sheet steel ¼ inch thick, 3 inches wide and 6 inches long (A.B.). Lay them together and drill holes thru at C for one-half inch bolts. Now make a strap of steel ¼ inch thick, 1 inch wide (D). Drill and lap out for half-inch rod at E. Now tap for bolt at holes in base, screwing a bolt in each. Now fix the plate A so it will slide up and down on the bolts as shown. Mount a thermometer F, also a screw G with a hand wheel H and the machine is ready to use.

To use it, obtain a sheet of stamp makers' matrix board. Set up the form with printers' type, that the stamp is to be made in. Then put this on the lower plate. Lay the matrix board on it and screw down the top plate by means of the wheel H. Now unscrew, and then lay the matrix board face up on the bottom plate; now lay a sheet of unvulcanized rubber, such as is used for packing auto tires, on the board.



By Means of This Simple Press Which Can Be Constructed by the Experimenter or Else Adapted from a Small Letter Press, It Becomes an Easy Matter to Make Your Own Rubber Stamps.

Screw down tight and set the whole machine on a stove. When the thermometer reaches 225° remove from the stove and then in five minutes the rubber is taken out and ready to fasten to the wood mount by means of glue. With this little machine anyone can make their own rubber stamps.

Contributed by A. H. WAYCHOFF.

SOAP PASTE.

Here is a soap paste that should interest every mechanic. I have used this for over a year and find it will remove paint, grease, tar, oils, etc.

To make this paste, take,

1 pound of ivory soap
1 pint water

and cut the soap in shavings. Next put in the water and get it boiling hot.

Now take one pint of light auto engine oil, and heat to the boiling point. Then stir into the soap mixture, letting it boil for about five minutes. Then add one pint boiling water. This makes a smooth white creamy paste that will remove any dirt. It it is also good for washing auto bodies, etc.

It may also be used simply by taking some on the hands, and rub well, then wipe off with a piece of clean waste or rag. No water is necessary. This leaves the hands clean, white and soft. And the best part of it all is that it only costs the small sum of 10 cents a gallon.

Contributed by A. H. WAYCHOFF.

"CEMENTS."

Cement for an Aquarium—Many persons have attempted to make an aquarium, but have failed on account of the extreme difficulty in making the tank resist the action of water for any length of time. Below is a recipe for a cement that can be relied upon; it is perfectly free from anything that injures the animals or plants; it sticks to glass, metal, wood, stone, etc., and hardens under water. A hundred different cements have been tried, but there is nothing like this. It is the same as that used in constructing the tanks of the Zoological Gardens, London, and is almost unknown in this country. One part, by measure, say a gill, of litharge; one gill of plaster of paris; one gill of dry, white sand; one-third of a gill of finely powderd resin. Sift, and keep corked until ready for use, when it is to be made into a putty by mixing in boiled linseed oil with a little patent dryer added. Never use it after it has been mixed with the oil for over fifteen hours. This cement can be used for a salt water aquarium.

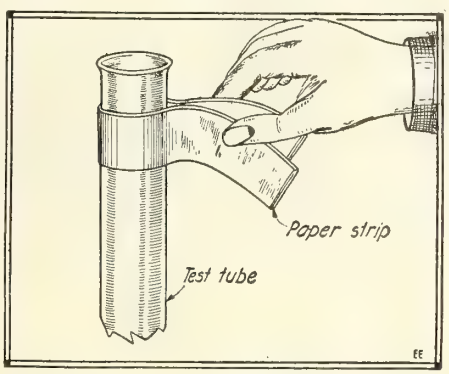
Cement for Attaching Metal to Glass—Take two ounces of a thick solution of glue, and mix with one ounce of linseed-oil varnish, and half an ounce of pure turpentine; these are to be boiled together in a closed vessel. The two bodies should be clamped and held together for two days after they are united.

Cement for Mending Broken China—Stir plaster of paris into a thick solution of gum arabic till it becomes a viscous paste. Apply it with a brush to the fractured edges and draw the parts closely together.

Contributed by RUSSELL M. REED.

TEST TUBE HOLDER.

A substitute for the usual wire holder used for handling test tubes can be made in a few seconds from a square of heavy wrapping paper folded to a strip one inch wide and eight inches long. The paper strip is wrapt around the tube, the ends being held between the fingers as shown.



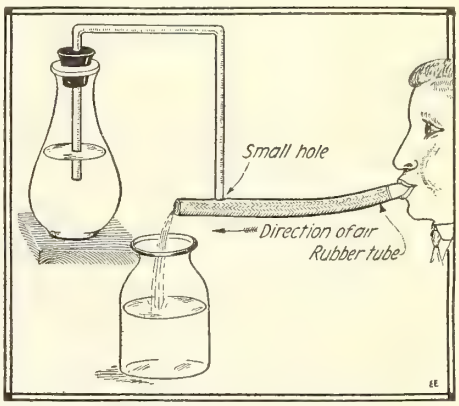
The Accompanying Illustration Shows a Simple Way to Hold Test Tubes, Especially When They Are Heated, by Means of a Paper Strip Doubled and Then Slipt Over the Test Tube and Clampt With the Fingers.

In this manner the tube can be held tightly without danger of crushing the tube or burning the fingers. This little stunt is used in one of the large commercial laboratories.

Contributed by THOS. W. BENSON.

A SIMPLE WAY TO START A SYPHON.

Contrary to the ordinary way of filling a siphon, by suction, all danger of getting any of the liquid in one's mouth may be avoided by using the simple method described below. A common piece of rubber tubing is the only apparatus required. A small hole is made in this to tightly fit the tube of the siphon as shown in sketch.



Here Is a Simple Way in Which to Start a Siphon by Blowing Thru an Auxiliary Piece of Rubber or Glass Tubing. The Air Blowing Thru This Tube Causes a Suction to Be Set Up in the Down-Coming Pipe, and This Causes the Liquid to Be Sucked Upward Into the Pipe from the Upper Jar. Once Started the Siphon Works Itself.

When air is blown thru this tube at A it causes a partial vacuum in the siphon, which in turn causes the liquid to rise in the siphon. The rubber tube may be left on or removed as desired. The liquid will then start flowing. The advantage of this method is in the absolute avoidance of any liquid entering the mouth. The rubber tube can be of any length, and the hole in it should be made to fit the siphon air-tight.

Contributed by EDMUND SMITH.

TO CAST FIGURES IN IMITATION OF IVORY.

Make finely ground isinglass (mica) and egg shells into a paste with strong alcohol. This mixture should be carefully warmed and then cast into your mold, which should be well oiled over.

Leave the figure in the mould until dry, and you will find upon taking it out that it bears a very strong resemblance to ivory.

If desired, the warm paste may be tinted with any color you may wish.

Contributed by
WALTER CHAS. MICHEL.

TO MAKE FUSIBLE SPOONS.

Melt about four ounces of bismuth in a crucible, and, when fused, throw in about 2½ ounces of lead, and 1½ ounces of tin. These metals will combine and form an alloy, which melts at a very low degree of heat.

If some of it is formed into teaspoons (which may easily be done by making a mold in clay from another spoon), the spoons thus made will cause much amusement; for if one be placed in hot tea it will melt, or if it does not melt it will bend, considerably surprising the person using it.

Contributed by
FRANK. R. NICKERSON.



RADIO DEPARTMENT



The New Radio Corporation

By C. D. WAGONER

of the General Electric Company.

CONNECTING the nations of the world by wireless thru mammoth radio stations, equipt to send messages at the rate of 100 words a minute is the plan of the newly organized *Radio Corporation of America.* These stations will be similar to the one at New Brunswick, N. J., which accomplisht some wonderful feats during the last six months of the war. The radio service establisht by this station proved to be reliable practically every day of the year and every hour in the day. It was thru this station that President Wilson kept in close communication with Washington while at sea on the transport *"George Washington,"* it was thru this station that instructions were sent to the great armies overseas and it was also via this station that President Wilson sent his famous message demanding the abdication of the Kaiser.

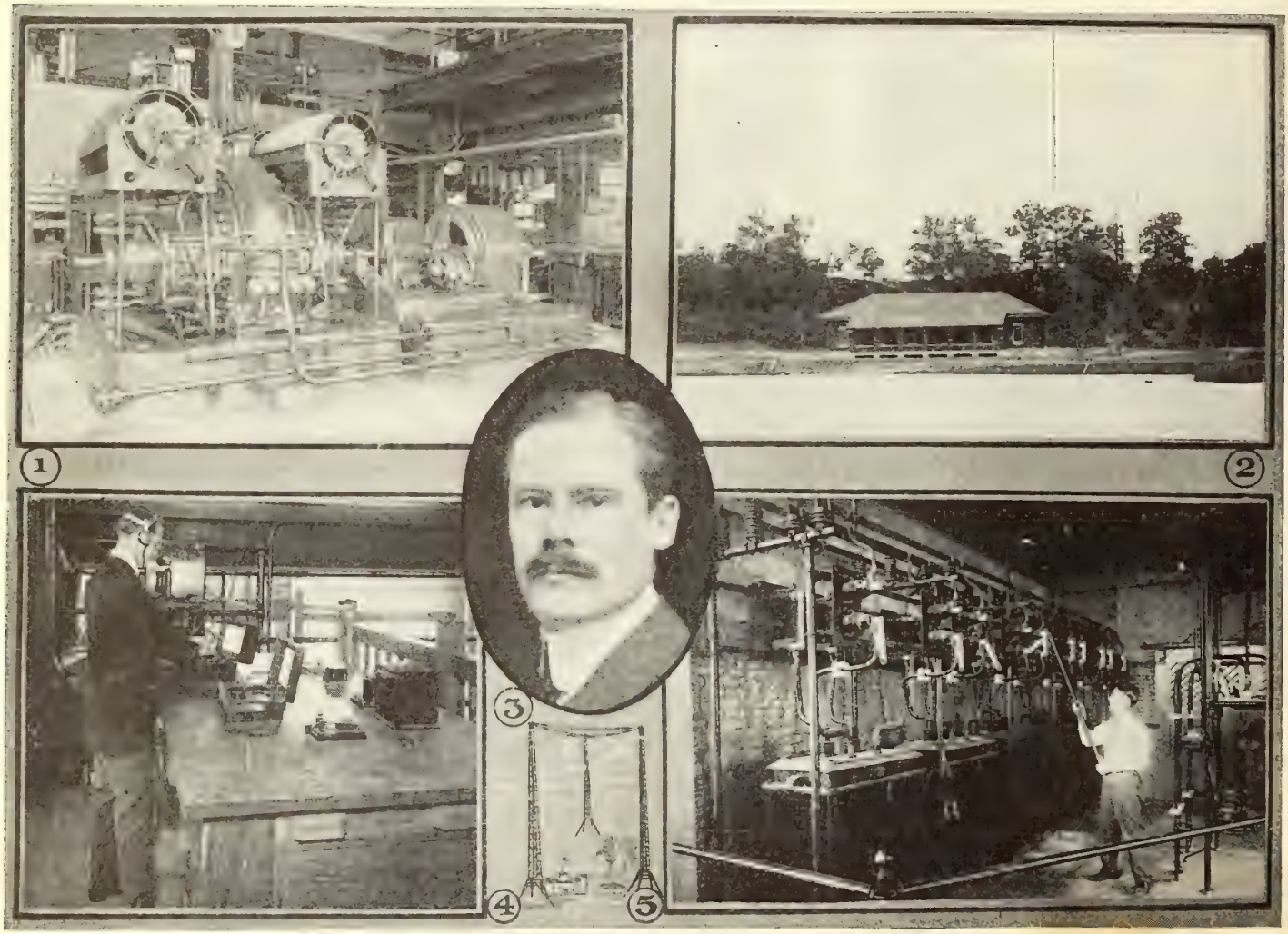
Thus the war, bringing about this remarkable achievement in wireless, demonstrated the great possibilities of supplementing the now overcrowded cables and bringing America to the front in the world's commerce.

The Alexanderson alternator is known for its clean cut and pure wave or tone, which can be so easily distinguisht that the messages do not get mixed up with each other even if they are of nearly the same wave lengths. Thus, five such alternators may be operated simultaneously transmitting five separate messages, where older types of apparatus could send only one.

Up until this time when we have thought of wireless we have always thought of Marconi, because he has been the principal factor in its development. Now a new name enters the field. It is that of Ernst F. W. Alexanderson, consulting engineer for the General Electric Company and considered one of the foremost radio experts of the world. He came into the limelight with the invention of his high frequency alternator, the machine which made possible the accomplishments of the New Brunswick Station.

But this is not all that Mr. Alexanderson has done for the wireless art. His *magnetic amplifier* and *barrage receiver* have also proven big assets in trans-oceanic radio. The former, a device attached to the alternator, magnifies a telephone current into a trans-oceanic radio message, and the latter in an instrument whereby the operator may turn a deaf ear to all signals or noises other than those intended for him. This is important, as brought out in the tests made during the war. The Germans endeavored to destroy communication between America and France by sending out equal wireless wave lengths and under ordinary conditions they would have been successful, but with this barrage receiver the operator was able to pick out the message he wanted and bar all others. This device also makes it possible to receive messages from several sta-

(*Continued on page* 110)

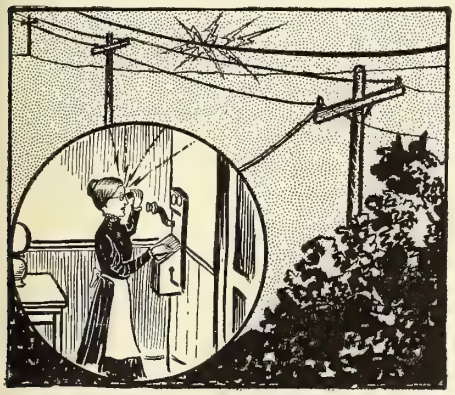


1—Alexanderson High Frequency Alternator, Which Has Made Possible Sending Wireless Messages 3,000 Miles at a Speed of 100 Words Per Minute. 2—Operating House at the Trans-Atlantic Receiving Station for the Radio Corporation of America, Belmar, New Jersey. 3—E. F. W. Alexanderson, Inventor of New High Frequency Alternator and Chief Engineer of Radio Corporation of America. 4—The Operating Table at the Trans-Atlantic Transmitting Station at New Brunswick, New Jersey. 5—A Bank of Condensers at the New Brunswick, New Jersey, Station, of the Radio Corporation of America.

A War-Time Radio Detective

By PIERRE H. BOUCHERON

I MUST start off with an apology. War stories are admittedly passé, so if I mention the words "great war", "German spy", "submarine", "spy radio stations", etc., a little too often please have patience with me as in some cases it will have to be done, even at the cost of the reader's displeasure.



Among Several Thousand Choice Stories Sent in to Be Investigated by Patriotic Citizens During the War Was That Vouched for by a Lady, Who Swore That She Heard Secret Dots and Dashes of the Telegraphic Code on Her Telephone Every Day, at a Certain Time. This Was Investigated and Found to Be Due to a High Tension Line Brushing Against the Telephone Wires.

During the recent "scrap" it was my good fortune (or shall we call it misfortune) to be connected with a no less awe-inspiring outfit than the "Intelligence Department" of the Radio Censorship Bureau. It was the duty of men attached to this department to investigate reports of illegal radio activities occurring in neighboring districts. The sources of information came from all manner of ways, such as the secret service, allied bureaus of information, various governmental bureaus, the police, home defense leagues, amateur "deteckatives," and sometimes over-zealous citizens. They forwarded the reports by telegraph, cable, special delivery mail and "fleet-footed" messengers. In one case, a patriotic youth actually ran a marathon (27 miles, isn't it?) in order to inform us that Mr. Heinberger of Dingville, L. I., had been seen using a pocket flashlight for "signaling" purposes at 3.00 o'clock in the morning.



Finally, After Chasing Hundreds of False as Well as Worthy Spy Cases, a 100 Per Cent Radio Spy Was Located and caught "Red Handed" by the Author and the Secret Service Operatives. The Camouflaged Antenna Used by This Spy was Truly a Work of Art.

No. 1. A Few Accounts Describing Some Unusual Experiences Connected With War-Time Radio

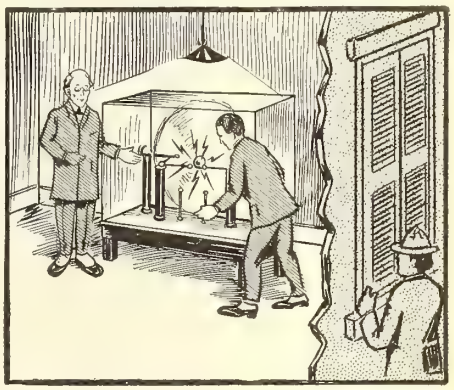
Many of these reports were totally unfounded and in many instances were even ridiculous in their childish character, demonstrating total ignorance of "radio telegraphy" matters. Well-meaning but misguided persons (males and females, if you please) would note a peculiarly twisted clothes line in a back yard, or a telephone wire running between two houses, or a guide wire attached to a pole or tree and would immediately decide that the locality was the rendezvous of "spies" in direct communication with the *Wilhelmstrasse,* in Berlin.

Strange to say these reports had to be investigated whether they appeared ridiculous or not, and it was often my lot to have as many as four or five of these reports to work upon during a single day. Of course there were many of them which on the surface looked fairly reliable and seemed to be really suspicious and worthy of the skill of some of our best men. I will say, however, conservatively, that not more than 5 per cent of the investigations resulted in a discovery of some plan definitely designed to secure information by means of *radio* and thereby break the existing laws concerning complete dismantling and inoperation of all unofficial radio stations in the United States.

I will, therefore, cite a few of the many cases which at first gave great promise, but alas, turned out to be complete fiascoes. This may give the average reader an idea of the amount of time and expense which the government was obliged to put forth in order to thoroly investigate the reports of well-intentioned, tho too often misinformed patriots.

FOREWORD

No, regular subscriber, the "radio detective" is not a new system of dictagraph, nor is it a twenty-fifth century mechanical device having the power of tracking down criminals by means of distant radio control. The radio detective is, or rather was, (for he has temporarily ceased activities since the fall of October 1918) *a very ordinary human being just like yourself, possest, however, with the knowledge of being able to distinguish a radio antenna from a clothes line, as well as the unusual ability of being able to "nose out" an underground antenna within a radius of one mile. This individual was formerly a regularly enlisted radio operator of the U. S. Navy or Army, who, during the war, pursued his unusual calling in various sections of the United States and particularly in districts close to the Atlantic and Pacific coasts. He operated alone but sometimes was accompanied by an assistant. His equipment consisted of a small hand-bag which contained a complete portable radio receiving set of a rather original design, an automatic revolver, and a raincoat! In some instances the portable set included a loop or radio compass so that when the trail was especially strong, "bearings" of unknown transmitters could be secured. But this is getting ahead of the story so we will let the author tell it in his own words.*



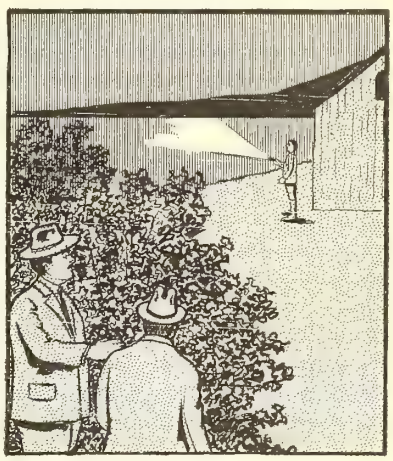
The "Static Manufacturing Plant" Was a Wild Tale, Which We Are Not Going to Disclose Here. A "Boy Scout," Passing by a Doctor's Office Near a Naval Radio Station, Heard the Static Spark Crashes and Reported the Matter. The Outcome of This Mystery Is Entertainingly Told by the Author.

THE "STATIC MANUFACTURING" PLANT.

In the spring of 1918 there came to our notice a report to the effect that a large static machine had been installed in the immediate vicinity of the Brooklyn Navy Yard. The machine, it was said, had been designed for the express purpose of sending out "static" on a broad wave and thereby seriously interfere with the reception of important naval dispatches at the Brooklyn Navy Yard radio station. That is to say, the apparatus was capable of simulating *strays* or atmospheric disturbances known in the parlance of radio men as *static.* Coincident with this, it may be well to say that during this time the local naval radio station was encountering difficulty with regular and very real static, so that a report of this nature coming at this period was worthy of investigation; and particularly so, for it came from Secret Service operatives.

This happened to be my first case so I was more than anxious to make good. I therefore sallied forth, armed to the teeth,

(*Continued on page* 102.)



Another Wild Tale Which Looked 100 Percent "Gilt Edge" Was That of a Man Who Was Seen at Certain Times Using a Pocket Flashlight at Night. Investigation Proved This to Be a False Alarm, as the German Using the Flashlight Was Only a "Peaceable" Farmer Going About His Chores.

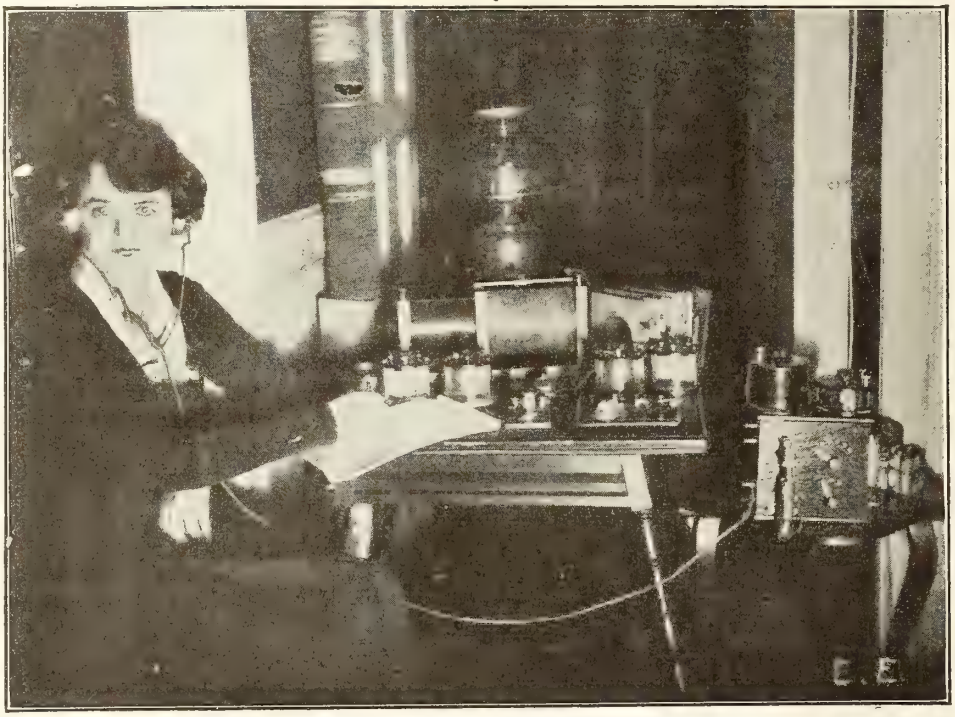
New York Girl's Radio Set

By ABBY P. MORRISON

I GIVE herewith a detailed description of my radio set, which has been in commission since the War ban was lifted, and it has given me very satisfactory service. It is purely home-made except for the condensers, one of the couplers, audion box and batteries.

The three-foot-square "loop aerial" frame, wound with twenty-two turns of rather heavy wire, is not shown in the picture. It was made by myself. In addition the loop 3'x 1½', noted in the background, was wound on a trunk tray with twenty turns of fine double cotton covered wire. With the latter loop and an audion detector I am able to receive local, Navy Yard and ship signals; with the former loop considerably larger I receive 600-meter messages and when using all twenty-two turns receive those of 952-meter wave length. This wave length I have presumed to be accurate without resorting to wave-meter tests, inasmuch as the messages come from the Navy Yard and from ships a day or two out at sea.

These nearby messages I have detected with the three-foot loop and on a crystal detector very clearly. I have not had time to experiment much with either this loop or a four-foot home-made loop just added. However, with an outdoor aerial of four wires, seven-strand copper, spaced each two feet apart and spanning about eighty-six feet in length with a lead of forty feet, I have received signals up and down the coast and out to sea for a good distance. These signals, both dampt and undampt, included, as well as ship and coast wavelengths, Arlington and the higher waves.



Miss Abby P. Morrison and Her Elaborate Experimental Wireless Station. Miss Morrison Receives on an Indoor Loop Aerial Which She Built Herself.

The set beside the aerial and loops contains two home-made coils of No. 28 wire wound on cardboard tubes three inches in diameter, being respectively 1¼ feet and 1½ feet in length, which I can use either as inductances or as a coupler. I have also a large old coupler, the secondary of which pulls out on a set of wheels. This works very smoothly and efficiently.

There are four other home-made coils, each wound tightly, the winding separated by layers of waxed paper, to distribute the capacity, and mounted between two pieces of cardboard four inches square. The Audion is mounted on a panel, the box of which contains a "B" battery of ten square dry cells, aggregating forty volts. On the front of the box are two switches, one of three taps for switching off the "A" battery from the filament and, in case of a bulb with two filaments, enables the change from one filament to the other. The other switch has five taps for regulating the amount of current from the "B" battery, sections of which are attached to each tap. The Audion in use at present is an old-fashioned tubular one which necessitates the box to be placed on the edge of the table to enable the end of the bulb to rest comfortably below the table level. On the right side of the box is a filament battery rheostat and binding posts for the "A" battery. On the left side are binding posts for the telephone and tuning circuit. I have had to rearrange the wiring inside the box on account of my desire to try out different circuits, also occasionally substituting a new battery for the old one. A small "grid condenser" is contained within the box, and I have found no need for a grid leak, altho I always have one at hand in case of necessity.

I have used nearly all of the ordinary audion circuits and also those employing a tickler. Eight variable condensers and the 'phones, together with odds and ends, complete the station.

A friend of mine, recently returned from France, has brought me a complete set, picked up practically from the battlefield, consisting of a German and French combination, five-step amplifier, one step of which can also be used as detector, condensers, coils, batteries, etc., for receiving. There is also in this set complete sending apparatus consisting of a spark coil, a rotary spark gap, batteries, step-up and oscillation transformers, condensers, etc. I also have a ¼ kilowatt motor-generator.

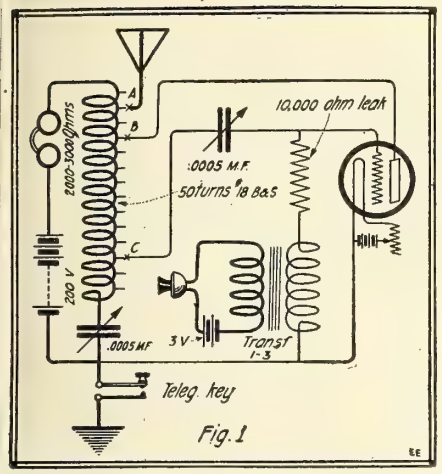
Plan For World-Wireless

A scheme now under consideration in France for embracing the whole globe with wireless stations erected wholly on French territory is described in a recent issue of *Le Génie Civil*, by Mr. Boutillon, head of the French Government wireless department. As the result of a mission to America in 1917 to study the wireless systems of the New World, the author has concluded that to assure continuity of communication at great distances powers much higher than those now usual are needed. The following is an abstract of the Boutillon article:

"All the great stations in existence (with ranges from 3,000 to 5,000 miles), with the exception of Nauen, employ powers between 200 and 400 kilowatts, and possess antennae ranging in height between 500 and 650 feet. The energy radiated from them is overabundant in the periods most favorable for transmission, but is insufficient when, as often in summer, to unfavorable conditions of transmission are added strong atmospheric disturbances. Communication then may remain impossible often for many hours together. To overcome this inconvenience, the author holds it needful to raise the power to at least 1,500 kilowatts and adopt antenna of at least 1,500 feet in height. As regards the world-embracing network, the author proposes a continuous line of stations of about 3,700 miles' range, which, starting on the west, will comprise the stations at Tahiti, New Caledonia, Indo-China, Djibuti, and France, where splitting into two arms it will terminate at the Senegal and Martinique stations, respectively. The center of the network is naturally placed in France, and comprises a station of medium power able to communicate with North Africa and three stations of great power to communicate respectively with (1) the United States; (2) Martinique and Brazil; (3) West Africa, and with Djibuti. In West Africa, at Djibuti, and in Indo-China there will be double stations (one of great power to communicate at great distances, and one of medium power for local uses). In detail the network will comprise (1) a quadruple station in France (three stations of great power and one of medium power); (2) three double stations; West Africa, Djibuti, and Indo-China (one large station and one medium); (3) three stations of great power; Martinique, New Caledonia, and Tahiti; (4) six stations of medium power: Morocco-Algeria, Tunisia, Kongo, Madagascar, and French India. As to the organization of the multiple stations the author proposes to place transmission centers at considerable distances one from the other. For instance, in France the four transmission centers will be situated at Arles Nèmes, Bordeaux, and Basse Loire. Reception posts may be placed near those of transmission, and at such a distance as to permit the service in duplex or (and this solution the author seems to prefer) may be united in a single center of reception near Paris, which they will communicate by wire with the four sending posts."

A One Tube Radio-Telegraph and Radio-Phone Transmitter

By PIERRE H. BOUCHERON

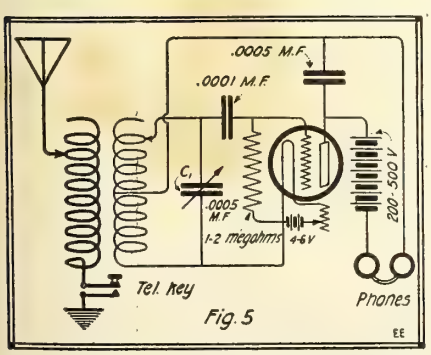


Complete Wireless Telephone Hook-Up, Sending and Receiving, Using but One Audion.

AMATEURS, do you realize that a great deal of interesting experimenting is at the present day done by many amateurs all over the country employing undampt wave transmission? For the most part this is being accomplisht by the use of one or more vacuum tubes on oscillating circuits well below two hundred meters. This is possibly one of the reasons why you do not hear them. Another reason is that it is continuous wave and not readily intercepted when ordinary dampt wave receivers are employed.

Some of you who have the necessary equipment, simply hook up a short wave regenerative circuit, or any other form of oscillating vacuum tube connection, then tune down from two hundred to one hundred meters, and behold, you will hear a regular medley of *amateur undampt signals.* This of course applies to thickly populated districts notorious for their generous scattering of amateur aerials; such as, for instance, New York, Philadelphia, Boston, Baltimore, Chicago, New Orleans, San Francisco. Los Angeles and their respective suburban districts.

A Marconi vacuum tube of the receiving type, or any other receiving tube of dependable manufacture, when used in a radio phone circuit having the proper constants, will, under good operating conditions be sufficient to carry on conversation within a distance of five miles altho a friend of the writer's has frequently covered twice this distance. Therefore, if five miles can be covered by the use of one tube it may be estimated that a considerable additional distance could be covered by employing a series of tubes. However, owing to the considerable initial expense of the tubes as well as the up-keep of such an arrangement, Radio-telephony under conditions of this kind is not always practicable nor possible for the average experimenter's pocketbook. For instance, the much talked of government test at Washington some years ago in which three hundred and ten tubes were employed, and where a space of approximately 5,400 miles was effectively bridged by the human voice, cost for the operation of the vacuum tubes alone was about $10,000 per hour. We will therefore confine our immediate attention to a circuit employing one tube, the total cost of which should not greatly exceed $20. As a matter of fact the actual cost will be less, for there are few amateurs indeed who have not at least one vacuum tube at their disposal. Providing we have the tube, the biggest item is therefore the plate voltage battery which must have a potential *of at least two hundred volts.*



Undampt Radio-Telegraph Transmitter Using a Single Audion for Generating the Oscillations.

In May "Radio Amateur News"

A Practical Radiophone for the Amateur.
By Herbert W. Harmon.

Found via Radio
By Leroy Archer

A Compact Vacuum Tube Control Panel
By J. Stanley Brown.

Pioneer Days in Wireless Telephony.
By Austin C. Lescarboura.

Timely Information on Aerials.
By Pierre H. Boucheron.

French Applications of Vacuum Tubes
By our French Correspondent.

A Synchronized Commutator Set for Spark Coils.
By Nat Sauberman

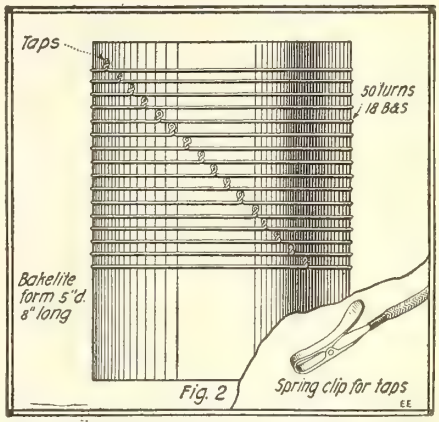
A Closed Core Magnetic Rectifier.
By J. Stanley Brown

NECESSARY INSTRUMENTS.

In Fig. 1 we have a simple and yet effective circuit which may be employed for either radio-phone or for continuous wave radio telegraphy. It will be noted that *conductive* coupling between the antenna and the tube circuit is employed rather than *inductive,* for it has been found to give better results in radiophone circuits of the kind. The reason for this is that a greater amount of energy is transferred to the antenna with a single coil of this type than would be the case with a loose-coupler arrangement, and the resulting wave is sharp enough to cause little or no interference.

Briefly the instruments necessary to carry on experimenting in this direction are as follows:

1. A vacuum tube with suitable filament battery and rheostat.
2. A variable inductance.
3. A pair of 2,000 or 3,000 ohm receivers.
4. A plate battery of 200 or more volts of the small flash light type.
5. Two .0005 mfd. variable condensers.
6. A 10,000 ohms grid leak.

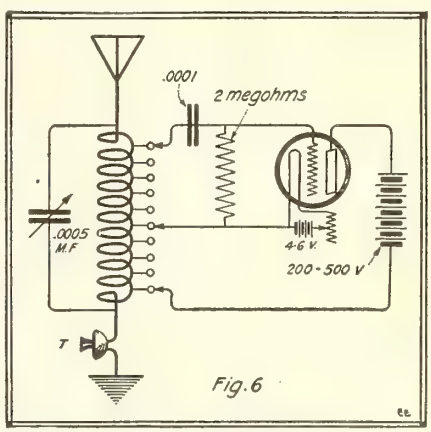


Detail of Inductance Coil Used in Wireless Telephone Transmitter of the Single Bulb Type.

7. An ordinary telephone repeater with a one to three ratio between primary and secondary.
8. An ordinary telephone transmitter.
9. Two large dry cells.
11. An ordinary telegraph key.
11. Suitable flexible wire connectors.

It will be noted that the greater part of the above instruments are usually part of the amateur's equipment except possibly the telephone repeater coil. This, as well as the telephone transmitter, may be purchased at most any experimenter's supply house at about $1.00 a piece. The preparation and construction details of the instruments necessary to complete the experiment may be briefly described as follows: The variable inductance is made by first securing a Bakelite—dilecto or fiber tube, five inches in diameter and eight inches long. If this form of tubing is not procurable, cardboard may be used instead, providing it is well coated with a good insulating preparation such as molten paraffine. Upon this form should be wound fifty turns of number eighteen B & S cotton or silk covered wire, or even ordinary bell wire may be used. It is advisable that these fifty turns be tapt. This may be done in the following manner: after having wound a complete turn a small loop of the wire is scraped of its insulation then twisted, and this small twisted loop is left projecting from the coil. After this the second turn is wound and upon arriving at the first tap, or twisted loop, the second

(*Continued on page* 107)

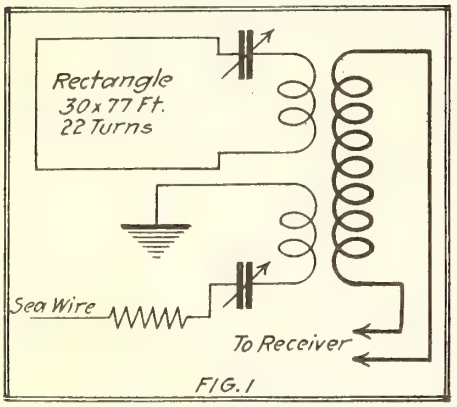


Simple Wireless Telephone Circuit Having Microphone in the Ground Circuit—a Standard Form of Connection.

Long Waves and "Strays" on Rogers Antennae

By LIEUT. COM. A. HOYT TAYLOR, U. S. N. R. F.

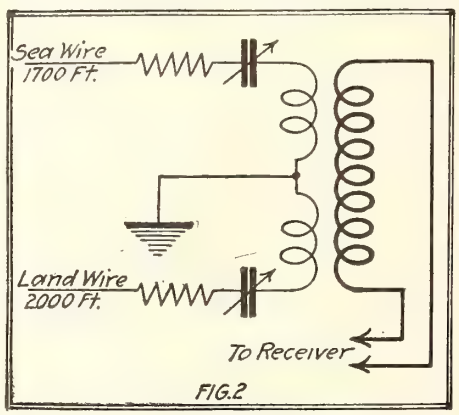
MANY of the properties of ground wires with respect to long wave reception have been touched upon in a previous paper which dealt mainly with short wave work (PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS, volume 7, number 4, 1919). "The purpose of this paper is to take up some of the special problems of long wave reception with ground wires, with special reference to the work done by the writer on the elimination of strays," Commander Taylor continues in the December, 1919 issue of the Institute of Radio Engineers' Proceedings.



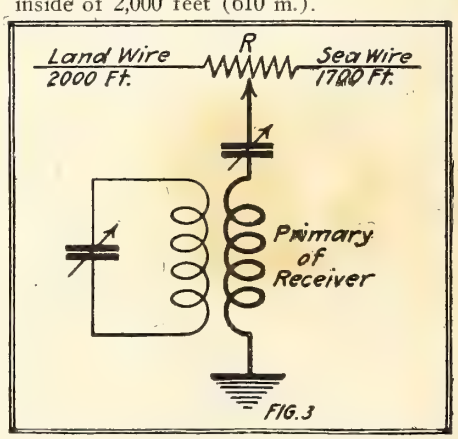
It Having Been Determined That the "Sea" Wires Had Twice as Good a Ratio for Signals and Strays as Rectangles. It Seemed Likely That One Ought to Be Able to Balance the Strays from a Rectangle, Those from the "Sea" Wires and Strays Having Some Signal Strength Left. The Differential Transformer Used in this Experiment Is Here Shown, There Being Two Primary Coils, One for the Loop and One for the "Sea" Wire Circuit.

OPTIMUM WIRE LENGTH FOR LONG WAVES.

Number 12 rubber covered wire was used for all of the earlier experiments on optimum wire length because it was found to hold its insulation for several weeks and was cheap and easy to handle. It is not recommended for permanent installations. It has already been shown that for 600 meters the optimum length for this wire was 125 feet (38.1 meters) each way, and that up to 1,125 meters this length seemed to be proportional to the wave length. It was therefore expected that a similar relation would hold for waves between 4,000 and 15,000 meters. For 12,000 meters the length was therefore expected to be 2,500 feet (763 meters). Since there was comparatively little arc work being done by stations south of Great Lakes, and since there were no arc stations north of Great Lakes, it was necessary in the work done there, to attempt optimum length experiments on stations either east or west of Great Lakes. At the laboratory on the bluff, it was not possible to lay wires in trenches for so great a distance, while at the station on the beach, it was only possible to lay a wire in one direction, using it against a ground. An attempt was made in two ways to determine whether or not optimum length existed for these long waves. First the signals from Lyons, France, on 15,000 meters were observed on a wire 3,000 feet (915 m.) long, running straight east into the lake, the outer end of the wire being sixty feet (18.3 m.) under water. This wire was gradually pulled in and observations taken. It was a laborious and difficult matter to obtain satisfactory observations in this way, but those that were taken indicated that 2,650 feet (808 m.) gave the best signal for Lyons. The signals were too weak to get, with the amplification at that time available, any adequate measure which would indicate whether the ratio of signal to stray was better at this length than at others. About this time Doctor L. W. Austin reported that, as far as he could determine from the experiments made in the slightly brackish water of the Potomac at Anacostia, District of Columbia, there was no optimum wire length for long waves and that no proportionate increase in signal was observed after 2,000 feet (610 m.). In the Great Lakes experiments, all signals were compared with those received on a standard wire, 2,000 feet (610 m.) in length. In order to avoid the laborious process of hauling in the long wire, which occupied considerable time, the problem was attacked at Great Lakes on a different basis. Two wires, separated 50 or 60 feet (15 or 18 m.), running in the same direction were compared. They were both fixt in length, one being 2,000 feet (610 m.) and the other 1,750 feet (534 m.) long. For various wave lengths between 5,000 and 14,000 meters, the ratio of signals on the 2,000 foot (610 m.) wire to signals on the 1,750 foot (534 m.) wire was determined. These observations were insufficient in number to be at all conclusive, but the best ratio was obtained at 12,600 meters, Nauen's wave, indicating that 2,000 feet (610 m.) was not far from the optimum length for this wave. It is, of course, possible that the relation between optimum wire length and wave length is not exactly linear, and it is deemed that the data herein reported is not entirely satisfactory. The experiments on optimum length were continued later at the U. S. Naval Radio Station, Belmar, New Jersey, which was then the principal station and control center of the trans-Atlantic system and where the writer was stationed as trans-Atlantic Communication Officer. The Belmar experiments on wires laid in the inlet (salt water) in front of the radio station, showed that up to the length of 1,500 feet (458 m.) signals from Nauen on 12,600 meters continued to increase. It was impossible to obtain a greater distance than 1,500 feet (458 m.) without deviating too far from the proper direction. During the month of January, ice formed on the inlet and a piece of "packard cable," number 14 high tension, was laid on the surface of the ice for the purpose of determining the optimum length of Nauen's short wave, 6,300 meters. The signal strength rose rather rapidly until a thousand feet (305 m.) were used, after which it rose very slowly so that it was difficult to determine exactly where the optimum length lay. It was estimated to be 1,600 feet (488 m.). Similar experiments with a wire on the ice, using Lyons' spark wave of 5,300 meters, indicated an optimum length of 1,200 feet (366 m.) and showed also that the rise of signal strength was very gradual and that there was no practical advantage in using over 800 feet (344 m.) of wire for 5,000 meters and not over 1,000 feet (305 m.) for 6,000 meters. About this same time, January, 1918, *lead-covered cable* on the surface of the ground was tested at Belmar. The sheath of the cable was grounded at a number of points, special care being taken to get a good ground at the receiving end. The core of the cable contained two number 18 copper wires, which were connected to the receiving set and used against a ground connection. The behavior of lead-covered cable showed at once that the most suitable length for long waves was decidedly different from that proper for ground wires or submerged wires. For instance, while 2,000 feet (610 m.) of underground wire was found very suitable for waves of 10,000 meters and upwards, it was found that a lead-covered cable 3,000 feet (915 m.) in length showed up best on wave lengths between 5,000 and 6,000 meters. A lead-covered cable 7,000 feet (2,135 m.) in length was then opened at a series of points 500 feet (153 m.) apart and observations were taken on Nauen's 6,300 meter wave, comparison being made in each case with the signals obtained on a fixt 2,000-foot (610 m.) ground wire. A curve was plotted from this data which showed a maximum at 3,000 feet (915 m.); the curve was, however, very flat. A little later experiments were undertaken with a ground wire buried seven feet (2.1 m.) deep, a number of pits having been dug for the installation of disconnecting switches. Observations were taken on signals on 9,500 meters from Stavanger, Norway, and on Nauen's 6,300 meter wave. The total length of ground wire available was 2,000 feet (610 m.). The observations were inconclusive, the Stavanger signals at 9,500 meters indicating a maximum when the full length of the wire was used, whereas measurements on Nauen indicated a linear rise proportionate to the length of the wire, that is to say, the Nauen observations indicated no optimum length inside of 2,000 feet (610 m.).



Another Attempt Made at Balancing Out the Signals and Strays Was Made, as Here Shown, by Placing a "Land" Wire Against a "Sea" Wire, but with Indifferent Results.



The Third Attempt Made in an Effort to Balance the Signals and Strays Is Here Shown. A Small Potentiometer, R, Permits the "Land" Wire To Be Balanced Against the "Sea" Wire. This Arrangement Did not Give the Results That Had Been Expected.

RATIO OF SIGNALS TO STRAYS.

In order for the ground wire system to be of practical value it must be able to show advantage in readability of signals not only over an ordinary aerial but over a properly designed receiving frame or closed loop, since the latter is more compact and easier of installation. The elimination of *actual static* is, of course, fairly complete on the ground wires, but the relative advantage of ground wires over rectangles, as far as the elimination of *all* strays was concerned, had to be made the subject of exhaustive tests. Early in January, 1918, the writer requested Lieut. A. Crossley at Great Lakes, to construct a rectangle 11 feet (3.36 m.) square, wound with 80 turns of number 13 double cotton-covered wire spaced 0.5 inch (1.27 cm.) apart. This rectangle was compared for a considerable period of time with the 1,200 foot (366 m.) "packard cable" at the Great Lakes laboratory station on the bluff, the cable being buried four feet (1.22 m.) under the surface of the earth. The ground wires gave signals averaging three times as strong as those on the rectangle. The ground at that time was partly frozen.

The average readability of signals at Great Lakes was 62.6 per cent better on the ground wire than on the rectangle. About the time the frost penetrated well into the ground at Great Lakes, it had been noted that the strays became distinctly worse. The same thing was noticed on the sea wires at Belmar when the shallow inlet froze up so that the wires were partly covered with a three-inch sheet of ice. In order to get further evidence, wires were laid at Belmar on top of the ice and directly over the sea wires and the ratios of signals to strays on many trans-Atlantic stations were obtained in comparison with the signals on the sea wires frozen in the ice. The readability of signals, defining readability as the ratio of signals to strays, was twice as good on the sea wires under the ice, altho not as good as on the same wires without any ice over them. In the meantime hundreds of observations had been accumulated at Belmar comparing the ratio of signals to strays received on rectangles 77 feet (23.5 m.) long by 30 feet (9.2 m.) high, with 12 turns of number 10 copper wire spaced 6 inches (15.2 cm.) apart, with those obtained on 1,200, 1,400, and 1,700-foot (366, 427, and 519 m.) sea wires and with those obtained on a 2,000-foot (610 m.) land wire buried 2 feet (61 cm.) deep. Many observations were also made on a 2,000-foot (610 m.) land wire buried 7 feet (2.14 m.) deep. This latter wire gave louder signals than the one buried 2 feet (61 cm.), but the same ratio of signals to strays. The general average showed that the signals obtained on rectagles and sea wires were of approximately the same intensity, but that the readability of the signals received on the sea wires was twice that received on the rectangles. On the other hand, the ground wires, altho giving signals four to five times as strong as the rectangle, showed no advantage whatever in readability.

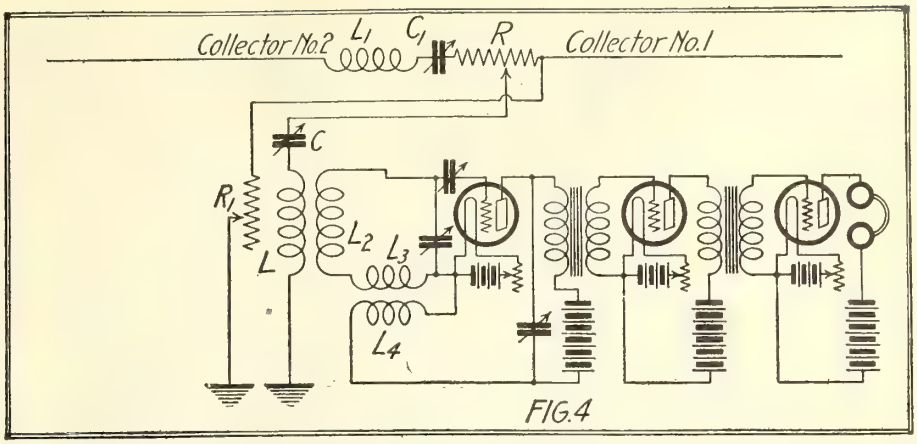


FIG.4

This Illustrates the Circuits Used in the Final Arrangement for the Balancing of the "Land" Wire Against the "Sea" Wire, Where a Phase-Adjusting Device, L_1C_1, Is Put in Series with Either "Land" or "Sea" Wire. The Signals Were Amplified by Several Audions in the Manner Indicated.

THE ELIMINATION OF STRAYS FROM LAND AND SEA WIRES.

It was finally decided that the only way to do anything towards the further suppression of strays over and above that already obtained by the use of a good sea wire, was to apply the method of elimination ahead of the primary of the receiver. Considerable improvement in the ratio of signal to stray was obtained by placing a low resistance of value between 1 and 25 ohms across the primary of the receiving set. It will be remembered that the receiving sets were standard Navy long wave tuners and, therefore, had a series condenser, and that in ground wire work the tuning of the primary is dependent only upon the constants of the primary and not upon the length of the ground wire, the only exception being when exceedingly short ground wires are used. There is also probably some slight deviation from the rule when working with short waves around the optimum wire length. The placing of the shunt around the primary therefore did not in any way affect the tuning of it. The improvement in signal-to-stray ratio obtained by the use of the shunt is at the cost of considerable diminution in signal strength and is not therefore of very great value in improvement in readability except in special cases. It having been determined that the sea wires had twice as good a ratio of signal to stray as the rectangles, it seemed likely that one ought to be able to balance the strays from a rectangle against those from a sea wire and still have some signal left over. This was first attempted by coupling magnetically the primary of the receiving set by means of a differential radio frequency transformer to both sea wire and rectangle. The differential transformer had one secondary coil which was in series with the primary of a receiving set and it had two primary coils, one of which by means of a series condenser was tuned to a rectangle and the other tuned by means of another series condenser and suitable loading coils to one of the sea wires. See Figure 1. As a balancing arrangement the device worked perfectly, but altho signals even of very great intensity could be accurately balanced out, it was not possible to balance out strays. It should be noted that the planes of the rectangle pointed in the same direction as the sea wire, that is towards the European stations. The failure of the experiment was, at the time, laid to a lack of exact similarity in directive properties of the two component parts of the balanced system, but it is the present opinion of the writer that the failure was due to the fact that the rectangle constitutes a relatively feebly dampt receiving system, while the sea wire is, especially for long waves, aperiodic. A similar attempt, shown in Figure 2, was made to balance a land wire against a sea wire and with the same results as far as this circuit is concerned. This is probably due to the fact that a land wire in dry soil is not so nearly aperiodic as a sea wire. If the land wire were laid in wet soil the experiment would also fail, because the ratio of signal to stray would be too nearly the same for both sides of the system. The next attempt, shown in Figure 3, was to balance by means of a small potentiometer arrangement, a land wire against a sea wire. The resistance R was a slide wire rheostat, various values being tried from 50 to 2,000 ohms. The idea in the arrangement of Figure 3 was that the current from sea wire to ground would be opposed in phase

(*Continued on page* 100)

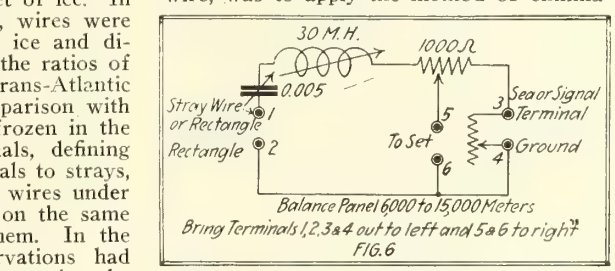


FIG.6

Design of Panel To Be Placed to the Left of a Standard Navy Long-Wave Radio Receiver; This Panel Provided the Necessary Terminals for "Sea" Wire and "Land" Wire, or Rectangles. It Also Contains the Phase-Adjusting Device in Series with the Rectangle or "Land" Wire, the Balance Resistance, and the Shunt-to-Earth on the "Sea" Wire Terminal.

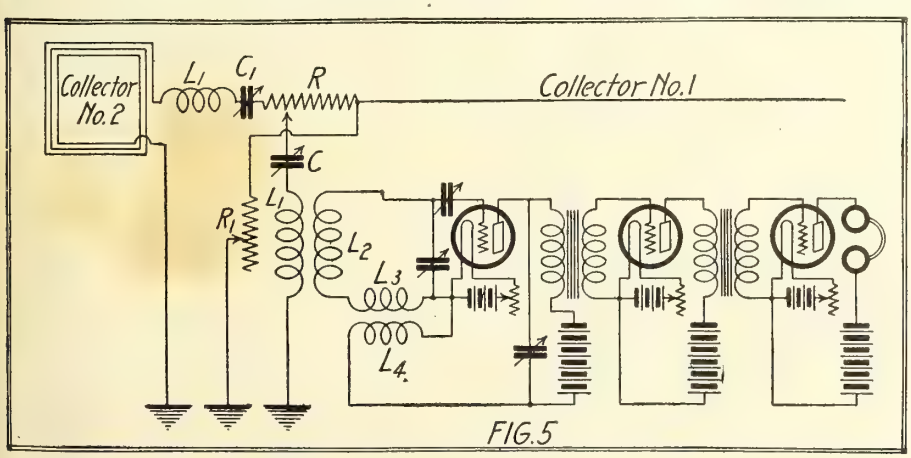


FIG.5

This Circuit Shows an Arrangement for Balancing the Loop, Collector No. 2, Which Serves as a Substitute for the "Land" Wire Balanced Against the "Sea" Wire, as Shown in the Previous Circuits. Notice That the "Sea" Wire Is Shunted Thru a Resistance R_1, Which Was Found Very Important. The Resistance R Is Sufficiently High to Give the Loop 2 a Very High Decrement.

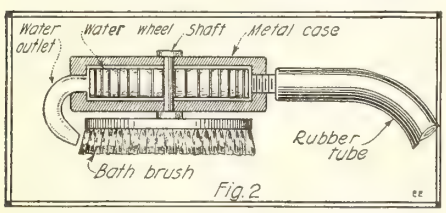
What To Invent

By JAY G. HOBSON

IN the tobacco-growing states many farms have two or more tobacco-curing barns, or sometimes called smoke-barns, that are used during the harvesting season for drying out the green leaves preparatory to selling the crop to the tobacco warehouse. The number of barns depends upon the acreage given to the valuable weed.

These hot houses are operated by the system of constructing a long flue-like fire-box similar to the common culvert of brick in use under country roads. The fore end is made open as the mouth of the furnace, while the aft end is formed into a chimney rising vertically above the roof of the barn. The heat and smoke from the fire-box are circulated thru pipes arranged around the inner wall of the barn, from where it passes into the chimney and out into the air. The green tobacco leaves are hung to long horizontal poles and placed in tiers, one above the other until the barn is filled. A thermometer is fastened inside the door to register the temperature. A fire is built in the fire-box to supply the heat required for proper treatment of the moist tobacco. Here is where the wearisome work begins that is very important. For two days and nights some member of the family must sit up and fire these barns in order to carefully guard the temperature therein, which cannot exceed 100 degrees Fahrenheit. The sap in the stems of the leaves has to dry out gradually.

The third day the temperature is raised slowly until 160 degrees Fahrenheit is reached, at which degree it is maintained until the charge of tobacco is thoroly cured.



What's the Matter With This Idea? Instead of Simply Pouring the Water Over You, Why Not Put the Water to Work—by Causing It to Drive a Small Water-Wheel, and Thus Rotate a Bath Brush. The Same Water Would Come Out and Flow Right Thru the Brush—a Sort of "Multum in Parvo."

The above work necessarily occurs in the hottest months of the year, and it is extremely tiresome keeping the fires going without sleep.

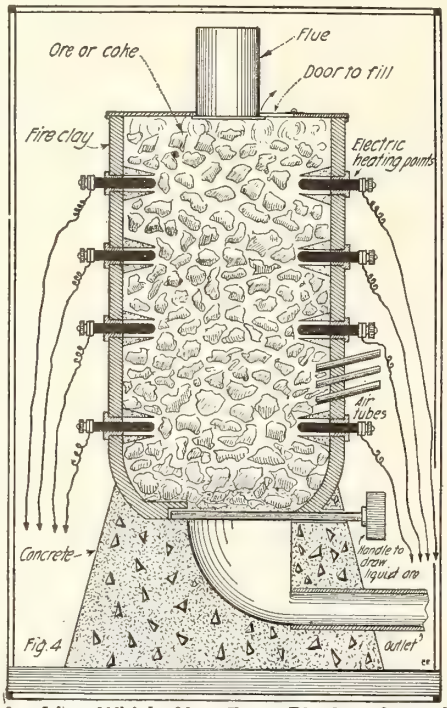
A needed improvement on this system could be introduced to tobacco growers with great success, making big money for the inventor. The accompanying illustration designates my suggestion for a practical improvement along this line. Fig. 1.

An attachment for the fire-box of the barn in the form of a coal-bin located outside, above the opening in the furnace, a chute leading from the coal-bin into the fire-box, a furnace door with a trap or draft door in the face of it for controlling the fire, an electric thermostat temperature regulator secured inside the barn and connected by a small wire to the draft gate on the furnace door.

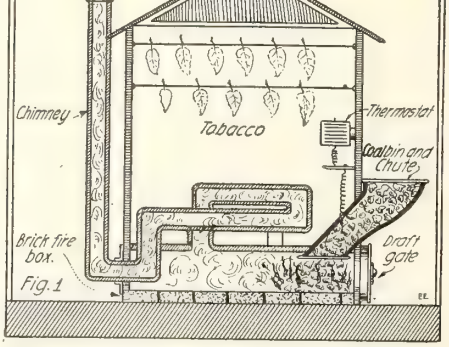
The owner sets the thermostat controller at the desired temperature, fills the coal-bin, builds a fire and leaves the night work to the mechanical fireman, resting assured his tobacco will not be spoiled; and probably obtaining better results because of the precision employed by the new improvement.

Did you ever dive into the bath and discover there was plenty of soap and water but no brush to massage the soap over the body? To be sure, but possibly the following idea has never appeared to you as being of large commercial value. An improvement in bath brushes is in order. One constructed of a small metal case, round in contour, embracing a handle connected to a rubber tube, a water drive wheel supported therein by a short shaft, and a small opening would be made for the outlet of the water upon the round brush secured to the drive shaft. See Fig. 2.

In operation the rubber tube is fastened to the water faucet, the water is turned on, the water wheel is rotated rapidly, causing the brush to revolve, thereby massaging the soap over the skin, giving a cleansing more satisfying than any device in use nowadays. An improvement of this kind would be a splendid agents' article, selling house to house in large quantities. Utilizing water power for operating the brush would eliminate the ever-present danger of fatality when electricity is employed around water.



An Idea Which Has Been Playing Around My Cranium for Some Time Is Here Illustrated in the Form of an Electric Concentrating Furnace for Ore. At the Present Time the Ore Is Past Thru Several Different Complicated Machines in Order to Separate the Various Minerals, Etc. But Why Not Put the Whole Mass of Ore Into a Large Electric Furnace, Melt It All Down, and Draw It Off at the Bottom?



While Travelling Thru the South, Where Have Seen a Large Number of Tobacco "Smoke Houses," It Has Often Occurred to Me That Much Labor Could Be Saved by Substituting an Automatic Thermostat Connected to the Coal-Bin and Chute, So as to Feed the Fire Automatically. At the Present Time, Some One Has to Watch It Continually.

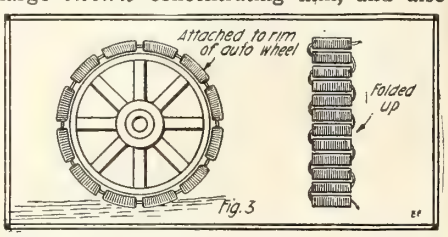
Copyright—1920—by the author

Many motorists experience the difficulty of repairing a puncture or changing a deflated tire when driving in the country thru mud, rain and snow. To continue driving on a flat tire not only ruins the casing and inner tube, but depreciates the stability of the car in withstanding the bumps over rough roads when running on the rim of the wheel.

This can easily be improved upon thru the instrumentality of a simple rim arrangement as illustrated in Fig. 3. This attachment is made of flat metal or wooden blocks surfaced with solid rubber and joined movably together to allow it to be folded into a compact size when not in use. When desired it can be quickly unfolded and placed around the wheel, providing caterpillar feet, somewhat like the traction arrangement on several well-known autotractors.

The merit of this improvement rests in the fact that it can be stored under the seat when not in use and applied promptly when needed. It would be of great assistance in giving trackage in soft ground, and eliminates the necessity of changing tires when driving under unfavorable conditions.

While spending a wonderfully pleasant vacation in the great mountains of the West I chanced to visit a producing copper mine using the very latest machinery for treating the copper, gold and silver ore which were the valuable minerals of this mine. The superintendent kindly showed me thru the large *electric* concentrating mill, and also thru the mine workings bulging with "pay ore."



Forty Miles from Home, With a Hopelessly Blown Tire, Spells Disaster, or Something Like It. You Motorists Know! What's the Matter With Having One of These Link Belts, Comprising a Series of Solid Rubber Feet, Carried Under the Rear Seat—and In Dire Emergency, Yank It Out and Strap It Around the Wheel. Home You Go, Smiling! Next!

In the course of our instructive conversation about the habits of the red metal he explained, in detail, the simple process employed in concentrating the ore. Concentration, he said, meant separating the values in the rock from the rock itself brought up, combined, in the act of mining it.

In the mill there were found a host of costly machinery for concentrating the ore. At the head of the mill, where the ore first enters, is a giant gyratory crusher that swallows big chunks of ore the size of a man's head. This powerful machine kept crunching, biting and breaking these big pieces of ore until they were broken into hundreds of smaller stones about two inches in size. These numerous particles of rock past thru the bottom of the crusher onto a conveyor belt that carried them to the mouth of a massive revolving ball mill, horizontal in position, and similar in looks and operation to the long tubular washing machine in the public laundry. Inside of this herculean machine were hundreds of steel balls about the size of the popular baseball. The total charge of balls weighed over seven thousand pounds. The reduced size ore, to-
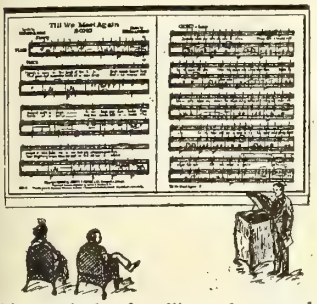
(*Continued on page 70*)

LATEST PATENTS

Music-Selling Device.

(No. 1,331,254, issued to J. M. Goudelock and R. E. Weinberg.)

The inventor of this device has certainly combined some logic with

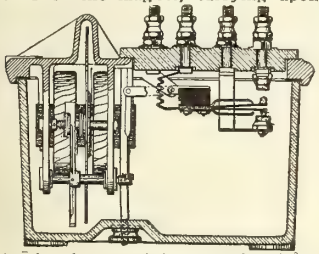


his method of selling phonograph records and sheet music, by allowing a person to see the sheet of music and hear it, but still not handle, stating, as he does, that the desire to own a piece of music is diminished in proportion to the length of period during which the buyer is handling and reading the music, as during that time the individual handling that music is practically the owner. Essentially, the device consists of a series of racks from which large music sheets are suspended. Other racks hold these sheets in a rolled-up position like curtains. The phonograph record and the display of the sheet of music are operated simultaneously.

Alternating Current Relay

(No. 1,333,070, issued to Oscar S. Field.)

In this A.C. relay a revolving non-magnetic disk rotates between the ends of the magnet, carrying upon

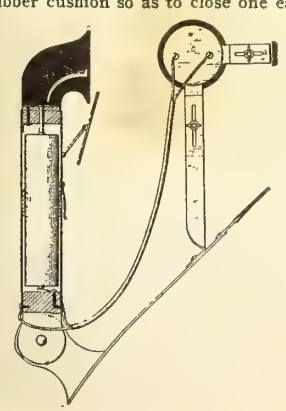


its bearing a pinion. This pinion engages a rack-like device, which allows for a lever-like movement. On conversion of this movement, thru grafite contact points, the circuit is closed or opened.

Instrument for Use of Music Teachers.

(No. 1,331,053, issued to Bertrand de Bernyz.)

This device is for instructing vocalists and elocutionists, and enables them to hear the effect of their own voices, the same as tho heard in an auditorium. A transmitter having a battery in its body is strapt on the chest. Cords lead to a telephonic head-band, one end of which has a rubber cushion so as to close one ear

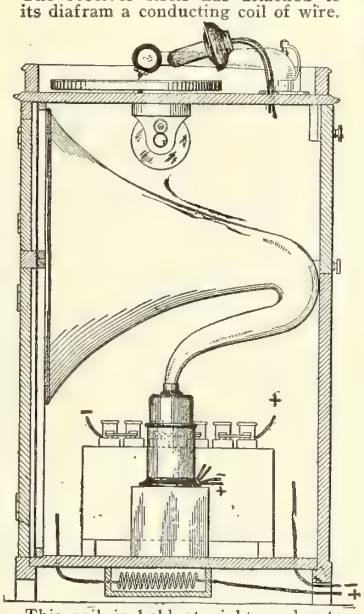


effectively cutting out all undesired sounds. In this way the student can, via the receiver, hear his own voice and correct any defects.

Sound-Magnifying Phonograph.

(No. 1,329,928, issued to E. S. Pridham and P. L. Jensen.)

In this invention a microphone is attached to the reproducing chamber of a phonograph and the microphone transmitter connecting to the amplifier, a means being embodied whereby the sound volume may or may not be amplified, as desired. The receiver itself has attached to its diafram a conducting coil of wire.

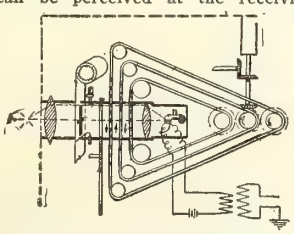


This coil is held at right angles to the lines of force of a magnetic field created by a horseshoe electro-magnet. Thus, a variation in current passing thru the said conducting coil (caused by different sound waves) will react against the lines of force of the magnetic field, resulting in a vibratory action upon the diafram.

Telephotographic Apparatus.

No. 1,329,688, issued to André D. J. A. Voulgre.)

This apparatus relates to television and telephotography. The invention is based on the principle that the division of an image into a plurality of parts and the successive transmission of luminous impressions emitted by each of those parts can be perceived at the receiving

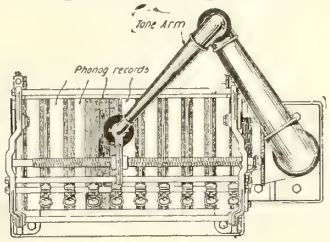


end, due to the rapidity of their reception allowing in that manner a retention of the entire picture by the eye. A light, such as emitted by a mercury vapor lamp, is used which is interrupted by a revolving shutter having longitudinal slits therein, and three other shutters having horizontal slits. These latter are belt-like; two of them revolve in one direction and the other in the opposite direction. The light emitted from these causes the object to be cut up into a series of transverse and vertical bands. At the receiving end an amalgam, made up of sodium and rubidium, is contained in a vacuum tube, which assists in reconstructing the image. Both apparata must, of course, be driven in synchronism.

Plural Record Phonograph.

(No. 1,326,473, issued to George W. Bowers.)

The record holder itself constitutes part of the amplifying horn, altho, rotating about its longitudinal axis

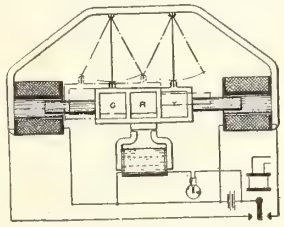


carrying the records at the same time. This will do away with a large portion of the amplifying horn in present use in phonographic machines. In operation the needle of the reproducer is lifted at the proper time and led to the desired position on the succeeding record, due to the action of cam protuberances which are separately and adjustably mounted. It is then released and the second record commences to play.

Light-Signal.

(No. 1,333,046, issued to Herbert B. Taylor.)

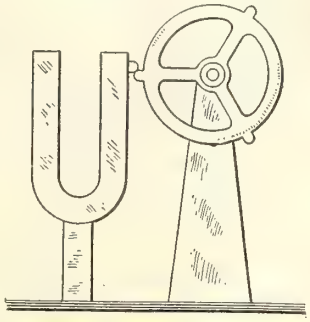
This inventor employs only one light and three screens. These screens are actuated by a two-way relay which energizes a solenoid at either end, causing the filters to swing over to a different position. A magnet at the bottom prevents oscillation of the swinging arm, carrying the filters and core of the solenoid. This magnet is just sufficiently energized to prevent oscillation and yet not interfere in any way with the regular operation.



Submarine Sound Signaling.

(No. 1,331,149, issued to Walter Hahnemann.)

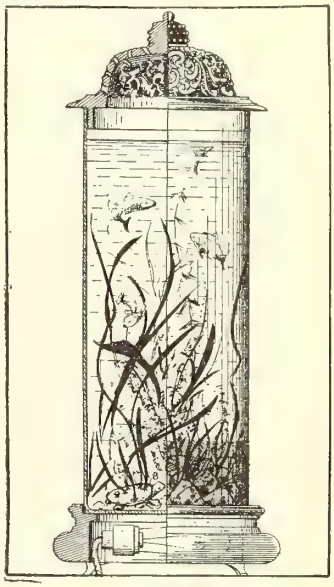
A special membranous transmitter constructed in such a manner as to transform the energy produced in the form of shocks into acoustic vibration, is the essential feature. This is very simply done by attaching a tuning fork transmitter to the membrane or diafram and then by means of a hammer, driven in any manner and regulated by a remote electric control, the prongs of the tuning fork are caused to vibrate. A body connected to the stem of said tuning fork and impinging on the water causes vibrations to be thus transmitted. Another form is to have a wheel with cam teeth strike upon the projecting lug on the prong of the fork.



Illuminated Aquarium.

No. 1,333,454, issued to Natsuo Sato.)

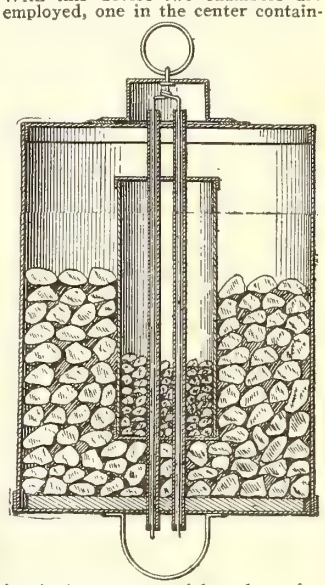
A very attractive aquarium is the result of this new invention. There is a glass container with a suitably mounted incandescent light in the bottom. No gravel is used and plants and vegetation are attached to miniature imitations of turtles, rocks or other weighted devices serving to anchor them. The light shining through the glass upon the fishes and vegetation causes a very pleasing effect.



Marine Torch.

(No. 1,333,313, issued to G. Holmes.)

Usually such torches have two chambers, one above the other, water being admitted to the chambers thru independent openings. Because of their peculiar position, water is prevented from entering at times interrupting regular operation. With this device two chambers are employed, one in the center containing igniter gas material, and another one surrounding this, containing illuminating gas material. Now, when the torch is thrown into the water, the top is automatically torn from it, giving the gas a chance to escape. The two rods extending downward and sealing the entrances to the two active containers are automatically pulled out, allowing for the action of water upon the materials, thus lighting the torch.



Scientific Humor

$3.00 FIRST PRIZE

START HER IN THE ILLUMINATING BUSINESS.

Little May—"Mother, what makes my hair crackle when you comb it?"

Mary's Mother—"It's because you have electricity in it, my dear."

Little Mary—"Oh! Isn't that funny? I have electricity in my hair and Grandma has gas in her stomach!"

—S. B. Seeley.

RATHER ARCHAIC!

"Who invented the electric light?"

"Edison."

"No. Noah, he made an ark (arc) light on Mt. Ararat."

—No Name.

WATT IS?

Teacher—"Jones, name me a unit of electricity."

Jones (just waking up)—"What?"

Teacher—"Right."

—No Name.

A TRAGEDY IN THREE ACTS.

Volt.
Jolt.
Cold.

—Carl Brown.

WIREMORE OR WIRELESS?

"I see you have a 'wireless' station."

"Yes, I ordered some aerial wire from a radio concern over two months ago and I haven't received it yet."

—Doro Kantro.

SURE! DRY CURRENTS GIVE YOU A "BUN."

A—"Why did you drop that bun?"

B—"It gave me a shock."

A—"Huh!"

B—"There was a currant in it."

—J. F. Gillis.

ALL CELLS DRY SINCE JAN. 16.

Judge—"Take the prisoner to his cell."

Prisoner—"It's too damp there, my rheumatism will kill me."

Judge—"Put him in a *dry cell.*"

—Anita H. de Hecht.

THE JOB "ATTRACTED" HIM.

A—"My brother just got a good job selling electro-magnets."

B—"He must have had some pull!"

—J. F. Gillis.

SCIENTIFIC JOKE CONTEST.

OUR scientific joke contest promises to be a huge success. We print here a few samples of the first crop, and hope that you will like our endeavor. These were selected carefully from about 2,000 contributions that poured in on us, and out of 2,000 some 1,990 were more or less duplications. Out of these 1,990 there were about 1,900 with "currants" hidden away somewhere in their anatomies. We got so sick of looking at these "currant" jokes that when we look at currant pie now we are "shocked" to death. So please don't send us any more jokes with currents in them, as they will not be considered. We print a few samples to show what has been done.

Another favorite is the "watt" joke. Hundreds of these came pouring in with various variations. Then there was the "shocking" joke, with its "currants" "shocking" one to death when stept upon. Most of the jokes printed below are not new by any means. They are all of considerable vintage.

So why not try and let us have some **original** *jokes; that is what we are after. At any rate, look over the present crop and see if they will "shock" you into a smile*—EDITOR.

All jokes publisht in this department are paid for at the rate of $1 *each besides a first prize of* $3.00.

RATHER VITRIOLIC.

"Here lies William Johnson,
Now he is no more;
What he thought was H_2O
Was H_2SO_4."

—Max Goldman.

GREAT DISCOVERY.

First Professor (in high-powered motor-car)—"We've got it at last."

Second Professor—"G-got w-what?"

First Professor—"Perpetual motion—I can't stop."—*The Queenslander (Brisbane).*

WHO PLANTED THIS ONE?

Smarty—"Say, pop, what do currants grow on?"

Pop—"They grow on plants, my boy."

Smarty—"But father, I mean electric currents."

Pop—"On power plants, most likely."

—S. B. Seeley.

UP TO THE MINUTE.

Jack—"My watch is the smartest around here."

Lou—"Perhaps—but it won't last long."

Jack—"How so?"

Lou—"Why, I can tell from the face of it that its hours are numbered!"

—Albert Monck.

AND TO TRANSFORMER.

Mutt—"Say, Nut, can you tell me why a woman is like a street car?"

Nut—"Give up."

Mutt—"Because it takes a man to controller."

—William Lilly.

PROBABLY BELONGS TO THE UNION—THEY ALL "NON."

Nervous Passenger (during a thunderstorm)—"Ain't it dangerous to be on a street car while it's lightning so?"

Calm Passenger—"Not at all. You see, the motorman is a non-conductor."

The nervous one felt easier.

—Paul Young.

CHEMICAL LOVE.

Said A. Tom to Molly Cule,
"Will you unite with me?"
Said Molly Cule to A. Tom,
"You're my affinity."
Under the arc light blaze,
He promised he would meet her;
BUT she eloped with A. Rascal Base
And her name is now Salt Peter.

—Lucien Tuckerman.

Trapping by Electric Shocks.

Wa-a-ll, wa-a-ll, we'll be horn-swoggled if one of our esteemed contemporaries hasn't unearthed a real, dyed-in-the-wool genius. His name is Palmer Stover—and . . . well . . . we won't say here how much we would pay this brilliant author for articles of this class. But, anyway, friends jest listen once to the tale of how Brother Stover catches foxes on an electrified wire!! Step right up, Ladies and Gents. It won't shock you—neither . . . well, read on:

"Last year I had a present made me of a small dynamo. At once I started to put into practise what I had long been contemplating.

"First I purchased a hundred feet of copper wire. Then I went to a good trapping place. At this place I dug a pit large enough to hold my dynamo and some batteries.

"I placed the dynamo, connected to the batteries and wire, in the pit. (*But, why the dynamo AND the batteries?*) Then, taking the roll of wire, I started to walk away, unrolling the wire as I went. When I reached the end of the wire I buried it in the ground. Having done this I took some staples and a hammer and fastened the wire to the ground. (*How do you get that way—Palmer.*)



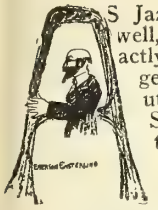
One morning I found a large red fox standing on the wire. The current was strong enough to hold him fast, but not to kill him! (*Look him over, Gents! Ain't it fine?*Q

He netted me fifteen dollars!!!

NOTE.—We declare Palmer Stover the foxiest ananias of the century.—Editor.

Science in Slang

By EMERSON EASTERLING



S Jazz Stokes is laid up with—well, the home brew didn't exactly agree with him—I'll try and get this month's—wait a minute until I answer the 'phone. Stokes says he'll be right up to see me. He is feeling better. I hope he didn't drink all—but that's neither here nor there.

Jazz just left—oh, you want to hear about the electrons. Well, after about an hour talking over such things as ——— ..... ——— and "?$%@, and "Sh-sh-sh, now listen to this one" we found ourselves drifting into the old rut of scientific palaver, and he opened fire by:

"The little old electron is *some* thing! The old Greeks tried to tell us that everything was composed of fire and water—some had one theory, another another, but it all went to show that the God-made-us stuff didn't satisfy their curiosity, and while they did not altogether disbelieve the propaganda as regards the source—except in the cases of individuals—they wanted to be wised up a little more as to the process; and moreso about the stuff that went to make up everything. The alchemists were sent seeking for an alkehest in which they could dissolve anything they could get their hands on. If they had found it we might be drinking extract of pig iron instead of taking nuxated steel for the all-ins.

"Anyway, when the old birds chanced upon the solution which had it that everything tangible, and some other things that we can't hardly conceive, is made up of many million funny little dufinheimers we find elucidated under the caption 'electron' in the nomenclatural dictionary, we find that the alkehest has been discovered in the sense that Sir Galahad found a certain dish; and from a field opened up by these gents of science we have in reality found material things as desirable as the all-solvent.

All About Electrons! Maybe.

"It all started when a certain guy by the name of Crookes, who carried around the title of Sir (that's nothing on us Americans, eh?) and experimented with exhausted tubes and bulbs until *he* was exhausted, found that there were an uncountable, vast, or countless number of minute particles of *something* leaves the cathode plate like a bunch of bums from a 'Men Wanted' sign. He started the big fourth dimension noise—and lifted the lid and also let a negative charged cat out of the bag—unmetaphorically, he started the searchers and researchers down the right trail toward the goal of the explanation of the wiles and ways of matter. It may not seem so, but the matter of matter, as a matter of fact, matters muchly with us.

(Second verse.)

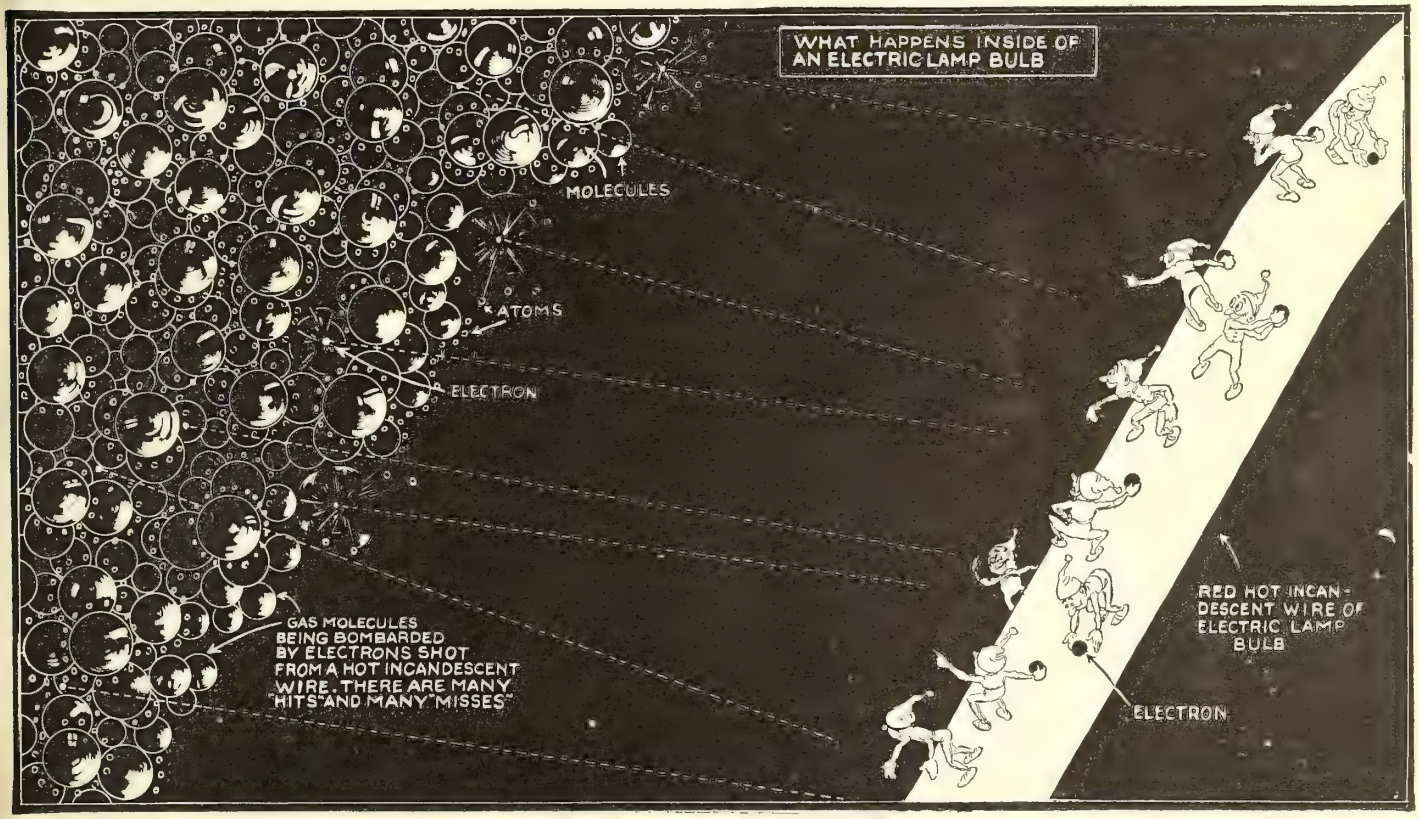
"Along about three years before the calendar manufacturers began marking 'twentieth century' on their products a gink, double J. Thomson, succeeded in making 'em believe that in spite of his implicating name, that Sir Billy Crookes was straight about the cathode rays and so forth, at least, mostly. With some sort of micrometers or diminutive yard stick he measured the electron and told 'em it was about one-thousandth the size of a normal full grown hydrogen atom, which, up to this time occupied the Tom Thumb chair in scientific circles. By capturing one of the elusive electrons and tying a speedometer to its tail and by also timing them with stop watches he found out that they generally galloped along about at the rate of anyway from twenty thousand up to fifty thousand miles per second; all of which was somewhat in excess of the speed limit at that time.

"The guys that tried to get acquainted with the little 'find,' found that there were lots of them emitted from arcs, from surface of glowing metals, from metals exposed to ultra-violet rays—and even from that light that you are in the act of applying at the end of that cabbage rope in your face." (I was lighting a cigar.)

"The electron," he continued, sniffing beggingly at my "smoke." I extended one. "The electron seems to be an indivisible unit of electricity. They have a charge of four hundred and fifty-five quadrillionths of a coulomb. Later scientists have remeasured the electron—by better methods or a finer yard stick—and find that it is one thousand, seven hundred times as minute as the hydrogen atom.

"Lord Bill Kelvin takes up the trail and sets down his deductions and discoveries and everything in a neat little volume with 'Aepinus Atomized' printed on the cover. Lorentz predicted, and Zeeman verified experimentally, that a magnetic field effected light; then Albert Einstein comes along

(*Continued on page* 87)



POPULAR INTERPRETATION OF THE ELECTRON FAMILY

To the Right We See a Red Hot Filament in an Incandescent Lamp. Each Second Millions of Electrons are Shot Off From This Filament at a Speed Approaching That of Light. These Electrons are Now Thought to Have Mass and are Shot Into the Rarefied Atmosphere of the Exhausted Bulb. Even in the Most Perfect Vacuum that Man Can Make, There Still Remain Thousands and Thousands of Gas Molecules Inside of the Bulb, and in Their Bombardment, the Electrons are Shot Right Thru Molecules or Atoms, but Sometimes There is a Miss, and the Electron Passes Between Them and Hurls Itself Against the Glass Wall of the Bulb.



THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

NEW DYNAMO DESIGN QUERY.

(1042) John Lunstra, Paterson, N. J., asws:

Q. 1. Why not design a dynamo without the large, expensive commutator on the armature, and use instead a simple small one for reversing the field coil polarities?

A. 1. It is hard to tell sometimes just what a certain proposed design of dynamo-electric machine will do when one cannot test it out under laboratory conditions, but from previous knowledge of the design of such machines, it would seem that no one has ever seriously proposed or applied a design of direct current motor or generator in which the armature is stationary and the field poles are rotary, the commutator being here utilized to control the direction of current past to the field coils. This is so for certain well-known technical reasons, among which are the following:

As you probably know, the "break" current induced when a field coil circuit is opened, has a very high E.M.F. or voltage which will establish a very considerable arc. The reason for this high induced E.M.F. and arcing when the field circuit is broken, is due to the great number of turns of wire in that they possess a very high self-induction. The second feature which influences this arcing, is dependent upon the rapidity with which the break takes place; the more rapid the break, the higher the induced E.M.F. and the shorter its duration. This high E.M.F. generated in the coil at the opening of the circuit, is very liable to puncture the insulation of the windings, or the insulation from winding to iron core. In all power stations or wherever dynamos are used of over 50 K.W. capacity, and even in smaller sizes, special precaution has to be taken in opening the field coil circuit, so that the high induced E.M.F. in the field at the break of the circuit may be absorbed by a high resistance. Special *field-break switches* are designed and used for this purpose with auxiliary contact blades on them. You can readily imagine what would happen if you were to hook up a commutator in the fashion you show thru a series of high inductance field coils. You would have a series of long arcs on the commutator segments, which would burn away the edge of the bars very rapidly, and in fact you would have a great deal of trouble in blowing them out at all unless you used compressed air as in the old Wood type arc lighting machines. In the second place the high induced E.M.F. in the coils as the circuits were rapidly broken in possibly 1/50 to 1/100 second would puncture the insulation of the coils between turns and the strain on the windings would be constant and persistent.

This philosophy is exemplified by a consideration of the electrical quantities predominant in the modern dynamo and motor. Here you will see on reflection that the armature coils have a very low self-inductance, and secondly the induced current at the break of the circuit as the commutator rotates is low also.

RELATIVE EXPANSION OF GASES.

(1043) L. Saunders, Tofield, Alberta, writes this department:

Q. 1. Do all gases expand equally on account of their units being constructed in the form of a spherical lattice work?

DOLLARS FOR JOKES

A SCIENTIFIC magazine is supposedly notorious for its dry reading. Still we flatter ourselves that the ELECTRICAL EXPERIMENTER can hold your attention without your yawning too frequently.

Of course you like to laugh—we all do. Sometimes we make you smile while you peruse the EXPERIMENTER. Perhaps sometimes you laugh out loud—at some of our "preposterous ideas" which we print here. And then of course the joke's on us, because we were real serious!

Now it occurred to us that we would like to print a column of real, original jokes every month, but here's the hook: The joke must be a SCIENTIFIC JOKE. No, this is no joke, we mean it!

Anyone can print or re-print jokes, but we want them with a dose of science. So, till further notice we will pay $3.00 as a monthly 1st prize for the best joke, and $1.00 for each other one we print.

So you will know what we mean with a "Scientific Joke," we print one here, which we purloined from the "Baltimore American":

LOGICAL.—"I want some good current literature."
"Here are some books on electric lighting."

Now of course, our readers can do much better than this. So let's wait and see. One reader can submit as many jokes as he pleases. Even if it is old the joke is not necessarily barred or condemned. There is one rule however: The joke must not be too technical; in other words, it must be readily understood by anyone. Not more than 100 words can be used. Use only one side of the paper.

Address
SCIENTIFIC JOKE EDITOR,
Care of this publication.

A. 1. As to whether all gases expand equally, particularly on account of the fact of their spherical lattice work structure, we are not in a position to say as to whether or not the gases expand equally when heated, because of this fact, as it is mostly a theory as yet; but, however, it is a well-known physical fact that all gases expand alike or very nearly so when heated.

As Sir Henry E. Roscoe says in his "Lessons in Elementary Chemistry": "Solid and liquid bodies expand much less over equal increments of heat and gases; they also expand differently, while all gases expand alike, or very nearly so. It has been found by exact laboratory experiments that all gases expand 1/273 part of their volume at 0° C. for every increase in temperature of 1° C., and this is known as the Law of Charles. 1/273 equals .003665; thus one volume of air at 0° C. becomes 1.003665 volumes when heated to 1° C."

SIZE AND WEIGHT OF THE EARTH.

(1044) A. D. Ward, Jr., New Bern, N. C., writes the *Oracle:*

Q. 1. Asking several questions about the earth's weight:

A. 1. The earth is about 7,920 miles in diameter, not exactly spherical, slightly flattened at the poles. The polar diameter being nearly twenty-seven miles less than the equatorial, its density is about 5.53 times that of water, according to the best data obtainable, and its mass is 6,000,000,000,000,000,000,000, six thousand millions of millions of millions of tons. The earth's surface in square miles is 197,000,000 square miles. The air pressure on the entire surface will be the area multiplied by 14.7

According to Flammarion, the weight of the earth is 6,833,000,000,000,000,000,000 tons. And the atmospheric pressure on the same is 6,151,000,000,000,000 tons. Even tho the earth appears to be very rough, nevertheless it is quite the other way; that is to say, it is smooth, a good deal more so in comparison than the skin of an orange.

The ether of infinite space is not supposed to have any weight. This has been demonstrated by obtaining as nearly perfect a vacuum as is possible. If all the air could be exhausted, there would still be ether left, which we presume corresponds to the ether of infinite space.

As a demonstration that there is some substance which we call ether present we would advise that a ray of light be shot toward the container, from which all the air has been exhausted. It will be found that this ray of light will actually pass thru and be seen on the other side, much the same as the rays of light come thru an exhausted tube such as an electric light bulb, and as no light ray can be propagated thru space without the agency of some medium, there must be some medium in the bulb which we call *ether.*

SELENIUM CELLS.

(1045) W. S. A., Schenectady, N. Y., asks:

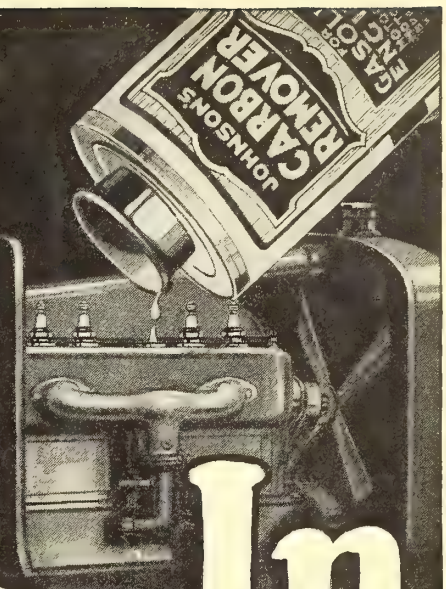
Q. 1. Some questions on selenium cells.

A. 1. It is a known fact that selenium cells vary considerably as regards their quality as well as their electrical resistance, it being possible to obtain cells of the same size for any resistance between ten and one million ohms, and also the cell may remain in good working condition for several months while another will become useless in as many weeks.

The ability of a cell to respond to very rapid changes in illumination, to which it is exposed, is due largely to its *inertia,* it being a known fact and verified by experimentation that the higher the resistance of a cell the less the inertia, also the greater its sensitiveness. The effect of

(*Continued on page* 66)

JOHNSON'S CARBON REMOVER



In

YOU can keep your motor snappy and full of "pep" by ***preventing*** the accumulation of carbon.
Don't wait until your engine is choked and caked with it.
Use Johnson's Carbon Remover every 500 miles, then the carbon is removed while it is soft and powdery, eliminating the frequent grinding of valves and ***keeping*** the motor ***always*** clean. No experience or labor required—you can easily do it yourself in ten minutes—and the cost is trifling.

Easy — Clean — Safe — Quick

Johnson's Carbon Remover is the easiest, cleanest, safest and most satisfactory remedy for carbon. It will save you from $3.00 to $5.00 over any other method without laying up the car. A dose of Johnson's Carbon Remover, the engine laxative, will stop that knock—quiet your motor—save your batteries and reduce your gasoline consumption 12% to 25%.

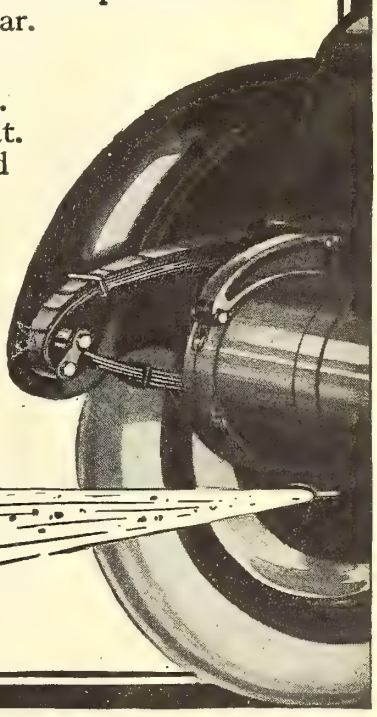
Keep Your Car Young with Johnson's Car Savers

Start today to reduce the depreciation of your automobile. An hour or two every month and JOHNSON'S CAR SAVERS will prove their value in dollars and cents when you come to sell or turn in your car.

Johnson's Radiator Cement—liquid.
Johnson's Stop-Squeak Oil—a wonderful spring lubricant.
Johnson's Valve Grinding Compound—gives a velvet seat.
Johnson's Cleaner and Prepared Wax—make body, hood and fenders look like new.
Johnson's Black-Lac—the perfect top dressing.
Johnson's Auto-Lak—a splendid one coat body varnish.
Johnson's Hastee Patch—can be applied in two minutes.

Write for our folder on "Keeping Cars Young"—it's free.

S. C. JOHNSON & SON **Dept. EE-5** **Racine, Wis., U. S. A.**



Out



Learn How to

Know Men!

—to sell them
—to employ them
—to direct them

HAVE you ever lost an order in selling? Picked the wrong man for a position? Found it a problem to direct some men successfully? Of course you have! Why? Because **"you did not know your man."**

Mistakes in judging human nature are vital and seriously affect one's success in the business and social world.

No one has given an equally direct, simple method of judging men as has Mr. Wilson M. Taylor, Sales Efficiency and Employment Expert in his new book,

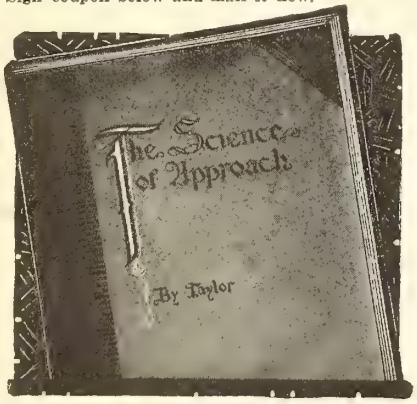
"The Science of Approach"

The Key to Men's Minds

Mr. Taylor classifies the various types of men and shows you the best way to quickly appraise the minds of men of various types, to determine their inclinations, their process of thinking, their basis of judgment and decision.

He tells you why people like you or do not, how to handle the procrastinator, to know the type of man who thinks and acts slowly, the type of man who thinks and acts quickly, the type of man who is emotional or non-emotional. To know these facts is to know in advance the proper way to approach men of all types so as to sell them, or to judge them so as to employ or direct them successfully.

You and a million other men should send for Mr. Taylor's wonderful book and read it. He has agreed to send it on 5 days' approval. Sign coupon below and mail it now.



WILSON M. TAYLOR, Inc.,
35 West 39th Street, New York City

Please send me copy of your book, "The Science of Approach," on 5 days' approval—enclosed find $2.00. If I decide not to keep the book, I will return same to you within 5 days and you are to return the $2.00, without question.

Name .....

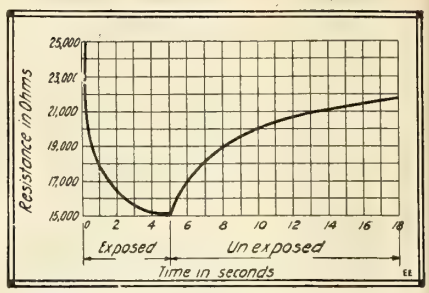
Address .....

E.E. 5-20

The Oracle

(*Continued from page* 64)

inertia can be readily seen by attempting to make a graph of the time it takes the cell to respond to light and the time of recovery. This is known as a *lag*. This can be greatly reduced by enclosing the cells in an exhausted glass tube. Not only will this decrease the *lag* in the cell, but also prolong the life of the cell considerably. Continued illumination projected on a cell causes a permanent defect which is generally known as fatigue, the cells then becoming very sluggish in their action and their sensitiveness gradually becoming less. The maximum sensitiveness of a selenium cell is toward the yellow-orange portion of the spectrum and hence light of that color will have a direct effect upon a cell. Likewise heat has been found to vary the electrical resistance of selenium in a very remarkable manner. At 80° C. selenium is a non-conductor, but up to 210° C. the conductivity increases, after which it again diminishes.



Graphic Curve Showing "Lag" of Selenium Cell or Time for Recovery.

All we could advise in this matter is that you either build your own selenium cells or enclose them in an exhausted glass tube and attempt to keep the cells covered when not experimenting with them. Perhaps a *photo-electric* cell would meet your need more exactly than selenium.

A Bullet-proof Searchlight Reflector

By EDWIN F. LINDER, M.E.

(*Continued from page* 19)

It was of vital importance that something be done to safeguard the searchlight equipments from the ever increasing wave of destruction to which they had ben subjected.

An American engineer, who had specialized for many years in the use of searchlights under very novel circumstances, gave this difficult problem very serious thought and toward the close of the war conducted a series of tests that resulted in the production of a device which he named the "Bullet-Proof Mirror." This device was experimented with in model form under similar conditions to those which might be expected on the battlefields; smaller apparatus was employed, of course, than would be operated under actual military engagements, nevertheless this new departure in searchlight methods gave very satisfactory results.

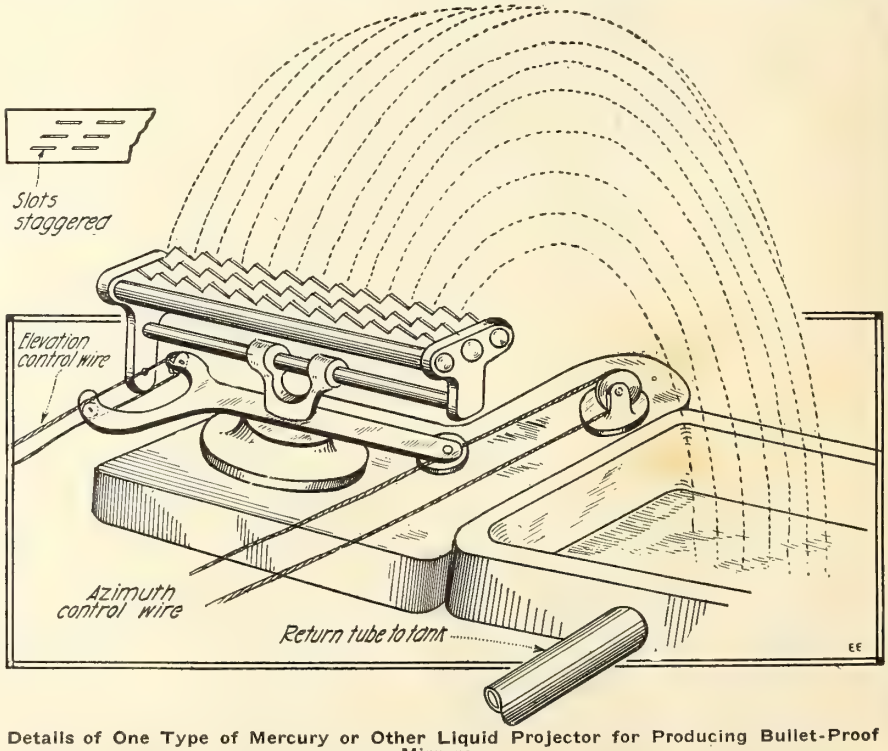
To insure absolute protection against destruction by shell fire an underground chamber, the roof of which is approximately thirty feet below the surface, is excavated at the end of an inclined tunnel. This chamber contains the major part of the projector and generator units and many of the auxiliary mechanisms used in conjunction with the new liquid reflector apparatus, which is set up at the upper end of the inclined tunnel, referred to above. A second dugout, somewhat similar to the larger chamber, is provided for the men controlling the operations of parts of the outfit at the new mirror.

The apparatus creating the flat *fluid reflector* is possibly of more interest than the others and is of very simple construction.

DETAILS OF THE "BULLET-PROOF" MIRROR.

Three tubes, closely fitted together, have attached to the upper surfaces a series of

(*Continued on page* 68)



Details of One Type of Mercury or Other Liquid Projector for Producing Bullet-Proof Mirrors.



Be a Draftsman
Raise Your Income

Get into this paying profession and have positions opened to you by manufacturers, architects, railroads, contractors—by every kind of a corporation where mechanical design and construction are carried out. Draftsmanship puts you in the class of specialists, raises you above the crowd of job hunters, makes you a man whose services are needed.

You have the same opportunity to get the training that other men had who took the Chicago "Tech" Course in Draftsmanship and are now drawing large salaries and holding important, responsible positions. You also can learn how to earn

$25 to $100 a Week

Not enough really skilled draftsmen are available to fill the places open now. All you need is training to be prepared to answer the call that will mean more money for you Begin your training without delay. Don't waste time waiting. The Chicago "Tech" experts are ready today to give you the thorough, practical instruction which will enable you to step into the drafting room of some big organization prepared to do the kind of work that earns high salaries and leads to advancement. At least write. Mail the coupon below or a letter stating which branch specially interests you.

Drawing Outfit
(No Extra Charge)

Every student of the Chicago "Tech" Home Study Course in Draftsmanship receives this drawing outfit—set of instruments in case, drawing board, T square, triangles, scale, curve, drawing paper, pencils, etc. or a cash credit in case he already has an outfit. These instruments are of the same make and sizes as used by high salaried experts in drafting rooms of factories, shops, railroads, etc. You use them while learning — then take them right into your practical work.



Come to Chicago "Tech" OR TRAIN AT HOME

Chicago "Tech" has its students everywhere. If you can't come to Chicago, take the Home Study course. The same professors who direct the resident courses will teach you by mail. You will have their personal direction, you will learn the most modern methods—all this while holding your present job. We train hundreds of ambitious men—and see them quickly rise to success. You therefore need not be denied this technical education. Sign and mail the coupon.

Get Practical Training from Practical Men
NO TIME PUT IN ON NEEDLESS STUDIES

Enrollment with Chicago "Tech" means getting direct personal instruction from men who for years have planned and directed big architectural and engineering work in leading cities. They have weeded out useless theories and needless studies and will give you the kind of instruction which will enable you to work beside the most experienced men.

That is one reason why you can get a complete, thorough technical training here in such a short time. Also the reason why Chicago "Tech" men are in such great demand. They go into work prepared to give the kind of service wanted.

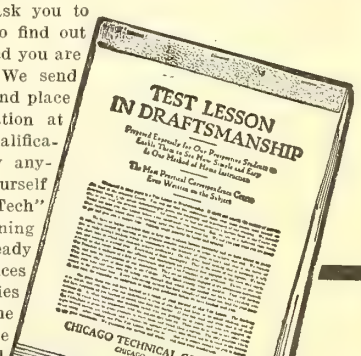
This is the training you are offered either at the college or by mail. And this is the time to enroll when there is such a pressing need for highly trained draftsmen. Use your spare hours to fit yourself for a bigger salary—a more important position. Chicago "Tech" offers you the opportunity. **WRITE.**

EASY PAYMENTS

Low tuition fees and easy terms of payment. Pay as you go along. Get training which will soon repay in extra earnings all the cost of the course. You know the salaries received by skilled technical men today. Get information on the opportunities which are opened wide to you by Chicago "Tech". We will give you all this information about fees, terms, etc., and send testimonials from Chicago "Tech" graduates on how they have profited from our instruction, if you will send the coupon.

FREE TEST LESSON

Other institutions ask you to pay first—and then to find out later how well qualified you are for this profession. We send the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything. And see for yourself just what Chicago "Tech" offers you in training which will bring a ready market for your services and open opportunities which are closed to the untrained man. The coupon will bring all the facts about the course, the small fee, and the easy terms.



Auto and Gas Engine Course

All about automobile mechanism—its construction, operation and REPAIR—taught by mail. You train directly under the Chicago "Tech" automobile experts. Learn all about Principles of the Automobile, all about Gas Engines, Power Plants, Transmissions, Lubrication, Cooling, Batteries, Starting and Lighting Systems, etc.

KNOW HOW TO FIX TROUBLES

Most complete instruction in auto repair work. Equips you for high pay or to start a business. Big demand for trained repair men.

Aeronautics

Complete, practical instruction in Aeronautic Engineering. Every principle made clear. Construction of every type of machine fully explained. This course equips you for expert work. Get the catalog and information. Send coupon.

WRITE

Below we list our principal courses in Drafting and several others. Just mark X in the [ ] to show which course interests you and we will send catalog and information about that particular subject. If in doubt about yourself, tell us your ambitions and we will advise you. Sending this coupon may mark a turning point in your career. May lead to a larger measure of success than you have expected. We can train you as we have trained others. Send the coupon today.

CHICAGO TECHNICAL COLLEGE
545 Chicago "Tech" Building, Chicago

CHICAGO TECHNICAL COLLEGE
545 Chicago "Tech" Building, Chicago

Without obligation upon me, send your Catalog on subject indicated below. Also FREE Lesson **if inquiry is on Drafting or Plan Reading.**

Mark X opposite work in which you are especially interested.

[ ] Architectural Drafting
[ ] Machine Drafting
[ ] Electrical Drafting
[ ] Structural Drafting
[ ] Sheet Metal Drafting
[ ] Builders' Course
[ ] Plan-Reading—Buildings
[ ] Plan-Reading—Shop Men
[ ] Estimating
[ ] Surveying
[ ] **Autos and Gas Engines**
[ ] **Aeronautics**

Name.....

Address.....

City.....State.....

College or Home Study? State which.....

BEATS GASOLINE AT 15 CENTS A GALLON

New Invention Makes Fords Run 34 Miles on Gallon of Gasoline. Other Cars Show Proportionate Savings.

A new carburetor which cuts down the gasoline consumption of any motor, including the Ford, and reduces gasoline bills from one-third to one-half is the proud achievement of the Air Friction Carburetor Co., 382 Madison St., Dayton, Ohio. This remarkable invention not only increases the power of all motors from 30 to 50 percent, but enables everyone to run slow on high gear. With it you can use the very cheapest grade of gasoline or half gasoline and half kerosene and still get more power and more mileage than you now get from the highest test gasoline. Many Ford owners say they now get as high as 45 or 50 miles to a gallon of gasoline. So sure are the manufacturers of the immense saving their new carburetor will make that they offer to send it on 30 days' trial to every car owner. As it can be put on or taken off in a few minutes by anyone all readers who want to try it should send their name, address and make of car to the manufacturers at once. They also want local agents to whom they offer exceptionally large profits. Write them today.—Adv.

BE AN EXPERT



Auto and Tractor Mechanic Earn $100 to $400 a Month

Young man, are you mechanically inclined? Come to the Sweeney School. Learn to be an expert. I teach with tools not books. Do the work yourself, that's the secret of the

SWEENEY SYSTEM

of practical training by which 5,000 soldiers were trained for U. S. Government and over 20,000 expert mechanics. Learn in a few weeks; no previous experience necessary.

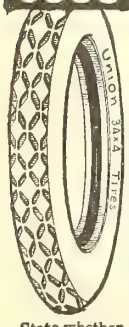
FREE Write today for illustrated free catalog showing hundreds of pictures men working in new Million Dollar Trade School.

LEARN A TRADE

Sweeney

SCHOOL OF AUTO-TRACTOR-AVIATION
66 SWEENEY BLDG. KANSAS CITY, MO.

FREE Puncture Proof **TUBE**
6000 Mile Guarantee



UNION TIRES represent the highest standard in reconstructed tires. Their reinforcement of 4 extra layers of fabric reduces greatly blowout and puncture possibilities. Over 200,000 in use. To further increase mileage, we include with every tire ordered **A PUNCTURE PROOF TUBE FREE** that under ordinary conditions will last ten to 20,000 miles. Our 5,000-mile tire guarantee certificate with every tire.

Prices Include Tire and Tube

30x3	$7.40	32x4½	$12.00
30x3½	8.60	33x4½	12.50
32x3½ S.S. only	9.10	34x4½	13.15
31x4	10.35	35x4½	13.40
32x4	10.70	36x4½	13.85
33x4	11.15	36x5	14.85
34x4	11.50	37x5	14.95

Reliner Free With Every Tire

State whether you want straight side or clincher, plain or non-skid. Send $2 deposit for each tire ordered, balance C.O.D., subject to examination, or 5 percent discount if full amount is sent with order.

UNION RUBBER COMPANY
Dept. 88 Racine Ave. & 15th St., Chicago

PERSONAL MAGNETISM WINS!
No difference what you want, use it. Worth more to you than all else besides. "How to Win" 362 pp. $2. "How to Hypnotize," Complete Manual of Instruction, 126 pp., illustrated, $1. "Health Culture" Insures Vital Strength 25c. Address, Science Inst., D.E. 6435 N. Clark, Chicago.

Bullet-proof Searchlight Reflector

(*Continued from page 66*)

narrow slotted nozzles, which are so arranged that the ends overlap one another. It is thru these nozzles that thin flat ribbons of fluid are sent upward, producing the *Bullet-Proof Reflector,* discharging finally into a collector at the end of the tubes. From here the liquid is returned to the storage tank to replenish the supply and make it possible to maintain a constant spray screen at the nozzle tubes.

The mechanical features permit the changing of the angle of the nozzle tubes, thereby giving considerable scope to the elevation and lowering of the projected beam. It is also so constructed that the device may be rotated in azimuth; this allows the operator to direct the sweeping light beam over considerable territory on either side of it.

During the early stages of experiment, mercury was adopted as the substance for creating the reflector, but this was found to be impractical for many reasons. Finally a substitute was employed which was better suited for the purpose. This was *a strong solution of silver nitrate,* to which were added a tartrate, ammonia water and ground glass. The chemical process of obtaining the desired quality of reflective strength which this solution contains cannot at this time be disclosed.

The many advantages of this device are easy to comprehend; however, it might be stated that as the projector and reflector stations are quite remote from one another, it is exceedingly difficult to locate the initial source of the ray. This being nearly a hopeless task, it gives almost perfect protection for the major portion of the plant and its attendants. Only by chance would it ever occur that the reflector unit could be damaged and as this can be readily replaced, not much loss would be suffered in time or cost.

The most important benefit gained is the continuous operation of the outfit, the beam being in constant play, defying the hail and storm of the foe's bullets throughout the dark of night.

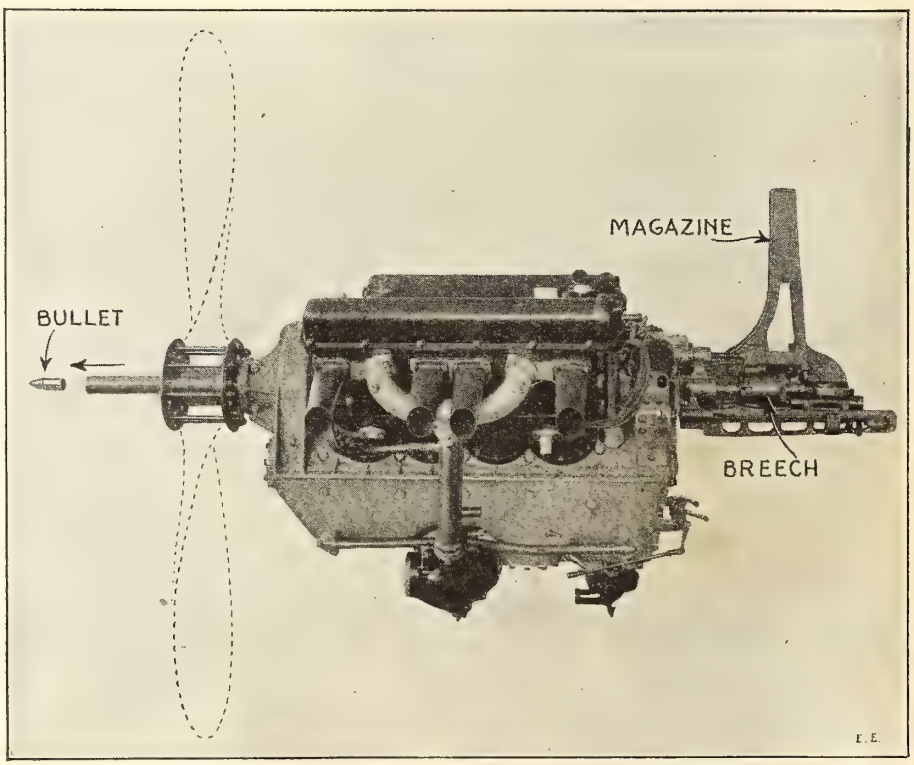
Such an apparatus would indeed have baffled the coolest heads, who after having destroyed thousands of the other types would be at a loss to understand why this mysterious target did not give way under concentrated range firing by their foremost marksmen.

Not being able to destroy this new type of equipment as quickly as the old, the time thus gained to replace the latter would have finally brought about a complete lapse in night attacks; in other words, it would have placed the Bullet-Proof Mirror corps in a position to flood the enemy lines constantly with light sufficient to make it impossible to make any surprise attacks that would be successful. Thus making perpetual daylight of the night would certainly have been an obstacle that no foe, however brilliant in the art of military strategy, could surmount without long previous preparation.

New York Aero Show

(*Continued from page 32*)

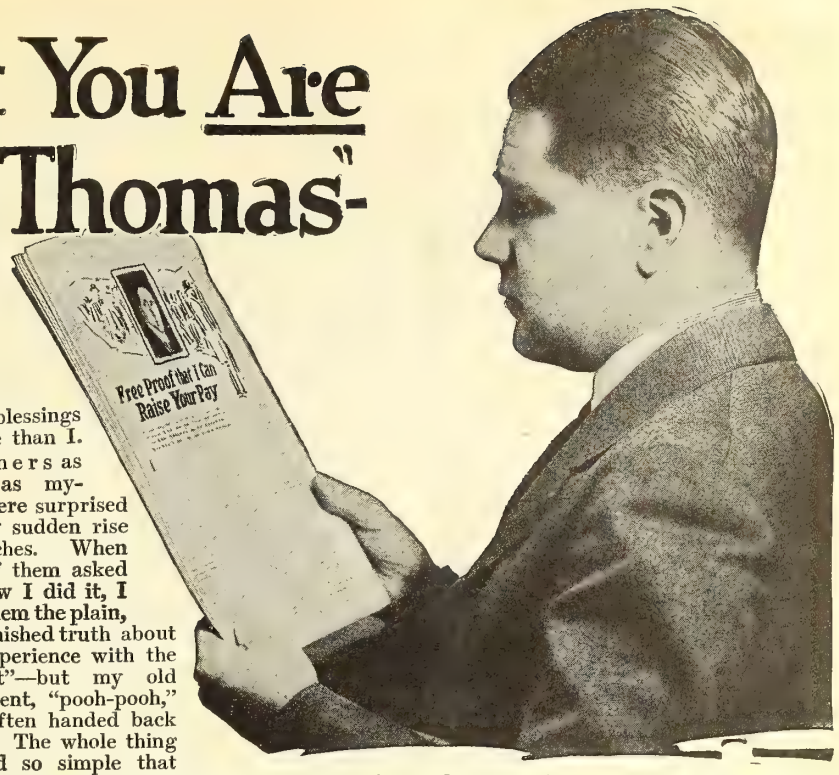
This giant flier attains a maximum speed of 110 miles on hour and can climb 6,000 feet in nine minutes. It can carry 3,000 pounds of mail on long flights, or 6,000 pounds on short ones. It carries a crew of two pilots, one radio operator and one mechanic, besides the large weight of mail above mentioned. It has a cruising radius at low speed of 16 hours, and at high speed, 10 hours.



This New Wright-Hispano "Cannon Motor" for Airplanes Has a Thirty-Seven Millimeter Automatic Cannon, Which Was Developed by the U. S. Ordnance Department, Shooting Thru the Propeller Shaft. The Engine Is Also Equipt With Two Synchronizer Attachments for the Operation of Additional Quick-Firing Guns.

I Hope That You Are a "Doubting Thomas"

--because that gives me my chance to prove that I can raise your pay.



NO matter how much money you are making now, I can show you how to earn more—much more.

That's a strong statement, isn't it? Perhaps you doubt it? I hope so, for I *know* what it means. And it will give me just as much pleasure to prove it to *you* as I experienced when I proved it to myself.

Make me prove that I *can* raise your pay. Here I am in Meriden, Connecticut—Albert L. Pelton—ready and willing, yes, and happy to do it—but it's to be *entirely at my risk and expense.*

That's fair, isn't it? It's as fair as if I offered you a horse, and refused to accept a cent until you had driven him a month—and found him sound in wind and limb.

If you *are* a "Doubting Thomas"—one of the people who keep on reading, and disbelieving, my advertisements—here is your chance to make me make good in your case.

I'll tell you why I'm so positive about this. There are two reasons: First, I was convinced after being a doubter myself—and second, because 400,000 other people have been. Thousands of them were literally lifted from poverty to riches by the surprising power of the "secret" they learned from me. One of them gave me the title, "The man who makes men rich." It has stuck to me because it's true. That's why it's not handing myself a bouquet to admit its truth.

As I said, I was a "Doubting Thomas" about this "secret" myself. I was a plain, unassuming, *poor* man when I heard of it. I was deply in debt. I was "eye to eye" with black despair. I had had failure after failure; it seemed as if everything I touched became "hoodooed."

One day I met a man who told me the "secret." But at that time I didn't recognize its amazing power. In answer I advanced an argument which seemed unanswerable to me—I said "pooh-pooh." Afterward I did some hard thinking and made up my mind that if the "secret" was a humbug I would investigate it and expose it.

The more I thought about the secret, the more I realized that here was the truth I had always lacked. I began to use the secret. It was a good time to test its power, for I was flat broke.

From the first I was thrilled with a new sense of power, but I was afraid to believe that my tide of misfortune had turned, until opportunities, and money, actually flowed in on me. Things I never believed I could do became easy as turning over my hand. My business tangles straightened themselves out, and I began making money at a rate that made me gasp! "Doubting Thomas" Pelton was convinced at last.

Now I have money, a beautiful home for which I paid $50,000 cash, I go traveling when I want to, and I have besides a wealth of friends. Few people have more of the real blessings of life than I.

Others as well as myself were surprised by my sudden rise to riches. When any of them asked me how I did it, I told them the plain, unvarnished truth about my experience with the "secret"—but my old argument, "pooh-pooh," was often handed back to me. The whole thing seemed so simple that some of these inquirers never investigated farther. I am sorry for them, for those who did, gained results from the secret that were simply astounding!

One of the men who overcame his doubts, and put the book I furnished him to work in his life, rapidly rose from a rank failure to a position that paid him $600 a week. He visited me in my summer home on the coast of Maine last season and told me that he had just been made president of a 16-million-dollar corporation.



Mr. Pelton's Residence in Meriden, Conn.

And listen to this:

In a little town in New York lives a man who two years ago was pitied by all who knew him. From the time he was 14 he had worked and slaved—and at sixty he was looked upon as a failure. Without work—in debt to his charitable friends, with an invalid son to support, the outlook was pitchy black.

Then he learned the "secret." In two weeks he was in business for himself. In three months his plant was working night and day to fill orders. During 1917 the profits were $20,000. During 1918 the profits ran close to $40,000. And this genial 64-year young man is enjoying the pleasures and comforts he little dreamed would ever be his.

I could tell you thousands of similar instances. But there's no need to do this, as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for *you.*

I don't claim I can make you rich overnight. Maybe I can't do it at all. Sometimes I have failures—everyone has. But I do claim that I can help 90 out of every 100 people if they will let me.

The point of it all, my friend, is that you are using only about one-tenth of that wonderful brain of yours. That's why you haven't won greater success. Throw the unused nine-tenths of your brain into action and you'll be amazed at the almost instantaneous results.

Develop your will-power and money will flow in on you. Rich opportunities will open up for you. Driving energy you never dreamed you had will manifest itself. You will thrill with a new power—a power that nothing can resist. You'll have an influence over people that you never thought possible. Success—in whatever form you want it—will come as easy as failure came before. And those are only a few of the things the "secret" will do for you. The "secret" is fully explained in the wonderful book, "Power of Will."

How You Can Prove This At My Expense

Send no money—no, not a cent. Merely clip the coupon and mail it to me. By return mail you'll receive, not a pamphlet, but the whole "secret" told in this wonderful book, "Power of Will."

Keep it five days. Look it over in your home. Apply some of its simple teachings. If it doesn't show you how you can increase your income many times over—just as it has for thousands of others—mail the book back. You will be out nothing.

If you pass this offer by, I'll be out only the small profit on a three-and-a-half-dollar sale. But you—you may easily be out the difference between what you're making now and an income several times as great. So you see you've a lot—a whole lot—more to lose than I.

Mail the coupon or write a letter now—you may never read this offer again.

SPECIAL NOTE

In nearly five years the price of "Power of Will" has been increased only 50c. We find it necessary now to raise the price to $4.50 as soon as the present edition is gone. This means that by July 1st or sooner the price must be increased to $4.50.

Pelton Publishing Co.

30-J Wilcox Block Meriden, Conn.

Pelton Publishing Company,
30-J Wilcox Block, Meriden, Conn.

You may send me, "Power of Will" at your risk. I agree to remit $3.50 or remail the book to you in five days.

Name .....

Address .....

A Phonetic Phenomena: DOLLARS!

For One Dollar

How to become: "A Telegrapher without a teacher."

How to increase your speed without much effort and become the pride of the wire.

How to enjoy your wireless station by getting what is coming to you!

All of this, without a teacher, in your spare time, with a little effort, and at almost *no expense!* That is what our course, entitled, "How to learn Telegraphy (either code) without a Master, by the "Phonetic Memorizing System" will do.

HUNDREDS have written us as follows:

Please find enclosed ten dollars for the course, "How to Learn Telegraphy Without a Master, by the Phonetic Memorizing System," sent to me on trial. After I had tried for years to become an operator without the desired result, thanks to the Phonetic Memorizing System I am now employed as an operator with the C. N. R. (Signed) J. Crackle.

ANOTHER WRITES: I have been in the employ of the C. P. R. for six years, and although I have worked my way up to chief delivery clerk, I could not succeed to learn telegraphy. I bought your course, and now I can copy thirty-five words per minute easily on the mill. The course has just worked as you stated it would. The Phonetic Memorizing System is a corker. (Signed) E. W. Thomas, Calgary, Alta.

A typical letter we received from Mr. T. T. Hamilton, operator at Pacific B. C. He writes: You should have heard my wife's opinion of your Phonetic Memorizing System as applied to the teaching of Telegraphy, when I handed her my first pay check. (This man, from a warehouse helper at fifty dollars monthly, and a sick wife and big family, with the aid of our course in his spare time, and **on credit**, has become a divisional station agent with a **fat income.**)

We have qualified with the aid of the Phonetic Memorizing system in one single term one hundred and fifteen students, and raised their combined monthly incomes by $19,895.00.

The full course, worth its weight in gold, costs ten dollars, and we will send you same on free trial, you to be the judge.

To defray expenses for mailing, correspondence, etc., pin a one dollar bill to the coupon, and we will forward the full course without delay.

If after two months you are satisfied that the course has done for you what we claim, send us TEN DOLLARS, we will then register you in our free employment office. We secure positions for our qualified students.

GO TO IT. DO IT NOW.

CANADIAN SCHOOLS OF TELEGRAPHY AND RAILROADING
314 Catherine St., West Montreal, P. Q., Canada

To The Treasurer of "The Canadian Schools of Telegraphy and Railroading," 314 St. Catherine Street, West Montreal, P. Q., Canada.

Dear Sir:—Please forward to me for a two month's trial your course, "How to Learn Telegraphy Without a Master, by the Phonetic Memorizing System." I will give this course a fair trial, and if after two months it has done for me what it claims it will I promise to send you ten dollars. Otherwise I will not be under the slightest obligation to you.

Name .....

Address .....

Reference .....

What to Invent

By JAY G. HOBSON.

(*Continued from page* 60)

gether with oil and water, was fed into the mouth of this mill, where the rapidly pounding steel balls chewed it into a million fine particles of pulverized stone in the form of muddy water.

As the mill revolved the momentum carried the charge of balls upward, threw them around, across and down, inside, like some mighty hail storm of metal. The detonation caused by this constant pounding of steel against steel was deafening, but indicative of the fine work being done by this great machine.

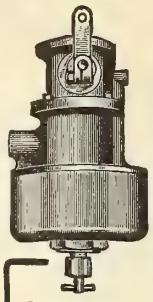
The powdered ore, now in the form of muddy water, came out the lower end of this ball crusher into a trough where a special device classified the mud. The larger particles of ore were separated from the smaller and returned automatically to the ball crusher for regrinding. The properly ground ore ran down the trough into a box-like machine with vertical mixers or beaters that churned this combination of copper, gold, silver, oil and dirt very much as butter is churned. These machines were called floatation cells, getting their name from the peculiar method used to save the ore values. The oil in the water when stirred rapidly formed bubbles or a froth that had a special affinity for the copper, gold and silver metal but not the waste rock. This oil froth acted like a magnet to the mineral, the copper, gold and silver flakes united with the oily froth, the air in the bubbles raised it to the surface of the box where slow-moving paddles skimmed the valuable froth off very much the same as cream is skimmed from milk.

Another trough carried the froth over steam pipes in the drying bins, where the oil and water is dried out, leaving a rich black powder called concentrates. While this is the most efficient ore treatment known to science today, yet it is not all that mining men desire. These concentrates must be hauled miles to the smelter that has the facilities to separate the three metals from each other. The smelters of today use a very slow and expensive system of ore separation which calls for a needed improvement in ore treatment as shown. One operated entirely by electricity that would concentrate and separate the ore at the mine, all in one and the same operation. My suggestion is in the shape of a large blast furnace operated by great electric heaters that will reduce the mixture of coke, copper, gold, silver and rock to a liquid mass. The heaviest metal naturally would gravitate to the bottom first, then the next and on until only the waste slag remained to be disposed of. A practical invention of this kind would soon revolutionize the mining industry. It would be the needed means of making hundreds of dividend paying mines from the many that are working at a loss because of the excessive cost of operation and handling of their low-grade ore.

An invention of this description will go down in history as one of the greatest, ranking with the threshing machine, the automobile, the binder and the electric power in value to mankind. While it may require years to accomplish the above it surely will be done some not distant day. The fame and fortune assured from the perfection of the above is well worth the effort and sacrifice necessary to obtain it.

A new use for the aeroplane has been found in the conveyance of material for the construction of a wireless telegraph station in the far interior of China.

SAVE 1/2



Your "GAS" and ALL Your Trouble
15-DAY FREE TRIAL
Money-back Guarantee
Entirely NEW principle—not a moving part—Simple. Has the Pep and Power.

U. & J. Carburetor

Doubles Mileage—Guaranteed to start car in zero weather—No Priming. 50,000 delighted users. Now ready for Ford, Dodge, Maxwell and Overland.

DEALERS—Service Stations, Salesmen: The "U. & J." sells on demonstration—installed in thirty minutes—some good open territory.

We also manufacture the U. & J. FORD TIMER. Will last as long as the car. PRICE $2.50

U. & J. CARBURETOR CO.
Dept. 275—507 W. Jackson Blvd., CHICAGO



SLIGHTLY USED STANDARD MAKE TIRES

Size	Price	Size	Price
30x3	$5.00	33x4½ (Cords)	$16.00
30x3½	6.50	34x4½	12.75
32x3½	8.00	35x4½	13.75
31x4	8.75	36x4½	14.50
32x4	9.50	37x4½ (Cords)	25.00
33x4	10.50	35x5	14.75
34x4	11.75	36x5	15.00
32x4½ (Cords)	15.00	37x5	15.50

Special Brand New Tubes, Guaranteed.

Size	Three sizes only.	Price
30x3		$1.75
30x3½		2.00
31x4		2.35

Order now. Shipment made the same day. $1 deposit required with each tire ordered. Balance C. O. D., subject to your examination. Specify whether you desire to have clincher or straight side tire. Special cash discount of 5 per cent. if full amount accompanies order.

G. & H. TIRE & VULCANIZING CO.
2559 S. State St., Chicago, Ill.

Learn Autos and Tractors



Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O.

DRIVER AGENTS WANTED

116-inch Wheel Base



158-inch Spring Suspension

5-Pass. Touring

To drive and demonstrate 1920, 4-cyl., 37 H. P. BUSH Car—Timken Bearings—Willard Batteries—2-Unit Stg. & Ltg.—Full Floating Axel. Write at once for the best Automobile Offer in existence—don't wait—prompt shipments. Money-back guarantee.

BUSH MOTOR CO. Address J. H. Bush, President, Dept. E19 Bush Temple, Chicago, Illinois

ENINGER WILL SAVE

$40

BIG MONEY SAVINGS FOR YOU



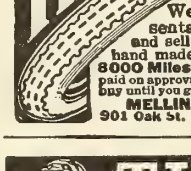
Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog

Deninger Cycle Co., Rochester, N.Y.

YOU 25 TO 50 DOLLARS

Tire Agent



We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. **Guarantee Bond for 8000 Miles.** (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.
901 Oak St. Kansas City, Mo.

TIRES 1/3 LESS



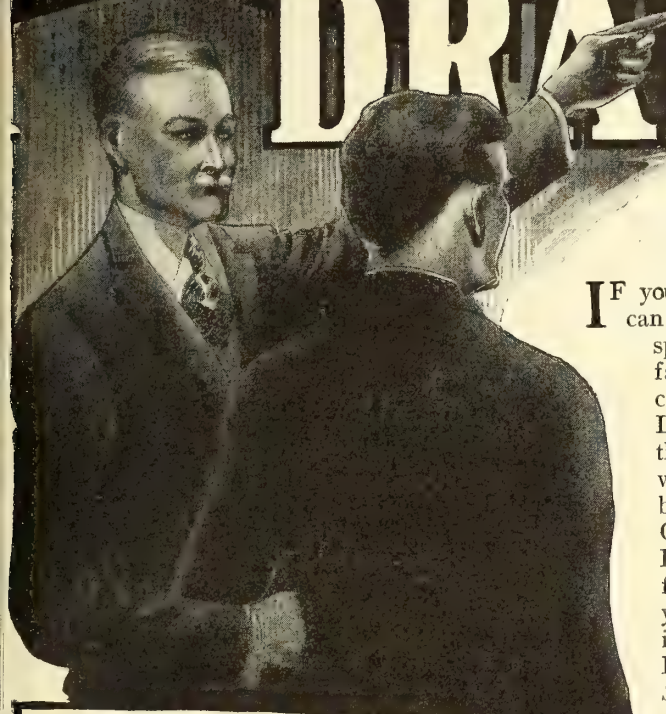
Perfect, new tires, all sizes, non-skid or plain, fabric or cord. Prepaid on approval. 8000 to

10,000 Miles Guaranteed

80,000 Customers. Catalog Free. Agents Wanted.

Service Auto Equipment Corporation
995 Service Bldg., Kansas City, Mo.

The World of Industry Needs DRAFTSMEN



You Can Learn Mechanical Drafting Quickly By Our Practical Method

IF you are a person of even average ability you can master this profitable profession in your spare time at your own home through our famous "Home Study Course". You can, in a short time, become a first class Draftsman because our training is most thorough and practical and because you will be personally instructed and coached by the President of the school, Roy C. Claflin, whose long experience as a Draftsman and a teacher especially qualifies him to give you the kind of training you need. We teach you to make drawings just as you would in an actual drafting room, and when you finish our regular Mechanical Drafting Course you are given your choice of one of our *Special Post Graduate Courses without extra cost.*



Roy C. Claflin, President, The Columbia School of Drafting

Draftsmen Get $35.00 to $100.00 a Week

On account of the importance of his work, the Draftsman is paid an excellent salary and is always in line for advancement. Drafting is not only one of the best paying professions, but is the stepping stone to bigger opportunities. Many men, receiving up to $40,000 a year and over in technical positions, owe their success to their knowledge of drafting. General construction companies, manufacturers of machinery, locomotives and automobiles, designers of tools and special equipment, makers of aeroplanes, large engineering companies, in fact, all branches of industry need Draftsmen today in greater numbers and at better salaries than ever before.

"Columbia" Graduates Are the Kind of Draftsmen That Are Needed

The properly trained Draftsmen, such as those graduated from the COLUMBIA SCHOOL OF DRAFTING, are the ones who get the preferred positions and best salaries. The success of our graduates proves this to be true. Columbia Graduates are filling important positions as professional Draftsmen throughout the country and prominent concerns are continually offering positions to our graduates.

No Previous Training Required

As our students are given practical Drafting work from the beginning of our course, no previous training or drafting experience of any kind is required to take up this work with us. The training we give you is all that is needed to secure a position as Draftsman. (See Laurence Johnston's letter).

How Columbia Students Succeed

(More letters on request)

"I have accepted a position as draftsman, paying $2,640 a year to start. I had no previous drafting experience aside from my training with you, which has proven all that was needed for me to become a professional draftsman."—Laurence P. Johnston. (Mr. Johnston is making as high as $200 a month extra in his spare time, which makes his total income from Drafting over $5,000 a year.)

"Several firms have offered me $40 and $45 a week to start. As I am doing nicely as draftsman up here and about to receive my second increase in salary, have decided to stay. I find that there are hundreds of openings for draftsmen and if I quit where I am I could secure another position in three hours' time. There will be a still greater demand for Draftsmen."—Geo. Murray, Jr.

"I wish to express my appreciation for your courteous treatment and sincere interest in the progress of my studies and for aiding me upon completion of your course, to secure a very desirable position at $140 a month to start. I am getting on well and the chances for advancement are excellent."—A. L. Gash.

"I have accepted a good position with a large manufacturing concern in Chicago and wish to thank you for the training your school has given me."—Emil B. Johnson.

A few of our many other successful graduates are: *G. Tangorra,* $2,800 *a year; T. R. Brown,* $2,860 *a year; R. Fowkes,* $3,700 *a year.*

Drafting Outfit Furnished Students

We furnish, without extra charge, an individual drafting outfit to all our students for use throughout the course. This becomes your own property as soon as the course has been paid for.

Send This Coupon Today

or write to **Columbia School of Drafting,** Roy C. Claflin, President, Dept. 1127, 14th and T Sts., N. W., Washington, D. C.

Columbia School of Drafting,
Roy C. Claflin, Pres.,
Dept. 1127, 14th & T Sts., N. W., Washington, D. C.

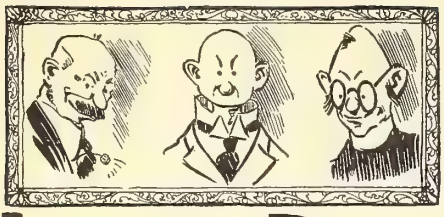
I am interested in your practical training in Drafting. Therefore, without obligation to me, please send me FREE your illustrated book of particulars, testimonials, terms, etc. I am particularly interested in the Course checked below:

Mechanical Drafting	Patent Drafting .....
Architectural Drafting	Sheet Metal Drafting.....
Structural Drafting	Topographic Drafting.....
Electrical Drafting	Ship Drafting .....
Highway Drafting	Statistical Drafting .....
Aeroplane Drafting	Automobile Drafting .....
Special Machinery Drafting.....	Builders Course.....

Name .....

Address .....

City ..... State.....



Learn to Draw at Home

Illustrators, Cartoonists, Commercial Artists earn big money, $25 to $100 a week and more. Learn at home in spare time under personal direction of Will H. Chandlee, famous newspaper, magazine, advertising artist of 35 years' successful experience.

BE AN ARTIST

Delightful, fascinating profession. Wonderful new home-study method makes drawing easy! Send coupon or postal today for special offer of complete Artist's Outfit Free to new students. Write for handsome book, "How to Become an Artist." Don't delay—write or send coupon at once. Address

Washington School of Art, Inc.
1497 H St., N. W.
Washington, D. C.

FREE COUPON
Washington School of Art, Inc.
1497 H St., N. W.
Washington, D. C.

Send me particulars of FREE ARTIST'S OUTFIT offer and Free Book, "How to Become an Artist."

Name.....
Address.....
City.....State.....

"Old Town Canoes"

Form a canoe club. We will furnish constitutions and by-laws. You can pick a fleet of "Old Town Canoes" from the new 1920 catalog. Thirteen graceful models pictured in natural colors. Complete list of accessories. All prices given. First cost is the last—there is no upkeep to an "Old Town". Write for free, postpaid catalog today.

OLD TOWN CANOE COMPANY
955 Fourth Street
Old Town, Maine, U. S. A.



Learn Wiring!

See page 7

"The Ellis Music Master Reproducer"

made for all phonographs. Pleases the most exacting music lover. Eliminates twang. Perfect harmony of accompaniments, individuality of artists, voices and instruments reproduced from records in life like reanimation. It sells on its merits. Send 10c for booklets E, "Hints to Music Lovers" and "Music Masters." Agents wanted
J. H. ELLIS, P. O. Box 882, Milwaukee, Wisconsin

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(*Continued from page* 43)

plication arising from the fact that the velocity is varying and becomes zero at the center. A body falling along any other than the polar shaft, *in vacuo*, would be affected by the earth's rotation in such a manner that it would describe the arc of a spiral curve, the law of motion being extremely complicated. All that can be said in regard to the deflection under such circumstances is that the body would be thrown toward the *Eastern* wall of the shaft and after falling only a distance of two hundred miles along an equatorial shaft an object would hit the eastern wall unless the width of the shaft was about two and a half miles.

Consider now the effect of *air resistance* upon the motion of the body.

Within the polar shaft (which is the only case we can consider owing to the complications arising from the effect of the earth's rotation upon the fall in other shafts), the air will increase in density toward the center of the earth. The density of the air in terms of the density of water at sea-level is .08. Its density at lower levels has been found by Legendre's law. (See Table.) And increases in proportion to the distance from the center of the earth. At the center its density is .33 or *one-third the density of water at the surface.* If the shaft were filled with *water* instead of air, *its density at the center would exceed that of surface rocks.*

We can compute by simple mathematics the amount of this retarding force for a ball six inches in diameter. Manifestly we cannot consider a man falling down a shaft so we will assume the falling object to be the ball mentioned above. From the dimensions of the ball we find the time values of 5^m, 10^m, 14^m, 15^m, counted from the moment the body leaves the surface by means of a formula for simple harmonic motion of a body falling in a resisting medium along the earth's polar diameter. See table. We find that the retarding force of the air is so great that the body is *brought to rest* two thousand miles below the surface about fourteen minutes from the time it started. The velocity of the body and the retarding force of the air are equal at this point and amount to approximately 23,000 feet per second or four and three-tenths miles.

Table showing, for various depths, time of falling thru a shaft in vacuo (along polar axis), acquired velocity and corresponding resistance, body would meet in air; as well as force of gravity for different depths, and density of air, water and earth material (according to Legendre's Law).

Depth	Time of Falling (In Vacuo)	Acquired Velocity (In Vacuo) Ft. per Sec.	Air Resistance (For Ball Six Inches in Diameter) Ft. per Sec.	Density of Earth	Density of Air in Shaft	Density of Water	Gravity Ft. per Sec.
At Surface..	.....	.....	.....	2.65	.08*	1.0†	32
7,500 ft.....	22 sec.	693	7	2.7	.08	1.0	32
270 mi....	5 min.	9,450	1,500	3.5	.10	1.3	30
1,050 mi....	10 min.	17,610	9,860	5.9	.18	2.2	24
1,480 mi....	12 min.	20,250	15,210	7.0	.21	2.7	20
2,030 mi.*..	14 min.	22,680	22,730	8.5	.25	3.2	16
2,225 mi....	15 min.	23,340	25,030	9.0	.26	3.4	14
Center of Earth....	21 min. 3 sec.	25,940	39,640	11.2	.33	4.2	0

*Note that a body falling in air will be stopt even before this point is reached by air resistance. (7,500 ft. approx. greatest depth yet reached by man).

†All densities are relative to density of water at surface.

Note: Water at earth's center would be more dense than surface rock, and density of air at center would be one-third that of water at the surface.

After the body has been brought to rest it will start to fall again with a new velocity which will be that for the point where it is brought to rest. It will encounter greater air resistance than before and be brought to rest again. This process will be repeated indefinitely. Each time the velocity will be less and air resistance stronger until finally air resistance will overcome permanently an extremely weak attraction and the object will remain buoyed up by the air a short distance from the earth's center.

As a matter of fact the tremendous velocity acquired long before this point is reached would cause the body to be completely consumed by air friction.

Table showing, for various depths, time of falling thru a shaft *in vacuo* (along polar axis), acquired velocity, and corresponding resistance, body would meet in air; as well as force of gravity for different depths, and density of air, water and earth material (according to Legendre's Law).

Oddities of Sound

By H. WINFIELD SECOR

(*Continued from page* 18)

Thus, if we know the time elapsed between the origination or start of a sound wave and the exact time when it strikes our ears, and as we know the velocity of sound travel thru the air, 1,132 feet per second, all we have to do to determine the distance of a locomotive steam whistle, for example, is to watch when the steam escapes from the whistle, and then by means of a stop-watch (or an ordinary watch) count the number of seconds it takes the sound to reach us. The writer has often done this while standing on a high mountain at the base of which a railway wended its way. It is a very interesting experiment, and one that any person can easily perform. To get exact results the stop-watch should be started (or the counting of the second hand on the ordinary watch started) when the steam is first seen to escape from the whistle, as it will be the sound caused by this first escape of steam that you will hear when it has reached you. As soon as you hear the very first sound, the stop-watch key is closed, and the elapsed time taken note of. The air line distance to the whistle or train will then be the number of seconds elapsed, multiplied by the velocity of sound, or 1,132 feet per second for 70° Fah. See Fig. 4.

THE STORY OF THE ECHO.

We have all been amused and perhaps startled in our younger days, when walking thru a tunnel or visiting a cave where we found that, if we talked, whistled or sang, after a short period we could hear our voice repeated in the form of the well known *echo.* The echo is a common phenomenon in the physics of sound, and is caused invariably by the reflection of the originating sound due to its striking some acoustically reflecting body such as rock, wood or other material suitably arranged so that one or more of the reflected sound waves impinges on our ears. See Fig. 5.

(*Continued on page* 74)

LEARN WIRELESS AT HOME

The Demand for Wireless Operators Far Exceeds the Supply

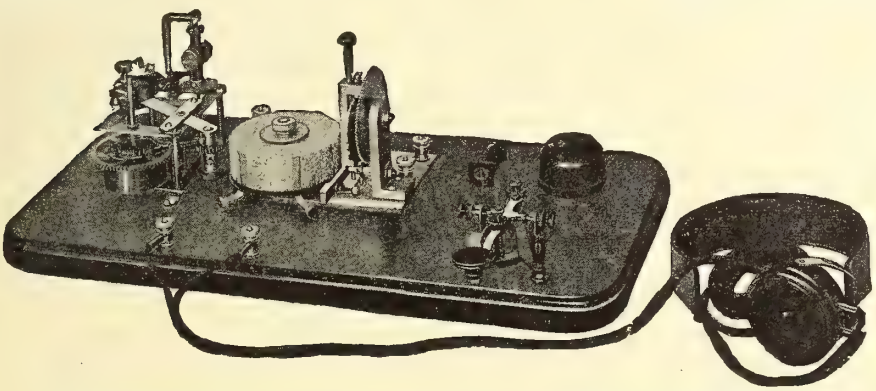
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, Chief Radio Inspector, Bureau of Navigation, N. Y. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way, will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free,* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do,* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wirelesss Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* **This set is not loaned, but given to all students completing the course.**

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph,* place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S Radio Inspector to verify this.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—*but do it today.*

NEW YORK WIRELESS INSTITUTE,
Dept. 12, 258 Broadway, New York City.

New York Wireless Institute
Dept. 12, 258 B'way, N. Y. City.

Send me free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your *Free Instrument Offer.*

Name .....

Address .....

City or Town.....State.....

$1.00 Postpaid
SHAVES WITH GILLETTE BLADES
equal to any $5.00 safety razor.



Rogers Bros. Safety is as nearly perfect as any safety razor can be made, and no expense is spared to make it the very best ever offered to the user of a high-grade razor at the lowest possible price.

Note the Rogers Bros. exclusive "HEXIGON HANDLE" with a Guarteed Double Silver-Nickel Electroplate throughout. Why pay Five Dollars for an article when you can get one at an advertising price of *One Dollar.* "Unnecessary expense can be cut out through the direct-by-mail selling."

— —Mail This Money Saving Coupon— —

D. A. R. Sales Company
2521 17th Ave. So.
MINNEAPOLIS, MINN.

Enclosed find one dollar for your special safety razor offer

Name .....

Address .....

.....

Getting Ahead

is the story of Peter Perkins and how he accumulated $10,000 in ten years by investing $25 a month in high-grade listed stocks and bonds, on a novel plan. "Getting Ahead" is as interesting as anything you ever read. Thousands have read it and are now "getting ahead" financially on the same plan.

You will be fascinated with it. But better still, it will show you a new way to invest your savings monthly—how to get interest, plus a PROFIT, on your money—without sacrificing safety. We send it free. WRITE FOR IT TODAY.

KRIEBEL & CO.
INVESTMENT BANKERS
141W South La Salle St., Chicago

Complete Chemical Apparatus

First-class used Microscope, Spectroscope, accurate balance, barometer, glassware, etc. Also chemicals. State in detail.

A. A. CLARK
207 W. Main St., Springfield, Ohio



GO INTO MOVING PICTURE BUSINESS
Small Capital Starts You
Our Catalog FREE. Show you how to earn $25.00 to $50.00 per day
on our easy payment plan. Begin now and get your share. We sell everything. Write today.
Atlas Moving Picture Co.
Dept. 50 538 S. Dearborn St., Chicago

Oddities of Sound

(*Continued from page 72.*)

THE UNMUSICAL PARLOR.

Possibly you may have had some experience in the direction of musical or rather we should say *unmusical* metal picture frames, glass vases, brass candlesticks, chandeliers, etc., which possess the undesirable property of vibrating in sympathy as certain musical notes are played on the piano or organ. He remembers particularly one dastardly brass picture frame measuring about 10 by 15 inches, which reclined gracefully on its easel atop the piano. Every time the note one octave above middle "C" was struck, this frame sizzed and zizzed for several minutes and caused such an horrible discord that it had to be removed each time the piano was played. At another time a glass vase committed the same criminal offense and had to be removed from the piano. Practically every little object in the room where a piano is situated responds to sympathetic vibration whenever a note or chord is sounded on the piano which corresponds to the fundamental note or frequency of the object in question. Altho it need not necessarily be the fundamental note that is played which causes the trouble, but even a harmonic will do it. The brass tongs and other trimmings surrounding the open fireplace often prove offenders as well as metal piano lamps, chandeliers, stoves, loose window panes, etc. See Fig. 6.

(*To be concluded.*)

The Amateur Magician

By JOSEPH H. KRAUS

(*Continued from page* 44)

sometimes—various other things, and is comparatively cheap, financially speaking. The model hand of wax is carefully balanced so that it is just a little heavier at the wrist than at the finger tips. The finger tips have been drilled open and iron cores inserted into two of them, the wax, of course, being carefully smoothed over the holes made for these cores. Iron wire answers the purpose very well. Of course, a hand must be obtained which will have a peculiar position such as shown in the photograph which you have there. This allows for a reasonable rocking motion and results in the subsequent raps.

"The table is arranged practically the same as in various other stunts of mine, namely, two wires travel up the legs and terminate at the top in an electromagnet 6 inches long, 4 inches in diameter, having a 1-inch core. This is wound with No. 18 D. C. C. magnet wire, making quite a powerful magnet and inserted in the table as shown in the diagram. When an electrical contact is made thru to a storage battery conveniently located by means of switches or buttons well within reach, sufficient magnetism is created to tip the hand over on to its finger tips and cause it to tap out the desired answer, the glass table not affecting or disturbing the magnetic effect. The buttons as you see are connected in parallel to the same wires and so placed that I can move around and yet control the hand without it being noticed. There is no skill required in the making of the table and its wiring is simpler yet. The contacts in the legs are arranged so that the table may at all times be moved without creating suspicion and yet when placed over the floor plates immediately becomes operative.

(*Continued on page* 87)

Advertising Talks
NUMBER 7

In one of my talks a few months ago, I explained how advertising reduces prices. The advertising manufacturer does business so much more easily and in such larger quantities than his competitor that he can pay for his advertising, make a substantial profit and still sell you his goods for less.

The many concerns who spend thousands of dollars for space in the ELECTRICAL EXPERIMENTER every month, don't do it for love of the magazine! They do it because it costs them less to sell their goods with advertising than without. That's why they continue to advertise.

Since it costs them less to do business, they can naturally give you better prices.

But even if you didn't save a cent by buying advertised goods, even if they cost you more (which they never do for the same quality), it would pay to trade with advertisers. No manufacturer can afford to advertise an unreliable product or service!

The immediate results of any advertising seldom pay for its expense. In order to make advertising pay, it must secure regular customers. Those manufacturers therefore, who advertise regularly month after month in the ELECTRICAL EXPERIMENTER, *must* be securing regular customers, and *must* be giving their customers complete satisfaction.

Many of you will probably remember the famous "7 point" gum that was so widely advertised a few years ago. Why did that advertising campaign fail? Not because the advertising wasn't good,—it was excellent.

The trouble was, the *gum* was no good. People bought it once, but they didn't *keep on* buying it.

This is just the point I am trying to make about the firms who *keep on* advertising in the EXPERIMENTER. The fact that their advertisements appear continuously shows that they, unlike the chewing gum people, are *keeping* their customers, by giving them prompt service and their "money's worth."

An additional protection you enjoy when ordering from the EXPERIMENTER'S advertisers is that the publishers reject all advertising in any way misleading or objectionable.

Read the advertisements in the ELECTRICAL EXPERIMENTER carefully,—and order from them. Remember, the advertisers sell more cheaply, care more about satisfying their customers, and are backed up by the magazine!

R. W. de Mott
Advertising Manager.

ONE ON EDISON.

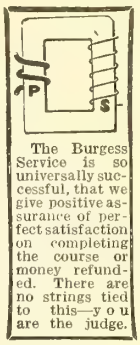
Years ago Thomas A. Edison used to try to instill the rudiments of science into the head of his young son and never overlooked an opportunity to use some every-day happening to illustrate some principle of mechanics. On this particular occasion, chancing to spy a peddler pushing a handcart, the great inventor cried: "Now there's a good example. I don't suppose you can tell me why he pushes the cart instead of pulls it. I don't know whether the man himself could answer. I'll ask him."

"My good man," said the inventor, turning to the peddler, "why do you push the cart rather than pull it?"

"Cause I ainta da hoss, you damma fool," was the unscientific, tho disconcerting answer.—San Francisco *Argonaut.*



Electricity
taught by a practical man!



The Burgess Service is so universally successful, that we give positive assurance of perfect satisfaction on completing the course or money refunded. There are no strings tied to this—you are the judge.

Hundreds of Burgess-trained men and boys have advanced to better positions by means of the practical electrical knowledge easily learned at home by this method. Give a little of your spare time and you can do the same.

Home Study For Beginners and Electrical Men

This home study course is based on the years of practical experience of Yorke Burgess who gives personal attention to each student. Burgess students are invariably promoted and get better salaries. Beginners get employment in electrical work after taking the course a short while. Burgess students are in demand, over 80 per cent are now engaged in electrical work.

FIFTY-FIFTY EASY TO LEARN—EASY TO PAY FOR

A simple method of learning practical electricity—supplied on easy payments, including apparatus, instruments, materials, etc. Start any time—stop any time. Your payments cease if you are not satisfied. Send for Burgess catalog today. Gives full information without cost or obligation.

YORKE BURGESS, Supt.

BURGESS ELECTRICAL SCHOOL, 745 East 42nd St., Chicago, Ill.

BURGESS BLUE BOOK

a practical and handy reference book for

ELECTRICAL MEN AND STUDENTS

Contains over 200 CALCULATION FORMULAS and WORKED OUT PROBLEMS showing their use. DRAWINGS of ELECTRICAL MACHINERY DEVICES—INSIDE CONNECTIONS—ALTERNATING CURRENT CALCULATIONS and hundreds of every day problems are also covered. Recommended by electrical men all over the country. Purchased by electrical concerns for their employees and customers.

PRICE $1.00

We refund your money if the book does not meet your approval.

BURGESS ENGINEERING CO., 750 East 42nd St., Chicago, Ill.

YORKE BURGESS, President

Consulting Electrical Engineering. Power Plants, R. R. Signals, Electric Railroads, Industrial Problems a Specialty. Information furnished on electrical subjects. Inventions perfected.

Electrical Slide Rule

Invaluable to Any Electrical Man

In response to many requests, Mr. Burgess has prepared a set of simple and concise lessons for those who desire to take up the use of this practical instrument.

A HIGH GRADE SLIDE RULE

in a leather case, and a COMPLETE COURSE OF INSTRUCTION will be supplied at a very reasonable

SPECIAL COMBINATION PRICE

We have selected the best rule for the purpose. The simple lessons will enable you to understand its use thoroughly.

Write us for full information

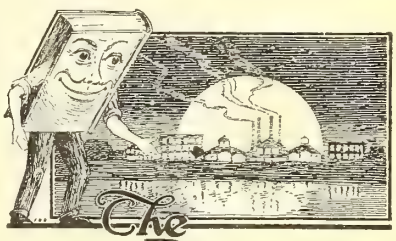
BURGESS ELECTRICAL SCHOOL

750 East 42nd St. **Chicago, Ill.**

FOUND!

A book which relates in a manner as fascinating as fiction, the romantic side of electrical engineering, "ROMANCE OF A GREAT FACTORY," by Charles M. Ripley, presents a striking picture of the industrial romance encountered in the manufacture of modern electrical machinery. Dr. Steinmetz, the eminent engineer, says in his introduction to the volume: "In the modern factory there is far more romance and poetry than there has ever been in the history of the past." The general public does not realize this. "ROMANCE OF A GREAT FACTORY," written in non-technical language, tells the story of electrical machinery as manufactured in the General Electric Works at Schenectady, New York.

Illustrated with 99 photographs and artists' drawings of scenes in and out of the shop. These illustrations alone are worth the price of the book.



The Romance of a Great Factory
making its first bow to the Public.

"ROMANCE OF A GREAT FACTORY" is a book for everyone; the engineer, student, worker, soldier or sailor—in fact, a book of valuable information for the GENERAL PUBLIC. Every public library should have a copy. Get a copy of this volume and learn what lies back of the modern machinery which drives the wheels of commerce.

ROMANCE OF A GREAT FACTORY



Dr. C. P. Steinmetz
Who wrote the introduction

By CHARLES M. RIPLEY with Introduction by Dr. Steinmetz

Price 2.00 net

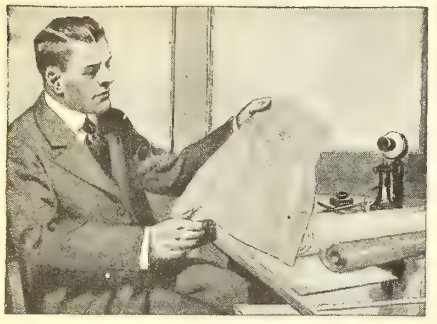
Trade Selling Agents—THE BAKER & TAYLOR CO.
354 Fourth Avenue, NEW YORK

Order from your local book store, or send $2.00 to the author, 1414 Union Street, Schenectady, N. Y.



Chas. M. Ripley
Who wrote the book

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6231, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

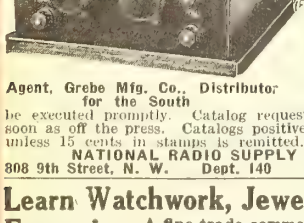
Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____

NOTICE TO AMATEURS:



We carry in stock practically every known piece of radio apparatus on the market today that is worthy of consideration, and in most cases can make immediate shipment from our stock. Due to circumstances over which we have no control, our catalog will not be ready May 1st, as advertised in QST. We will begin mailing out catalogs about the 15th of May. Send in your orders and they will be executed promptly. Catalog requests will be filled as soon as off the press. Catalogs positively will not be sent, unless 15 cents in stamps is remitted.

Agent, Grebe Mfg. Co., Distributor for the South

NATIONAL RADIO SUPPLY COMPANY
808 9th Street, N. W. Dept. 140 Washington, D. C.

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

Cutting the Boche Electrified Barbed Wire

By VAN LOUIE MARTIN

(*Continued from page* 15)

the French were relieved and completely out of the sector. Compare this with when five weeks later the French troops relieved us in this sector they were with us three days and nights before allowing us to depart for the rear. I went into the lines on this front as an automatic rifleman but by the dawn of the first day I had been transferred to the Battalion Intelligence Department, or the S. O. S. platoon, and placed on observation post at once; but my experience as an observer is another story. Only a few days had elapsed when one of our scout lieutenants leading a patrol thru "No Man's Land" became entangled in the enemy barbed wire and was electrocuted. Upon the strength of this incident and probably partly due to my natural mechanical talent, I was selected as one of two from our outfit to immediately be sent to the rear to attend a French Electrical School, conducted in a small village near Gerardmer.

It was here I was taught the gentle art of cutting the enemy electrified barbed wire without danger from the current to myself, or comrades and without the enemy detecting the trick. More than once since that time have I been called upon to do this most hazardous night work. A wire cutter's outfit consists of a rubber suit of union-alls, a pair of gauntlet rubber gloves, half knee length rubber boots, an insulated "bridging" wire, and an insulated pair of wire snips of holders. The glove sleeves are worn underneath the coat sleeves and boot tops underneath trouser legs to keep out the water. Just before going on a job a wire cutter has taken from him every weapon of defense, as well as his belt, gas mask and helmet. He will have a partner to work with him and sometimes two sets of partners work together, one set holding the wire while the other cuts it. He leads a patrol over "No Man's Land" to a place of hiding near the entanglements from where they are supposed to keep him protected, while he and his partner go forward and cut a panel of the wires for them to pass thru.

The Germans electrified their wires in sections, each section being independent of the other. Connected in the circuit of each section, and located at front line headquarters, is a sensitive gold leaf detector that registers any fluctuation of the current. Trained upon each section is a machine gun, automatically controlled and connected in this same circuit. Any one cutting this wire *without first bridging the gap with insulated wire*, or who short circuits it by falling into it, or in any other manner cause an interruption of the current, will immediately cause a small bell to ring in this said machine gun emplacement and that same machine to automatically traverse that section of the wires with bullets.

The Germans usually used hydroelectric or portable gasoline plants with which to electrify their wires, and I will say here that when ever the Americans took over a sector, the current was turned into the wires of that sector much earlier in the afternoon than was customary. The Germans had a custom of placing a stumbling wire, not electrified in front of the charged wires, and it was these stumbling wires, hidden by the grass, that caused the death of our Lieutenant Carter.

In October we had our first snow and of course most all vegetation was killed but we could trace the live barbed wires quite a distance, with the aid of our glasses, by the streak of green grass that was yet growing all along underneath it.

How To Sell YOUR Real Estate

Is a Free Book that Tells

how you can get cash for your property by using the *Simplex Plans for Selling Real Estate*, which have already sold more than 5,000 properties of all kinds in the U. S. and Canada. No matter where your property is located, these successful plans will show you how to sell it *yourself*, without employing agents, or paying commissions to any one. Don't spend a *minute's* time, an *ounce* of effort or a *cent* of money *trying to sell* without first reading this important book and learning *how* to sell your property *quickly, economically* and at the *highest possible price*. The reading of this book has *saved property owners hundreds and thousands of dollars in commissions* and it can do the same for you. As the book is sent *absolutely free*, you have *everything to gain* and *nothing to lose*.

Send your name and address at once—a postal will do—and you will receive by return mail, postpaid, a copy of this important book, *without cost or obligation*.

THE SIMPLEX CO., Dept. 262, 1133 Broadway, New York.

Quick Results!

"Sold my house within two weeks by following the Simplex Plans."—*F. Stark, Wis.*
"Sold for cash in 10 days."—*W. H. Cartland, Mass.*
"Sold my property. Your plan quickest I ever saw."—*Johnson String, N. J.*
"Sold my home for cash within three weeks."—*M. E. Lounsberry, Okla.*
"Sold my lots for cash."—*R. P. Moodie, Ottawa, Can.*



The Electric Safety razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."
A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.

Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

VIBRATING ELECTRIC RAZOR CO.
729-31 West Broadway, Council Bluffs, Iowa

REBUILT ELECTRIC MOTORS

General Electric
Westinghouse
Crocker-Wheeler
Emerson
Century
Wagner
etc.



All Motors Guaranteed For One Year

Motors bought, exchanged and repaired
ELECTRICAL SUPPLIES
Wholesale Prices
Sockets, wire, tape, loom, fuses, switches, cut outs, etc.
New illustrated catalogue free. Satisfaction guaranteed or money refunded.

HYRE ELECTRIC CO.
631 S. Dearborn St. Chicago, Ill.

FREE



$20

TENOR BANJO Ukulele, Hawaiian Guitar, Violin, Mandolin, Guitar, Cornet or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.

SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 41 CHICAGO, ILL.

HERE AT LAST

A THOROUGH INTERESTING COURSE IN ELECTRIC WIRING, EXPLAINED AND ILLUSTRATED IN SUCH A WAY AS TO MAKE IT A PLEASURE AND NOT AN ARDUOUS STUDY.—WRITE H. K. BLATCHLEY, Electrical Engineer, P. O. Box 1477, New Haven, Conn.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page* 47)

DETECTION OF NITRATES.

Nitrogen may also be present in the form of nitrates but, since nitrates from other than organic sources are much more common than nitrites, their presence is not so indicative of contamination.

First prepare a solution of phenol-sulfonic acid by dissolving 15 grams of carbolic acid in 185 grams of concentrated sulfuric acid. Place the mixture in a flask and immerse in a beaker of water maintained at the boiling temperature for several hours.

To make the test evaporate 100 cc. of the water to dryness in a porcelain dish placed on a water bath. Add 2 cc. of the phenol-sulfonic acid and stirring thoroly follow it with 10 cc. of distilled water and 5 cc. of ammonia water. If nitrates are present a characteristic yellow color will appear.

A simpler nitrat test can be made as follows: Evaporate 50 cc. of the water to a few drops and add 2 cc. of concentrated sulfuric acid containing a minute quantity of *brucin*. If a coloration results, nitrates are present.

ORGANIC MATTER.

In making this determination the first step is to prepare a standard solution of potassium permanganat by dissolving in one liter of distilled water 0.395 gram of the salt. Preserve in a clean, well-stoppered bottle. Also prepare a solution of sulfuric acid by pouring very carefully 18.5 cc. of the concentrated acid into 166.5 cc. of distilled water.

Then measure into a clean porcelain dish 100 cc. of the water and add 10 drops of the sulfuric acid solution. Warm the contents of the dish nearly to boiling and add from a burette, drop by drop, standard potassium permanganat solution, stirring and heating after each addition. Continue until the first permanent tinge of pink appears, i. e., a pink color that does not disappear on stirring and heating.

The organic matter in the water absorbs oxygen from the potassium permanganat, thereby decolorizing it. By taking the readings of the burette before and after the titration, the amount of permanganat solution used may be obtained and this will give an indication of the quantity of organic matter present. Each cubic centimeter of the solution used means one part of absorbed oxygen per million parts of water. More than 4 or 5 parts per million, without some known source, indicates pollution.

PHOSFATES.

Potable water will never contain more than traces of phosfates. To detect their presence evaporate 100 cc. of the water to dryness, moisten with a few drops of ammonium molybdat solution and warm gently. If a decided yellow color results, animal contamination is indicated.

To prepare the ammonium molybdat solution, dissolve 15 grams of the salt in 100 cc. of water, adding a little ammonia water if necessary to effect solution. Pour the solution with constant stirring into a mixture of 50 cc. of nitric acid and 50 cc. of water. Let the mixture stand in a warm place for several days and pour off the clear liquid.

Lead: One method of testing is to evaporate 100 cc. of the sample to 10 cc. and add a few drops of potassium bichromat solution. If lead is present a yellow precipitat results.

If another test is desired add 5 cc. of ammonia water to 2 liters and follow it with acetic acid, until the water reacts *acid* to blue litmus paper. Evaporate this to 10 cc. and pass into it hydrogen sulfid gas. A black precipitat confirms the presence of lead.

(*Next:—"Mineral analysis of water."*)

Enjoy These Wonderful Health Treatments In Your Own Home!

VIOLET RAYS

The Amazing New Source of Health, Energy and Beauty



Health, vitality and beauty are within easy reach through the magic of Violet Rays. Science has perfected a wonderful new machine for home use, so simple that a child can operate it, and absolutely safe and harmless. Its cost is so trifling that anyone can afford to own it and you may try it in your home without risking a penny.

ENJOY wonderful, sparkling health! Feel the thrill of the bounding vitality of youth! Increase your store of energy, revitalize your worn out cells, make every fibre of your body tingle with a new life and vigor! All this you can have through the magic of Vi-Rex Violet Rays right in your own home!

Violet Rays penetrate to every cell in the body, imparting that stimulating vigor which brings the glow of health, tones up the entire system, putting life into overtaxed and sluggish tissues. As a quick relief from pain Vi-Rex has no equal. Its soothing rays quickly find the source of distress and afford speedy comfort. Headaches, nervousness, skin blemishes and many other complaints vanish as if by magic through this marvelous treatment. You will be amazed at the splendid, quick results through the use of this wonderful new Vi-Rex Violet Ray Machine—right in your own home!

How These Simple, Delightful Treatments Benefit

Vi-Rex Violet Rays are effective for a host of disorders and ailments. Physicians in all parts of the country are adding this scientific outfit to their equipment and recommending its use to their patients. Beauty specialists have long realized its efficiency for inducing a clear and healthful skin. Until recently expense prohibited the use of this remarkable health-building force in private homes. Now the practical, inexpensive Vi-Rex Violet Ray Machine enables everyone to enjoy all the benefits of this marvelous treatment at home.



The Vi-Rex Violet Ray Machine is *not* a vibrator—does not shock or jar the delicate nerve ends. Its effectiveness is obtained through its power of penetration—not through the mere manipulation of surface muscles. There is no feeling of soreness or exhaustion after use—only a comforting, agreeable sense of relief.

The operation of the outfit is simplicity itself. Current from your electric light socket is transformed into an effective healing agent as pleasant to the senses as a ray of spring sunshine. It may be used on the very young and the very old without the slightest discomfort. No shocks or jolts—just a soft, steady ray of violet light filled with an abundance of health and energy. (Special equipment is supplied to you at a trifling cost if electric current is not available.)

20 Home Treatments FREE

You don't have to take any risk in giving Vi-Rex Violet Rays a trial. For a limited time we are making a very liberal trial offer, which enables you to prove the value of the machine before you buy. Take twenty free treatments in your own home. Use this marvelous machine morning and evening for ten days. If you do not find quick relief, if you do not feel better, sleep better, *look* better—send it back and you will not have lost one penny. This special offer is now open for a limited period only and may be withdrawn any time, so act quickly.

Magic-Like Treatments for:

Asthma	Goiter
Boils	Hay Fever
Blackheads	Headache
Catarrh	Insomnia
Colds	Nervousness
Corns	Lumbago
Constipation	Pimples
Dandruff	Rheumatism
Ear Troubles	Tonsilitis
Eczema	Sprains

Send For Free Book

Write to-day for our free book describing the wonderful Vi-Rex outfit and particulars of our unusual 10-day trial offer. Read what hundreds of users say about the Vi-Rex and the astonishing results which have been obtained. Learn why it is the most economical and practical machine of its kind available. Find out how Violet Rays will help you. Mail the coupon or send a postal. Do it now!

Vi-Rex Electric Co.
Dept. 45, 326 W. Madison St.
Chicago, Ill.

Vi-Rex Electric Co., Dept. 45
326 W. Madison St.
Chicago, Ill.

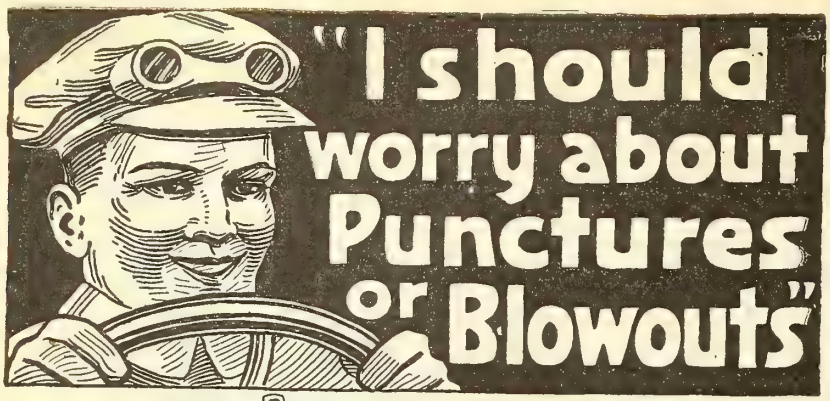
Please send me without cost or obligation your free Book describing your wonderful Violet Ray Machine, and details of your 10-day Trial Offer.

Name.....

Address.....

City.....

State.....



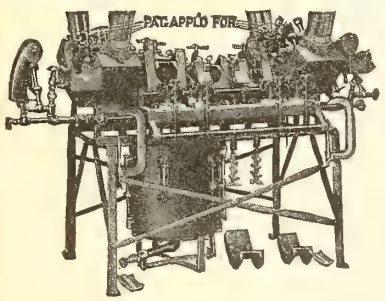
with NN'ER ARMOR TIRES

A written guarantee bond of 5,000 miles of satisfactory service is furnished with every order. We have perfected a simple way to manufacture these **NN'ER ARMOR TIRES.** Everybody knows that FULL VALUE that goes into any article manufactured is put in where THEY ARE MADE. When a tire passes from the factory to the jobber, and then through the dealer and there is a large overhead expense added for national advertising, the price is double or more than the actual value of the tire. The middlemen do not add one red cent's worth of value to any tire. All they add is profits and expense. **NN'ER ARMOR TIRES** are Puncture Proof, prevent blowouts and are powerfully built for rough usage; and best of all, they are sold direct to you—not through dealers. **NN'ER ARMOR TIRES** give you your money's worth in the largest sense of the word. You cannot find another tire that possesses all these features at the prices listed below. Don't deprive yourself of the economy and safety gained by the use of **NN'ER ARMOR TIRES.** Over a hundred thousand satisfied users. Order a complete set today.

Size	Armor Tire	Heavy Tube	Size	Armor Tire	Heavy Tube	Size	Armor Tire	Heavy Tube
28x3	$3.75	$1.50	33x4	$6.25	$1.90	35x4½	$8.75	$2.65
30x3	4.00	1.50	34x4	6.50	1.95	36x4½	9.00	2.70
30x3½	4.50	1.55	35x4	6.75	2.00	37x4½	9.25	2.75
32x3½	4.75	1.60	36x4	7.00	2.10	34x5	10.25	3.10
31x4	5.75	1.80	33x4½	8.25	2.55	35x5	10.50	3.15
32x4	6.00	1.85	34x4½	8.50	2.60	37x5	10.50	3.25

We pay all express charges when complete remittance accompanies order. We recommend that you remit in full, thereby saving the express charges and the C. O. D. return charges. With your order for **NN'ER ARMOR TIRES** we will furnish our exclusive agency proposition, which will give you an opportunity of establishing a profitable business in your territory.

Auto Owners' Tire Factory, Michigan Ave., Dept. 84 Chicago



YOUR OWN BUSINESS AND A BIG INCOME FROM TIRE REPAIRING

We receive hundreds of letters from enthusiastic men all over the country who are making $2000.00 to $5000.00 a year with Vanderpool's latest improved Tire-repairing Outfits.

28,000,000 TIRES WEARING OUT EVERY DAY

The field is enormous, profits are great. Motorists in your community would welcome the opportunity of having their tires repaired and getting extra mileage.

VANDERPOOL'S VULCANIZER PRODUCES MORE AND BETTER WORK

The Vanderpool Springs save you the work of continually tightening bolts, once set they are always on the job, holding down the tire while it settles in the ribbed-tread molds, until the vulcanizing is finished, resulting in perfect retreads with no separation or blisters.

Send for booklet which shows latest models and sizes and tells you how to make money in this rapidly increasing business.

Write now; a day lost is money lost forever.

In answering Address Dept. 9E.

THE VANDERPOOL VULCANIZING CO.

SPRINGFIELD, OHIO

BATTERY CHARGED FOR 10 CENTS

A 6 Volt 80 Ampere Hour storage battery in good condition will be charged from 1150 to 1280 gravity on 1 K.W. Hour or unit of current costing 3 to 15 cents depending upon your local rate for current, by the

F-F BATTERY BOOSTER

Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current

Bantam—Type 6-6 amp. 6 v. battery....$15
Type 16-8 amp. 6 v. battery.... 20
Type 166-12 amp. 6 v. battery.... 32
Type 1626-12 or 7 amperes in combination for 6 and 12 volt batteries 48

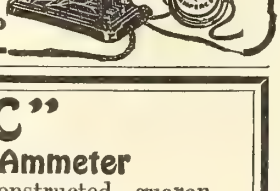
Bantam—Type 12-5 amp. 12 v. battery..$20
Type 112-6 amp. 12 v. battery.. 24
Type 1612-7 amp. 12 v. battery.. 32

$15 AND UP

Shipping weight complete with Ammeter and Battery Clips, 11 to 15 pounds. All outfits do the same work except as to time to complete a charge.

Include postage and insurance charges with remittance for parcel post shipment.

Ask for bulletin No. 12 describing these and other F-F charging apparatus of larger capacities and of other voltages and cycles; also Boosters that operate on Farm Lighting Plants and Direct Current.



THE FRANCE MANUFACTURING CO., Cleveland, Ohio



"MAC"

Vest Pocket Ammeter

The only scientifically constructed, guaranteed dry cell tester. Simple one-piece aluminum dial construction with no soldered connections makes it long lasting and fool-proof. Genuine Bakelite case. At leading dealers or send $1.25 with dealer's name to the

INTER-STATE AUTO PARTS CO., Inc.

1778 Broadway, New York City, N. Y.

No ammeter at the price is as good.
No ammeter at any price is better.

Aladdin's Lamp

By CHARLES S. WOLFE.

(*Continued from page* 33)

time that he made his first simple bend in a piece of glass tubing heated over a Bunsen flame, until the completion of his *first successful lamp,* it seemed to Johnny that life was just one d—— hot thing after another. Glass in general, and hot glass in particular, has several annoying habits. Any one so minded can readily demonstrate this to his own satisfaction, and almost before Johnny had learned that he could easily blow a bubble of hot glass, he had found that he could even more easily burst a bubble of hot glass. Then there had been the question of *pumps.* At the outset, Johnny had known just a trifle less than nothing at all of the methods employed and the tools used to produce a vacuum. He was now a wiser, but fagged-out man. But as a reward for his labors he had built his pumps, had constructed gauges, had created bulbs, had mastered the trick of sealing in electrodes, had conquered.

Shutting the door of the laboratory behind him, he crost to the table and picked up a tube, a three electrode De Forest type bulb which he had recently constructed. Turning it over idly in his hands he fell to musing. Mentally he reviewed the features of the tube, its capabilities and its limitations. Many things it could be made to do. Many it could not be made to not do. Static, just for instance. Static! You got your signal, yes, many times amplified under the proper conditions, but the way it *amplified* static was criminal!

Why? mused Johnny, why can't it be made to ignore static any way? What is static, in the first place! The accepted theories, glib enough, raced across his mind in review. The attempts that had been made to eliminate it. Circuit after circuit, loop and buried antennae. Yes, even submerged! Now, thought Johnny, arrange your circuits as you will and your chain is no stronger than its weakest link. In trying to eliminate the static disturbance, you're almost bound to weaken the incoming signal.

A couple of nights later, he was finished, and his handiwork lay before him ready for the test. At midnight, he straightened up, disgusted. Failure, and a bad one at that. The blame thing wouldn't function at all as he expected; the results it did give were far inferior to other bulbs he had constructed. In the darkness, in bed, his body resting, but his mind refusing to call it a day, he thought on. Suddenly, as if a voice had spoken into his ear, the word "Gas" came to him. Gas! Well, he would try it.

The decision cost a couple of weeks' work. Gas after gas, from coal to hydrogen, had gone into that obstinate tube without helping matters in the least. Thoroly disgusted by now, he straightened up one night, tube in hand, his eye searching the particular spot on the wall where it would give him the greatest satisfaction to shatter the offending bulb. One of the greatest inventions of the age trembled on the brink of destruction. Then his hand fell. Combination! A couple of gases; that might be the secret. Followed more wearying work. Combination after combination failed to give the desired results.

One evening, more listless than was his wont, he came into the laboratory, prepared to give the tube another test. This time he had filled it with a previously untried combination. He connected the bulb in circuit with his conventional radio apparatus, using the same circuits for the additional electrodes that he had used thruout his experiments with the thing. He closed the antenna switch carelessly, and lit the filament, idly making other needed adjustments

with one hand for a smouldering cigarette had the other occupied. Suddenly there was a roar in the 'phones, making him jump involuntarily, then silence—dead silence.

A quick glance showed the bulb to be burning the same as before, quick readings of his meters showed what he thought to be proper voltage pressures on the various electrodes. Puzzled, he stript off the headset, preparatory to searching out the cause of this sudden trouble. Something caused him to screw off the cap of one of the receivers, and as the diafram was exposed to view he gave a whistle of astonishment. BENT! Pulling it aside, he glanced at the magnets. Suspicion waxed, and he began to test the windings. A few seconds sufficed. Startled, he laid the useless 'phones on the table. "Burnt out," he muttered.

Sadly he surveyed the wrecked headset. The only high resistance receivers in the place. Well, anything that strong ought to make some impression on a polarized relay. Suiting the action to the thought, he soon hooked a relay in the place previously occupied by the 'phones, and once more threw in his antenna switch. With the lighting of the filament, the relay at once gave up the ghost. Thoroly aroused now, he stood staring at the bulb. An inkling of the truth burst on him. He must be receiving a goodly proportion of the radiated energy of some station.

Eyes roaming over the room in quest of something to substitute for the ruined relay, his mind in a turmoil, he stood before the wonderful tube irresolute. Then, struck by a sudden idea, he grinned. Pulling open a drawer, he brought forth a little motor, designed to run on dry cells, a relic of his first experiments. Chuckling, he turned to the tube. "I guess this will hold you, old girl," he laughed aloud, and, disconnecting the uselss relay and sounder, he put the motor in circuit. Up went the antenna switch again. With a frantic whirl the armature spun dizzily. Came the smoke of burning insulation. With an oath Johnny yanked down the switch, but the motor was thru for that evening. *Wireless transmission of power was an accomplisht fact.*

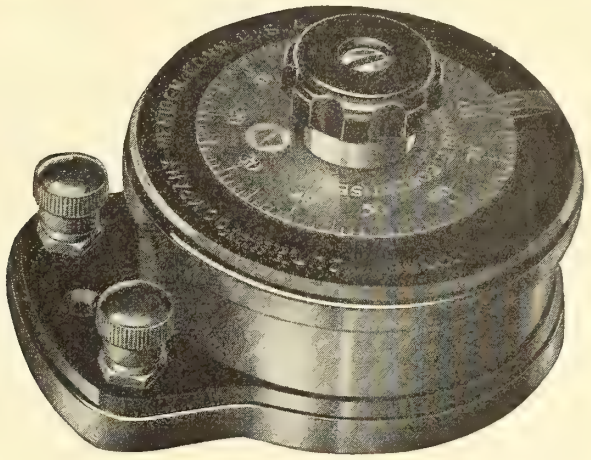
Johnny Hartman dropt into a chair, and sat staring at this creation of his. He was in much the same predicament as a respectable hen, who, with all the best intentions in the world, has been tricked into bringing forth an eaglet.

A thousand unanswered questions racing thru his mind, he strove for composure and methodical reasoning. What were the possibilities of this marvelous lamp? Just what was he receiving, and from where? How could he measure the energy received, and what would have to be the capacity of the meter used? What ——? And then that queer flicker he had received in the brief instants the bulb had been functioning. Was it the fluctuation of a current of Heaven alone knew what strength? Or was it a phenomena entirely new to man?

He was seized with a desire to rush forth and find somebody—anybody—who had knowledge of this type of apparatus, and bring them face to face with this wonder. But second thought restrained him. Some idea of the possible monetary value of this invention began to dawn on him, and he was suddenly very anxious that no one should get an inkling of the things that were transpiring in his humble work shop. Despairing of getting his thoughts out of their chaotic state, and not daring to experiment farther without charting his course and feeling his way, he put out his light and went to bed. But not to sleep. Long he pondered, and some time in the night a thought came, staggering in its immensity, unthinkable, and yet——

The next morning found him incapable of going about his daily tasks. Instead he locked himself in his shop and worked feverishly all day on the queerest piece of apparatus that he had yet evolved. Fin-

CONNECTICUT RADIO



An Entirely New Type *of* Variable Condenser

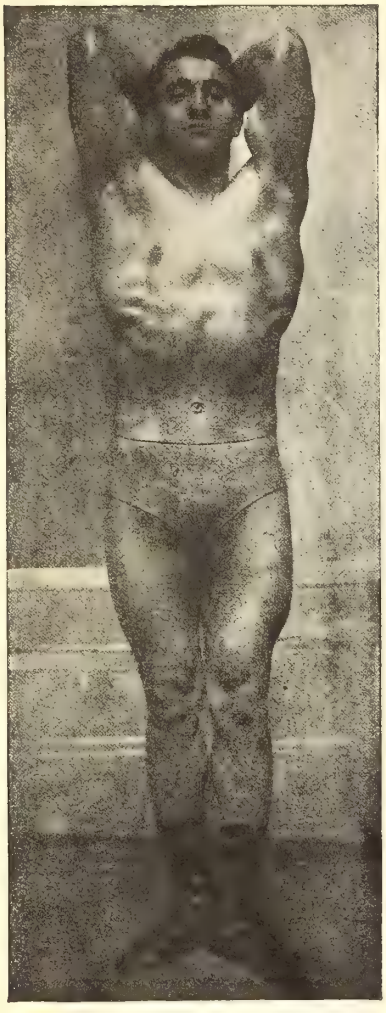
THE CONNECTICUT Research Laboratories have developed a radically new type of Variable Condenser, unique both in design and performance. It is smaller than any other on the market. Much more stable, does not easily get out of order, insures a stronger signal, permits work at the ends of the scale, and obtains much finer adjustments than any previous type.

Send for our booklet "The CONNECTICUT Variable Condenser," which contains much interesting and important new information. Every radio man should read it.

Mention your dealer's name.

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut

STRENGTH



The Biggest "Little" Magazine Ever Published

As one of the readers of "Strength" so aptly states *"Strength is the biggest little magazine ever published."* It is devoted to the interests of good health, and contains many articles of value and interest to those who are desirous of bettering their physical condition.

"Strength" is superbly illustrated, and contains pictures of the strongest and best developed men in the country. The illustrations alone are worth the price of the magazine. "Strength" is now issued bi-monthly and the subscription price is one dollar ($1.00) per year and one dollar and twenty-five cents ($1.25) in Canada and foreign countries. Beginning Sept. 1st, it will be issued monthly. Those who subscribe now will be entitled to receive "Strength" bi-monthly until September, and monthly thereafter. Send in your subscription today.

Subscription Blank

Date.....

MILO BAR BELL CO.
Diamond and Third Sts. Philadelphia, Pa.

I herewith enclose one dollar ($1.00) in payment for one year's subscription to "STRENGTH." ($1.25 Canada and foreign countries.)

Name .....

Street Address.....

City or Town.....State.....

isht, it stood on the table ready for test. With trembling fingers he connected the tube and his latest product in the tentative circuit he had evolved. He dropt into his seat, and his shaking hand reached for the antenna switch. Pausing, his nervous fingers hovered over his apparatus. Long wave, or short? Deciding to try first with the longer waves, he switched in a big loading coil. His left hand closed over the handle of his aerial switch, his right reached for a snap switch near at hand. Came a click, and the room was plunged in darkness. Simultaneously the grating of the blades of the big switch sounded in the darkness.

A queer, flickering light hovered over the whole front of the big mysterious box he had given the day to building. It grew brighter, waned, grew brighter. Hartman's breathing, unknown to him, filled the room with hoarse sound. Vague shadowy blotches appeared and disappeared on the front of the new cabinet where that weird light played. Hartman was tuning frantically, inductance switches and condenser handles twirling under his perspiring touch. And then, suddenly clear cut and bright, it was there on the cabinet front, *the moving picture.*

Incredible, but no less a fact. A stately ship rode majestically thru a calm sea, the smoke belching forth from her funnels, the white foam curling under her prow. The sharp exhalation of Hartman's pent-up breath broke the silence, as the image blurred and faded under his tuning fingers. Again and again came images, scenes close, and scenes far. On an extremely long wave, a lovely island somewhere in the Pacific had shown in riotous color for a moment, to be followed by a setting sun in some far Western state. Overcome by his emotions, unable to continue, Johnny snapt on the lights and disconnected the aerial. He realized now that on the table before him rested in very truth—*Aladdin's Lamp!*

The only way in which he could account for the phenomena he had just witnest was by the vague theory that he had formulated the night before. It had occurred to him that light rays, traveling thru the atmosphere, caused sufficient friction to set up an E. M. F.,—faint, doubtless, but definite; a current faithfully modulated by every variation of the ray that gave them birth. There came the realization of the power placed in his hands by this device for good or evil. Drunk with power, he arose, grapst a hot-wire ammeter, determined to try the reception of power once more.

As he feverishly made the necessary connections, it occurred to him that if his theory anent the light rays were correct, much of the static disturbances must be due to this source; perhaps unknowingly men had been listening to the stars for years. Chuckling over this, he tightened the last post with his right hand as he once more threw up the antenna switch with his left.

Amid the crash of falling hills and the darkness of fading light, Johnny Hartman's soul left his already lifeless body. Electrocuted by his own invention, his inert form crashed down on the table, splintering to dust that priceless bulb.

And thus they found him many hours later, his face horribly cut by the fragments of what police officer Finnegan called in his testimony at the Coroner's inquest *an electric light!*

(FINIS)

[This story is based on actual possibilities and accords with the cathode ray telephotographic apparatus for transmitting pictures by wire or wireless, as described several years ago in this journal. The theory is right and it certainly seems that if some genius can perfect the proper bulbs and auxiliary details, that "movies" via wire or radio will be as commonplace as the screen movie of today.—Editors.]

Save on SOX



Buy Now Direct

Cut out extra profits. Buy your sox direct at rock-bottom prices — less than present manufacturing costs. Offer good this month only. Last lot sold out fast. Everybody delighted. Never again a bargain like this. Your chance NOW.

Lisle Finish Sox! Extra Strong Heel & Toe

Extra fine quality — positively not seconds — medium weight. Cost you 50c to 75c a pair elsewhere—our price at the rate of per pair..... **only 31c**

Sell by dozen only at $3.75 — a clear saving of from $2.25 to $5.25 per dozen for you. Colors: white, natural, tan—very popular now—and black. Come packed in neat box. Sold only in dozens. Colors and sizes mixed if desired. Order today.

SILK SOX! Best Pure Thread Silk

Absolutely real genuine thread silk. Supreme quality. Guaranteed perfect. Now 3 pair for only $2.95. Best for dress — most comfortable, too. Silk hose indicates the man with money. Get this wonderful bargain now. Better sox than many that sell everywhere for $1.75 per pair. Colors: black, white, champagne, brown, navy, green, purple and gray—assorted if desired, same price, at the rate of per pair..... **only 98c**

Buy now—quick, before they go. We can't replace them today for that figure.

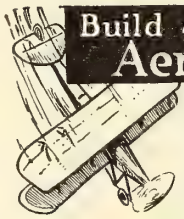
Free Examination

Look at these sox. Examine carefully before you decide to keep them. Thousands of buyers are now wearing Bach Bros. Sox. Some buy six, eight and twelve dozen pair for selves and friends. Order today.

Send No Money

Only your name and address. Sox mailed prepaid. You pay postman cost of sox on delivery. No extra charge of any kind. Guaranteed to please or money refunded. Order now! The risk is ours. Make this enormous saving today. **Be sure to give size and color.** When ordering state Dept. 225

Bach Bros. 20 Years' Satisfying Customera Our Record. References Dun or Bradstreet
115th St. & Michigan Ave., Dept. 225 Chicago



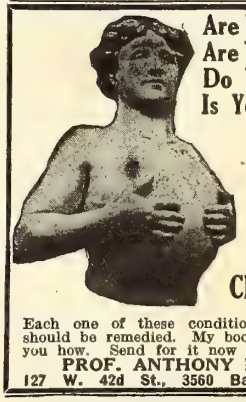
Build and Fly Model Aeroplanes

Learn about Aeroplanes and how they fly. Build a Model Aeroplane that will fly like a real one. With IDEAL Scale Drawings and Building and Flying Instructions you can build exact 3 ft. duplicates of famous 'planes. Send now for Drawings and Instructions for the one you want to build.

N C-4 (4½ ft.) Naval-Curtiss Seaplane
DeHAVILLAND Battle Plane
Curtiss Military Tractor
Bleriot Monoplane
Nieuport Monoplane
Taube Monoplane
35c Each Postp'd

Catalogue of IDEAL Model Aeroplanes and Supplies, 5c if you write at once. Regular price 10c. None Free.

IDEAL AIRPLANE & SUPPLY COMPANY
Making Model Aeroplanes Since 1911
159-161 Wooster St., Cor. West Houston St., New York



Are You Flat Chested? Are Your Lungs Weak? Do You Lack Vitality? Is Your Carriage Faulty?

If any of these conditions fit your case you urgently need my book.

CORRECT BREATHING and CHEST EXPANSION

Each one of these conditions can and should be remedied. My book will teach you how. Send for it now before you forget. **25c coin**

PROF. ANTHONY BARKER, D. C.
127 W. 42d St., 3560 Barker Bldg., New York



Learn Navigation by Mail Hundreds of officers needed by big shipping companies and merchant marine. Captain Warren Sheppard, formerly instructor for U.S. Shipping Board, will tell you how to qualify.

SALARIES UP TO $412 PER MO. AND EXPENSES

Write immediately for valuable free booklet, "Your Future is on the Seven Seas."

WORLD TECHNICAL INSTITUTE
Dept. 10, Fuller Bldg. Jersey City, N. J.

THE PERFECT VACUUM TUBE COMBINATION

PRESENTING TWO *NEW* TYPES OF VACUUM TUBES FOR EXPERIMENTERS

—the De Forest 20 Audion Detector and the Moorhead VT Amplifier-Oscillator: perfected to meet the increasing demand for tubes of superior efficiency, wherein all desirable characteristics are combined without subordinating any essential elements.

THE DE FOREST 20 AUDION DETECTOR

Type 20 combines all the advantages of the tubular type De Forest audion, in its extreme sensitiveness as a detector, with those of the Navy standard base. This tube is of the so-called "soft" type, requiring relatively low B battery potential, and is unexcelled as a detector.

Both types of tubes are of unusually rugged construction.

THE MOORHEAD VT AMPLIFIER-OSCILLATOR

The VT Amplifier-Oscillator is similar to the Navy "hard" tube, and is designed and manufactured expressly for amplification and oscillation purposes.

A combination of two or more Moorhead tubes as amplifiers with a De Forest tube as the initial detector or oscillator is the ideal receiving combination for long distance amateur or long wave reception.

These Tubes are Licensed under the De Forest Audion and Fleming Patents.

PRICE $7 EACH

Specify full names of tubes when ordering. Orders may be placed through a dealer or sent direct, with check, draft, or money order, to the Laboratories. Immediate delivery.

Dealers—write for prices and particulars.

PACIFIC RADIO SUPPLIES CO., SAN FRANCISCO

SOLE SALES AGENTS FOR MOORHEAD LABORATORIES, Inc.

REFERENCES, THE AMERICAN NATIONAL BANK, SAN FRANCISCO.

Through Yellowstone with an Auto-Wheel

It makes a dandy hike. You can load all your baggage on the

Auto-Wheel Coaster

or the

Auto-Wheel Convertible Roadster

and see all the sights. See Old Faithful Geyser shooting a column of steaming hot water 125 feet in the air, or a thousand other wonderful things.

The Auto-Wheel Coaster or Convertible Roadster is a mighty dependable helper on such tramps. It carries all the baggage—even a 1,000 pound load is carried without effort. Roller-bearings make the Auto-Wheel pull easily over most any old road.

You may not be able to hike through Yellowstone but the woods 'round your home will make a fine hiking ground. Try it some day.

Our New Magazine for Boys

tells how fellows are making hiking trips. We'll be glad to send it to you. We'll also send you a **Free Felt Pennant** and tell you about the Auto-Wheel Coaster Club which you can organize, if you write telling us the names of three coaster dealers, mentioning which handles the wagons with the name "Auto-Wheel" on the sides.

The Buffalo Sled Co.,

163 Schenck St.N. Tonawanda, N. Y.

In Canada: Preston, Ont.



PROSPECTIVE STUDENTS

B. C. N. will give you your N.D. degree in two years, day and night classes. This institution teaches Electrical Therapeutics, Static, High Frequency, Violet Ray, Galvanic Current, X-Ray, Osteopathy, Orthopaedics, Chiropractic, Psychology, as embodied under the Triplicity of Sciences known as **Natureopathy.** The field is unlimited right now for Natureopathic Physicians. Our experienced faculty of fourteen practical physicians will guide you surely and carefully to attain success. Earn while you learn if you so desire. Graduates of single branch schools who are here now say that the Blumer System is the most wonderful drugless healing system in existence. Write today for our catalogue. Start right. Address Executive Secretary,

BLUMER COLLEGE of NATUREOPATHY
97 Ann St., Dept. H., Hartford, Conn.

15 cents postage will bring to you "The Scientific Natureopath." Address Publicity Dept. of the above college.

Earn $75. a Week!
See page 7

You can be a DRUGLESS PHYSICIAN

A well-paid profession is open to you. The field beckons to both men and women. Combined home study and college course. Heal without drugs. Free catalog. International College of Drugless Physicians, Dept. E.E.5 4200 Grand Blvd., Chicago.

ALL THE PARTS AND PLANS



75c (no stamps) 1920 Circulet 4C. Other models we make are New York Wasp, Philadelphia Bee, Far Flier, Cloud Clymer, Niagara Moth, Air Bug and Constructo Outfit. All cloth wings, favorite colors. Address: Mail Order Dept.

HERE BOYS
NIFTY NOVELTY & TOY CO. Newark, N. J.

The Electrical Machinist

By H. WINFIELD SECOR

(*Continued from page 49*)

hold on each pulley, that is, driver and driven, is very good, but where the belt becomes loose, this does not appear from the writer's experience, to be as satisfactory as the 45 degree or similar angular drive. A 30 degree drive is also very good, this lying between the horizontal and the 45 degree drive. From the 45 degree onward toward the 90 degree or vertical drive, the efficiency of belt transmission appears to fall off until it is at its lowest efficiency on the 90 degree or vertical angle. This is the poorest drive possible as careful tests have shown, and as much as 66 per cent of the power at the *driver* shaft at the top may be lost in transmission via the vertical belt drive to the *driven* shaft at the bottom.

On any size or width of belt drive the highest efficiency is always obtained when the belt is cemented or made *endless*, as it is called in machine shop parlance. If the belt is to be laced, a good pig-skin lacing is about as satisfactory as any, altho there are several very good lacing hooks on the market which work very well if properly installed. But on small drives such as bench motor work and other small machines, laced belts are not eminently satisfactory, and an effort should be made to make a cemented joint in the belt, of uniform thickness with the rest of the belt. There are available from belting and machinery supply houses various forms of clamps for holding the two ends of the belt in position while it is cut and properly tapered to make a cemented lap joint, where the belt cannot be removed from its pulleys and cemented out of its normal position, so that one can work on it. Various turns sometimes have to be made in belt drives, especially with round belts, a right-angle turn being shown at Fig. 2B.

At Fig. 2C a useful wrinkle is shown, where an idler pulley, which is usually mounted on an adjustable arm counterbalanced by a weight or else a spring, is brought into play so as to insure the proper arc of contact on the smaller pulley, where a belt drive is to be made at short range. Generally speaking, and wherever possible, the distance between centers of the driver and driven pulleys should be not less than three to four times the diameter of the larger pulley. In thousands of cases, however, and wherever there is no other way open, the scheme shown at Fig. 2C with the idler pulley, is very sucessfully used, and the friction between the belt and the pulleys is efficiently controlled by means of the idler pulley.

At Fig. 2D a novel form of belt drive is illustrated which the writer saw some years ago in a large electric power station. This might at first be thought to be applicable only to small motor drives and the like under certain special or freak conditions, but it might be surprising to know that the driver or larger pulley was the fly-wheel of a 500 H.P. steam engine, while the two smaller belt pulleys were on the shafts of two 200 H.P. arc lighting dynamos. The two belts past over the fly-wheel pulley in the maner apparent and a very strong frictional contact was obtained by this novel drive; this peculiar arrangement having been necessitated by the peculiar alinement of the three machines in a certain amount of floor space in this power station.

The method of obtaining reversed direc-

(*Continued on page 83*)



THE REALITIES OF MODERN SCIENCE. An introduction for the general reader. By John Mills. Illustrated, 322 pages. Cloth covers, size 6 x 8 inches. Publisht by the Macmillan Company, New York, 1919.

In this general treatise on the practicabilities of modern science, the author has, we believe, given the layman and student of scientific matters, such as the electron theory, much food for thought. The text has been written in a clear style and in the few places where mathematics appear they are explained so that anyone can understand them.

The author starts with the "Beginnings of Knowledge" and speculates philosophically in an interesting manner just how man first started to use tools, how and why he first made fire, etc. Then he tells of machines of the ancient world; weights and measures; the beginnings of science; the realities of science; the molecular composition of matter; some uses of mathematics; rates of energy; force—mathematically considered; molecular motions and temperature; motions of electrons; interactions of moving electrons, including the hypothesis of the action of magnets, for example—why two magnets attract or repel, etc. The chapter dealing with the explanation of the famous Millikan experiments is certainly commendable and one that tells the story so that the lay reader can grasp it. All in all, the work is highly recommended as a "recreation in scientific literature, but for the student who wants to learn such matters quickly and thoroly, this treatise is too drawn out and not sufficiently illustrated.

THE ELEMENTS OF ASTRONOMY. By Charles A. Young, Ph.D., L.L.D. Profusely illustrated, 464 pages + 42 pages of Uranography, and 4 double page star maps. Cloth covers, leather back. Size 5¼ x 7½ inches. Publisht by Ginn and Company, New York, 1919.

Without a doubt this well-known astronomy test-book by Prof. Young is the best that can be put into the hands of the average student. It should prove to be of inestimable value in all school work, and equally of value to the home-study enthusiast. The illustrations are particularly clear and plentiful as well. One is amazed at the great variety of subjects covered in this one book.

For example, you hardly ever find a small, general treatise on astronomy which says very much about large telescopes—but Young tells you all the essentials of telescopy in clear unmistakable language. He explains why a refractor is superior to a reflector mirror telescope, and why this will probably always remain so.

Every single fact worth knowing on astronomical topics can be found. The reviewer tried to stump it—but the book was there every time with an answer. Young answers such questions as—What is the ecliptic; the earth's interior; gravity; the azimuth and zenith, photography of heavenly bodies; the mountains of the moon; the three librations of the moon in its orbit; is there water or atmosphere on the moon?; sun spots; solar heat constant; sun motors; frequency of solar and lunar eclipses; celestial mechanics; the sun's and moon's tide producing powers; tidal waves; the planets—how to know them; comets—their photography; the spectoscopic study of stars, etc., etc.

PRINCIPLES OF TRANSFORMER DESIGN. By Alfred Still, Professor of Electrical Design, Purdue University. Illustrated with 67 line cuts. 204 pages. Cloth covers. Size 5½ x 8 inches. Publisht by John Wiley & Sons, New York, 1919.

There has been a distinct and noticeable dearth of literature on transformer design for some reason or other, and so this new manual of design by Prof. Still will undoubtedly meet with a ready response. Of course the subject of transformer design cannot be treated without mathematics, but the author has managed to keep most of the text in sufficiently readable form for the non-mathematical reader.

The various types of transformers are discust and examples of design procedure shown. Different methods of core construction receive due attention, as also the insulation and ventilation of transformers, particularly the insulation of high potential transformers. Other sections cover such practical and important topics as: The efficiency and heating of transformers; magnetic leakage in transformers; procedure in transformer design; transformers for special purposes—including those for large currents and low voltages; constant current transformers; auto-transformers, showing the superior efficiency of this type for a certain range of work and its design characteristics; induction regulators of various types for single and polyphase systems.

The Electrical Machinist

(Continued from page 82)

tion of the driving shaft in any case is shown at Fig. 2E, and this is quite often done by crossing the belt. In some cases, altho they are not very desirable owing to the power lost in such a drive, belts used under such conditions having been noticed as wide as from six to eight inches. But this practise is to be strongly condemned and the reversal of direction derived in some other manner, such as by means of suitable friction clutches and the general arrangement of the machinery. Proper efficiency of the drive is here curtailed by the tendency of the belt to turn away from the pulley before it completes the proper arc of contact, i. e., 180 degrees of the pulley circumference or more; and also due to the slapping and friction manifested between the two rapidly moving sides of the crost belt.

The speed of motors and line shafting, etc., are usually taken by means of an ordinary watch and *speed indicator* or speed counter, shown at Fig. 2F. Engineers usually make use of an instrument known as the *"tachometer"* the needle of which indicates the speed in revolutions per minute, directly, without using any watch or other attachments. The price of a tachometer is, however, quite high, while the ordinary speed indicator can be purchased for about two dollars or less. There are several other methods of checking up the speed of machinery, especially where large pulleys or slow moving pulleys are in question, where a chalk mark on the pulley or belt can be accurately counted as it rotates or passes by the observer. Using the speed indicator shown, there is provided a friction clutch so that the indicator does not move around the dial to indicate the revolutions of the shaft until the instant that the operator wishes to start his minute or one-half minute as the case may be, as he looks at the second hand of his watch. The rule for determining quite closely (ignoring belt slippage which is always a variable factor), by counting the number of times the chalk mark on a belt past by the observer in a minute, is as follows:

By means of a tape measure or a six-foot rule, the inside length of the belt is first determined, then a white chalk mark is made on the outside of the belt and the machinery started. Say this belt passes by the observer ten times in one minute and if the length of the belt is thirty feet, then the speed of the belt in feet per minute is 10×30 or 300 feet per minute. With a tape measure, or else by computation, the circumference of the pulley the speed of which is to be determined is carefully measured. Suppose that this is 20 feet; accordingly, the speed of this pulley in revolutions per minute (R.P.M.) would be 300 divided by 20 or 15 R.P.M. The circumference of a circle is equal to 3.1416 times the diameter. If the diameter is measured in inches, then to find the circumference in feet, the product should be divided by twelve. Of course this is all very simple on a slide rule if you are accustomed to using one, and if you have much of this work to do you will save much misdirected energy by at once going to your nearest engineers' supply house and buying yourself one, and they are available for one dollar and up. Here's how to make a slide rule for 10 cents—and a very accurate one, too, so that you can multiply and divide decimals to your heart's content. From an engineers' supply house, such as Keuffel and Esser, New York, purchase a sheet of ruled logarithmic paper for a few cents. Cut two



"Don't tell me you never had a chance!

"Four years ago you and I worked at the same bench. We were *both* discontented. Remember the noon we saw the International Correspondence Schools' advertisement? That woke me up. I realized that to get ahead I needed special training, and I decided to let the I. C. S. help me. When I marked the coupon I asked you to sign with me. You said, 'Aw, forget it!'

"I made the most of my opportunity and have been climbing ever since. You had the same chance I had, but you turned it down. No, Jim, you can't expect more money until you've trained yourself to handle bigger work."

There are lots of "Jims" in the world—in stores, factories, offices, everywhere. Are *you* one of them? Wake up! Every time you see an I. C. S. coupon your chance is staring you in the face. Don't turn it down.

Right now over one hundred thousand men are preparing themselves for bigger jobs and better pay through I. C. S. courses.

You can join them and get in line for promotion. Mark and mail this coupon, and find out how.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6230, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Car Running	☐ Outdoor Sign Painter
☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ BOOKKEEPER
☐ Mechanical Draftsman	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Ship Draftsman	☐ Traffic Management
☐ Machine Shop Practice	☐ Commercial Law
☐ Gas Engineer	☐ GOOD ENGLISH
☐ CIVIL ENGINEER	☐ Common School Subjects
☐ Surveying and Mapping	☐ CIVIL SERVICE
☐ MINE FOREM'N OR ENG'R	☐ Railway Mail Clerk
☐ ARCHITECT	☐ STATIONARY ENGINEER
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

INDEX to **ELECTRICAL EXPERIMENTER SCIENCE & INVENTION**

For Vol. 1, 2, 3, 4, 5 **15c**

EXPERIMENTER PUBL. CO.
Book Dept., 231 Fulton St., N.Y.

10 LESSONS FREE

Learn Public Speaking

Write—quick—for particulars of this extraordinary offer; an opportunity you will never forget if you take advantage of it. Ten lessons in effective public speaking absolutely FREE to those who act promptly. This offer is made to introduce our course in localities where it is not already known.

NEW, EASY METHOD

We teach you by mail to talk before club, lodge, board meetings, respond to toasts, make political speeches, etc. Become a powerful and convincing speaker, overcome stage fright. New method, easy and simple. Do not let this chance escape you.

SEND THIS FREE COUPON

This special offer of Ten Lessons Free is made strictly for introductory purposes and for a limited time. Write now before it expires and receive full particulars by return mail. No obligation. Simply tear off and mail this free coupon. Dept. 7445
NORTH AMERICAN INSTITUTE, Manhattan Bldg., Chicago

FREE LESSON COUPON

NORTH AMERICAN INSTITUTE
7445 Manhattan Building Chicago, Ill.

I am interested in your course in Effective Public Speaking and your offer of ten lessons free. Please send full particulars. This request places me under no obligation of any kind.

Name.....

Address.....



EQUIP YOUR CAR AT ONCE WITH THE

"ALSOP-ALL-SPARK"

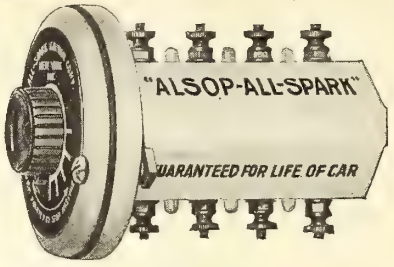
SAFE — SIMPLE — SURE

It eliminates the cost of new plugs, by causing old, cracked, carbonized and oil soaked plugs to give powerful sparks, which retards carbon, saves gas, develops greater power, and insures continued driving without misfires.

Control is from a handsome dial on dashboard, so that a low voltage hot spark can be used for starting.

NOTE:—This device does not contain **DANGEROUS EXPOSED SPARK GAPS**, which may **SET YOUR CAR AFIRE** and make your engine **HARD TO START.**

WRITE for our great Catalogue of GOVERNMENT TESTS.



Controlled from a handsome dial on dashboard.
PRICE: 4 cylinder type $7.50 with money-back Guarantee

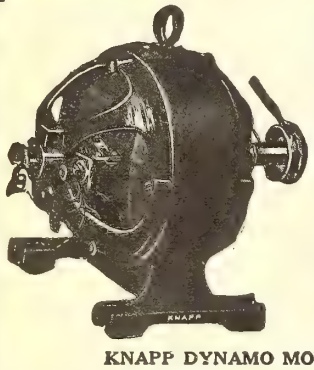
DEALERS—AGENTS—SALESMEN—WANTED

ALL-SPARK IGNITION CO., Inc. - 13X Water St., New York

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

Motors, Electrical Toys and Specialties Are Best

Knapp Goods have stood the test for 29 years. No detail in construction has been spared to make them the best that money can buy. The complete Knapp line includes Toy and Power Motors, Generators and Dynamos. Specialties and Novelties that amuse and instruct. Fans, Rheostats, Compasses, etc. And Knapp prices are always lowest. Always insist on Knapp Goods.



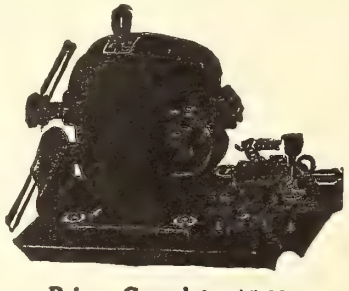
KNAPP DYNAMO MOTOR

Will electroplate, charge storage batteries, run lamps, motors, train of cars, induction coils,—in fact, the number of experiments it can be used for is unlimited. Runs on 4 to 6 Volts or can be connected to run on 110 Volts through a transformer.

Price, Complete, $9.00

KNAPP "LEADER"

An efficient and reliable motor that greatly resembles the big motors of real power plants. Drives from either pulley. Two speeds and reverse. A motor that you will be proud to own and one that will give you unlimited service.



Price, Complete, $5.00

Order to-day. Or your dealer can secure them for you. DESCRIPTIVE CIRCULAR and CATALOG of celebrated **KNAPP MOTORS** *and Electrical Specialties from 10c up mailed FREE on request.*

KNAPP ELECTRIC & NOVELTY CO., 523 West 51st Street, New York City

10¢ OR 25¢ AK **Anti-Kamnia** FOR HEADACHE, NEURALGIA, INFLUENZA AND ALL PAIN-- Ask For A-K Tabs **TABLETS**

LOOK, FELLOWS—SOMETHING NEW!

WIRELESS TELEPHONE COURSE

Covers completely the theory and practice of Electricity, Radio and Wireless Telephone. A small payment starts you in this easy, interesting course. Immediate action will assure you a good future. Vacuum tube and other apparatus furnished each student, free. Write to-day to

Chicago Electrical Engineering Company, Dept. W, 1000 Diversey Parkway Chicago, Ill.

READ THE CLASSIFIED ADVERTISEMENTS ON PAGES 116 TO 119. YOU'LL FIND MANY GOOD THINGS THERE

strips of this paper about one inch wide and mount them on two pieces of cardboard or light wooden strip. The divisions of this paper correspond to those on the standard slide rule and by looking at one of these, or in any handbook describing one of them, you will at once observe how to place the figures from one to nine on them. You can purchase an instruction book on slide rules for fifty cents from the makers of these instruments.

MEASURING THE LENGTH OF BELTING.

It is often necessary, especially where belting is to be ordered without seeing the installation, to compute the length of belt quite exactly, which is required for certain drives. A method of doing this, used by millwrights and engineers very extensively, is illustrated at the diagram Fig. 3. This method is based on the solution of the hypothenuse of a triangle by geometry; it is apparent that the length of the belt required to connect the two pulleys shown at Fig. 3 is one half the circumference of the large pulley D, plus the half circumference of the small pulley d, plus the two slanting sides at top and bottom or H and H. Where the two pulleys are of the same size, H, or the length of one side, is the distance between the two pulley diameters, and is equal to the length between the pulley centers or L. However, when the pulleys are of different diameters, which is commonly the case, then H forms the hypothenuse of a right angled triangle, the base of which, B, is equal to the distance between pulley centers or L, which quantity is easy to determine. The next quantity which we have to determine or measure is A or the altitude of the triangle. This is equivalent to one-half (D minus d). The length of "H" or the hypothenuse, is then found from the formula $H = \sqrt{B^2 + A^2}$.

It is evident that in any case, all of the dimensions must be either in inches or feet. The length of the belt L in inches or feet, as the case may be, is then found by the following algebric expression: $L = \frac{1}{2}(D_c + d_c) + 2 \times H$. Where D_c and d_c are the respective pulley circumferences.

RELATIVE SPEED OF PULLEYS.

Probably the most important calculation which the young electrical machinist is interested in, in belt drives, is the relative speed of two or more pulleys. Taking two pulleys of respective diameters D and d, the relative speeds are in the same ratio as the one diameter is to the other. In any case, the dimensions must be either in inches or in feet, and all the speeds in a given problem, figured in either revolutions per second or revolutions per minute. Then:

$$D = \frac{s \times d}{S}; \quad d = \frac{D \times S}{s}; \quad s = \frac{D \times S}{d};$$

$$S = \frac{s \times d}{D}$$

The relative speed of two toothed gears are very positive as there is no slippage of pulleys or belts to alter the relation even in the slightest degree, and the speed of the driven gear is exactly proportionate to the ratio of its number of teeth and the number of teeth on the driver. If the driver has 100 teeth and the driven 50 teeth, then the ratio of the small gear to the larger is two to one and the speed of the shaft carrying the small gear will be twice the speed of the shaft carrying the 100 tooth gear. If the 50 tooth gear was made the driver and the 100 tooth gear the driven, it would rotate at one-half the speed of the driver.

(In the next installment we will consider the various forms of gear and chain drives.)

Experiments In Physics

By JOHN J. FURIA, A.M.

(*Continued from page* 41)

drawn out, making the right side longer than the left side, the sound grows fainter and fainter until finally it is practically zero. As the tube is drawn out further, the sound increases to a maximum and then decreases to zero again. At the zero points the sound coming to the ear is practically silence; the waves coming from each side of the tube are opposite in phase and neutralize each other or *interfere*. The above case is one where the sound waves neither come from different sources nor are reflected, the difference in phase is produced on waves from the same source by a change in the size of the path traversed.

INTERFERENCE BY REFLECTION.

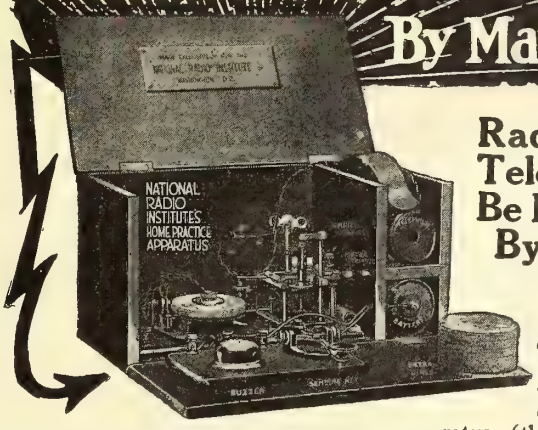
Sound waves can also *interfere by reflection*. Attach a thin cork about an inch in diameter to one end of a brass rod three or four feet long. Clamp this rod firmly in the middle as shown in Fig. 5. Slip a piece of glass tubing a little over an inch in inside diameter and three or four feet long over the cork as shown in the figure, and stroke the brass rod longitudinally with a resined cloth. A loud shrill note will be heard. Now scatter some cork dust inside the glass tube and repeat the experiment. The cork dust will be agitated and will form little piles at regular intervals (maximum agitation) alternated by points of rest. This is a case of *interference by reflection*. The sound waves striking the cork at the end of the glass tube are reflected and alternately reinforce and neutralize each other, and the cork dust in the tube is agitated at the reinforcements and remains at rest at the neutral points.

INTERFERENCE OF LIGHT WAVES.

In *Light* interference phenomena are almost innumerable. They are detected in the form of bands (*Interference Bands*). Since light is a wave phenomenon, if we cause two different beams coming from different sources or two parts of one beam coming from the same source to arrive at a point in opposite phases, they *interfere* and an extinction of the light occurs; where they arrive at the same phase reinforcement occurs. The above condition can be brought about in many ways, the simplest being by the reflection of the beam from two surfaces of a thin medium. If a plano-convex lens of slight curvature is placed on a piece of plate glass, and a ray of light strikes it near the point of contact T, the ray will in part go thru the lens and be reflected at C to the eye at E and in part will go thru the air space and be reflected from D to the eye at F (F and E practically coincide because of the very small distance between D and C). See Fig. 6. When the two portions of the ray AB reach the eye at E and F, they will differ in phase by the difference in length between the lines EC and DF, and if this is such as to cause the rays to be in opposite phase, they will interfere and the eye will see alternate bands of brightness and darkness in monochromatic light or alternate bands of colored light in white light. (Since white light is composed of different colored lights, interference will produce darkness of different colors in the different bands, and overlapping brightness of different colors.)

Let two pieces of plate glass about one-half inch wide and three or four inches long be separated at one end by a thin sheet of paper while the other end is clampt tightly together. This will give us

LEARN WIRELESS
By Mail - In Ten Weeks



Radio Telegraphy and Telephony Can Now Be Mastered at Home By Marvelous New Method.

THROUGH our famous Home Study Course and with the help of our specially designed Home Practice Apparatus (the Natrometer) you can now learn both Wireless Telegraphy and Telephony in a few short weeks, in your spare time and at home—without inconvenience or loss of time from work. Students of this institution have finished the course and secured their official license after approximately only three months' study.

This Fine Natrometer Outfit Given

to Students of the National Radio Institute. It is a wonderful set, specially made for us and comes in neat, strong carrying case. Comprises Standard Automatic Transmitting and Receiving Set for use throughout the course. These fine instruments are yours to keep when you finish the course.

Special Privileges to N. R. I. Students

Students of the National Radio Institute receive the following:

Complete combined course in Wireless Telegraphy and Telephony. (This is the first school to teach wireless telegraphy and telephony by mail.) Special Post Graduate Course;

Five text books — one hand book —46 Special Lessons and 18 personal Examinations;

Complete natrometer Home Practice Set;

Membership in the N. R. I. Relay League and handsome blue and gold membership pin;

Large Diploma suitable for framing;

Personal Help in securing a wireless position, and endorsement of institute officials.

Choice of correspondence instruction or personal class at either of our two local schools in Washington (Special Summer Class Now Forming).

FIRST GRADE LICENSE GUARANTEED

Our complete course is so thorough and our method of instruction so practical that we are able to guarantee that after successfully completing our course you will be able to secure a First Grade Government Operator's License.

SALARIES UP TO $15,000 A YEAR

Our graduates start work as Senior Operators at $125 a month with all living expenses paid. Advancement is rapid to high positions with bigger pay, as follows:—Radio Aids $6 to $15 a day;—Aerial Mail Service $1,500 to $2,400 a year and 10% bonus;—Radio Inspectors $1,200 to $3,500 a year;—Radio Engineers $2,500 to $15,000 a year. Our Graduates are guaranteed positions upon securing their official license after taking our course.

TRAVEL AND SEE THE WORLD

or locate at one of the many Land Radio Offices in America. Radio presents a broad field of opportunity and activity. If you like travel you can visit foreign countries—if life on the sea or lakes appeals to you there are positions in Coastwise and Lake Shipping Service—if you are best fitted for indoor work and prefer to be located nearer home there are the Land Stations, Manufacturing Plants and Railroads and for real adventure Aerial Mail and Commerce.

SEND This Coupon FOR FREE BOOK

We have prepared a book telling all you want to know about wireless and the future it offers you. Startling facts you are interested in are freely discussed. It tells how we have helped hundreds of ambitious men and women and how we will help you. Send the coupon TODAY or write to

The National Radio Institute

America's First and Foremost
Dept. 210
14th & U Sts., N. W., Washington, D. C.

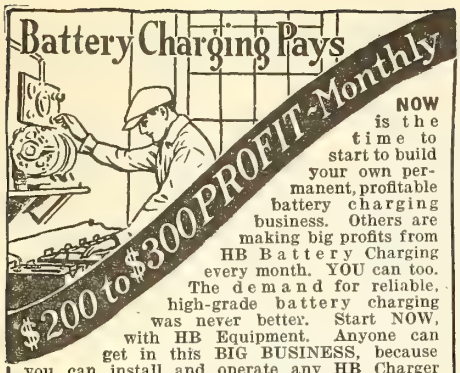
THE NATIONAL RADIO INSTITUTE,
Dept. 210, 14th & U Sts., N. W., Washington, D. C.

Send me your Free Book "Wireless the Opportunity of Today." Tell me about your famous Home Study Course in Wireless Telegraphy and Telephony—your Post Graduate Course, Membership in the N. R. I. Relay League and your Special Wireless Instruments Offer.

Name.....

Address.....

City.....State.....

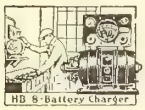


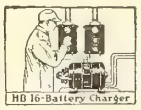
NOW is the time to start to build your own permanent, profitable battery charging business. Others are making big profits from HB Battery Charging every month. YOU can too. The demand for reliable, high-grade battery charging was never better. Start NOW, with HB Equipment. Anyone can get in this BIG BUSINESS, because you can install and operate any HB Charger without electrical or mechanical knowledge.

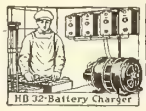
MAKE HB BATTERY CHARGING YOUR BIGGEST MONEY-MAKER

It costs only 10c to 15c each to charge batteries—the customer pays 75c to $1.50. Figure your profits. All HB Chargers are sturdy, dependable and absolutely reliable. Built of practically wearproof materials. Nothing to burn out, no expensive renewals or repairs. Plain, honest, profit-producing service 24 hours a day. No attention except occasional oiling. Use power from your lighting lines. Big, quick, clean profits, easily made.

An HB Battery Charger for Every Size Business CHOOSE THE SIZE YOU NEED


HB 8-Battery Charger


HB 16-Battery Charger


HB 32-Battery Charger

SMALL CASH PAYMENT—BALANCE ON EASY MONTHLY TERMS—Sold on Trial Under HB Absolute Money-Back Guarantee.

All HB Equipment is sold under our absolute guarantee of complete satisfaction. You run no risks. If not satisfied after using any HB Equipment 10 days, you may return it and receive all you pay us. The HB Monthly Payment Plan is an additional guarantee.

Select the Charger You Need. Check the Coupon Below. Do It NOW

Mark on this coupon the HB Charger you are interested in. Tear it out and mail TODAY. This is your BIG CHANCE. Let us help you start your own money-making business. Be the first in your town to have an HB Charger. Don't delay. Act Now.

---------- TEAR OFF HERE ----------

Hobart Brothers Co., Box 57E, Troy, Ohio.

Send me information about the HB Equipment checked below, and tell me about the HB Money-Back Guarantee and Trial plan:

....HB 8-Battery Charger ....HB 16-Battery Charger ....HB 32-Battery Charger ....HB Belted Charger (Used where electric current is not available.)

Your name.....

Address .....State.....

MONEY IS WAITING for the Electrical Man in the Motion-Picture Field

Specialize in this work and command a better position. Learn the secrets of successful illumination employed by the big moving-picture theatres.

Motion Picture Electricity

By J. H. Hallberg

280 pages, handsomely bound, profusely illustrated. A remarkable book by a practical electrical expert. Explains all electrical terms, formulae and principles, resistance and resistance devices, electric service, wiring, lighting, etc. Also contains practical suggestions and all necessary reference tables on wire sizes and capacity, weights and measures, heat units, etc., etc. Explains the principles of correct illumination, both inside and for advertising purposes. Instructs in the correct projection of pictures. Gives prices of equipment and cost of operation.

Price $2.50 Postpaid

Whether you are a motion picture theatre owner or an ambitious electrical man who wants more money, you need this book. Order your copy today.

CHALMERS PUBLISHING CO.
Room 604, 516 Fifth Ave., New York City

Send To-day for the "Electrical Worker's Friend"

An electrical book of 66 motor drawings with complete instructions for rewinding and reconnecting A.C. motors. Special at $4.00

Or write for full particulars of this valuable book

SMITH & SMITH PUBLISHING CO.
Dept. B. 1524 Lowrie St., N. S., Pittsburgh, Pa.

conditions analogous to the previous experiment, i. e., two pieces of glass separated by a thin wedge of air. Stand the outfit on its wider end (Fig. 7) and place before it a Bunsen flame coming from a burner having a piece of asbestos or filter paper soaked in a solution of common salt at its tip. The flame will have a bright yellow color due to the *sodium* in the table salt, and will for practical purposes give monochromatic light. A series of black and yellow lines will be seen across the plates, the black denoting the neutral light points and the yellow the reinforced points. This experiment must be performed in a fairly dark room. The explanation of the phenomenon is the same as that of the previous experiment.

Most everyone has noticed the colors coming from thin liquid films, perhaps the most common being the film of kerosene on water. The wave is reflected from both the faces of the film and when the reflected beams reach the eye in opposite phases, interference colors are seen.

The classical experiment of Thomas Young performed in 1801 was the first experiment on the *interference of light.* The method is illustrated by Fig. 8. A beam of light is allowed to enter a darkened room, thru a pinhole H. In the path of the beam is a screen of tinfoil having two small holes close together A and B. If either A or B is covered up a bright spot appears on the wall at the point C.

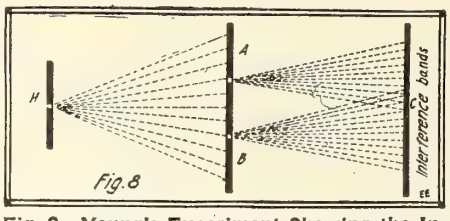


Fig. 8. Young's Experiment Showing the Interference of Light. A Beam of Light Enters a Darkened Room Thru a Pinhole, H. In the Path of the Beam Is a Screen of Tin-Foil Having Two Small Holes, A and B. In It. If Either A or B Is Covered Up, A Bright Spot Remains on the Wall at the Point C; With A and B Open, However, a Round Bright Spot Surrounded by Alternate Dark and Light Circles Is Formed on the Wall. The Light Waves at A and B Here act as Two Waves From Two Different Sources, A and B, and "Interfere" on the Wall or Screen at "C."

However, if both are allowed to remain open a round bright spot surrounded by alternate dark and bright circles is formed on the wall. The waves on reaching A and B act as two waves from two different sources A and B, and *interfere* on the wall.

Obviously, since electric and wireless radiations are waves, interference phenomena occur, but their discussion tho similar is beyond the scope of the paper.

(To be continued)

ATTENTION!!!

RADIO, ELECTRICAL and CHEMICAL laboratory owners, refer to our monthly laboratory prize photo contest for prizes offered for laboratory pictures. We have not received any worth while photos for several months. Now is the time to get busy with that camera and take a photo of your "Lab," and do not forget one of yourself! The more good ones we get, the more we will publish,—so send us some "real Lab" photos by the very next mail, won't you?

DIAMONDS ON CREDIT

WE WILL SEND YOU ANY DIAMOND, WATCH, JEWELRY, SHOWN IN OUR CATALOG FOR *FREE EXAMINATION*


Most Popular Rings

There are 128 illustrated pages of Diamond Rings, Diamond La Vallieres, Diamond Ear Screws, Diamond Scarf Pins, Diamond Studs, Watches, Wrist Watches; also our wonderfully showy assembled Solitaire Diamond Clusters. Our Catalog shows all the standard world renowned Watches—solid gold and gold filled cases. Splendid bargains in 25 year guaranteed watches on credit terms as low as $2.50 a month. We Accept Liberty Bonds

We are offering wonderful values in these and all other Diamond Rings, at **$50, $75, $85, $100, $150 and up.** Every article in our Catalog is priced **unusually low.** Whatever you select will be sent prepaid by us. If satisfied, pay one-fifth of purchase price and keep it, balance divided into eight equal amounts, payable monthly.

Send for Catalog Today

Lowest Prices

Easy Terms

LOFTIS BROS. & CO.
THE NATIONAL CREDIT JEWELERS
Dept. N-22 108 N. State St., Chicago, Ill.
Stores in Leading Cities

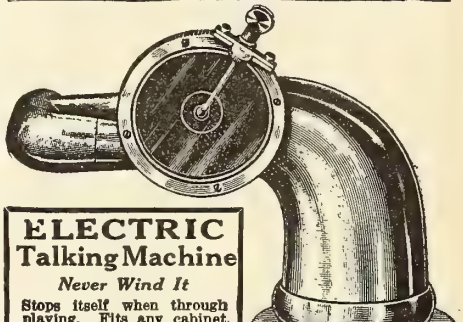
"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 22 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 80 Big Pages, 300 illustrations, 200 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 22 measures 6" x 9". Weight ½ lb. Beautiful stiff covers.

WIRELESS

Send 6 cents in stamps or coin for which we will send our latest Cyclopedia Catalog No. 22 as described.

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City



ELECTRIC Talking Machine

Never Wind It

Stops itself when through playing. Fits any cabinet.

Electro Mechanical Parts Co.
160 N. Wells St., Chicago, Ill.

RAISE HARES FOR US



Big demand. Wonderful profits easily and quickly made raising **BELGIAN HARES** in backyards, sheds, cellars, attics, etc. We furnish guaranteed class A Stock and buy all you raise at $7.00 to $12.00 a pair and pay express. Valuable illustrated book and contract **FREE.**

GENESEE VALLEY FOOD AND FUR ASSOCIATION
25 Gladstone Street, Rochester, N. Y., Dept. No. 86

Telegraph Pictures

BY ELECTRICITY

Complete sets of two machines of this marvelous equipment at ridiculously low prices. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Will transmit pictures, maps, drawings and hand writing. Picture telegraphing is the coming science. Write today.



J. LEISHMAN CO., Dept. T Ogden, Utah

The Amateur Magician

(*Continued from page* 74)

"Four posts are placed in the table top and thin flexible wires of the same size are fastened to them. These posts may be of wood or may be nickel-plated as desired. The wires fasten into the four glass corners of the glass table, thru which tiny holes have been drilled or other suitable fastening means substituted which fastening means do not have to be very elaborate, as the weight of the arm and hand is quite negligible."

"That is all very fine, Professor," I said, "but how did you know what card I had chosen from the deck?" "My dear man," he continued, "you are a worse magician than I thought you were. Only a month or so ago I told you of the universal pack and here you turn right around and forget it. In addition, you will find that the hand will rap better upon the table, causing a louder sound than on the glass, and sometimes the effect is clearly enhanced if this is done." "Yes, but what made it tap in time with the music when you were sitting at the table?" "Look under the table," he said, "and you will see." A telegraph key in a convenient position revealed there told me the answer—which accounted for the speed of the taps transmitted.

Science in Slang

By EMERSON EASTERLING

(*Continued from page* 63)

and startles the world that light didn't have any specified speed limit and that it didn't always follow the nearest path between two points that school children are forever talking about, but that it sidled up toward Old Sol on its transetheral trip from some speck in space way off in another solar system to our observatories. In the light of Lorentz's and Zeeman's dope, I can't see that Al's line is so startling. Of course he has his place in the sun along with the other *knows*.

"Thomson and Drude tells 'em that the electrons move through atoms of metal like two per cent through a sieve; and from that they began to try and find a place for the electron. We now have it sized up as going to form everything from solid ivory to the paper the Peace Treaty was scribbled down on. They tell us that atoms are built up of electrons, that molecules are built up of atoms, and that that ring on your finger is built up of ——"

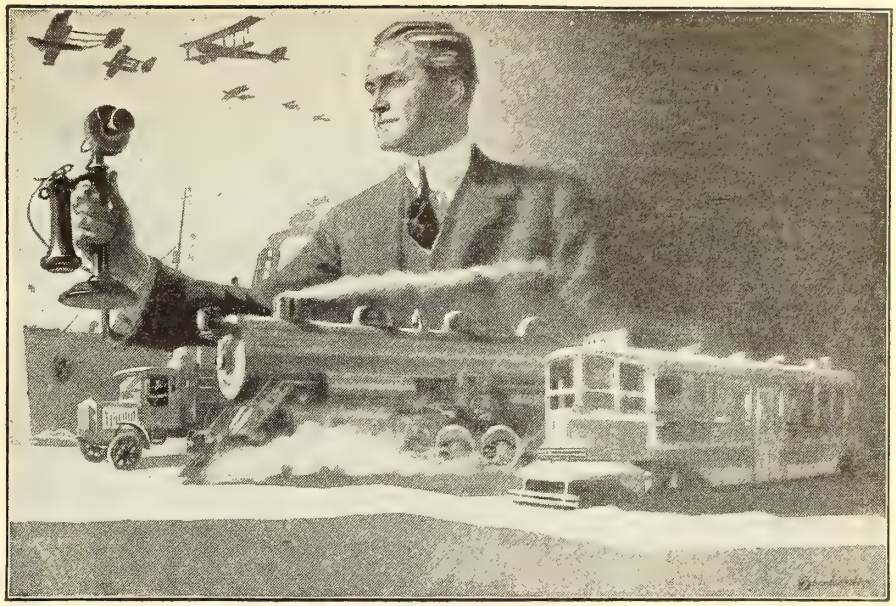
"Brass!" I shouted before he could beat me to it.

"Anyway," he went on, "the electronic theory of the composition of matter bears a striking resemblance to our solar system. The electrons in the atoms resembling our planets in action. In fact it is often referred to as an 'ultra-minute' solar system.

"And how do we know—from this—but that we are to something else as the germs and bacteria are to us—or worse yet, that our Earth is but an electron to some immensely greater constitution; and, on the other hand, that the electron, as we conceive it, an indivisible particle of electricity, is as divisible, could we but fathom it, as is our Earth?

"It's a big world, as the boy from the country said after a trip into an adjoining county, but the universe is so much bigger that the Earth with its world is hardly in it."

"Where is it then, if it isn't in the universe?" I put to him laughingly. But that's neither here nor there.



The Measure of Progress

The progress of the past, as well as that of the future, is measured by criticism—for criticism exists only where there is faith in ability to improve.

We do not criticise an ox cart or condemn the tallow dip, for the simple reason that they are obsolete. During the reconstruction period through which our country is now passing, if the public does not criticise any public utility or other form of service, it is because there seems little hope for improvement.

The intricate mechanism of telephone service is, under the most favorable conditions, subject to criticism, for the reason that it is the most intimate of all personal services.

The accomplishment of the telephone in the past fixed the quality of service demanded today; a greater accomplishment in quality and scope of service will set new standards for the future.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

The Breakers

Atlantic City's Newest Fire-Proof Hotel

Ocean Front. Unusually attractive during the Autumn and Winter seasons.

American and European Plans



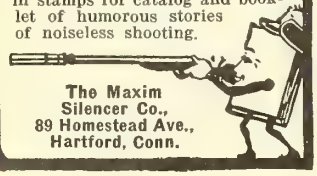
Luxurious lobbies, spacious verandas and sun parlors overlooking the ocean Charming afternoon musicales and evening concerts. A palatial residence for those seeking rest and recreation. Sea water baths. Fireproof garage. Illustrated booklet sent on request.

Shoot Without Noise

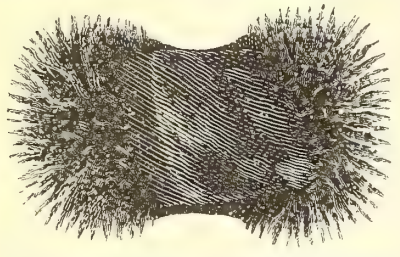
Learn to be a good shot at home. No disturbance even in the house when your rifle is equipped with a

MAXIM SILENCER

Price, .22 cal., $6.00. Send 6c in stamps for catalog and booklet of humorous stories of noiseless shooting.



The Maxim Silencer Co., 89 Homestead Ave., Hartford, Conn.



The Lucky Lode Stone

Have you a cabinet of minerals? Are you interested in scientific or wireless experiments? In aviation—in the magneto, and its magnets? Would you like to solve the unsolved problem of perpetual motion? Would you like to make a Viking compass out of a Lode stone? Do you think you can find an insulation for its magnetism? (so far unfound).

Get a Lodestone!

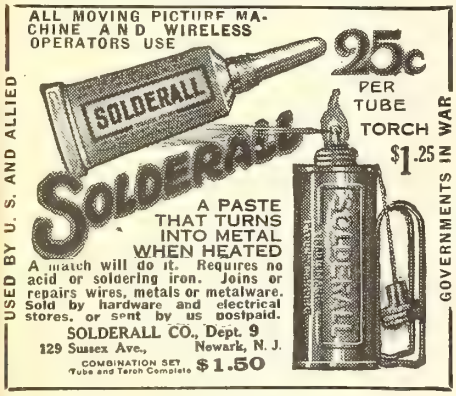
The writer has a few very powerful imported stones for sale—prices ranging from $1 to $5 according to size, shape, beauty and power. Write today.

Eugene S. Todd

113 FULTON STREET NEW YORK

ALL MOVING PICTURE MACHINE AND WIRELESS OPERATORS USE

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR



25c PER TUBE

TORCH $1.25

A PASTE THAT TURNS INTO METAL WHEN HEATED

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. 9
129 Sussex Ave., Newark, N. J.

COMBINATION SET Tube and Torch Complete $1.50

STURDY

THAT'S WHAT YOU'LL SAY when you see this new handy Utility Chest. Built with a solid oak frame, and joints that are not dovetailed, but lock-cornered for extra strength. This chest is a sturdy keeper of tools; bang proof, knock proof, and weather proof. Auto-mechanic, electrician, lineman, will find the right house for his tools in this

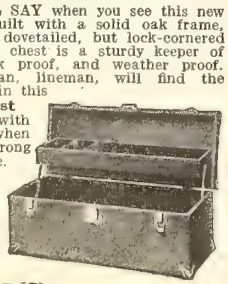
UNION Utility Chest

Note tray that lifts with cover, yet fits snugly when cover is closed. Strong handle, hinges, hardware.

Write for Catalog

prices and name of nearest dealer. Sold on "Satisfaction or Money-Back" guarantee.

UNION TOOL CHEST CO., Inc., 36 Mill Street, Rochester, N. Y.



UNION TOOL CHESTS

The "Lodestone" or Natural Magnet

By EUGENE S. TODD

(*Continued from page 27*)

sustain four ounces of iron, but which when capt, according to his method, with finest steel and close fitting, could support twelve ounces. But, he calculates, on the greatest force of a combination, or rather a united nature is seen when two stones, armed with iron caps are so joined by their concurrent or contrary ends, that they mutually attract and raise one another. In this way, a weight of 25 ounces of iron is raised, while either stone uncapt lifted but four ounces.

Now Galileo went far beyond this, since he was able to fashion by his other artifices, small stones of extraordinary power, such as the one he speaks of;—saying it weighed six ounces and uncapt, it could support one ounce only—whereas when suitably capt it could life one hundred fifty ounces or twenty-five times its own weight. He had this stone with him when writing his "Dialogue" of 1632, when he speaks of its being still in his possession. Later, he appears to have presented it to the Grand Duke Ferdinand the second, as we gather from Castelli's "Discorso Sopra la Calamita."

I have seen a small stone only six ounces in weight, capt with iron by the exquisite diligence of Signor Galileo, and presented by him to the most serene Grand Duke, which holds suspended, fifteen pounds of iron, worked into the form of a sepulchre.

This stone is now preserved in the Tribuna de Galileo, in Florence, Italy, and after 300 years, still holds as firmly as ever, its weight of 15 pounds! Is this not remarkable? The weight as just stated, is in the form of a tomb, a form which was probably suggested by the legend of Mahomet's coffin supported in mid-air by lodestones.

Galileo had always great admiration for Gilbert, and for his great work "De Magnete" publisht in 1600. This book, which came into his hands by chance, appealed to him for two reasons, just because its arguments traversed many of the principles of the Aristotelian school, and secondly because it contained a number of original experiments, coupled with philosophical reflections of a far-reaching kind; all of which appealed to his free and daring spirit.

There are, according to Gilbert, many myths and superstitions about lodestones. For example, that a lodestone rubbed with garlic does not attract iron nor also when in the presence of a diamond. There is another assertion that a lodestone placed unawares under the head of a sleeping woman, drives her out of bed if she be an adulteress, or that by its fume and vapor the lodestone is of use to thieves as if the stone were by nature, given to promote thefts, in that it withdraws bolts and opens locks as Serapio insanely imagines.

DISCOVERY OF THE LODESTONE.

In concluding, let me quote from Gilberts "De Magnete" publisht way back in 1600, or over 300 years ago.

"This stone is commonly called *magnet* either after its finder (not Plimp's mythical herdsman, copied from Nicauder, the hobnails of whose shoes and the front of whose staff, were held fast in a magnetic region, while he was pasturing his cattle), or after the district Magnesia in Macedonia, abounding in lodestones; or after the city of Magnesia in Ionia of Asia Minor on the River Meander; hence Lucretius writes—'It is called Heracleus from the city of Heraclea, or after the unconquerable hero Hercules, because of its great strength and its power and dominion over iron, which is known as the *subduer* of all things.' The lodestone is also called Sideritis, as tho one should say *Ferrarius lapis*, meaning iron stone.

Something New

on a subject that is not understood by many people. This is the question of the relationship between SEX and the PHYSICAL and MENTAL HEALTH.

"The Abuse of the Marriage Relation"

written by an experienced physician, who has investigated this subject and has found it to be the origin of most chronic diseases. This is also the cause of so many unhappy marriages. This is a very valuable book for those who are married or intend to get married; it will avoid considerable unhappiness and heart-aches. This book will be sent you prepaid upon receipt of

50 Cents in Money Order, Stamps or Coin

Natural Life, 110 E. 41st St., New York City

Wire Your Own House! See page 7

SELL SANITARY BRUSHES!

You can make big money because the need of our goods is great! A hundred different kinds of brushes for homes, hospitals, public buildings, garages, barber shops, etc. Splendid sales helps and fine sample cases free to salespeople. Unique plan of gaining entrance to homes by invitation. Credit to reliable people. Learn about the best line sold direct to the user — the big line of everyday, useful home goods!

BIG COMMISSIONS AND PROTECTED TERRITORY

NORTH RIDGE BRUSH CO. Box 32, FREEPORT, ILL.

CATALOG J.

Contains 24 pages of reliable apparatus, standardized parts and raw materials. Complete line switch points, knobs, switches, rod, aerial wire, etc.

Send 5c in stamps for your copy today.

Shotten Radio Mfg. Co., P. O. Box 3, Scranton, Pa.



Send for a Complete Catalog of

MASONIC BOOKS Jewelry and Goods

REDDING & CO.

Publishers and Manufacturers

Dept. 5 200 Fifth Avenue, N. Y.

TELEGRAPHY

Both wire and wireless, and Station Agency taught thoroughly and quickly, BIG WAGES NOW PAID, some of our recent graduates procuring $138.00 per month to start. Great opportunities for advancement. Our school the oldest and largest—annual enrollment 600 students. Endorsed by railway, telegraph, wireless and government officials. Expenses low—chance to earn part. Catalog free. Write.

DODGE INSTITUTE, 22nd St., Valparaiso, Ind.

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 766 Bogue Bldg., Indianapolis



"BOW LEGS and KNOCK-KNEES" UNSIGHTLY

Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.

PERFECT SALES CO.

140 N. Mayfield Ave., Dept. 50, Chicago Ill.



CRIPPLES and those interested in the Handicapped will profit financially, educationally, by reading the only MAGAZINE published to help cripples. Large size, profusely illustrated, constructive, helpful. Year, $1.00; 6 months, 50c; copy, 15c. 150 H. S. BLDG., FARMINGTON, MICH.



Printing Cheap

Cards, circulars, labels, book, paper. Press $8. Larger $25 Job press $100. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE, cards, etc. THE PRESS CO., D-47, Meriden, Conn.

Compressed Air Motors

The New way of propelling your model aeroplane. Built of the finest materials. Guaranteed to be as represented or your money refunded. Engines and Model Aeroplanes built for you from your drawings at reasonable prices. Give us a trial and be convinced. Write for a circular of these wonderful motors. IT'S FREE.

HEC AEROPLANE CO.
345 East 49th Street New York City

YOUR FUTURE

depends upon the use you make of present opportunities. Write now for literature explaining our day and evening courses in Chiropractic, the greatest science of the age. Hurry for prices advance soon. New classes forming now.

The New York College of Chiropractic
1416 Broadway, New York City



SAVE 25% to 60%
on slightly used
GRAFLEX-KODAKS
Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. **All goods sold on 10 days' Free Trial. Money back if not satisfied.** You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.
CENTRAL CAMERA CO., Dept. 115 124 S. Wabash, Chicago



Cleartone Phonographs
$4.00 to $200.00 Retail
Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.
LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B East 12th Street, N. Y.

Learn Watch Repairing
Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates.
Ask for our Free Book. It explains our system and terms.



THE DeSELMS WATCH SCHOOL
720 Perry St., ATTICA, IND.

Learn the Sign-Show Card Business
Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.
EARN $25. TO $75. WEEKLY
You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.



DETROIT SCHOOL OF LETTERING, 685 D- S. L. Bldg. Detroit, Mich.

AVIATION Information FREE
Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.
AMERICAN SCHOOL OF AVIATION
DEPT. 7745. 431 So. Dearborn St., CHICAGO

Music Lessons UNDER MASTER TEACHERS At Home
Complete Conservatory Course by Mail
Wonderful home study music lessons under great American and European teachers. Endorsed by Paderewski. Master teachers guide and coach you. Lessons a marvel of simplicity and completeness.
Any Instrument Write naming course you are interested in: Piano, Harmony, Voice, Public School Music, Violin, Cornet, Mandolin, Guitar, Banjo or Reed Organ —and we will send FREE CATALOG. SEND for it NOW!
University Extension Conservatory, 6307 Siegel-Myers Bldg., Chicago

STAMMER NO MORE
Kill the fear of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Write for a copy today.
THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago

YOU Can Double Your Ability to Earn Money! Hold Friends! Win Love and Happiness! Our System of Personal Efficiency tells you **how!** Success Studygram and Personality Sketch for 10c and birth date. Thomson-Heywood Company, Dept 350, Chronicle Building, San Francisco.

Some Laboratory!!

By THOMAS REED.

(*Continued from page* 45)

blacked our shoes—mostly on Sunday mornings.

Finally, after years of strategic warfare, I overran the most sacred place of all, the "cold-closet," a brick-partitioned room devoted to the storage of the family jellies and jams. It's a tough fight to oust "preserves," and truth compels me to state that it was won only when my good old mother was no more, and my sisters had married and flown the parental coop. I guess "fight" is the wrong word, anyhow. The process was more like that of the Meek inheriting the earth. "Blessed are the meek," you know. I always used to wonder how they did it.

I wish I had a picture for you of "my shop" as it finally looked, with all its shelves, cabinets, tool-racks and boxes, stuffed and dripping with strange junk, and overlaid with shavings and dust; but alas, I never thought of taking its picture till it had become a thing of the past.

However, to show my interest in the "EXPERIMENTER'S Laboratory Department," I'll send you something much better, some views of the magnificent shop maintained by an amateur of long standing, who began "even as you and I," and by a life time of collection and improvement has arrived at something that'll make your mouth water.

Here are the pictures. What would you give for a "shop" like that? Well, what would I myself, you ask me? Oh, nothing particular, only my right eye, and maybe a leg thrown in as a final inducement, that's all; I never did care much for "shops."

No, indeed, I wouldn't care a hang for a whole well-lighted basement, with a solid concrete floor and white walls, equipt with electric lights and power, with shafting to each machine. I'd yawn and saunter away from all those vises, emery-grinders, taps, dies, reamers, drills and things; and I'd be particularly bored with the outfit of power machine-tools, a list of which is as follows:

Reed lathe, 12 in. swing, 5 ft. bed.
Barnes lathe, 9 in. swing.
Rhodes shaper, 7 in. stroke, 9 in. traverse.
Aurora drill-press, 14 in. swing, boring to ¾ in.
Sensitive drill, speed 1200 R.P.M.
Beckett horizontal power feed milling machine.
Power hacksaw.

No, I would not, and you know it. I may as well be frank. When I view that shop, I feel the way "Sis" does when she sees the Movie star standing with one foot up on the running-board of her pink limousine, drest in her million-dollar fur coat, and her gold hat, and her glove-silk stock—— no, you can't see those on a real nice one, can you. That feeling, my child, is Envy.

Some of this amateur's works are also shown. They include miniature steam engines, dynamos, motors, and almost every kind of electrical apparatus, lathes, clocks, every sort of mechanism that a real "Bug" likes, and likes tenfold, if he has made it *himself*.

This "palace of amateur industry" belongs to Mr. A. M. P. Cowley, of St. Paul, Minn., and if you don't believe me, here is his own likeness to prove it. It was funny how I happened to become acquainted with Mr. Cowley. While I was publishing those clock-articles in the ELECTRICAL EXPERIMENTER a year of two ago, Mr. Cowley got the craze, made himself some clocks, and incidentally made some improvements, about which he wrote me.

Now the letters I get are mostly all from young fellows, whose fearless viewpoint and hearty mode of expression I know very well; and Mr. Cowley's letters showing ex-

How to Make and Keep Friends

The man who knows how to make and keep his friends is a success in business—at home—in social life. He is welcome wherever he goes. Everyone is glad to see him.

You can be sure of winning men's confidences, of anticipating their desires, of knowing beforehand their likes and dislikes, if you know how to read their character as shown in their handwriting.

Just as certainly as any other science discovers truth, so does the science of reading handwriting reveal the truth about your character—your ability—your fitness for one job rather than for another.

Look your future frankly in the face. Find out the truth about yourself from

How to Read Character from Handwriting

By Hugo J. von Hagen, Ph. D.

This is not a new fad. It is an organized, exact science which scholars have studied for years. But you need not be a scholar to understand it.

In this work you will find a searching study of hundreds of types of handwriting.

It will tell you secrets about yourself and your friends that you may never have suspected.

WHAT TRAITS OF CHARACTER DO THESE THINGS SHOW?

1. Wide margins.
2. Letters in words often unconnected.
3. Heavy down strokes.
4. Back handwriting.
5. Large capitals.
6. Flourishes.
7. Lines of letters slanting upward.
8. Words larger at beginning than at ending.
9. Letters slanting in different directions.
10. Separate words joined together.

This book will tell you all about these and dozens of other things which you will notice on every letter you get after you know them.

And We Will Analyze Your Own Handwriting Besides

When you mail the coupon, send with it a sample of your handwriting, and at a small additional charge we will tell you your faults and your virtues—your talents—your defects—what you are best fitted to do—how you will succeed and what will hold you back. We will tell you what to cultivate in your own mind and character and what to fight.

Learn where lies your strength and where your weakness. Find out the truth about your ability. Do the work you were made to do, and be sure of success.

Know yourself—your sweetheart—your friends—your employer—your customers—your employees.

This cannot be a permanent offer. We are giving it to you now only to introduce to you this great work. Soon this offer to analyze your handwriting will have to be withdrawn. So you must act now if you would get the benefit of this expert analysis that will mean so much to you. **Don't wait until it is too late. Sign the coupon and mail it today.**

ROBERT R. ROSS, *Publisher* E. E. 5-20
110 West 40th Street, New York

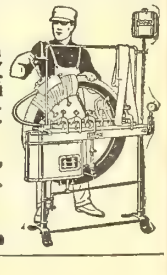
Please send me "How to Read Character From Handwriting." Within 5 days I will either return the book or send you $4.50.

NAME .....
ADDRESS .....
OCCUPATION .....
Enclosed find $1.00 and specimen of handwriting I wish analyzed.

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $600 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit
Improved Wrapped Tread Method Used by Tire Manufacturers
Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.



FREE Book
"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.
C. A. SHALER CO.
2204 Fourth St. Waupun, Wisconsin



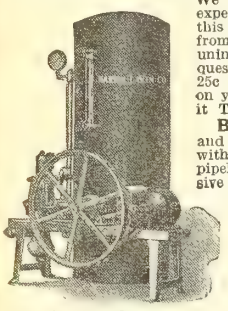
DO YOUR OWN PLUMBING & HEATING AT LOW COST



Any handy man can install a complete plumbing or heating plant in his own home by our new easy method. Every part comes Cut-to-Fit your needs. Our Engineers draw your plans. You can easily do the rest with a few simple tools. You save time, labor and unused material.

SEND FOR HANDY MAN BOOK

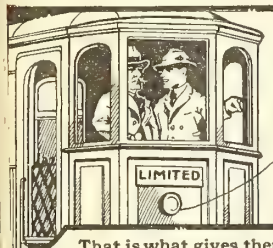
This big book tells you what to install and how to install it. It shows over 10,000 different fixtures at wholesale prices. Every builder, home owner, carpenter or contractor needs one. Save the high cost of labor on needed improvements. We have spared no time or expense in the preparation of this valuable book. To keep from sending it broadcast to uninterested persons we request a temporary deposit of 25c which will be refunded on your first order. Send for it Today.



BURN LESS COAL

and heat the whole house with an improved all-cast pipeless furnace. No expensive pipes or heating equipment. Makes mussy, unsightly stoves unnecessary. Costs no more than a stove. Can be installed in a day by anyone. They are described at wholesale prices in The Handy Man Book. Send for it today.

HARDIN-LAVIN CO.
40 years at 4510-20F Cottage Grove Ave., Chicago.
We guarantee Our Every Product.



RAILWAY TRAFFIC INSPECTORS ASSOCIATE WITH BIG MEN

That is what gives them chances for promotion. They start in at a good salary—$110.00 a month and expenses.

The work is important, for the safety of thousands depends on their vigilance. And when they do their work as we teach them they attract the favorable attention of their superiors. Promotions then are rapid.

Learn This Profitable Profession

All you need is a common school education for entrance to our three-month's course, which is easy to learn at home during your spare time. Take the initiative now, while the demand for Railway Traffic Inspectors is so good. **THERE IS A BIG DEMAND IN THIS FIELD.**

We know of fine openings for our graduates. Many who started our course a few months ago now hold positions.

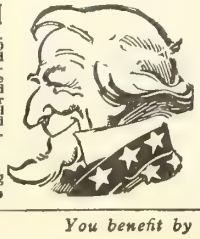
OUR BOOKLET tells of this ideal vocation—out in the big out-doors—how you associate with big men—how you can earn an excellent salary from the start—how you can climb to the very top. The opportunity COUPON (below) is your key to a better salary now and a much bigger future. Why not send it today? Remember you start at $110 a month, and WE SECURE YOUR POSITION.

WE ARRANGE FOR A POSITION

Standard Business Training Institute,
BUFFALO, N. Y.

Please send without obligation to me, your Booklet D119, explaining your Railway Traffic Inspector's Course.
Name .....
Address .....

OPY THIS SKETCH



d let me see what you can do with it. ny newspaper artists earning $30,00 125.00 or more per week were trained my course of personal individual lesby mail. PICTURE CHARTS make inal drawing easy to learn. Send ch of Uncle Sam with 6c in stamps for ple Picture Chart, list of successful dents, examples of their work and dence of what YOU can accomplish.

Please state your age

e Landon School of Cartooning and Illustrating
0 Schofield Bldg., Cleveland Ohio

actly the same characteristics, I naturally put him down as in the 20's.

Some of my fatherly advice must have amused him a lot. He turned out to be over 66, and the "Dean of all the Bugs"—a title which I thought I held myself, until I discovered him. Isn't it striking how an Experimenter never grows old? "Years is nix" with him. You see, Nature is so much older than any of us, and has so many more things up her sleeve than we ever succeed in extracting from it, that a kid with his first junk-built contraption is about the same to her as a wise old engineer like Nikola Tesla or Steinmetz, with a world-altering discovery; so whatever our degree of advancement, we tend to preserve the kid-like attitude as long as we live. Isn't that so?

Mr. Cowley's story, when I got him to tell it, interested me immensely, because it was my own, and yours too—if you're an old fellow. It's the familiar story of the square peg in the round hole—and of the peg retaining some of its squareness even after years of wear. In other words, our inclination for Science persists after almost a lifetime's confinement to business pursuits.

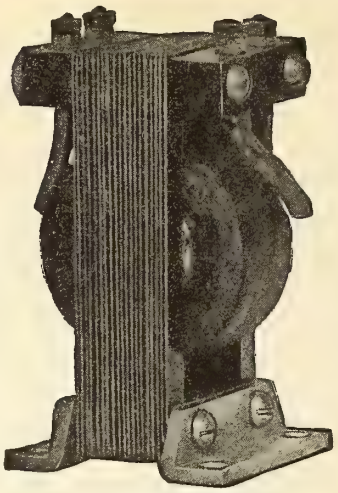
It all comes from the obtuseness of parents in regard to one's youthful ambitions. They are many, and I'll admit most of 'em are temporary, and need to be poohpoohed out of one's system. But when the permanent one comes along, parents should hang up the well-worn pooh-pooh, and take down the new and shining *back-patter.* When they don't, it works like this:

Of course, we began, Mr. Cowley and you and I, by envying the *policeman.* To a three-year-old, viewing the world from behind the front fence, the policeman's life is a peculiarly happy one, W. S. Gilbert to the contrary notwithstanding. The *postman* comes in for some notice, but his lofty rank seems to impose quite a little real work, while the policeman's only labor is to swing his billy when he needs the exercise, and the proudest citizen quails before him. When you're the youngest of the family, you feel that you've done more than your share of the quailing business, and you sure do yearn to be "quailed to" a little.

Then there's the *uniformed fireman;* his lot is almost too *perfect* for contemplation. He not only goes to all the fires, but is paid for doing it. Shakespeare cited "painting the lily" as a case of superfluous inducement, but paying a fireman has it reduced to a wearisome chore—indeed a fine art.

Later on, as the complex world opened out for our approval, we longed to be a *circus clown.* What superb poise, and command of repartee! He was reputed to draw an enormous salary, and to be secretly married to the beautiful bareback-rider, whose frankly exposed limbs set up a new standard of feminine charms. Mother was down on the circus. Money and women! Mercy, what thoughts were these for her innocent offspring to be entertaining?

One by one, we were wafted clear of these pet ambitions and shooed back to the beaten path. But when, a little later still, we were seized by the fever of invention and construction, we were let ramble a little. Parents at first welcomed this novel ambition, because it "kept one off the streets," which even in those guileless times were regarded as the haunts of sin. They found it hard to worry about; but of course, worry they must, and after a few years they began to worry lest we should be drawn by Science away from that serious undertaking known as "earning a living"—Dad gast it! When the kindly caller asked "And what do you want to be, little boy, when you grow up?" and I answered, "An inventor, like Samuel Morse and Alvan Clark," my mother looked "mortified,"—and the caller assumed the expression of one who has unintentionally rattled the family skeleton.



TRIODE
(TRADE MARK)
Audio Transformer Type P

This transformer provides a maximum of low frequency amplification and is superior to all others. It may be used with the Marconi and all standard vacuum tubes.

Permits reliable daylight reception from European stations.

Establishes new amateur long distance records.

Renders remarkable amplification of all signals.

Price $7.00 postpaid
WIRELESS SPECIALTY APPARATUS CO.
Engineers, Designers, Manufacturers
Boston, Mass., U. S. A.

Get Back Your Grip on Health



TAKE NUXATED IRON

For Red Blood, Strength and Endurance

If you are not Satisfied with your job-- See page 7



BE A BOXER

Our unique course teaches boxing and self-defense at home. No partner needed. It includes shadow boxing, daily exercises, 8 jiu-jitsu holds, 8 holds in standing wrestling and Mike Donovan's book "The Science of Boxing." Over 175 illustrations. All for $5. **Send no money.** We send course on approval.

MARSHALL STILLMAN ASSOCIATION
Suite E-5, 461 Fourth Ave. New York

ELECTRICAL—FIRES

are feared by all fire fighters. Water or ordinary chemicals are dangerous to use and have no effect on fire. A

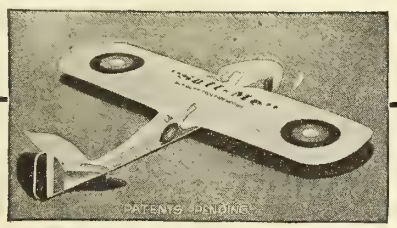


Nu-Ex FIRE-KILLER

breaks electrical arcs and extinguishes the fire instantly. It can be directed into electrical machinery without damage to apparatus or injury to operator.

Write for Our Agency or Distributors Plan

THE NU-EX FIRE APPLIANCE CO.
COLUMBUS, OHIO



"Sail-Me" **The Wonderful Miniature Airplane**

Pronounced by Aviators as scientifically correct. Sample will be mailed on receipt of fifteen cents. Quantity prices on request. "Sail-Me" will duplicate the stunts of the most daring aviator.

C. J. VAN HOUTEN & ZOON (Sole Distributors)
R-732 Marquette Bldg., Chicago

Radio Parts Supplies

Bakelite-Dilecto sheet, sheet fiber, brass rod, round and square, tubing, copper rod, sheet brass, brass and iron machine screws, brass wood screws, knobs, switch points and levers, binding post, sheet aluminum, tuning coil cylinders, 3 in., 3¼ in., 4 in. and 4¼ in. Hard rubber sheet, etc., etc. Prices very low. Send 2 cent stamp for price list, at once. We do machine work for experimenters.

Keystone Radio Company
Greenville, Pa.

AMAZING PROFITS

In Hares and Cavies



We pay $7.00 to $25.00 a pair for Hares and $1.50 to $2.00 a pair for Cavies, and Express Charges. We furnish largest and finest guaranteed high grade stock and buy all you raise.

Free Illustrated Booklet and Contract.

UNITED FOOD & FUR ASSOCIATION
329 West 48th Street Dept. E New York

STUDY HUMAN NATURE **MAKE PEOPLE LIKE YOU** get along better, make more money, develop a winning personality, learn to know people as they are. Send 5 cents (stamps) for "Personal Power," a little book that points the way.

Address, **Progress League, 2931 Union Sq., New York.**

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S., 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.

L. B. DOVER OVERLAND, MO.

For their mental picture was not that of the distinguished scientist, sought out for honors and decorations, but of the humble jack-of-all-trades, Sam Jenkins, the village handy-man. Did I want to be like Sam Jenkins, who wore overalls, and rendered his modest bills by word of mouth on the completion of his job—"Wal, would eighty-seven cents be too much?"

Sam could do all kinds of mechanical work—"picked them up," as the saying was, from observation: carpentering, bricklaying, gas-fitting, everything; and could and did do them well.

Regular contractors, however, looked down on him. He had no loft, with "Carpenter & Builder" lettered across the front, nor a store with dirty windows containing a few faucets and washbowls, and the gilt sign, "Plumber." But what a welcome man Sam was, when some household furnishing went on the blink, and the baleful shadow of the upholsterer or the clock-repairer fell "athwart" the family hoard of cash!

Remember how different the times were then. The head-wagging was not over exorbitant incomes earned. The guessing was not that "They'll be sorry some day they didn't save, instead of buying needless things at awful prices." Far, far from such. Prices were reasonable enough. Eggs and butter, those great test staples, were 12 and 15 a throw, respectively; but the problem was where to find the 12 and 15—respectively. Barring Science, each man knew what was the rottenest, worst-paying business in the world: *it was his own.* What you had to sell, people could get along without; but what you had to buy—oh boy! Therefore Sam, with his modest charges and enduring work, was a refuge and defence against the lordly artisans, with ruin in their glance and a mechanic's lien in their inside pocket.

To emulate Sam was *not* our ambition, however, and in citing him as a horrible example, our parents were not quite candid. For all that, we ourselves could never regard his status as an humble one. He had a wonderful shop, furnished with the tools of all trades, which we boys were free to use in a pinch, in our little industries, on condition only that we used them properly, and left them sharp. He taught us ingenious ways of economy; how to use broken and discarded parts—the classic "junk" of Boydom—and was not at all afraid of "spoiling his trade" by such disclosures.

Forgive me for another paragraph on the life of Sam. While the regular artisans were sitting around the winter sawdust-box, settling the country's economics, extending their promissory notes, and laying broad plans against the expected day of business revival, Sam was quietly pervading the community in his overalls, into the pockets of which there trickled a stream of coinage—not a fat stream, but a constant one. The first thing we knew, Sam (still in his overalls) was the owner of an apartment-house, then another, and another. Perhaps, in time, you found your own rent payable to him; and if it was a little late, it was up to Sam to be nice about it, and say that "next week would do." It seemed odd for him to be really owning anything. Or, if your mortgage turned up in his hands, you felt sort of humiliated that your respectable debt had got into such plebeian company, and he had to explain that he "just picked it up in a trade," and it wasn't to make any difference between you and him. And so on, and so on, till the foreign influx flooded us all, and you only caught glimpses of Sam in his limousine, or happened on his name as President of the Board of Trade or something—when you tucked in the frayed edge of your coat sleeve, and comforted yourself thinking of "old times."

What the old folks would have thought of Sam's rise, will never be told. But in his former estate, he lacked prestige; I



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This Course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years.* You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

TAKE 10 LESSONS FREE So that you may see for yourself how thorough and complete our training is. We invite you to take *ten lessons* in the High School Course—or any Course of specialized training in the Coupon below—before deciding whether you wish to continue. If you are not then satisfied you are not out one cent. *We absolutely guarantee satisfaction.* On that basis you owe it to yourself to make this test. Check and mail the coupon NOW for full particulars and Free Bulletin.

AMERICAN SCHOOL
OF CORRESPONDENCE
Dept. H. 265, Chicago, Illinois

TRAINING—THE KEY TO SUCCESS

Please explain how I can qualify for the position marked X

..High School Graduate	..Lawyer
..Electrical Engineer	..Business Manager
..Elec. Light & Pr. Supt.	..Certified Pub. Accoun't.
..Hydroelectric Engineer	..Accountant & Auditor
..Telephone Engineer	..Bookkeeper
..Telegraph Engineer	..Stenographer
..Wireless Operator	..Fire Insurance Expert
..Architect	..Sanitary Engineer
..Building Contractor	..Master Plumber
..Civil Engineer	..Heating & Vent. Eng.
	..Automobile Eng.
..Structural Engineer	..Automobile Repairman
..Shop Superintendent	..Airplane Mechanic
..Steam Engineer	..General Edu'n Course
..Draftsman & Designer	..Common School Br'ch's
..Photoplay Writer	..Employment Manager

Foreman's Training Course

Make Your Own
ELECTRICAL APPARATUS



SAVE ½

It is easy to make your own at home with the aid of these 4 up-to-date books that you can understand. Each has over 72 pages and over 60 illustrations, 3 color cover, size 5 x 7 inches.

HOME MADE ELECTRICAL APPARATUS
In Three Parts

VOL. 1—Contains working drawings and directions for making all sorts of Static Machines, Static Apparatus, Home-made Batteries, Storage Cells, Transformers, Rectifiers, etc.

VOL. 2—Contains working drawings and directions for all sorts of Voltmeters, Ammeters, Galvanometers, Switches, Rheostats, Telegraph Keys, Sounders, Telephones, Shocking Coils, Spark Coils, Experiments, etc.

VOL. 3—Contains working drawings and directions for making all sorts of Dynamos, Motors, Electric Engines, Miniature Lighting Plants, Wireless Telegraph Apparatus, Tesla Coils, Wireless Telephone, Electroplating, Experiments, etc.

HOME-MADE TOY MOTORS—Gives complete details with working drawings for making 12 simple but operative electric motors. Several built from sheet "tin." Others with castings.

35c each postpaid any THREE $1.00

GET THEM NOW

PRICE MAY ADVANCE ANY DAY

COLE & MORGAN, Inc. Publishers
Dept. 134, 19 Park Place, New York

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

Write Today for Our Free Blue Print Offer

Agents wanted for our ready built phonographs

Choraleon Phonograph Co.
Choraleon Bldg., Elkhart, Ind.



SAVE OVER HALF

The Seneca MOTOR CAR — Built for the Owner — $1185



Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. Comfortable E-Z riding

4 cyl. - 27 H. P. 108 in. wheel base

Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. Write or Wire NOW.

THE SENECA MOTORCAR CO., 45 Seneca Factory, FOSTORIA, OHIO



"Lighting Fixtures"
Ready to Hang
(Direct from Manufacturers)
Completely wired, including glassware. New designs.
Send for catalogue No. 18
ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

Book on Law Free



Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.

Write Today—now while we are making a special reduced price offer.

American Correspondence School of Law
7445 Manhattan Bldg. Chicago, Illinois

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.

suppose that was the cause of his lowly esteem. Dear old mother, how indignantly she would have repudiated any such attitude! Sam and his overalls were perfectly respectable, and we were not for one minute to get the idea we were above him. But all the same, we were to do just exactly what father said, and take that position—"position" it was—our uncle offered us in the Bank, where he would give us four dollars every single week—and regular. It was so good of Uncle, and her boy would be known as a *banker*, and wear a white collar, and undoubtedly own the bank in time! Not like Sam at all.

So the result was, we became "bankers," and swept out the dust, and filled the inkwells, and rustled checks over to the Clearing-House like regular "J. P. Morgans"—wearing our white collars and hating the work like sixty—that was all right, however, because work was the "curse of Adam," and not the sort of thing you were expected to enjoy. But halfway down the column of figures, we paused to think out an electrical "hook-up," or the application of a principle of mechanics; and, supper over, we donned the despised overalls, and hammered, filed and sawed, to the detriment of our lily-white banking fingers and oblivion of banking and all that pertained thereto.

We looked forward to the great year of freedom, when we should be 21, and resolved then to change all that. If "position in the community" demanded that we do office-work—why, machine-shops needed bookkeepers as much as banks did, and there we should be dealing with something we liked—might even make some valuable suggestion, and earn promotion for it. But when the great year came, we found ourselves just a little too well fixt at the bank to be willing to drop back and begin at the bottom elsewhere; so there we stayed—for life.

Oh, we're reconciled, in a way. We have our comfortable living, and our daily duties, which are the real source of happiness, after all. But when we see our contemporaries, like Harty and Rogers, Eastman and Ford, and so many others, playing their fascinating game for a living, we regret that our "living" was made a thing apart, with nothing left for Science to provide, except an occasional ride on our wild hobbies—Mr. Cowley making fine machines in that wonderful shop of his, and I, reduced to a drawing-board and typewriter concocting fool yarns like this!

Too much cannot be said about *vocational selection* and *training*. I'll say to parents, in a hissing undertone, "There's nothing more important for *your boy* than to discover what line of work he enjoys, and to give him an opening in it. And mind you, *his enjoyment is the test, not your own gratification* or pride."

MORE "ELECTRIC RABBIT" ECHOES.

Yes, Poetry, Too.

Br'er Rabbit stood on a copper plate
Chewing his cud with an air sedate,
When all of a sudden a blinding glare
Gave Br'er Rabbit a delicate scare.
He said to himself, "What I did expect
Was not to be tickled by 'skin effect,'
But to be stewed in electric broil
With juice distilled by a Tesla coil."

JOHN T. BUSHBY.
North Sydney, Nova Scotia.

ANTHONY HOW COULD YOU!

I cannot write three hundred words about the famous rabbit trick which you had shown in the December book or magazine also better known as the ELECTRICAL EXPERIMENTER. What I would say about it is that the immense high voltage acted on the rabbit the same as an overdose of poison, *it counteracted itself!*

ANTHONY P. SOUSA, JR.
138 Winthrop St., New London, Conn.

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures but 4½ Inches Long. Takes Regular .22 Calibre Cartridges



The new Baby Double Action Hammerless Revolver has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with all essential features of Efficiency and Practicability. It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety that guards against accidental discharge, making it quite safe for young and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be appreciated. It is obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finished nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. The price of the Baby Revolver is only $6.50 sent by mail, p.pd to any address.

$6.50

AGENTS WANTED

Cut Your Own Hair WITH THIS



ONLY 35c

SAFETY HAIR CUTTER Can cut your own hair with this marvelous invention. Cuts the hair any desired length, short or long. Does the job as nicely before your own mirror. You can cut the children's hair at home in a jiffy. Can be used as an ordinary razor to shave the face or finish around temple or neck. Sharpened like any razor. Lasts a lifetime. Saves its cost first time used. PRICE ONLY 35c, postpaid. Extra Blades 5c.

JOHNSON SMITH & CO., Dept. PM 17, 3224 N. Halsted Street, CHICAGO

THE U.S. BABY TANK It goes with real Yankee Pep—by its own power



Most remarkable Toy ever invented. By drawing the Tank backward, either with the hand or over the floor on table and then placing it down, it will crawl along, overcoming all obstacles, in the same lifelike manner as the larger Tank that proved so deadly in the great war. What makes it go is somewhat a mystery, for there is no mechanism to wind up as is usually understood with mechanical toys, yet this tank will keep plodding along ten times longer than the ordinary run of toys. It will perform dozens of the most wonderful stunts; it will go backward or forward at will, and altogether will give you more fun and amusement than any other toy yet brought out. 2½ inches long. Each packed in colored box. Price only 35 cents prepaid, three for One Dollar, or $3.00 by the dozen, postpaid to any address in the world. Johnson Smith & Co.

MAGIC FLUTE

Wonderfully Sweet Toned and Musical



Post Paid 25c

The Magic Flute, or Humanatone, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it, which when once acquired after a little practice, will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is as charming, as it is surprising. 25c ppd.

JOHNSON SMITH & CO., Dept. PM17, 3224 North Halsted Street, CHICAGO



Good Luck Ring
Quaint and Novel Design

A VERY striking and uncommon ring. Silver finish, skull and crossbone design, with two brilliant, flashing gems sparkling out of the eyes. Said by many to bring Good Luck, hence its name, Good Luck Ring. Very unique ring that you will take a pride in wearing. ONLY 25 CENTS.

JOHNSON SMITH & CO., Dept. PM17, 3224 North Halsted Street, CHICAGO



LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night

The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, emits rays of white light, rendering it perfectly visible in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES. Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push button or switch plates of your electric bells, match boxes, and innumerable other articles, make your own Luminous Crucifixes, Luminous Rosaries etc. Small bottle, price 25c. Larger sizes, 50c and $1 postpaid.

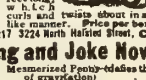
Mystic Skeleton

A jointed figure of a skeleton 14 in. in height, will dance to music and perform various gyrations and movements while the operator may be some distance from it. 10c pd



Serpent's Eggs

Box contains 12 eggs. When it with a match. Quite one gradually hatches itself into a snake several feet long, which curls and twists about in a most lifelike manner. Price per box, 10c ppd.



JOHNSON SMITH & CO., Dept. PM17, 3224 North Halsted Street, CHICAGO

All the Latest Surprising and Joke Novelties

Pharo's Serpents Eggs, box	10c	Mesmerized Penny—defies the law of gravitation)	20c
Miniature Water Pistol	10c	Mysterious Tumbler and Vanishing Coin Trick	25c
Cleopatra's Snake (very lifelike)	15c	Magic Plate Lifter	20c
Paper Mustache (fool your friends)	10c	Great Burglar Puzzle	10c
Automobile Puzzle (Latest)	20c	Wire Puzzles, 12c, 22 different, $2.50	
Mysterious Ghost, shines at night	10c	"Elec-Trick" Push Button	15c
Rubber Dagger (sensational)	20c	Inkless Fountain Pen (writes with water)	15c
Lookbackroscope (see behind you)	15c	Imitation Bed Bugs	10c
Great Mind Reading Mystery Cds.	10c	Squirting Cigar	25c
Thurston's Mysterious Trick Cds.	10c	Glass Watch	25c
X Ray Novelty	10c	Multiplying Billiard Ball Trick	25c
Trick Pencil	15c		
Rubber Tacks (a good joke)	10c		

JOHNSON SMITH & CO., Dept. PM17, 3224 North Halsted Street, CHICAGO

You Can Save $50.00

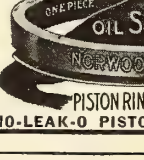


$8.46 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

"NO-LEAK-O" Reg. U.S. Pat. Off.



ONE PIECE

On market 5 years. 1,000,000 a month. Beware imitations. "NO-LEAK-O" Patented.

NO-LEAK-O PISTON RING CO., BALTIMORE, MD.

An HOUR a DAY
MAKE YOUR SPARE TIME PAY!

Take subscriptions for ELECTRICAL EXPERIMENTER. It's easy—every electrical man wants ELECTRICAL EXPERIMENTER—and we'll pay you well. Write now to

Subscription Department
ELECTRICAL EXPERIMENTER, 233 Fulton St., N. Y.

RADIUM IN PLAIN ENGLISH.

By W. E. Ernest, Radium Chemist.

AN ore is a mixture of elements. Sometimes it is a chemical mixture, or it may be a mechanical mixture; often it is both. When two or more elements unite to form an entirely different substance (compound), we call this a chemical mixture. It can only be separated back into the constitutional elements by chemical means. A mechanical mixture is simply what the name implies—a mixture of elements or compounds of elements which can be separated by mechanical means. If iron filings are mixed with flowers of sulfur we get a mechanical mixture. We can separate the iron from the sulfur by drawing a magnet through the mixture; but, if we again mix iron filings with sulfur and heat the mixture the iron unites with the sulfur *chemically* to form iron sulfid. Now, iron sulfid is nothing like iron or sulfur either. By going thru a long chemical process we can separate the iron from the sulfur, but it is a difficult job, and, furthermore, when we get the iron back it will not be in the form of filings.

Now, ores are combinations of chemical and mechanical mixtures, as we said before. *Iron ore,* for instance, contains many elements, some in large quantities and often just traces. You find in it sulfur, iron, carbon, manganese, phosphorous, silicon, calcium and oxygen. Iron is the only element that we try to get out of the ore, but some of the others come out as impurities of the iron.

Carnotite is an ore found in Colorado mostly. It contains a whole list of elements just as iron ore does. The elements in it which interest us are all metals—Uranium, Vanadium, Barium, Radium. These elements are separated from the ore by treating (boiling) the ore with certain acids or alkalies.

Barium and Radium are similar in many respects. Radum acts exactly as Barium acts, when they are both treated in the same way. Let us say that Radium does everything that Barium does, but Barium does not do everything that Radium does—i. e., Radium does many things in addition. When the Barium is extracted from the ore (as the chlorid salt) the Radium comes out with it as an impurity of the Barium—not all, but most of the Radium does. The reduction concerns can only get about ninety percent of it out with the best methods of extraction.

Now, the big job is to separate the Radium from the Barium. This would be impossible but for the fact that the Radium chlorid salt is not quite as soluble as the Barium chlorid salt, so they dissolve the Barium chlorid with its Radium impurity in water, boil some of the water off, and let the solution cool. Speaking generally, more salt can be dissolved in hot water than in cold, so that when the solution cools crystals of Barium chlorid separate out. Since the Radium is not as soluble as the Barium you can see that most of the Radium is with the Barium crystals that separate out. Remember, all the Barium did not crystallize out; some of it is still in the cold solution. Well, right here we get rid of some of the Barium. Now, if we repeat this crystallization over and over again, each time getting rid of some Barium, the Radium will become more and more concentrated in a few crystals. Eventually, you will have more Radium than Barium in the crystals. It is possible to keep on crystallizing until only *five* percent of the crystals are Barium and *ninety-five* percent Radium.

When we consider this natural rarity—*about one part of Radium to eight million parts of ore*—and that enormous quantities of acid are used in its extraction, which requires many months work, its high price is quite evident.

Flying In a Vacuum

(Continued from page 22)

the exhaust vapor from the engine freezing in the air. This frozen vapor from the engine exhaust hung behind the falling plane in a long stream.

It is truly remarkable to think that in the short course of, we might say ten years, the high altitude flight for airplanes has been raised from a few hundred feet up to nearly 7 miles, at which point the air pressure has changed from 14.7 lbs. per square inch at sea level, to a pressure of but 3 lbs., per square inch at 7 miles. Not only is this a severe strain on the aviator, the blood pressure becoming almost unendurable as the lack of air tends to expand the blood vessels and tissue of the body, which might even burst at so nearly a perfect vacuum as this; but also, in this particular instance, the gasoline tanks on the airplane were crushed in, as the plane descended earthward owing to the rapid increase in atmospheric pressure in so short a time. It is also remarkable that the aviator did not suffer from nose bleeds and ruptured blood vessels so common in persons passing from a lower pressure to a greater pressure in so short a time.

50,000 FEET ASCENT FLIGHT PLANNED.

Prof. David Todd, director of the observatory and professor of astronomy and navigation at Amherst College, announced recently in New York City that he would take part in an aerial expedition shortly in a plane driven by Major Leo Stevens of the United States Air Service to discover new data of astronomical and meteorological importance.

The flight will be made from the field of the United States Air Service at Omaha, Neb., and a new altitude record of 50,000 feet will be attempted. This is 14,000 feet higher than the altitude attained by Major Schroeder, whose 36,020 feet climb is now recognized by the world as a record, according to L. L. Driggs, President of the American Flying Club.

The expedition will be equipt with all the instruments and recording devices necessary to discover any electrical and other disturbances, presence and proportion of gases in the upper air and similar data.

Major Stevens was in New York to consult with Professor Todd over details. It will be the first expedition of its kind.

SOME MECHANICAL CONSIDERATIONS OF HIGH FLYING.

Our front cover illustration as well as the accompanying view, show some of the newest devices for flying at high altitudes, and which the aviator of tomorrow will undoubtedly have to use if he is to reach any such altitudes as 40,000 feet, as contemplated by Major Schroeder for his next attempt.

The accompanying illustration shows among other things, powerful electric heaters for warming the air inside the heavy glass-enclosed cab which the high altitude planes are about to be equipt with. Major Schoeder has rightly remarked after his last flight of 36,020 feet, that now since he has found out how to make the engine function properly on high flights where the air is extremely rarefied and depleted of oxygen, he is going to try and reach a still higher ceiling, possibly 40,000 feet, by means of a glass-enclosed cab, and an extra large supply of oxygen, stored in tanks.

There are also wireless telephone and telegraph sets installed on the plane here shown, and the same instruments which are fitted in the leather helmets can be used to carry on inter-communication between the pilot at the rear, and the observer at the front. The aviator's suits are made extra heavy and fitted with electrically heated



STRONGFORT
The Perfect Man

QUIT!

Pills, laxatives, saline waters and purgatives will not cure that constipated habit—you ought to know it by this time. Be sensible—you have been whipping your bowels shamelessly into action, and weakening their natural functioning more and more. Now you are full of ailments—your system is upset—your blood is poisoned—you are sluggish and dull witted—your food will not digest well—you lack stamina—you are nervous, listless, lack ambition—have no energy — no vitality—you are failing in manhood—it's all your own fault. No matter what your condition or ailment may be—under my method of physical and health upbuilding known as

STRONGFORTISM

you can be restored in vigor and vitality and be entirely free from constipation or any other ailment or disorder let it be what it may—whether you suffer from early excesses, induced by pernicious habits, or whether losses weaken you, or you feel your vitality waning—Strongfortism will restore, rejuvenate. Send three 2c stamps to cover mailing expenses, and I will send you my book

"Promotion and Conservation of Health, Strength and Mental Energy."

Read this book. It is for your interest and welfare.

LIONEL STRONGFORT

Physical and Health Specialist

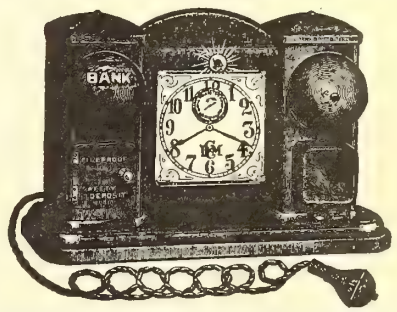
1269 Strongfort Institute, Newark, N.J.

Electric Alarm Clock and Bank

SERVES FIVE DISTINCT USES

Electric Alarm, Electric Call Bell, Electric Lamp, Savings Bank, and Safety Deposit

Guaranteed Accurate Timekeeper. Alarm Rings Until You Get Up and Stop It.



It lights up the Dial of the Clock at any time of the night. Alarm is Continuous—rings until you get up and stop it. Simply press the button at end of cord and it instantly illuminates, not only the clock, but the entire room. By changing the switch you can use lamp or call bell as desired. As a call bell in sick room, office, shop or home, it is always ready and at hand. Not the least useful parts about this Clock are the Savings Bank and Safety Deposit. The Safe Deposit opens by a Secret Combination Lock. The Clock is an Excellent Timekeeper, made of steel, fully nickel-plated. It is operated by an ordinary No. 6 Dry Battery, which lasts a couple of years and can be replaced at slight expense. Batteries are obtainable everywhere.

Price Only **$10** Shipped by Express, charges collect, or by parcel post, prepaid, if you add $1.00 more. Weight, 9 lbs.

JOHNSON SMITH & CO., Dept. E9 , 3224 North Halsted Street, CHICAGO

Latest Book On

SELENIUM CELLS

Their Construction, Care and Use

By F. W. BENSON

73 pages, 15 diagrams and 3 halftone page plates, 7½ x 5¼ inches. Cloth.

PRICE $1.50

Uses of Selenium

Measuring Light - Transmitting Speech through the Telephone—Automatic Control of Buoys, Street Lights and Illuminated Advertising Signs — Control of Ships and Boats at a Distance — Most Efficient Burglar Alarms, etc., etc.

SPON & CHAMBERLAIN
120 G Liberty Street, New York



Voice Thrower 10c

Learn to throw your voice into a TRUNK, under the bed, out in the hall or anywhere. Lots of FUN fooling the Teacher, Janitor, Policeman, Parents, Neighbors, or Friends.

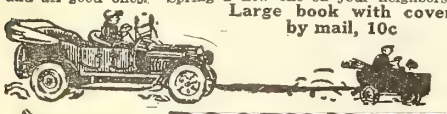
THE VENTRILO

is a little instrument that fits into the mouth out of sight. BOYS or GIRLS can use it in conjunction with the above for imitating birds and animals. Never fails. A 32-page book on Ventriloquism sent with the Ventrilo for 10 cents.

NEW FORD JOKE BOOK 1920

All the latest jokes on the Ford auto. Hundreds of them, and all good ones. Spring a new one on your neighbors.

Large book with cover by mail, 10c



ROGEN X-RAY



Price 12 cents

HERE, BOYS, is just what you want. With this instrument you can apparently see the bones in your fingers. Think of the fun you can have with it. Sample by mail, TWELVE CENTS.



SKULL RING

Here is a handsome, up-to-date Ring, representing a Skull and Cross-bones. Has stones in the eyes and looks something frightful. Women won't like it, but for men or boys it is a great novelty. Sample, by mail, 15c.



Gee! What a Wad!

This is STAGE MONEY

Looks like the GENUINE STUFF. Some Green backs and some Yellow backs. Create a BIG sensation among your friends. The girls will all be after you when they see the wad. BIG roll of 15 pieces by mail, 10 cents.



ENCHANTED BARREL

The Most Wonderful Pocket Trick Made

CHANGE A CENT INTO A DIME

Ask your friend to drop a dime in the barrel. When he takes it out, Behold! It is a CENT. You make 9 cents every time you fool them. Never fails. They cannot get on to it. Sample barrel, with directions, only.... 12c



Hindoo Flower Pot Trick

You have all heard of the great Hindoo trick (making a plant grow out of a flower pot right in front of an audience). This trick has puzzled the whole world for years until an old Hindoo fakir gave it away. We send the whole outfit by mail with full instructions for 15 cents.

BIG VALUE for 10 Cts.



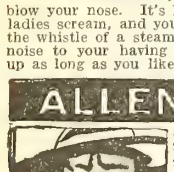
6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Baseball Book, giving rules for games; 1 Toy Maker Book; Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 5 Puzzles; 12 Games; 30 Verses for Autograph Albums. All the above by mail for 10c.

Trumpet in Handkerchief



The Trumpet in the Handkerchief has come to torment us. It is a startler. A small metal trumpet is ingeniously concealed in a handkerchief. On meeting your friends, after chatting awhile, you take out this handkerchief and blow your nose. It's like a sudden clap of thunder! The ladies scream, and your male friends will think they heard the whistle of a steam engine. You can blame the hideous noise to your having a very bad cold, and keep the fun up as long as you like. Price 10c, 3 for 25 cents, by mail.

ALLEN OUTLAWS



A new illustrated book in 42 chapters. Tells the provocation that led up to the most daring gun fight on record, where they shoot the Judge Sheriff, States attorney, 3 Jurors, and 8 others in the Hillsville Court Room. All crimes have a woman back of it, and BOYS, this one is worth reading. Large bound book in plain wrapper for TEN Cents.

Any of the above Mailed with Catalog

ROYAL NOVELTY COMPANY

417 East Ave., South Norwalk, Conn.

wires running back and forth thru the cloth in a fire-proof manner, and his helmet as well as his shoes are also electrically heated. Oxygen has usually to be taken when rising above an altitude of 17,000 feet, and a microphone for carrying on inter-communication or wireless telephone conversation with the earth, etc., is built right into the oxygen mouth-piece which can be strapt over the mouth and nose as shown in the accompanying illustration. The electrical energy for operating the wireless set as well as the electrical stoves and electrically heated clothes, corresponding to those worn by Major Schroeder, may be supplied from a small wind-driven dynamo mounted on one of the wing struts as here illustrated, or else from a storage battery.

In this way, all these things will help to make it more comfortable and safer for the aviator, who tomorrow will attempt to rise above the height of 30,000 to 35,000 feet and if perchance he happens to run into such a frigid atmosphere as that encountered by Major Schroeder, where everything becomes quickly covered with ice, including the meter dials on his control panel, etc. Here too electrically heated and motor-driven scrapers or wipers are fitted on the glass windows. These act also, to keep the window clear in case of rain storms, and are at present being installed on many automobiles. The only difference in this type, is that the revolving wiper arm carries a small electric heating coil which serves to prevent the severe cold at these high altitudes, from forming frost on the glass, under any consideration.

If the air pressure is kept at a higher value, approximately that at sea level, or even 2/3 or ½ of sea level, so that seven or eight lbs., pressure is maintained inside the glass enclosed aviator's cab, then the force acting on the glass at say an altitude of 36,000 feet, would tend to force the glass outward; as the airplane descended earthward the air pressure would steadily increase, and the strain on the glass would tend to reverse until it became equalized at sea level once more. However, where the plane might drop as did Major Schroeder's, 5,000 feet in two minutes, the chances are that the glass would break, due to the very sudden and almost instantaneous increase in air pressure, which as aforementioned, caused his gasoline tanks to cave in. This might be obviated by sensitive air pressure regulating valves fitted in the walls of the cab.

PROGRESS SINCE WAR.

Modern inventions unthought of before the war, made not only Major Schroeder's air voyage possible, but also enabled him to return with an accurate scientific record of the flight to substantiate his verbal claims. His machine was equipt with a Moss supercharger and was the same used August 2, 1919, when he broke the world's speed record for high altitude by flying 137 miles an hour at a height of 18,400 feet.

The Moss supercharger is a device composed of a gas turbine and centrifugal air compressor. The turbine derives its power from the red-hot exhaust gases from the Liberty motor. The power generated by the gas turbine is used to operate the centrifugal air compresser at about 22,000 revolutions per minute, and the air so comprest is fed to the carbureter at the same pressure as the air at sea level.

Thus the Liberty motor delivered full 400-horse power, even tho at high altitude.

Major Schroeder was drest heavier than any polar explorer who ever set forth. He literally was wrapt in flexible electric heaters. His flying suit was lined with the fur of Chinese Nuchwang dogs, and between the fur and outer lining, flexible electric heat units, connected by silk-covered wires with the dynamo of the engine, heated the entire suit.

In a like manner his head-gear, gloves and mocassins were heated.

(*Continued on page* 97)

Radio Men Wireless Amateurs

We carry a complete line of Grebe, De Forest, Marconi, Murdock, Clapp-Eastham, and all other leading makes of Radio Apparatus, from Contact Points to Complete Sets.

Agents for RADISCO Apparatus

Including Coils, "B" Batteries, Indicating Dials and other parts distributed by them. Mail orders given prompt attention.

Open Evenings until 9:30 P.M.

KELLY & PHILLIPS

312 Flatbush Avenue, Brooklyn, N. Y.

Telephone Sterling 2380

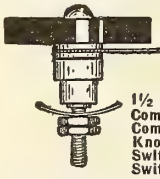
What 15 Cents Will bring You From the Nation's Capital

The little matter of **15 cts.** in stamps or coin will bring you the Pathfinder **13** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for the Nation; a paper that prints all the news of the world and tells the truth and only the truth; now in its **27th** year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, briefly—here it is. Send **15c** to show that you might like such a paper, and we will send the Pathfinder on probation 13 weeks. The 15c does not repay us, but we are glad to invest in new friends.

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, Box 976, Washington, D. C.

If you want to become an Expert Wireman Read page 7



WILCOX PANEL SWITCH

"The Best"

1½ In. Radius	Postpaid Price
Complete Switch, polished brass finish	50c
Complete Switch, nickel plated finish	60c
Knob, turned and polished	25c
Switch points, brass finish	2c
Switch points, nickel plated finish	4c

THE WILCOX LABORATORIES, Lansing, Mich.

The ROGERS

Violet Ray, High Frequency Generator

Does not burn out. No sparking—therefore all shocks are eliminated. An ideal outfit, fully guaranteed as to material and workmanship.

PRICE COMPLETE With One Surface Applicator **$25.00**

Send for free descriptive Booklet

The Rogers Electric Laboratories Co.

Dept. B, 2056 E. 4th St., Cleveland, Ohio

LEARN WIRELESS

At the **OLDEST, LARGEST** and **BEST EQUIPPED** school of its kind in New England. Positions guaranteed. Thousands of satisfied graduates all over the world. Splendid opportunities now in the Merchant Marine. Day and Evening classes. Start any Monday.

EASTERN RADIO INSTITUTE

899 Boylston St. Boston, Mass.

MARKO

STORAGE BATTERIES

ARE GOOD—TRY ONE

Paul M. Marko & Co., Inc.

1402-1412 Atlantic Ave.

Brooklyn, N. Y.

GET WELL—BE YOUNG—GROW TALL



This University discovery is the most important health invention of the Century.

It remakes and rejuvenates the human body. It produces normal spines. It frees impinged and irritated nerves, corrects contracted muscles, shortened ligaments, eliminates congestion, improves circulation and drainage of the body. It will increase the body's length.

THE PANDICULATOR CO., 332 Advance Bldg., Cleveland, O.



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

"How To Market Your Invention"*

By JAY G. HOBSON

THE belief among many people who have originated some new and useful improvement is that securing a patent for their device completes everything that is necessary to win fame, fortune and independence. But success seldom comes so easily.

Obtaining a patent generally constitutes the first and easiest step toward the success of an invention. The development of a practical, commercial, working model of a device is the second important step up the steep and trying hill of progress.

After the working model has proven satisfactory under all tests, we find the greatest obstacle still before us in the form of marketing the invention successfully. I believe it is true that more inventors miss success because of their ignorance of the proper way to market their product than for any other reason.

Lack of sufficient knowledge concerning the buying public and their wants; the manner or form in which they prefer to buy and the best system to reach these buyers, invariably spells failure to the inexperienced person having a good thing but a bad way of letting others know about it.

This ignorance of the selling or marketing end of any invention starts back and shows itself in the preparation of the working model. If an inventor is unfamiliar with commercial requirements, such as the appearance of a device, its size, shape and general contour; the kind of dealers and agents to select for serving the public; the way to pack the article for distribution and the proper advertising and literature to use in acquainting the purchasers with the product for sale; he certainly will not understand how to prepare his invention for the market in a way that will assure success.

For example we will recall the invention of the small metal cap for soft drink bottles which is so common today. A few years ago the inventor of this unique article was walking the streets trying to interest men with money to place it on the market. No one could see its commercial value because the inventor had not fully grasped the commercial requirements himself and incorporated them in his working model. Naturally others, less concerned, could not see what the inventor did not see and that which was not made in the invention. Capital was more interested in the commercial success and just enough in the mechanical side to be sure the ultimate consumer would be satisfied with his purchase.

For two long years this clever device was carried around by its inventor who was hopeful of future success, yet not knowing the secret of his failure up to that time. One day a kindly capitalist, who possessed a little mechanical imagination along with his broad commercial scope, suggested making the cap a little smaller, and more compact, and also outlined a few changes in its appearance which would make it more applicable to those for whom it was intended. At the same time he offered to back the inventor providing he would give him half interest in the patent rights and whatever profits to be made from selling it. This was agreed upon by both and within a short time the improved bottle cap was known the world over. Today the inventor is very opulent from the millions of pennies earned through the enormous sale of this little device.

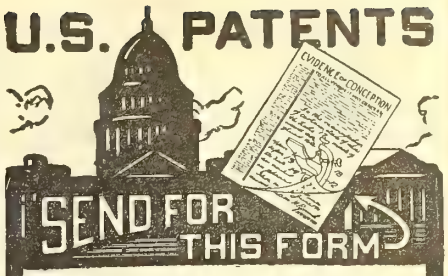
Then recall the case of the fountain pen. The first one invented was about three times as large as the present popular styles and very inefficient in use. Had the inventor fully grasped the public's desires in a liquid pencil they would have realized the present great success years ago.

This is also true of the present day automobiles. The first horseless wagons of twenty years ago were not all that was desired by the public. But it is possible they and the inventors did not know just what they wanted in a self propelled vehicle.

But today the buying public is more critical and better educated as to what an article should be to give them their money's worth, and it behooves each inventor to educate himself and learn all about the commercial necessities of any new improve-

* Owing to the publication of Mr. Hobson's article this month, no questions and answers are publisht in this number.

U.S. PATENTS



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE ON CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St. San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name ..... *Address* .....

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—**"Inventions and Trade Marks, Their Protection and Exploitation"** and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. **A postal will do—it is free.**

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE

In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c.

PATENTS

WRITE FOR THIS FORM



INVENTOR'S BULLETIN

Sent without charge. My free blank form

INVENTOR'S RECORD

For disclosing your idea. Simplifies procedure.

WILLIAM H. MULLIGAN
REGISTERED ATTORNEY
991 WOODWARD BLDG., WASHINGTON, D. C.

Do you know every move your attorney makes?

INVENTORS

My clients are immediately informed of every step in the prosecution of their applications. Write now—PATENTS—Send sketch. Booklet sent free on request

Office of WARNER I. CUBBERLEY, Patent Atty.
22 National Union Bldg., Wash., D. C.

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.

OFFICES

364 University St. Montreal, Canada
919 F St., N. W. Washington, D. C.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

ment before spending money to place it on the market.

Success is not a matter of luck, but a simple fact of knowledge properly applied to whatever plan or business a person desires to promote.

If you would be successful with an invention seek all obtainable knowledge from others about mechanical, commercial and financial plans of operation; absorb what you seek and find, digest it thoroughly and understand it *before* you attempt to become a manufacturer, then apply what you find to your invention which should assure your success under normal conditions providing you have a needed improvement as a foundation to build your success upon.

Copyright, 1920, by Jay G. Hobson.

WHAT DOES THE CLOCK SAY?

Why do we always regard a clock as saying "tick, tock," and not "tick, tick," like a watch? Is there really any distinction between the alternate sounds, or is it a matter of psychology?

The general opinion, it seems, has always been that it was merely a matter of chance whether the "tick" accompanied the left and the "tock" the right beat of the pendulum or vice versa. The first important discovery this authority made was that the "tick" always marks the moment when the pendulum reaches the extreme point of detonation from the perpendicular on its beat to the right, while the reaching of its swing limit to the left is marked by the "tock" in pendulums of all lengths. He found that owing to the fact that the anchor of the escapement mechanism is above the rotating escapement wheel and in the same plane with it, the conditions under which its arms strike the cogs of the wheel are not the same for both arms.

One of the arms of the anchor strikes a cog of the wheel moving upward, in a direction opposed to that of the anchor, while the other arm strikes against the cog while it is moving downward, nearly in the same direction as the anchor. The result of the unequal conditions under which the two arms of the anchor engage the cogs of the escapement wheel is naturally an acoustic difference in the sounds produced by the contact of the parts.

FROM A SWEDISH READER.

Dere Edditor;—

I bane sweede man and from you to me wood like to no some questions answered. Can you 2 me tell why it is that no spark comes akross my spark gap? Today I went by a wireless store and up my mind to be a operator made. So i me bought a spark coil which i seen give two inches of spark.

Tonight when i get him home and a few wires on her, it no work for a tam.

1st, I put one hundred and ten bolts of direct juice on the two binding posts who was nearest together. This is the place where that man said primary was. i next put the tick tick key on these 2 juicy wires what you call akross them. Well that coil she bane in awful hurry to run. She no wait for me to press the key but smoke rite up soon as i turn that switch on. I hear something rip way down in The cellar and the lights all out went.

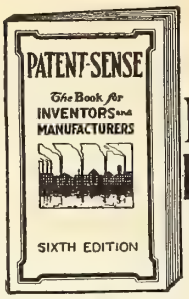
By the lite of a lamp I then notez that the little sprink that make the buzzer noise when the operation by the man was made did not. It was fast together with the other end of buz. i take fourteen inch wrench and make it loose.

I go by auto stable & By 6 dry batteys. The man in stable hook em up 4 me so I get 12 of dem bolts.

I make him buz this time but no spark. I to man say plenty of kick on other end of coil, so i my fingers wet & put em across - - - - - - ? * * ! ! * I yumped up. Yimminey! that Box got least sixty 2 million amperes and I wait from you to hear before I lose other hand.

Yours sparklessly—

"OLE."



"The Book for Inventors and Manufacturers"

SIXTH EDITION.

By return mail FREE.
Write **LACEY & LACEY**
Dept. K. Washington, D.C.



A BOOK OF KNOWLEDGE FOR THE INVENTOR

Based on actual experience. Shows the pitfalls to avoid and the proper course to follow in applying for a patent. Contains a list of inventions needed. There are fortunes to be made in simple inventions. Do not let ignorance of patent laws deprive you of rightful profits. Start right. Send for

The Inventor's Manual of Valuable Information
$1.50 per copy, postpaid.
G. E. PERRY CO., PUBL.
Dept. 20 1328 Broadway, New York

Free Book on PATENTS



Contains valuable information and advice to inventors. Tells how to secure Patents. Written by prominent patent lawyer of over 20 year's experience. Send model or sketch of your invention for opinion of its patentable nature—FREE. Write today for your free copy of this valuable book.

TALBERT & TALBERT, Patent Lawyers
4287 TALBERT BLDG., WASHINGTON, D. C.

PATENTS

Record your invention, before filing application, by using my form **"Fixing the Essential Dates of Invention,"** sent upon request with full information. Prompt personal services by an attorney-at-law having over twelve years' actual experience. Reasonable pre-war charges. **B. P. Fishburne.**
324 McGill Bldg., Washington, D. C.

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?

Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.
1926 Broadway, New York

PATENTS

C. L. PARKER
Formerly Member Examining Corps. U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, **"Protecting, Exploiting and Selling Inventions,"** sent upon request.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The **Scientific American** should be read by all inventors.

MUNN & CO., 622 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 622 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

Patents Promptly Procured

Send sketch or model for actual search of U. S. Patents. Highest references. Personal service. Moderate fees. Write for Free Patent Book.

GEORGE P. KIMMEL, Patent Lawyer
99-F Loan & Trust Bldg. Washington, D. C.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, **HOW TO GET YOUR PATENT.** Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

Flying In a Vacuum

(Continued from page 94)

Major Schroeder wore an oxygen mask of his own design.

An automatic altitude record is made on an instrument known as the "recording barograph"; the needle of this instrument moving in response to the changes of air pressures, as these changes are caused to act on a diafram or series of diaframs attached to one end of the recording lever. The other end of the lever carries the marking point or pen which draws a curve on a revolving clockwork driven drum, covered with fine ruled paper, the divisions of which correspond to a certain number of feet. In the cover illustration the barograph is shown connected with the outside atmosphere by means of a pipe leading from a Venturi or suction funnel, which are all mounted on the side of the fuselage. The recording barograph on official flights is always sealed before the aviator leaves the ground, and immediately upon the aviator's completion of the flight, the barograph is removed from the machine by officials in charge. The instrument is then carefully checked up or calibrated by experts and the record is then sent to the proper authorities at the Air Service Department, United States Army, or the Bureau of Standards at Washington, D. C. In case of army flights, they are then carefully checked or homologated. Until the record has been finally O. K'd and checked up by the higher authorities, and usually the Bureau of Standards, it is called an *unhomologated record.*

Two or three important things come into mind so far as the design of high altitude airplanes are concerned, and these are as follows: Owing to the much lower sustaining power of the thin air at these high altitude flights, the planes should be much larger for a given weight of machine, and also the propeller should be much longer and wider, or else of greater pitch. It has been proposed to use adjustable pitch propellers for such flying, so that at higher altitudes, the pitch could be increased and a greater thrust or force created in this highly rarefied air.

WHAT DR. CHRISTMAS, AVIATION EXPERT, HAS TO SAY.

Dr. William Whitney Christmas, the well known aviation expert and designer of the high speed "Bullet" strut-less airplane, had the following to say in an interview:

"The probable maximum height or altitude to which an airplane can ascend is governed by several factors, each of which are important in themselves alone, and very important in their relation to one another. Take the plane itself. Its success for altitude depends upon its resistance, weight, pitch and effectiveness of the propeller associated with the uniformity and reliability of the motor power which drives the propeller. It is manifestly evident that when we reach very high altitudes the propeller must be accelerated in its revolutions. This immediately brings to the front the question, How fast can a reciprocating engine, such as the gas motor we have today, revolve without disintegration? We can more or less definitely state that above 3,000 revolutions there is danger of disintegration. We then must find a means of increasing the pitch of the propeller as we ascend because the air gets thiner and thinner as we increase our altitude. This being the case, the propeller must be increased in pitch constantly because it must revolve against this attenuated pressure rapidly and forcibly to get the same results that we do when near the surface of the earth. Of course, with a reciprocating engine having a limit to the number of revolutions, makes such an engine unsuitable to reach the very highest altitudes. We must now seek for a better motor power to accomplish these

To cut down the cost per cut

250% More Work

In power hack sawing, compound acts more as a coolant than as a lubricant. Cutting heats the blade, and the purpose of the compound is to prevent the temper of the blade being drawn.

A few drops of oil or a scanty flow of compound simply tends to hold the chips in the cut and is frequently responsible for broken blades. Whatever you are using for a coolant, compound, or water, see to it that the work is flooded except when cutting iron castings. If you use compound, keep it thin and well agitated. Actual tests have proven that the use of compound will increase the amount of work accomplished by 250 per cent.

Get a copy of the Starrett Hack Saw Chart LE, pick the right blade, put on the weight, see to it your S. P. M. are right—and watch your cutting cost decrease.

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.



Use Starrett Hack Saw Blades

42-984

HEAR CARUSO IN YOUR HOME

Greatest Phonograph Bargain Ever Offered **Send $1 Only**

This is your opportunity to buy direct from the manufacturer

Wonderful $25 Phonograph for $10.98



Plays all Makes of Records Any Size or Cut

Send $1 and Coupon

Extra loud, clear, sweet-toned sound box, silent, powerful spring motor, automatic regulator, starter and stopper. Cabinet finished in Colonial mahogany. The metal parts highly nickeled. Will last a life time and is fully guaranteed in every respect. Phonograph will be shipped upon receipt of $1.00; you pay the balance, $9.98, after you get the phonograph.

Plays Victor, Columbia, Edison and Emerson Records

Send $1.00 today

Columbia Sales Company

53 Academy St., Dept. 690, Newark, N. J.

CUT OUT AND MAIL AT ONCE.

COLUMBIA SALES COMPANY

53 Academy St., Dept. 690, Newark, N. J.

Gentlemen: Enclosed find $1. Ship at once one guaranteed phonograph. If satisfactory, I agree to pay the balance, $9.98, after I receive the machine. If not satisfactory I will return the same, and you will refund my money.

Name .....

Address .....

SKINDERVIKEN TRANSMITTER BUTTON

Most Sensitive Microphone

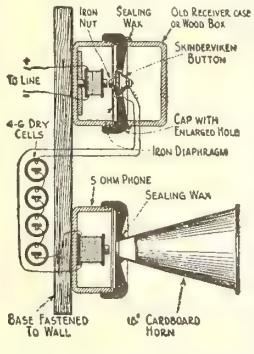

Actual Size

for $1.00

You can easily make a highly sensitive detectophone by using a Skinderviken Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. **This outfit was used by secret service operatives during the War. It is being used on the stage.**

One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position you like. It is the greatest invention in micro-phones and has won recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons can not be seen by any one in the room, as they are so small and light. Only a small brass nut is exposed to the view.



Full directions for connecting up the button for use as a detectophone are given in booklet which is sent with each button.

The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.

The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.

Send us Your Order TO-DAY

We have the utmost faith in this transmitter button. We guarantee satisfactory service or we will refund the purchase price. Boys—young and old—send in a dollar bill RIGHT NOW! You can't lose. If you're not satisfied, you receive your dollar back. Isn't that fair?

JOHNSON SMITH & CO.

Dept. E-17

3224 N. Halsted Street, Chicago

USE THIS COUPON

Johnson Smith & Co., Dept. E-17,
3224 N. Halsted St., Chicago, Ill.

Gentlemen:—Please ship at once to address below ..... Skinderviken Transmitter Buttons, for which I enclose $.....

Name .....

Address .....

City .....State.....

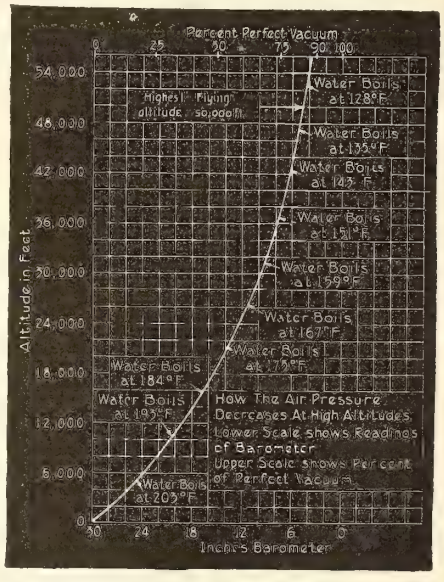
extraordinary results in reaching altitudes. This can be done much more effectively by a turbine engine, either of steam or gasoline, neither of which has yet been developed to such a state of perfection for airplane use that they can be used with confidence. The turbine can be turned up as high as 30,000 or more revolutions a minute, which would be of such tremendous speed that the propeller would not hold together, therefore, it would fly to pieces. However, the turbine can be turned up to the point just short of breaking the propeller. Of course, strictly speaking, no airplane could fly in a vacuum,—that is to say, it could not have a force within itself which would sustain it in a vacuum thru forward motion. Then, strictly speaking from a practical standpoint, there could be no possible reason for wishing an airplane to fly in a vacuum.

"Considering the airplane solely, and discarding the human element, which, after all, is the controlling factor, I would say that it would be possibly to fly an airplane with all the improvements necessary for this feat properly accomplished *to a height of say* 75,000 *feet*. This extreme height is more or less theoretical, but years of practice, application and invention may cause the airplane to reach such a height, but there are many mechanical obstacles to overcome to accomplish such a result, and we cannot hope for immediate success in this direction.

"By actual practical demonstration we find that water boils at a constantly decreasing temperature as we reach varying altitudes. This is due to the fact that the air pressure decreases constantly as we ascend. The laity, as a general rule, do not just understand the phenomena of water boiling. Water boils at 212 degrees at sea level. The reason for this is that this heat is necessary to disturb the equilibrium of the water particles under this pressure of approximately 15 pounds to the square inch, or about 14.7 pounds, to be more accurate. Now as this pressure decreases, it very naturally follows that water is violently displaced thru heat at a much lower temperature. This is an important thing in water-cooled engines, such as used in airplanes, and every natural means must be found for quickly dissipating all extra heat generated by the engine and enough reserve to cause the engine to properly function.

"The human element in altitude flying is even more important than the mechanical apparatus in which the man flies, altho the two cannot be dissociated in altitude work. Man is so peculiarly constituted that he lives at the bottom of this great deep air sea and consequently he lives under great pressure. As he is carried upward gradually and as this altitude constantly increases he begins to exhibit certain physiological phenomena which is detrimental to life function, and if carried to an excess endangers that life principle. One of the peculiar phenomena that we first notice is that the breathing apparatus becomes rapid in its action in its effort to get a sufficient supply of oxygen for proper body function. Another phenomena we have is, as the pressure on the surface of the body decreases there is a tendency for the fluids within the body to escape by the way of the surface and we see the prenomena of skin bleeding and bleeding at the nose, ears and eyes. This is due to the fact that the pressure is not sufficiently great to keep the blood circulation within its proper bounds. Another phenomena which is exhibited in altitude work is dizziness. This, of course, is also a result of decreased air pressure. These various physiological phenomena cause such a state of body and mental unrest that the aviator or observer, or both, constantly decrease in efficiency with a certainty that sooner or later all functions of an intelligent character will more or less cease if the altitude reached is sufficiently great.

"How must we overcome this? It can only be overcome in its entirety in extreme altitudes by inclosing the driver or observer in a hermetically sealed cabin. This cabin must be so mechanically arranged that sea level pressures can be maintained and such temperature, humidity and oxygen supplied as necessary to proper bodily function. There are many mechanical difficulties in the way of a proper accomplishment of this fact. However, these may be overcome to such an extent as to allow an airplane to ascend to such height as at the present moment may seem unattainable. It may be well to say here that the phenomena of boiling water at varying altitudes would have nothing whatsoever to do with the temperature of the body or the temperature of the blood. We have within the brain a point or section which is called the thermogenetic center. This area in the brain is very peculiar in having the automatic faculty of keeping the body temperature in a normal condition. If it were not for this self-regulating temperature government within the brain, it would be impossible for the human being to live under conditions

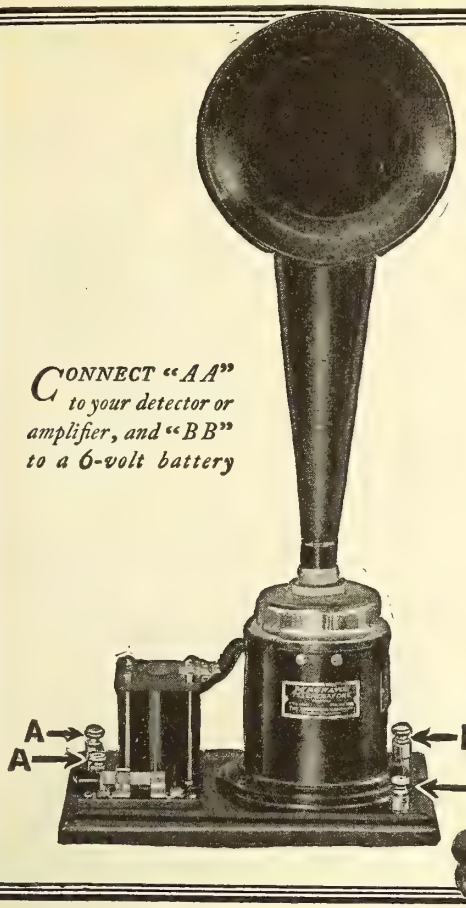


Graphic Curve Showing Per Cent. of Vacuum and Falling Value of Boiling Point of Water at Increasing Altitudes. 50,000 Feet, Is Believed to Be About the Highest Attainable Altitude. The Phenomenom of the Reduced Boiling Point of Water at High Altitudes Has Nothing Whatever To Do With the Body and Blood Temperatures As Dr. Christmas Points Out. Courtesy Charles M. Ripley, of the General Electric Co.

averse to bodily comfort and health. The layman may have an idea that such an altitude could be reached by constant decreasing pressure that the blood itself might have a tendency to boil. This, of course, is a fallacy and could not be thought of except by those who are entirely unacquainted with physiological function.

"As far as we can determine, the atmospheric sea seems to have a depth of about 200 miles. This, of course, is more or less a theoretical conjecture, but it can in a way be called more or less accurate, because the calculation is arrived at thru the law of decreasing pressure and decreasing densities.

"Altitude flying is fascinating, and its practical use will become more and more evident, but its practical limit of height will become more and more evident yet, and it is very reasonable to assume that for any possible commercial use we can confidently believe that 50,000 feet will be the limit for all useful purposes."



CONNECT "AA" to your detector or amplifier, and "BB" to a 6-volt battery

MAGNAVOX
RADIO TELEMEGAFONE

When used with one or more stages of amplification will reproduce signals with great volume. For the small fraction of a watt output of your receiver that is available for the production of signals, the MAGNAVOX TELEMEGAFONE will produce the greatest volume of sound

With Small Horn, as Illustrated $75.00
With Large Music Master Horn 93.00

WRITE FOR BULLETIN NO. 21020





THE MAGNAVOX CO.

PATENTED IN U.S.A. AND FOREIGN COUNTRIES

2701-2765 EAST 14TH STREET
OAKLAND, CALIFORNIA

LICENSED BY DE FOREST
AUDIOTRON
The Original Tubular Vacuum Amplifier

The AudioTron Vacuum Tube is now manufactured and sold as a genuine audion licensed under DeForest Patents Nos. 841,387 and 879,532 to be used only for amplification in radio communication and only for experimental and amateur purposes and only in audio frequency circuits.

The AudioTron has a double filament of special thorium tungsten and the operating life is over 2,000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40. Our guarantee insures satisfaction.

PRICE $6.00 EACH

If your local dealer cannot supply you we will ship postpaid when cash accompanies order.

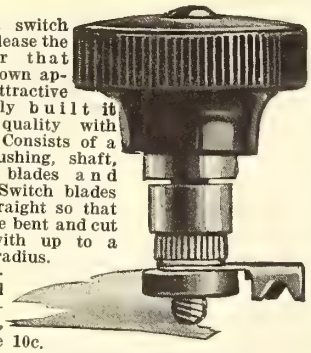
The AudioTron Exclusive Guaranty: Each and every AudioTron is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AudioTron Audio-Frequency Transformer $7.00
Laminated closed core, two coil type.

DEALERS:—Write for our attractive trade Proposition.

AUDIOTRON SALES CO. Lick Bldg. SAN FRANCISCO, CALIF.

PANEL SWITCH



Here is a switch that will please the amateur that builds his own apparatus. Attractive and durably built it combines quality with economy. Consists of a knob, bushing, shaft, laminated blades and terminal. Switch blades are left straight so that they can be bent and cut for use with up to a two inch radius. Switch as illustrated with laminated blade, **60c.** Postage 10c.

COPPER AERIAL WIRE
1c. for TWO FEET



Our stock of No. 14 gauge pure copper aerial wire is getting very low and an increase may be made on the next lot that we will offer for sale. By getting your order in early you can save yourself money and time as we make immediate shipment. All orders must be accompanied by money-order, check or cash in registered letter. Postage must also be included or wire will be shipped by express collect.

No. 14 copper aerial wire, 50c per 100 feet

No. 12 copper aerial wire, 80c per 100 feet

ELECTRICAL SPECIALTY COMPANY
Dept. E, 48-50 South Front St., Columbus, Ohio

MEMORIZE CONTINENTAL CODE ALMOST INSTANTLY

My Method is the Short Cut to Success

What They Say About It

Shortly before receiving your Chart had given up Wireless because of trouble in learning the Code, but after two evenings' study of your method knew all the signals and could make out some of the press matter. Am getting along fine.

RAYMOND ROBERTSON,
Weehawken, N. J.

Local address on request

COMPLETE CHART

and full instructions, TWO DIMES

C. K. DODGE
Box 100 Mamaroneck, N. Y.

HALF PRICE

General Radio Co. Hot-Wire Ammeters
The Same as the Signal Corps Used to Measure Radiated Current in Radiophones.

$5 each Regular $10 Flush Mounting Type with Scale Reading 0-2 or 0-2½ Amps, Compound Action—Jeweled Bearings.



The ORIGINAL AUDIOTRON ADAPTOR

Consists of a standard 4 prong base with appropriately placed brass pillars to accommodate five leads. Practical and convenient.

$1.75 EACH Postpaid Pat. Applied For

New "VT" Socket, $1.00 Postpaid

One look convinces you our **Paragon Filament Rheostat** is the best. The 6 ohm non-oxidizing resistance, permits fine adjustment on 4 or 6 volts. Cast in heat-proof Condensite 2¼" dia. for back or front mounting.

$1.75 Each, Postpaid

RADIO EQUIPMENT COMPANY
630 WASHINGTON ST. BOSTON, MASS.

Long Waves and "Strays" on Rogers Antennae

By LT. COM. A. HOYT TAYLOR, U.S.N.R.F.

(*Continued from page* 59)

from the current from land wire to ground and by suitably proportioning the two parts of the resistance R, the strays could be balanced out. Such, however, did not prove to be the case and it was recognized that the difficulty was due to the fact that the phase relationship of the current in the sea wire was not the same as for the current in the land wire. The final arrangement for the balance of the land wire against the sea wire is shown in Figure 4, where a phase-adjusting device, L_1 C_1, is put in series with either land wire or sea wire. It is not necessary to have this device in series with each collector. It was usually used in series with the land wire. It will be noted that the ratio of signal to stray on collector number 1, that is, the sea wire, has been further improved by the use of the resistance R_1, which shunts the end of that wire directly to ground. This circuit at once gave very satisfactory results and experiments were immediately continued to determine whether the balance of strays was dependent upon the length and nature of the land and sea wires. It was found that within the limits wherein observations were taken on sea wires, namely from 1,000 to 2,000 feet (305 to 610 m.), the length of the sea wire had but little influence, best results being obtained from 1,500 feet (458 m.) of sea wire. The length of the land wire was found to depend upon the wave length, in general, shorter lengths working better when shorter waves were to be balanced. The *lead-covered cable* was used as a land wire very successfully when the strays were made as bad as possible on the cable by intersecting the sheath, every two hundred feet (61 m.). It is desirable, of course, that the land wire have as bad a ratio as possible. Exceedingly satisfactory balances were obtained thruout the summer of 1918 on all wave lengths between 6,000 and 15,000 meters. No work was done on shorter wave lengths than 6,000 meters. The device was put into the hands of the operators on April 7, 1918, and either this circuit or the following circuit was used at Belmar from that time on for copying all trans-Atlantic signals. Encouraged by the success of this method of balancing two wires, attention was again given to the rectangle, since the rectangle showed just as bad a ratio of signal to stray as the land wire and should have sufficiently similar directivity. The rectangle was therefore substituted for the land wire. The resistance R is sufficiently high to give the rectangle a very high decrement. The tuning is exceedingly flat. No marked success was obtained until the circuit shown in Figure 5 was adopted, that is, until the sea wire was shunted to earth thru a small resistance R_1. The exact functioning of this resistance is not understood, but its presence, especially in the balancing of a rectangle against a sea wire, is of the utmost importance. Figure 6 shows the design of a panel to be placed to the left of a standard Navy long wave receiver, this panel providing the necessary terminals for sea wire and either land wire or rectangle. It also contains the phase-adjusting device in series with the rectangle or land wire, the balance resistance, and the shunt to earth on the sea wire terminal. This circuit, Figure 5, is dependent also for its success upon the proper choice of the dimensions of the rectangle, since it is necessary to have a comparatively high resistance in series with it at all times. The rectangle must, therefore, be designed to have adequate collecting power. Naturally

ANNOUNCEMENT

SUMMER session opens May 1st. Complete course preparing you for license and best paying positions. Rapid progress, individual attention, classes of limited size.

Write for descriptive literature.

Y. M. C. A. RADIO SCHOOL

Marcy Avenue near Broadway
BROOKLYN, N. Y.
Telephone, Williamsburg 3800

ATTENTION EXPERIMENTERS

We can furnish any radio material or instrument advertised in this magazine and guarantee prompt delivery. When you buy through this association you get wholesale price benefits. We guarantee a saving on anything you order.

SPECIAL OFFER:
Marko Storage Battery for Audion Lighting—$7.00 Each
Audiotron Tubes—$5.00 Each
Write for discount saving lists.

Mutual Purchasers Association
Dept. E22:—2-4 Stone Street
New York City

SELENIUM CELLS

Made by entirely new process. Highly sensitive and quick-acting. Suitable for all experiments. From $5 up.

Write for Catalog

Selenium Laboratories
Good Ground, Long Island, N. Y.

Arnold

Loose Couplers
Combination Loose Coupler Parts and accessories.

Send 3c stamp for literature which is sure to interest you.

J. F. ARNOLD **2082 Lexington Av. N.Y. Established 1910**



HERE IT IS

A sign for your den. Exceedingly attractive. Printed in bright red on white cardboard. No electrical bug should be without it. 7¼" x 11¼". 10c each in coin ONLY. Send stamp for postage.

LEONARD BECK, 1298 Carroll St., Brooklyn, N. Y.

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. Only 10
Finest Approval Sheets 50% to 60%. AGENTS WANTED. Big 72-p. Lists *Free*. We Buy Stamps. Established 25 yrs.
Hussman Stamp Co., Dept. 67, St. Louis, Mo.

this depends upon the wave length. For 6,000 meters a rectangle 30 feet (9.2 m.) by 77 feet (23.5 m.) with 12 turns of number 10 wire spaced 6 inches (15.2 cm.), was found satisfactory. For waves from 10,000 to 15,000 meters, a rectangle of the same dimensions but with double the number of turns was found best. The setting of the phase-adjusting condenser depends slightly on the depth of the water over a sea wire. As the tide came in it was found necessary to advance the phase slightly in the ground wire or rectangle, as the case might be.

METHODS OF ADJUSTING BALANCED SYSTEMS.

The method of adjusting the balanced system is described as follows (reference Figures 4 or 5):

(a) The slider of the resistance R is pushed to the right until there is little or no resistance between the slider and collector number 1. The primary of the receiver is adjusted by variation of the inductance L and the capacity C until it is tuned to the incoming signal. The resistance R_1 is adjusted to the lowest value which is consistent with good audibility of signal. The secondary L_2 is adjusted in the usual manner as are also the amplifiers.

(b) The slider of the resistance R is pushed to the left so that little or no resistance lies between the capacity C and the primary. Without changing the primary adjustment, the loading coil L_1 and the capacity C_1 are adjusted so that the same signal is received from collector number 2.

(c) The slider of the resistance R is then moved back and forth until the best readability of signals is obtained, the normal position being nearer the end of collector number 1 than to the capacity C_1. In other words, the larger part of the resistance R will normally be in series with that collector which produces the worst strays.

(d) The condenser C_1 is now varied so as to shift the phase slightly in collector number 2. This adjustment is fairly broad, as on account of the resistance R, the tuning in the circuit involving collector number 2 is extremely broad, in fact the circuit is almost, if not quite, aperiodic. After a few adjustments have been made, the balance of the circuit is extremely simple, reminding one forcibly of the method of balancing employed in the bridge method for comparison of inductance at audio frequencies, where variable resistances and one variable inductance are used and the other unknown inductance is fixt. The difficulty of balance is of exactly the same order, which means that after a very little experience, it is not difficult at all. In fact, after one or two days' training, this system was put into the hands of operators who had had comparatively little experience, men who had been thru the Naval Radio School at Harvard University and whose only practical experience was that which had been acquired in the course of duty at the Belmar station. From time to time slight corrections in the balance may be advisable, as the character of the strays changes. These corrections are, however, mostly in the phase-adjusting condenser C_1, and were thought to be due largely to the influence of the tide in shifting the phase of the signal in the sea wire.

CHARACTER OF STRAYS.

The behavior of the balanced system is such as to lead to the conclusion that strays are very complex. Certain very sharp and violent strays were soon recognized, after experience with this set, to be of comparatively local origin, traceable to some storm within a radius of about one hundred miles (160 km.). It would frequently happen that it was possible to obtain trans-Atlantic copy when there were violent storms in the immediate vicinity of the station.

"ASK ANYONE WHO HAS USED IT"

WHAT OUR PATRONS SAY

"I have never had to find fault with them in five years' use." (Name on request.)

BRANDES WIRELESS HEADSETS

CLEAR TONE
LIGHT WEIGHT
DEPENDABLE SERVICE



Score 100% efficiency in actual use. Sharp, Unblurred, Readable Signals assured by "Superior" Set, 2,000 ohms, $7

"BRANDES MATCHED TONE"

Exactly matching the tone of both receivers in each set and thus eliminating all confusion due to unmatched harmonics.

TRIAL OFFER

Buy a Brandes Superior Headset and use it critically for ten days. Then, if it doesn't come up to our claims or your expectations, return it and your money will be cheerfully refunded. Test it—compare with others—for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.

SEND 4c FOR CATALOGUE E.

C. BRANDES, Inc.
Room 814
32 Union Square
New York City, U. S. A.

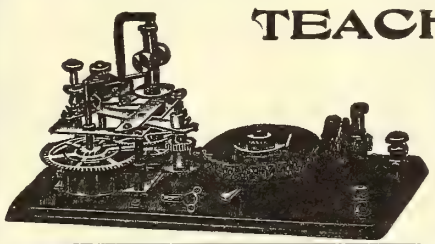
WIRELESS RECEIVER SPECIALISTS

Complete Line of Brandes Receivers for those in Canada. Send stamp for Pamphlet "E"
Scientific Experimenters, Ltd., 11 St. Sacrament Street, Montreal, P. Q., Canada

"THERE'S MONEY IN IT"

LEARN TELEGRAPHY AT HOME
MORSE AND WIRELESS

TEACH YOURSELF

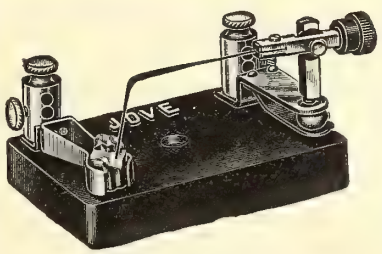


In half the usual time, at trifling cost, with the wonderful Automatic Transmitter, THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
39L Cortlandt St. New York

Bunnell INSTRUMENTS Always Reliable



(GHEGAN PATENT)

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

Send stamp for new edition 42E Catalog.

J. H. BUNNELL & CO., 32 Park Place, New York

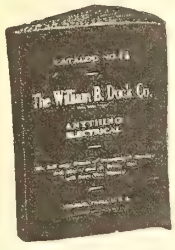
MONEY for YOU

Spend an hour each day taking subscriptions for the "Experimenter." We'll pay you well and you'll enjoy the work. Write for full particulars. Circulation Dept., ELECTRICAL EXPERIMENTER, 233 Fulton St., N. Y. C.

LEARN WIRELESS AT HOME

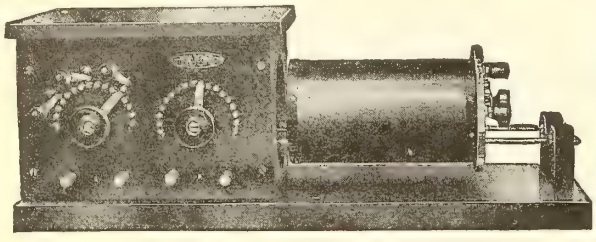
Operators earn $125 to $250 per month; instruments given free; we get you a position.

SOUTHERN WIRELESS INSTITUTE
423 Courtland St. Baltimore, Md.



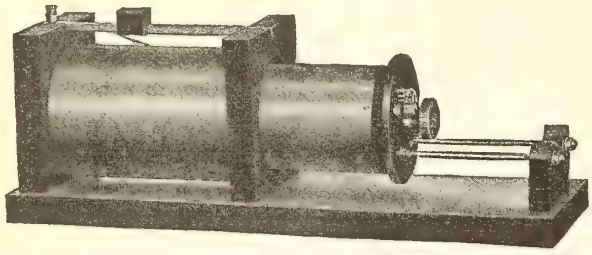
DUCK'S New Big-200 Page No. 14 Wireless Catalog and 100 Page Electrical Catalog

The wireless catalog mailed for 12c and the electrical catalog for 6c, either in stamps or coin, which amount you are privileged to deduct on your first order of $1.00. Catalog positively not sent otherwise. This edition of our wireless catalog is the most complete and elaborate we have ever put out. It embraces everything in wireless worth while. As an enclyclopedia of information it is invaluable. It is printed on excellent paper and with a beautiful cover. Your amateur friend will tell you that there never has been any wireless catalog to take the place of Duck's, and above all, that you can absolutely rely on the quality of every instrument listed in this catalog. In a word it is all worth while catalogs in one.



A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $23.50.

NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER

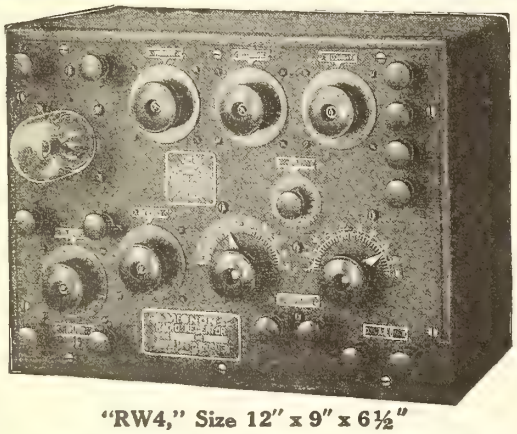


The secondary on our new type Arlington is divided into three sections with two dead end switches eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type permitting a looser coupling. It is a beautifully finished instrument.

Price only $12.50

OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio



MIGNON "RW4" UNDAMPED WAVE RECEPTORS

NO Loose Couplers
Loading Coils
Variometers
Amplifiers

"RW4," Size 12" x 9" x 6½"

Strongest, Most Distinct Signals

IMPORTANT—NOTICE

Ernest C. Mignon, inventor of the famous disc-core undamped wave receptor, is no longer connected with the Mignon Wireless Corporation, of Elmira, N. Y., or their successors—the Universal Radio Mfg. Corp. Address all communications for Mignon apparatus to

MIGNON MANUFACTURING CORPORATION, Newark, N. J.

DAMPED AND UNDAMPED WAVE APPARATUS FOR ALL PURPOSES

Endorsed by Radio Department of D., L. & W. R. R. Co.

Write for Literature.

MIGNON MFG. CORP.

Dept. E

NEWARK, N. J.

SUPERIOR MIGNON SYSTEM APPARATUS

Canadian Representative—Canadian Radio Mfg. Co., Bienville, Que.

A Wartime Radio Detective

By PIERRE H. BOUCHERON.

(*Continued from page* 55)

and prepared to put up a stiff fight with dangerous enemy criminals. Arriving at the suspected house I noted with satisfaction a shingle on a first floor window bearing the caption, "Dr. Heinrich Schmidt." Ah, I thought, this is meat! A maid admitted me and I asked to see the doctor. I had visions of meeting a German scientist peering at me thru miopic glasses whose business it was to help the fatherland along in his own particular chosen way. Incidentally I kept a sharp watch for any possible disappearing traps with which the touch of a button might send me hurtling thru space into a dungeon near the coal bin. The doctor finally came in, licking his chops, from which I inferred he had been at his meal. I had received a mental shock, for the doctor seemed nothing but a harmless old soul possibly eighty years old. However, I was not to be so easily hoodwinked. In my best stentorian voice I asked for a word in private. The doctor led me into his office where I explained to him briefly my mission, and that I wisht to make a complete search of the house. The doctor registered surprise, then amusement, after which he laughed heartily, and handing me a cigar said he would be *pleased* to have me investigate the premises.

I went thru the upper floors of the house without noting anything suspicious and finally came to his study on the second floor. Upon glancing around the room my eyes immediately spotted something which made my hair bristle up as it were, for there in one corner of the room was a *genuine static maker*—also known as a Wimshurst static machine. At this the doctor seemed as amused as I was surprised. I looked the machine over very carefully but could find no possible connection to a secret antenna or to either a gas or water pipe ground.

The doctor explained that he had had the machine twenty years, and had used it for the treatment of nervous diseases many years ago, and at a time when electricity in any form was considered to be the long-sought-for panacea or curer-of-all-ills. He explained also that he had not used the machine in years but that he could, however, account for the report in the following manner. About a week previous a curious patient had wanted to know what the machine was for and how it worked, at which the doctor had obligingly operated it by turning the rotating discs several times. This, of course, produced electric discharges between the two metallic discharge balls, and the noise could easily be heard by passersby on the street. It turned out later that it was during this instance that an alert "Boy Scout," with a hazy idea of the elementary principles of radio, happened to pass the house, heard the machine and due to its similarity in sound to so-called *static* had decided that it was for the express purpose of creating *static interference*. So much for fizzle number one.

THE TELEPHONE LINE "SECRET" RADIO STATION.

Reports of this type were probably the most frequent ones received at headquarters. In these interesting little comedies persons in and about New York City, Philadelphia, Boston and other large cities would report that they had heard secret wire messages being transmitted over *their* telephone lines; not only that, but they were *certain* it was the work of German

Super-Sensitive Microphone ONLY $8.00



This instrument is offered at an extremely low price. It is excellent for building your own amplifier. Can also be used in many experiments where a sensitive microphone is required.

Detectagraph, $18.00

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

Send for One To-day and Convince Yourself



Detectagraph $18.00



THE $18.00 MICROPHO DEAF-PHONE

is a super-sensitive instrument which has been developed to meet the demands for a practical and efficient hearing device at an extremely low price. It is equal to any $35 instrument made and superior to most of them. The outfit consists of One Super-Sensitive Transmitter with cord connector; One Super-Sensitive Ear Piece with small black cord; One Black Single Headband; Black Case and Two Batteries.

Adjusted Model "B" Horn, with No. 20 High Grade Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete.



Write To-day for Free Booklet

G. BOISSONNAULT CO.

26 Cortlandt St. New York

Makers of Super-Sensitive Microphone Apparatus

Fun, Magic and Mystery!

56 Feats in Magic, 250 New Jokes, 21 Puzzles, 1 Fortune Telling Tablet, 52 Money-Making Secrets, 15 Card Tricks, 71 Toasts, 58 Verses in Comic Poetry, 10 Funny Readings, 41 Epitaphs, and 11 Parlor Pastimes. You get all the above-mentioned and our big illustrated Catalog of 125 Magic Tricks for only 10 cents. Write today.

DETROIT TRICK & NOVELTY CO.

454-456 Dix Avenue Detroit, Mich.

A STEFFEY MOTOR



on your wheel will convert it into a practical and successful high grade motorcycle that will cost you less to operate than the more expensive machines. Write at once and secure lowest factory prices. Excellent opportunity for agents. Send stamp.

STEFFEY MFG. CO., Dept. E. 5025 Brown St., Phila. Pa.

I TEACH *Penmanship* BY MAIL



I won World's First Prize for best course in Penmanship. Under my guidance you can become an expert penman. Am placing many of my students as instructors in commercial colleges at high salaries. If you wish to become a better penman, write me. I will send you FREE one of my **Favorite Pens** and a copy of the Ransomerian Journal. Write today.

C. W. Ransom, 511 Essex Bldg., Kansas City, Mo.

UMAKEM

Airplane Workchest, containing aircraft work table with mitre cutting board and length gauge, steel drill, steel hammer, Model Maker's steel square, screwdriver, sandpaper block, 10" scroll saw, together with finest quality reed and bass wood, aluminum, silk, para rubber, full set of blueprints, directions, and all fittings for building one 36" Bleriot Model flying Monoplane. Price $10.00. Other UmakeM Outfits 50c to $50.

W. R. PRICE, Inc.

No. 2 UmakeM Building, 127 Fifth Avenue, New York

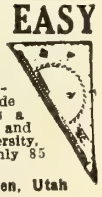
Be a SPECIALIST in ACCOUNTANCY

Write today for particulars of the most unusual course of its kind in existence. Learn how you may acquire thorough knowledge of this remarkably profitable profession and besides become a specialist in any branch you may elect. C. P. A. instructors of highest standing. Free book.

International Accountants Society, Inc.

Dept. 521, 2622-30 S. Michigan Ave., Chicago, Ill.

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only 85 cents Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah

spies in the immediate neighborhood. In many cases some of the informants claimed they had telegraphic as well as radio experience and could easily distinguish *some* of the words. In order to substantiate these naïve statements, they would forward copies and extracts of the messages with such suspicion-arousing words as "troops," "transports," "submarine," etc.

Reports of this nature were childish, to say the least, and one does not have to be well-versed in radio or in the handling of codes to know that anyone attempting to send such messages over a telephone line would not resort to such crude methods, but would use code and cipher, which might take months of constant work to decipher, and in some cases might never be fully understood.

However, I will mention one of the most interesting cases of these so-called "telephone-line radio stations." This was reported by an elderly spinster living near Islip, L. I. She lived in a rather secluded section of the country surrounded by a thickly wooded part. She had been hearing these signals for a period of several weeks and had called the attention of the telephone authorities to it, and altho the telephone company had investigated the matter in order to explain the probable origin of the signals, nothing had been definitely obtained and the signals were still being heard, usually at stated hours of the evening.

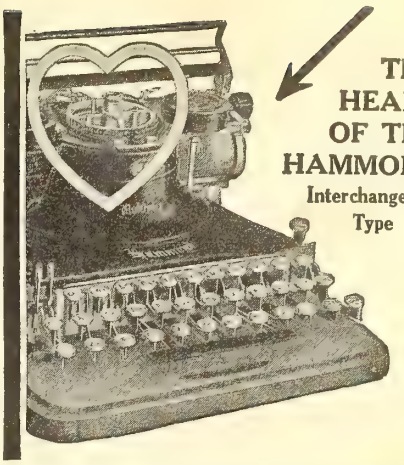
This worthy lady based her assurance that the signals were *radio* on account of the fact that she had made several trips across the Atlantic on large passenger vessels, and that she had visited the Marconi station on board, where the sending and receiving of messages had been *fully explained* to her by the operator. She was certain, therefore, and as she explained in her report, that "she knew what she was talking about." Also, she believed that her particular location would be an excellent spot for an *enemy radio station*, as very little traffic and few persons ever came near her home.

At the same time she reported that one of her gardeners who had been employed by her for the past few weeks seemed to act strangely at times, and there were many occasions when he could not be located. Strangely enough, he would usually make his appearance after she had heard the signals over the 'phone.

Investigation disclosed the fact that this "great radio mystery" was nothing more than a swinging high-tension power line in close proximity to the lady's telephone wire. This information was obtained after several days of hard work in testing many wires in the vicinity and in collaboration with the telephone officials. Numerous tests were made on various lines in the neighborhood, each one being isolated and separately tested. In this way, the fault was found. The signals were very strong on *rainy days*, which was due to the electrical leakage between the power line and the telephone wires. The swinging, of course, was not of constant amplitude but was controlled by the degree of wind pressures at spasmodic or intermittent moments and in such a peculiar manner that the induction or transfer of energy produced impulses on the telephone wires of *short* and *long duration*, greatly resembling dots and dashes. In fact, upon hearing them, even an experienced telegrapher would have doubts as to whether or not they were human made.

A REAL CASE AT LAST.

It is needless to say that we sometimes worked for many weeks before a real, honest-to-goodness case presented itself. The case of the *Grist Mill*, however, turned out to be the real thing altho at first it certainly did not look very promising. The



THE HEART OF THE HAMMOND

Interchangeable Type

One of the Greatest Achievements of Science and Invention.

Hammond MULTIPLEX

"Many Typewriters In One"

For the Mathematician, Engineer, Chemist, Astronomer, Surveyor, Navigator—there is no typewriter like the Multiplex Hammond! The Multiplex does many things that *no other typewriter* can do!

The Mathematical Multiplex contains the characters and signs used for writing in higher and lower mathematics, and for engineering, mechanics, etc., as well as for all the ordinary work that can be done on any typewriter. Just note these fine styles of Multiplex type—

TWO STYLES OF TYPE, or *two to five different languages*, carried on the machine AT ONCE. "JUST TURN THE KNOB" and change *instantly* from Roman Type, to *Italics*, or Miniature Roman, or our Beautiful Script Type, or from English to Greek, Russian, German, French, etc. *Any other type or language can be substituted in a few seconds.*

The above gives a slight idea of the versatility of the Multiplex which has literally revolutionized typewriting—has changed it from monotonous commercial work to the beauty of fine printing and engraving.

WRITE FOR FREE BOOKLET showing the many languages and type sets of the Multiplex—there's a type for every profession, every business, every science, including technical signs and symbols and chemical keyboard.

Fill out the Coupon and mail to us *now*—before you turn this page and possibly forget. You incur no obligation.



Also—an Aluminum PORTABLE Model

For Traveling—for home. Weighs about 11-lbs. Full capacity. Ask for special folder.

THE HAMMOND TYPEWRITER CO.

589 East 69th Street - - New York City

Name .....

Address .....

.....

Please write your occupation below.

RADIO TELEGRAPH & TELEPHONE
APPARATUS OF MERIT

The largest stock of wireless goods in the Middle West. Deliveries the same day your order is received. All apparatus guaranteed satisfactory, or your money back.

Distributors for

De Forest Radio Tel. & Tel. Co.
Amrad Products
Wm. J. Murdock Co. Clapp Eastham
Perfection Radio Co.

Send for Our Fifty-Page Wireless Catalog
IMMEDIATE DELIVERIES

Young & McCombs
L. P. BEST PRES.
ROCK ISLAND, ILL.

Announcement

Messrs. JOSEPH STANTLEY and JOHN DIBLASI

take great pleasure in announcing to their many friends that on May 1st they will engage in business for themselves as the

CONTINENTAL RADIO & ELECTRIC CORPORATION

at 6 WARREN STREET, NEW YORK CITY

These gentlemen have been affiliated with the electrical field, commercially and experimentally, for many years.

Mr. Joseph Stantley has been connected with the Manhattan Elec. Supply Co. for the past eleven years and during that time acted as manager of their Radio Department.

Mr. John DiBlasi has also been identified with the Manhattan Elec. Supply Co. for the past four years, and lately acting as general manager of their Radio Departments.

It is the earnest aim of this enterprise to furnish all manner and kind of Radio and Electrical apparatus and supplies necessary to the highly technical experimenter as well as to the novice. A special endeavor will be made to please all customers, both in the vicinity of New York and distant points throughout the country. If you live nearby, drop in and see us; if far away, drop us a line and try us out.

A combination of fair prices with quick and satisfactory service will be the first consideration offered to all our customers.

Our word of honor to you is our guarantee. Let us prove it.

Continental Radio & Electric Corporation

MODEL AIRPLANE SUPPLIES



Build and fly Model Airplanes

Send 5¢ for catalog of complete and knocked-down scale models of new machines, parts, fittings, and supplies.

Wading River Mfg. Co. 672 Broadway, Brooklyn, N.Y.

Become a Licensed Electrician!
Read page 7

LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries—thousands needed today. We give you personal and thorough training—practical, technical courses 3 months to 2 years under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. **Not a trade school.** Training is condensed—if your time is limited, come to the **Finlay Engineering College**—only one of its kind in the West. Day and night sessions—enroll anytime. Write for **FREE** catalog, a post card will do.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo

report came to us from a remote and complicated channel. In fact, I never did learn its real origin. No doubt it was the work of a closely veiled agency, which even we were not permitted to know about.

On a certain stormy March day I was dispatched to L..... in Ulster County, N. Y. Arriving there I met two plain clothes men attached to the New York state constabulary who had, by prearrangement, been sent to assist me in the sleuthing end of the case. Briefly the case was just this:

The armature of a large motor-generator had been seen transported from the railroad station to a grist mill a considerable distance away. Since the mill operated by water power a certain individual had, naturally enough, wondered to what use such a large piece of electrical apparatus could be put to in so remote a section of the country. It was, therefore, my particular duty to investigate the locality, "hang around" and ascertain just what the activities of the grist mill were, as it was inferred *radio* might have something to do with the case.

My two sleuthing friends and I accordingly hired a rig from the only stable L..... could boast of, and started out for the grist mill which was nearly thirty miles away. Under the guise of New York state watershed guards we stopt at a farm not far from the grist mill. Despite several days of careful investigating and a close study of external conditions connected with the mill we failed to note anything unusual or even suspicious, and my two friends were strongly in favor of dropping the case. However, my orders distinctly read to "stick around" regardless of time and not to overlook anything, even tho it began to look as if life at this particular grist mill was confined to nothing more interesting than an occasional farmer dropping off a few bags of corn or so and returning at nightfall for it.

After two weeks of "watchful waiting," I too decided the case to be another "false alarm" and was preparing to report my belief; in fact, had actually sat down to do so, when gazing absently out of the window of the shack we were stopping at I noticed on a distant hill a familiar telephone and telegraph pole on which were hung several wires. Of course there was nothing unusual about this, but I began to wonder just where this line led to, for I had not even seen or heard of a telephone in this vicinity, nor did the farmer know of one. Now I have always been interested in telephone and telegraph work; in fact, when I was a youngster, just beginning to learn telegraphy at the local railroad depot, I used to climb telegraph poles, tap various lines thru a portable set to ground and thereby have a "load of fun" with train dispatchers and towermen. I was finally caught in the act and shall never forget the experience. But that, as Mr. Kipling says, is another story.

Upon seeing this particular line, so far removed from its usual surroundings, I decided to look it up. I accordingly reached the spot of one of the poles where I saw there were exactly two wires stretched on the one crosstree carrying the usual glass insulators. Since the line was nowhere near the main road, curiosity led me to follow it which I did for a distance of about 1,000 yards. Imagine my surprise when upon reaching this spot the string of poles *terminated*, and so did the wires! The four wires simply were fastened to four glass insulators and stopt there. I concluded that the line was probably a discarded one and was thinking seriously of climbing the pole and testing each wire when I first decided to see how far the line went in the other direction. Accordingly I walked a distance of less than

MURDOCK No. 55



2000 OHM SET.....$4.50
3000 OHM SET..... 5.50

That these Murdock No. 55 Sets have earned a nation-wide reputation for value, is due, not so much to the fact that they are, without question, the best low priced receivers obtainable anywhere, as it is to the recognized fact that they closely approximate in operation the sensitive performance of the most expensive sets.

The customary assurance of "Satisfaction or Money Back" affords the opportunity of proving the exceptional value of these 'phones at no risk to you.

Other instruments — MURDOCK MADE—of recognized merit at equally reasonable prices are illustrated in Bulletin 19B, a copy of which will be mailed on request.

WM. J. MURDOCK CO.
55 Carter St.
CHELSEA (BOSTON 50) MASS.
509 Mission St. San Francisco, Calif.

Recognized as the Largest and Best

Service Radio School INC.

Send ten cents for descriptive catalog to Dept. A

900-902 Penna. Ave., N. W. Washington, D. C.

STAMMER

If you stammer attend no stammering school till you get my big new FREE book and special rate. Largest and most successful school in the world curing all forms of defective speech by advanced natural method. Write today. **North-Western School for Stammerers, Inc., 2331 Grand Ave., Milwaukee, Wis.**

a quarter of a mile where I was again surprised to note once more the end of the poles! This, however, was at a place covered by a considerable number of trees but imagine my amazement when by close scrutiny I noticed that the two telegraph wires reached a "common joint" to another well insulated heavier wire leading from the last pole thru the trees in a carefully insulated manner. There was only one answer to this unusual telegraph wire arrangement—it was a disguised *wireless antenna!* I could hardly contain myself with excitement, as I pusht my way thru the trees and heavy underbrush keeping my eye on what I now felt sure was a long wave listening-in station. After going down hill for a short space I began to hear the familiar waterfall and the overshot wheel of the grist mill, and finally I came to a slight clearing and noticed with satisfaction that the wire led, in a cleverly disguised manner, thru one side of the mill. I was now fully convinced that the place was equipt with at least a long distance receiving outfit. However, nothing could be done just then without arousing suspicion, as it was still daylight. I accordingly returned to the farmhouse and explained my find to my two companions. These gentlemen were for pulling out all artillery and making a "grand sweep" upon the mill; a suggestion which I quickly tabooed.

My plan was to come back at night, try to force our way into the mill, which I had previously noted could be easily done, and thus see what was actually "going on." We carried out this plan and found no trouble in slipping in at a point near the overshot wheel, and owing to the terrific racket it made, what noise we did make could not be heard. The three of us kept close together and prepared to make a stealthy but systematic search of the entire building. It took us exactly one hour to do this, after which we had heard absolutely no strange sound nor seen any gleam of light which might suggest the presence of anyone "listening-in." The place, to all appearances, was absolutely deserted at this hour of the night. Remembering the side upon which the lead-in was inserted, we decided to look again for a possible unexplored section of the building. We therefore climbed to the very loft and for fifteen minutes or so carefully and quietly listened for any unusual noise. After a short time our eyes had become accustomed to the darkness, and it was then that one of my companions touched my side and pointed my face towards what I saw to be a tiny gleam of light. We carefully moved in this direction and reaching it I applied my eye to the crack. My hair literally stood on its ends as I looked and saw a young man, telephone receivers on his ears and in the act of "copying." On the table and directly in front of him was what appeared to be a complete receiving set with several vacuum tubes burning brightly. What little noise we had made, of course, could not have been heard by the listener, owing to the telephone receivers clampt tightly on his ears, a fact which I communicated to the two men close to me.

Our flashlights disclosed a door which being unlocked enabled us to walk right into the room, where with drawn revolvers we suddenly faced the young man. He never batted an eye, and in fact hardly seemed surprised, taking the whole proceedings as a matter of course and part of the day's work. While my two companions were attending to the young man, I looked at what the operator had been copying and saw it was coded words similar to those which were frequently transmitted during the war by European high-powered sta-

DRAFTING



Learn at Home!

Employers everywhere are looking for skilled draftsmen. They are offering splendid salaries, and good positions are always open.

No line offers greater opportunity for advancement. Drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture.

There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in Drafting and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help but never were opportunities so great as now.

Let the I. C. S. help *you.* Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

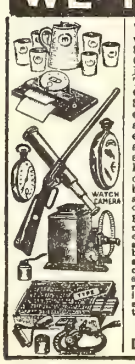
INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6232, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ MECHANICAL DRAFTING	☐ SALESMANSHIP
☐ STRUCTURAL DRAFTING	☐ ADVERTISING
☐ SHIP DRAFTING	☐ Show Card Writer
☐ ELECTRICAL DRAFTING	☐ Sign Painter
☐ ARCHITECTURAL DRAFTING	☐ ILLUSTRATING
☐ SHEET METAL DRAFTING	☐ Cartooning
☐ BOILERMAKER DRAFTING	☐ BUSINESS MANAGEMENT
☐ BRIDGE DRAFTING	☐ Private Secretary
☐ MACHINE DESIGN	☐ BOOKKEEPER
☐ ELECTRICAL ENGINEER	☐ Stenographer and Typist
☐ Electric Lighting and Railways	☐ Cert. Public Accountant
☐ Electric Wiring	☐ TRAFFIC MANAGER
☐ Telegraph Engineer	☐ Railway Accountant
☐ Telephone Work	☐ GOOD ENGLISH
☐ MECHANICAL ENGINEER	☐ Teacher
☐ Machine Shop Practice	☐ Common School Subjects
☐ Gas Engine Operating	☐ Mathematics
☐ CIVIL ENGINEER	☐ CIVIL SERVICE
☐ Surveying and Mapping	☐ Railway Mail Clerk
☐ STATIONARY ENGINEER	☐ AUTOMOBILE OPERAT'G
☐ Marine Engineer	☐ Auto Repairing
☐ ARCHITECT	☐ PLUMBING AND HEATING
☐ Contractor and Builder	☐ Textile Overseer or Supt.
☐ Concrete Builder	☐ Navigation ☐ Spanish
☐ Structural Engineer	☐ AGRICULTURE ☐ French
☐ CHEMIST	☐ Poultry Raising ☐ Italian

Name_____
Present Occupation_____ 7-25-19
Street and No._____
City_____ State_____

SEND NO MONEY WE TRUST YOU



We are giving away thousands of dollars worth of valuable presents, such as Watches, Sterling Silver Initial Water Sets, Air Rifles, Guns, Moving Picture Machines, Musical Instruments, Cameras, Printing Presses, Typewriters, Telescopes, Books, Puzzles, Games, Tricks, Toys and Novelties, Rubber Stamps, Household Labor Saving Devices, etc. All you have to do is to send your name and we will send you, without any charge, 20 extra large De Luxe colored pictures, to sell at 25c each. When sold, send us the ($5.00) and we will give you goods of your own selection to the value of $4.00 from our wonderful 300 page premium catalog. Remember, you get these goods as a premium for selling the pictures and sending us the money. You do not have to pay one cent for them.

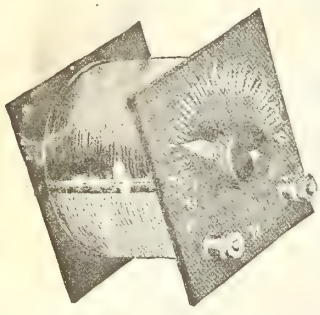
By continuing the sale of our goods you can earn a magnificent bicycle and many other expensive presents. We are a large and responsible concern, having a million customers on our books. Our goods have been extensively advertised in "Popular Mechanics" and all the leading magazines for many years. You can have your choice of $4.00 worth of these goods, and by our method we actually provide you with the means of purchasing these valuable presents. Send in your application at once, and we will immediately send you the first lot, accompanied by our big catalog to select your premiums from.

JOHNSON SMITH & CO.,
Dept. E9, 3224 N. Halsted St., CHICAGO

TEWNO WIRELESS PRODUCTS OF QUALITY

In all of the products shown below you will find we have used the finest of materials and the most accurate workmanship. All material guaranteed against factory defects, as it has always been a principle with us to manufacture products of superior type but at a reasonable price.

"Tewno" Variable Condenser



The rotary variable condenser is a necessity for all experimental wireless work and one or two of them are to be found in almost any wireless station. The two most popular types are the 43 plate and 21 plate with capacities of .001 mfd. and .0005 mfd., respectively. The large size has 21 rotary aluminum plates and 22 stationary aluminum plates. The small size has 10 rotary and 11 stationary plates. The ordinary rotary variable condenser is mounted in a cheap round metal case with a cheap composition top and coarse scale. Its plates are 0.15" thick and the shaft is 3/16" in diameter.

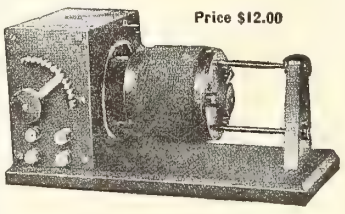
The "Tewno" Rotary Variable Condenser has two genuine "Formica" ends, a clear glass case, a ¼" shaft and plates .024" thick of a special grade of aluminum. However, the biggest feature in favor of our condenser is the form of end-piece used. It is square, facing the operator. It is not necessary to look over one's hand to see the scale, as was the case in the old upright type of condenser. The scales on these instruments are calibrated to 2½ degrees.

We recommend our 43 plate condenser for primary and secondary tuning on sets of fair range and for use in oscillating circuits. Our 21 plate condenser is well adapted to short wave tuning for use in small wave meters and a great variety of work calling for a small variable capacity.

Do not be fooled by an instrument that is "just as good." These are to date the best condensers on the amateur market.

No. 53—21 plate—.0005 mfd.....Price, $4.75 **No. 43—43 plate—.001 mfd.....Price, $5.50**

"Tewno" Receiving Transformer (Short Wave)



Price $12.00

Directly prior to the war, the amateurs were doing wonderful work with specially made short wave couplers of their own construction and through the use of Armstrong circuits or with straight audion circuits. Up to that time no manufacturer had placed such an instrument on the market.

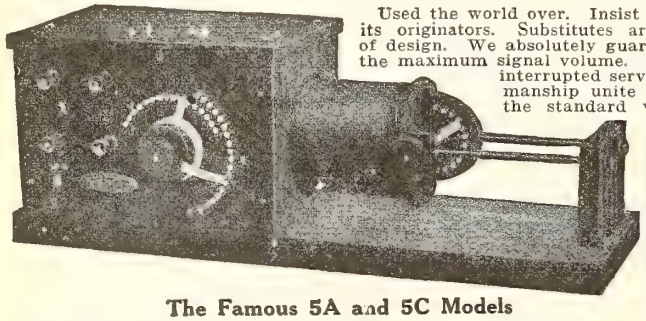
In our short wave receiving transformer the amateur will find the embodiment of all of his ideals. It is designed for use on amateur aerials of from 150 to 200 M. fundamental wave length and with a small capacity of variable condenser across the secondary will easily tune to 600 M. The windings are of the very efficient type known as bank wound (an expensive process) and are of heavy stranded conductor in silk sleeving. They are wound upon non-shrinkable tubes. Variation is obtained by means of two 12-point switches mounted upon "Formica." Switches and contacts are satin finish, nickel plated, which is in accord with the Government's specifications. All other metal work is polished and nickel plated. Woodwork has a beautiful hand rubbed mahogany finish.

No. 23—Price $12.00 *Order today as orders will only be filled in rotation as they come in. Remit by postal money order or check.*

The TEWNO COMPANY, 150-152 Chambers St., New York City

TRACO QUALITY

RECEIVING TRANSFORMERS



Used the world over. Insist on the genuine, built by its originators. Substitutes are expensive, irrespective of design. We absolutely guarantee our tuners to give the maximum signal volume. Delicate refinement, uninterrupted service and high class workmanship unite to make TRACO tuners the standard whereby all others are judged. If your Dealer does not handle them, order direct from us.

LIBERTY DETECTOR VALVES. RADIO AMPLIFYING PHONES, type used by the **UNITED STATES, BRITISH** and **FRENCH GOVERNMENTS,** now in stock, for sale.

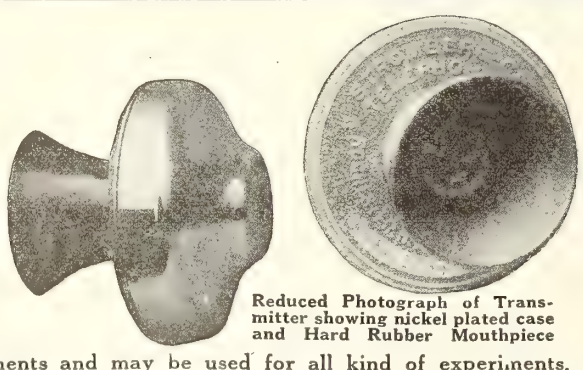
Send stamps for bulletins.

The Famous 5A and 5C Models

THE RADIO APPARATUS CO., Pottstown, Penna., U. S. A.

SPECIAL SALE!

We have on hand 2,000 **Carbon Grain Transmitters** as per photograph. They are first-class instruments and may be used for all kind of experiments, especially for wireless telephone sets, where a heavy current is to be passed through. Slightly used, but in perfect working order. Money refunded if not satisfied. A real bargain. Order one or more today.



Reduced Photograph of Transmitter showing nickel plated case and Hard Rubber Mouthpiece

$1.00 ONLY

Postage extra.

Ship. Weight, 2 lbs.

Diameter, 3¼ ins.

THE ELECTRO IMPORTING CO., 231 Fulton St., NEW YORK

WIRELESS AMATEUR

Send a 2c stamp for full description of the most efficient detector in the wireless field today.

Tested by Marconi Wireless Telegraph Co. and U. S. Government. Instantly adjustable at a constant pressure.

L. STEWART BARR, Inventor, Vice-President of The Service Radio School

THE BARR MERCURY-CUP DETECTOR **Dept. A, The Wyoming, Washington, D. C.**

tions. Upon listening-in myself I heard the familiar spark of "POZ" beginning its usual sing song "groupen, etc."

Upon questioning the operator we were unable to secure any information whatever, so we took him over to the farmhouse for the rest of the night. Next day upon looking over the grist mill we found an explanation for the use of the mysterious armature. In one part of the building a large motor-generator was in the process of being erected to be operated by water power. A large transformer and a considerable number of Telefunken radio telegraph parts were found about the place preparatory, no doubt, to the erection of a transmitting station probably capable of communicating with submarines at sea thru the use of the excellent telegraph line antenna possest of unusually long wavelength.

The details of the rest of this experience cannot be disclosed here, but suffice it to say that no "mistake" had been made in this particular round-up.

The next three cases of this series will unravel the "Singer Building Signaling Mystery," the "Phantoplex Circuit Paradox" and the "Enigmatic Shipment of 'Medical' Supplies to Mexico."

Newton's Less Popular Laws

By PROF. JAMES S. STEVENS.

(*Continued from page* 24)

so inclined. The mere bumping never hurts us; *it is the fact that the wall bumps back.*

Whatever changes may be made in Newton's great laws their value as underlying principles in physics will never be questioned. It was said of Newton that God displayed him as we display an ape, meaning that he was of such an unusual order of intelligence that he stood out conspicuously from the rest of humanity. Alexander Pope said:

"Nature and Nature's laws lay hid in night;
God said, Let Newton be! and all was light."

A newspaper has recently amended this,

"We thought that space was straight and Euclid true:
God said, Let Einstein be! and all was askew."

Those who are fearful that they will have to learn their physics over again on account of Einstein's discoveries need not give themselves very much concern. It will be many years in the future before Newton's laws will cease to be fundamental in our physical theories. Any modifications in these laws will be referred to at the bottom of the page by means of an asterisk, and the statement will be made that under certain unusual conditions in space, *which do not affect the dwellers on the earth in the slightest degree,* Newton's laws are subject to certain modifications.

$50.00 In Prizes

See Page 38

A One Tube Radio-Telephone Transmitter

By PIERRE H. BOUCHERON.

(*Continued from page* 57)

tap is made in a like manner but this time slightly passing the point of the first tap. This procedure is followed for the remainder of the forty-eight turns so that the final result will produce a diagonal row of taps in respect to the length of the coil. This slight spacing of each tap is necessary in order to avoid "bunching" connections and consequently a much neater and more workman-like appearance is the result. After this procedure, each twisted loop should be carefully soldered in order to make it a permanent and sturdy tap.

Connection to any of the above fifty turns may then effectively be accomplisht by making use of three universal clips, similar to the one shown in Fig. 2, and which may be purchased at slight cost. The connecting wires, of course, leading from the various instruments are soldered to the clip in the specially provided slot. The clips may then form a variable means of contact at A, B and C of Fig 1 and these as well as the two variable condensers having a maximum capacity of .0005, are varied accordingly until the proper value of inductance and capacity is obtained to secure best results. The grid-to-transformer resistance of 10,000 ohms will probably also have to be either decreased or increased until an effective grid resistance has been secured.

See Fig. 2 for a general idea of the scheme of construction and method of connecting. All tapping connections to and from coil as well as all other permanent connections of the circuit should be properly soldered. This precaution is very necessary in order to insure perfect contact, for in a system of this kind, the radiated energy is very small, possibly in the neighborhood of 0.2 ampere and it would not do to waste any of this small energy thru loose or "grinding" connections.

The telephone receivers should have an impedance of 2,000 ohms or more should the plate voltage be over 250 volts, as otherwise receivers of lower impedance might heat up and possibly burn out with higher plate voltages, for it will be noted by referring to the circuit of Fig. 1 that these receivers are directly in series with the high potential battery. The grid leak in this instance should be approximately 10,000 ohms and may be constructed by drawing a pencil line on a small piece of cardboard and connecting the two extreme ends of the carbon line with two battery binding posts.

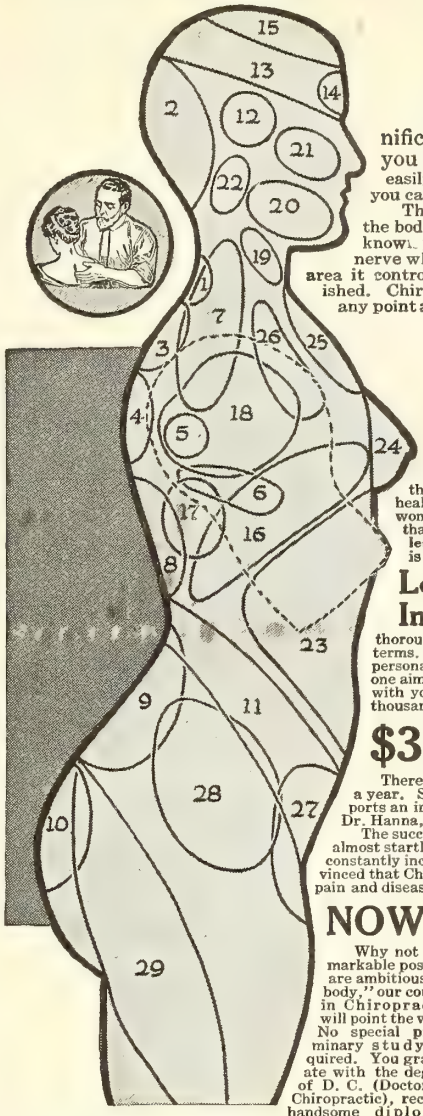
"B" BATTERY SUGGESTIONS.

The ideal way, of course, to secure the high plate potential of two hundred or more volts is by means of a small motor-generator set, but since these are not within reach of many amateurs and cost at least $75.00, the next best thing to do is to employ a large number of small dry cells of the flashlight battery type. Nine units of the twenty-two-volt type will furnish approximately two hundred volts, which will be quite sufficient to carry out this experiment successfully, altho if possible, a higher voltage is recommended should the amateur be in a position to purchase additional cells.

The two regular dry cells, which furnish approximately three volts, when joined, are connected in series with the primary of the telephone repeater coil and the telephone transmitter. The vacuum tube and the two variable condensers are connected in the manner shown in Fig. 1.

The antenna used in this case should not have a natural period over 150 meters wave length; in other words, it should not be much over 50 ft. in length and should preferably be of the two-wire type.

Learn to Treat Disease This Way



This is a small reproduction of one of 22 magnificent charts **all of which** we want to send you **ABSOLUTELY FREE,** just to show you how easily you can master Chiropractic and how successfully you can treat disease by this modern drugless healing method.

These charts show the different pain and nerve areas of the body. The science of Chiropractic is based upon the well known principle that when there is bone pressure on a trunk nerve where it leaves the spinal column there will be pain in the area it controls; and that by relieving the pressure the pain is banished. Chiropractic teaches you how to locate nerve pressure at any point along the spinal column and how to relieve it.

BE A DOCTOR OF CHIROPRACTIC

Advanced Science of Spinal Adjustment

The great profession that within the past few years has taken the longest forward strides ever known in the history of drugless healing. It has called to its ranks thousands of ambitious men and women from every walk of life. Today it is calling more insistently than ever because the **tide has turned strongly in favor of drugless healing. Right now** the demand for Doctors of Chiropractic is far greater than the supply.

Learn at Home In Spare Time The American University method of teaching enables you to study by mail or in class and obtain a complete mastery of Chiropractic in the shortest time consistent with thoroughness, while you hold your position. You can pay on easy terms. From the day you enroll your instruction will be under the personal direction of a splendid faculty of Chiropractic experts. Our one aim will be to make you successful. We will work whole-heartedly with you to advance **your** interests so that in a short time **you,** like thousands of Chiropractors, can earn a good income.

$3000 to $5000 a Year

There are many instances of Chiropractors earning from $3000 to $5000 a year. Some upwards of $10,000. Dr. M. D. Moore, of Kentucky, reports an income of $9,000 a year. Dr. L. H. Roche, New Jersey, $6,000; Dr. Hanna, of Kentucky, over $5,000 yearly.

The success of Chiropractors in many cases has come so quickly as to be almost startling. And yet, it is not to be wondered at when you consider the constantly increasing number of intelligent, thinking people who are now convinced that Chiropractic is the common-sense and really scientific way to relieve pain and disease and who, therefore, **demand the services of Chiropractors.**

NOW—Your Great Opportunity

Why not qualify **now** for this splendid profession that offers such remarkable possibilities for making **you** prosperous and independent? If you are ambitious to make money, increase your social standing and be "somebody," our course in Chiropractic will point the way. No special preliminary study required. You graduate with the degree of D. C. (Doctor of Chiropractic), receive handsome diploma, **FREE,** and are ready at once to open your office.

Get Free Charts offer at once. Regular value of the 22 magnificent charts is $31.50. Many of these charts are handsomely lithographed in life-like colors. Mail coupon and get all the facts. We will send you our beautiful new illustrated book, full particulars regarding course, easy terms, together with free charts offer immediately. Don't put it off —mail coupon or send your name on a postal card—**today.**

AMERICAN UNIVERSITY
Manierre Bldg., Dept. 721 Chicago, Ill.

AMERICAN UNIVERSITY
Manierre Bldg., Dept. 721 Chicago, Ill.

Without cost or obligation send me by mail, your new illustrated, 72-page book and your Free Charts offer.

Name.....

Street No. or R.F.D.....

City..... .....State.....

Another GREBE RADIO Achievement

The Grebe Special Type CR-3 Relay Receiver



Unparalleled performance on Relay wavelengths.

Constructed according to the highest engineering and manufacturing standards.

This Instrument was fully described in Q S T for March, 1920, and may be found on display by the following concerns:

Doubleday-Hill Electric Co., Pittsburgh, Pa.
Holt Electric Utilities Co., Jacksonville, Fla.
Manhattan Electric Supply Co., New York, Chicago, St. Louis
Pacent Electric Co., Inc., New York City
Geo. W. Parezo & Co., Washington, D. C.
F. D. Pitts Co., Inc. Boston, Mass.

A. H. GREBE & CO. Inc., 70 Van Wyck Blvd., Richmond Hill, N. Y.

NEW MOTORS

FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle
1800 R. P. M. with pulley

- 1/4 H. P., 110 volts, induction, full load start - - $28.50
- 1/2 H. P., 110-220 volts, induction, full load start - $38.50
- 1/2 H. P., 110-220 volts, repulsion, for compressor $52.50
- 1 H. P., 110-220 volts, repulsion, with sliding base - - $76.50
- 2 H. P., 110-220 volts, repulsion, sliding base $116.50
- 3 H. P., 110-220 volts, repulsion, sliding base $142.50
- 5 H. P., 110-220 volts, repulsion, sliding base $184.50

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

- 8 volts, 10 amp. - $19.50
- 15 volts, 10 amp. - $24.50
- 40 volts, 8 amp. - $31.50
- 110 v, 2½ amp. - $31.50
- 110 volts, 5 amp. - $46.50
- 40 volts, 30 amp. - $78.50
- 110 volts, 18 amp. - $106.50
- 110 volts, 25 amp. $146.50
- Moving Picture Arc Generator 60 v., 35 a. $106.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., complete with base and pulley.

- ½ H. P. - $46.50
- 1 H. P. - $64.00
- 2 H. P. - $81.00
- 3 H. P. - $96.00
- 5 H. P. $112.00
- 1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only - $36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase. Voltage as specified.

- 110-220 v., A.C., 150 watts, 15 v., with switchboard - $68.50
- 110-220 v., A.C., 150 watts, 30 v., with switchboard - $68.50
- 110-220 v., A.C., 175 watts, 24 volts, with switchboard $68.50
- 110-220 v., A.C., 250 watts, 35 volts, with switchboard $88.50
- 220 volts, 2 phase, 600 watts, 24 v., without switchboard $75.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL 1/4 H.P. 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley

WASHING MACHINE MOTORS Suitable for operating ½ Small Compressors, Coffee Grinders, Bottle Washers, Etc. $22.75 Each Reg. Val. $32.50

MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 12, West End, Pittsburgh, Pa.

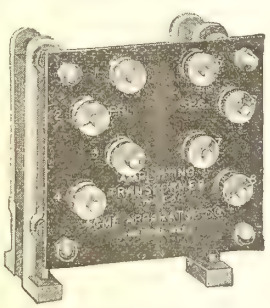
A REAL TELEPHONE

Guaranteed to work on two batteries a distance of 200 feet—price per set as shown including diagrams..... $1.50 Postpaid

TRANSMITTERS or RECEIVERS ONLY 30 Cents each, or four for.. $1.00 Postpaid

Catalogue for Stamp

INLAND SPECIALTY CO.
1562 N. ROBEY ST. CHICAGO, ILL.



RADIO TELEPHONY
REQUIRES A
MODULATION TRANSFORMER
GET AN ACME

Used by U. S. Government
Used by Manufacturers of Radio Telephone Sets
Used by Those Getting Results
Correct Primary and Secondary Impedences
No Distortion of Speech When Properly Used

Type A-3 mounted as shown..... $7.00
Type A-3 coil, core, supports assembled..... 5.00
Type A-3 coil and core assembled..... 4.50

Also Filament and Amplifying Transformers

Modulation Transformers Same mounting and size

ACME APPARATUS CO., 28 Windsor St., Cambridge 39 Mass.

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.

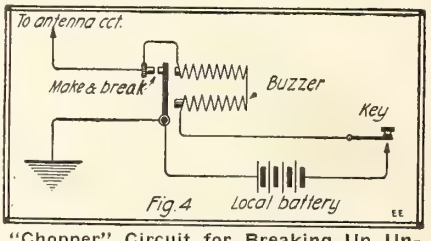
Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. Guaranteed by the maker. Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.

EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.

If the radio experimenter has a radio friend who lives a short distance away he can then arrange to have him "listen-in" until the most desirable results are secured, either when using the circuit as a radio-phone or as a radio-telegraph transmitter. After this, further experimenting will probably increase the range of the set until five miles or more are covered. *Right here it may be said that a similar circuit employing a 400-volt plate potential has successfully covered a distance of twenty-five miles.*

When it is desired to employ this circuit for radio-telegraph transmission by means of *undampt waves*, a key may be placed directly in series with the antenna circuit, in this case preferably in the ground lead as shown in Fig. 1. The key can be one of the regular telegraph keys having a circuit closing switch, so that the circuit may be closed when it is desired to use the radio-phone. With this arrangement, of course, the receiving station must be prepared to receive undampt signals; that is to say, be equipt with a short wave regenerative or oscillating circuit; or else a Poulsen tikker may be used.

On the other hand, if it is desired to telegraph by means of dampt waves, the emitted energy must be interrupted by means of a so-called "chopper." A chopper circuit suitable for this purpose may be secured by means of the arrangement shown in Fig. 4. In this case a high frequency buzzer is operated by means of a local key and battery and the contact, or make and break points of the buzzer, are connected in series with the antenna circuit. If the vibrator of the buzzer is adjusted to make and break 500 times or more per second it



"Chopper" Circuit for Breaking Up Undampt Oscillations in Antenna Circuit so as to Be Audible on Crystal Detector

is evident that 500 interruptions will occur in the continuous antenna circuit, and thus 500 groups of dampt waves will be radiated. With this arrangement the receiving station will receive the signals quite effectively with an ordinary crystal detector circuit.

RECEIVING-TRANSMITTING CIRCUIT.

In Fig. 5 we have a circuit capable of transmitting as well as receiving undampt waves. This circuit may be found quite useful because it employs a regular loose coupler receiving tuner and appropriate condensers. This permits a wide range for either sending or receiving; that is to say, undampt waves may be sent on as low as 100 meters, (providing, of course, that a small amateur antenna is being employed) and up to 1,000 meters or more. As will be noted, the circuit is an oscillating one. When it is desired to transmit on, say, 200 meters, both the primary and secondary of the loose coupler are tuned to that wave, the value of variable condenser C-1 is properly reduced and, providing the bulb is oscillating, undampt waves may be radiated into proper signals controlled by the regular telegraph key, which in this case is also connected directly in the ground circuit. When it is desired to receive, the circuit-closing switch of the key is closed and the circuit may then be adjusted for reception.

MODULATION.

The average amateur no doubt understands the meaning of modulation as employed in radio-phone circuits. Briefly, it means that the amplitudes of emitted or antenna oscillations are varied, up and down,

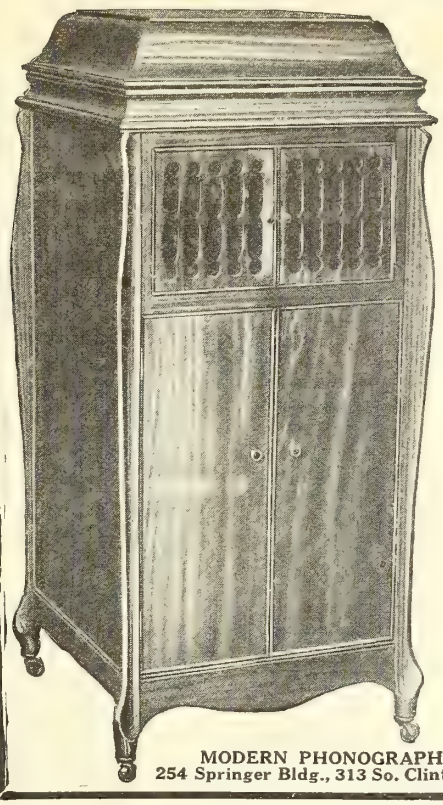
at frequencies corresponding to the intonations of the human voice. In this respect great care must be exercised in building necessary radiophone apparatus so that modulation may be effected *without distortion of the voice.*

In the circuit previously mentioned, that is, Fig. 1, modulation is obtained thru grid current control. There are, however, several other ways in which modulation may be obtained; in fact, the regular carbon grain transmitter mentioned here may be connected at many places of an oscillating vacuum tube circuit with more or less satisfactory results. For this reason the amateur should experiment in an attempt to discover the best place for the transmitter consistent with his own particular hook-up. That is to say, he should try placing it in the filament circuit, in series with the grid circuit, as well as directly in the antenna circuit. Some methods are, however, peculiarly adapted to one, bulb circuits. Fig. 6 shows a simple hook-up where the telephone transmitter is placed in the antenna circuit and modulation accomplisht by varying the amplitude of the emitted vacuum tube energy.

SUITABLE VACUUM TUBES.

Altho large vacuum tubes, also called oscillions, pliotrons, etc., are coming more and more into use for radio-phone and radio-telegraph work, the smaller and more readily obtainable receiving tubes may be employed by the amateur for any of these experiments. The Marconi V. T. No. 2 has an output of about five watts at a filament voltage of 4.3 volts, and will probably stand a maximum plate voltage of 550 volts. The Western Electric V. T. No. 2 also has an output of about five watts at a filament voltage of 7 volts and a plate voltage of about 350 volts. These figures are mentioned in order to give the amateur an approximate working idea.

YOU Can *Easily* BUILD This PHONOGRAPH



TREMENDOUS SAVING IN COST

You don't need to be a cabinet maker. We have made it an easy and a pleasant job with

Our Simplified Plans We furnish blue prints, diagrams, motor, ready-built horn, cabinet pieces and all metal parts complete. You do the assembling, **6 models to choose from.** A few hours' work, and you will have as fine a type of phonograph as any produced, and at a price away below what you would pay in a store.

Keep the Savings in Your Pocket

Machines play all records, have a wonderful tonal quality, excelled by none. No need now for any family to be without a phonograph because of the cost. THE MAKAFONE solves the problem. BUILD IT YOURSELF AT LESS THAN ONE-FOURTH REGULAR COST, but equal to the high priced cabinet machines. Free Records with each outfit. SEND TODAY FOR FREE CATALOG and full particulars of our wonderful offer. *Many a manufacturer got his start in this way. Why not you? Build machines and sell to your friends. Ask us about this.*

Agents Attention You can make and sell this machine from our plans at a profit of $50 to $75 each. Others are selling two and three a week. Here is your opportunity to make big money and become independent. Pleasant and profitable work START TODAY.

WRITE TODAY!

Modern Phonograph Supply Co.
254 Springer Bldg.,
313 So. Clinton St., Chicago, Ill.

Gentlemen: Please send me full particulars of your Makafone proposition, without obligation to me.

Name.....

Address.....State.....

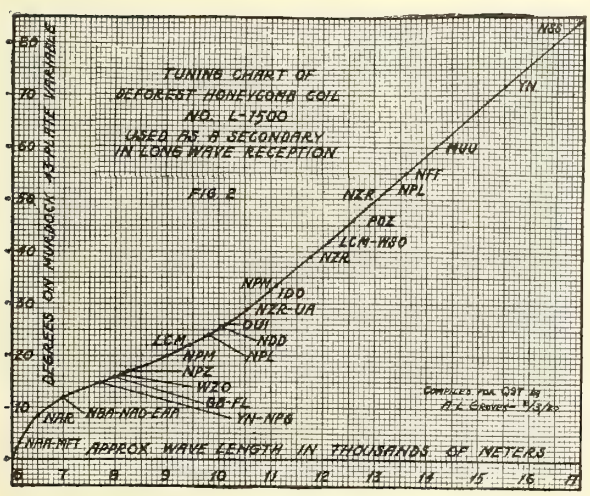
MODERN PHONOGRAPH SUPPLY CO.
254 Springer Bldg., 313 So. Clinton St., Chicago, Ill.

Insure getting your copy of Electrical Experimenter every month. Subscribe now! Only $2.50 a year! Circulation Dept., 233 Fulton St., N. Y.

DE FOREST

This is What Amateurs Do

with "Honey Comb" Coils and a Single Audion!



(Illustration by Courtesy of Q. S. T.)
A wave-length chart showing DeForest "Honey Comb" Coil reception by an Amateur unknown to us. He has written an article on the value of these Coils. Read it in the March number of Q. S. T.

Look at this chart. The Amateur who made it says that with DeForest "Honey Comb" Coils *"P O Z jumped up at me like he had suddenly moved a thousand miles nearer."* Nothing exceptional about his results. Thousands of Amateurs report equal satisfaction with DeForest "Honey Comb" Coils. Any Amateur can do as good. If you haven't tried DeForest "Honey Comb" Coils you are not getting signals you can brag about! Find out more about them now.

Send for the DeForest Catalogue

A 56-page book full of vital Radio information for the Amateur, including hook-ups and much other data. Sent postpaid for 10 cents in stamps.

Send for yours today.

De Forest Radio Telephone & Telegraph Company

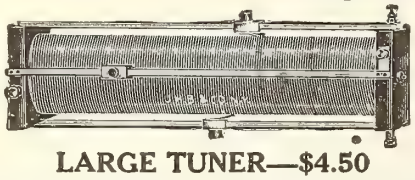
Inventors and Manufacturers of High Grade Radio Apparatus

1399 Sedgwick Avenue **New York City**

Lee de Forest, Incorporated, 451 Third St., San Francisco, Cal., Western Distributors
Shipments made from San Francisco Stock

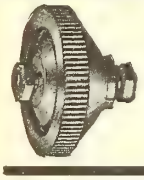
DE FOREST

"DEPENDABLE"
Radio Equipment
DORON BROTHERS ELECTRICAL CO.
Hamilton, - - Ohio
Manufacturers of
Binding Posts, Switch Points, Special Screws, Nuts, Parts, Variable Condenser Shafts, Separators, Plates, etc. Automatic Screw Machine and Punch Press Products of any kind. Get our prices on your Parts.
Have you a copy of our Radio Catalogue No. 9? It's free.

American Electro Technical Appliance Co.
235 FULTON STREET, NEW YORK CITY
FINEST "B" BATTERIES
22½ V. .....$.90 Large Size.....$2.00
DETECTORS
CONDENSERS
VT. BULBS
GRID LEAKS
GRID
CONDENSERS

WAVE METERS
QUENCHED GAP
DE FOREST'S
APPARATUS
CONDENSERS
etc.
LARGE TUNER—$4.50
2 SLIDE, SILK WIRE WOUND, 4000 METERS, BAKELITE ENDS
MAIL ORDERS require 10c for special delivery. ANY AND ALL PARTS FOR THE AMATEUR

WIRELESS MANUAL-W12
Our 180 Page Combined Manual and Catalog Illustrates and Accurately Describes the Uses of Standard Radio Instruments.
We Make a Charge of 25c for it, Issuing a Coupon Receipt Redeemable on a Purchase of $5.00 or More.
You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.
Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble. Ready about May 25. Send in your request now.
MANHATTAN ELECTRICAL SUPPLY CO., Inc.
New York—17 Park Place
Chicago—114 S. Wells St.
St. Louis—1106 Pine St.
San Francisco—604 Mission St.

UTTMARK'S Nautical Academy and Radio Institute
Telephone Bowling Green 8079. 8 State St., New York
Announcement
We have opened a new Radio School for Radio Instruction. Complete course. Modern apparatus. Day or Evening Classes. Write, phone or call.
UTTMARK'S *for Radio and Navigation*


SKINDERVIKEN TRANSMITTER BUTTON
The smallest and most sensitive transmitter in the world.
Send $1.00 for button and booklet with circuit diagrams.
J. SKINDERVIKEN
Inventor and sole manufacturer
414 Broadway, New York, or 154 West Randolph St., Chicago, Ill.

Handy Binder
FOR THE ELECTRICAL EXPERIMENTER
Holds and preserves 12 issues each of which can be inserted or removed at will, without tools. Will keep your magazines perfectly for all time or just preserve them permanently. Made of heavy material, extra strongly reinforced at the back and covered with handsome green cloth, suitably lettered in gold. **65c**
Add postage for 2 lbs.
Experimenter Pub. Co., Inc. Book Department 233 Fulton St., N. Y.

The How and Why of
RADIO APPARATUS
By H. W. SECOR
Explains fully in a simple, interesting way everything the wireless amateur should know.
Just off the press. Cloth bound in Velum de Luxe. Gold stamped and hand sewed—160 pages. Size 6 by 9 inches. No wireless enthusiast can afford to be without "The How and Why of Radio Apparatus". Postpaid $1.75.
Experimenter Publishing Co.
233 Fulton Street, New York City

The New Radio Corporation
By C. D. WAGONER
(*Continued from page* 54)

tions at one time, even if the wave lengths are the same, and it is the plan of the new company to utilize this feature in order to multiply the number of radio stations that may be operated simultaneously.

Mr. Alexanderson says of the barrage receiver:

"In the United States navy's tests of the barrage receiver, it was proven that it is possible to carry on simultaneous communication on exactly the same wave length. If this method of communication is carried out consistently in a world system of communication, it may be assumed that transmitting stations operating on the same wave length may be located as follows: One in Europe, one in the Far East, one in South America, one on the east coast of America and one on the west coast. Thus a message sent to one could be received by the other four, while at the same time messages are being exchanged by the other stations. The barrage receiver makes it possible for these messages not to conflict."

In briefly describing his high frequency alternator, Mr. Alexanderson recently said:

"The alternator which has been in use in the New Brunswick station is rated at 200 kilowatts. It is driven by an induction motor at a speed of 2,170 revolutions per minute to produce a wave length of 13,600 meters. The wave length is determined by the speed of the machine. The only part of the apparatus that moves is the solid steel disc, weighing three tons and turning between two laminated armatures. Directly connected to the alternator is the apparatus for controlling the radio frequency energy. This is known as the *magnetic amplifier.*"

It has been the belief of many that the greater the distance to be covered by radio, the higher the antennae must be, and for that reason it was considered that the practical limit for the use of radio would soon be reached. Mr. Alexanderson has also effected a remedy for this.

Instead of antennae reaching a thousand feet into the air, he has devised a means whereby the wires may be spread out over a broader area and fulfill the same purpose. For the new stations of the Corporation it is planned to use several antennae, each of which is four miles long, mounted on towers similar to those used in power transmission lines.

Edward J. Nally, who has devoted his life to communication service and who for several years has been vice-president and general manager of the Marconi Wireless Telegraph Company of America, has been elected president of the new Radio Corporation.

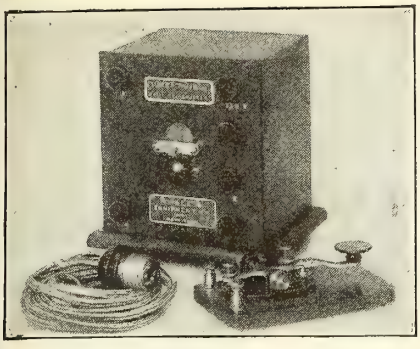
President Nally has outlined the purpose of the new corporation in the following statement:

"The principal aim and purpose of the new organization will be the establishment and maintenance of trans-oceanic and long distance overland communication.

"The corporation has been greatly strengthened thru its connection with the General Electric Company, by reason of which it will have available for its use the valuable wireless apparatus recently developed by that company, the principal device being already widely known as the Alexanderson high frequency alternator.

"Thru agreements made with the Marconi Wireless Telegraph Company, Ltd., of England, new powers and privileges are granted the new organization, extending its scope of activity and providing, among other things, for the formation of a South American Company to be managed by it."

NEW VIBRATONE Jr.
RADIO TRANSMITTING SET



This Set Illustrated Above Operates on
110 VOLTS, D. C. or A. C.
It is absolutely complete as shown. Needs no helix, spark gap, condensers, etc., etc. Simply connect to aerial, ground and electric circuit, and send.

NO BATTERY EXPENSE
Runs all day for 2 cents.
Sends three to five miles.

PRICE $18.00 COMPLETE
With Key, Plug and 8-foot Cord
Send for descriptive circular 145C—To-day
WIRELESS EQUIPMENT CO., Inc.
19 Park Place New York, N. Y.

BURGESS "B" BATTERIES



These batteries proved so successful in Government Apparatus that they are being used by progressive amateurs. Made in three sizes and now available for general use. For full information write to

BURGESS BATTERY COMPANY
Harris Trust Bldg. -:- Chicago



Radio Handbook & Catalogue
Contains much valuable radio information, tables and data. Describes a remarkable line of wireless instruments including "Red Head" 'Phones, Arlington Tested Minerals, DeForest, Murdock and Signal Apparatus. Write for this book today.
The Newman-Stern Co.
Dept. E. E. Cleveland, O.



Red Head Radio Phone
$7.00
The accepted standard in wireless receivers. If they are not BETTER than anything you've ever seen return them for full cash refund. Our Radio Handy Book and Catalogue, free on request, describes them, and many other instruments.
The Newman-Stern Co.
Dept. E.E. Cleveland, O.

ARLINGTON TESTED CRYSTALS



Why buy minerals on a gamble? Be SURE when you put a crystal in your detector that it is EXQUISITELY SENSITIVE. Buy Arlington individually tested Minerals. Galena or Silicon, post paid on receipt of price. **35¢**
THE NEWMAN-STERN CO.
Dept. E.E. Cleveland, O.

45 VOLT B-BATTERY $4.35 Shipped by Express only
Guaranteed Average Life of One Year
Order One Today
THE H. S. WIRELESS CO.
164 Ross Street, Dept. F, Brooklyn, New York

The Astronomical Spectroscope

By FLOYD L. DARROW

(*Continued from page 36*)

In 1858, Kirchoff and Bunsen discovered the following principles of spectrum analysis: (1) Incandescent solids and liquids and also gases under high pressure give a continuous spectrum, or solid band of color. (2) Highly heated gases under low pressure give a series of bright lines, whose number and position depend upon the elements present. (3) When white light passes thru a gas of lower temperature than its source, this gas will absorb from the white light those colors which it would produce, if viewed by itself in the incandescent state.

With the recognition of these principles it at once became possible to analyze the stars and nebulae of the heavens, for every element in the state of incandescent vapor has its own characteristic bright line spectrum of invariable color and position. But more, this instrument reveals the physical state of stars, nebulae and comets, for a continuous spectrum means an incandescent solid or a gas under great pressure, while a bright line spectrum proves the presence of a light vaporous firemist. This marvelous instrument, too, *discloses the motion of a distant star!* Whenever a star is approaching our solar system its spectrum is shifted from the normal position which it would have if the star were stationary, toward the violet. When the star is moving away from us the spectrum is shifted toward the red. From the amount of the shifting, the velocity may be told with a remarkable degree of accuracy. The alternate shifting of spectra first in one direction, and then the other has led to the discovery of twin stars rotating about a common center of gravity.

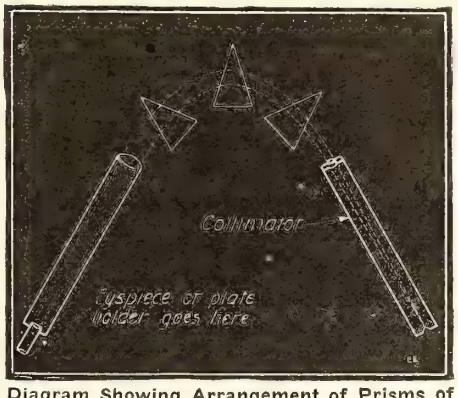


Diagram Showing Arrangement of Prisms of the Spectrograph, Such as Used in Connection with Astronomical Telescopes. To Be Used with a Spectrograph for Photographing the Spectrum, Three Prisms Are Usually Employed, so as to Obtain a Greater Degree of Dispersion, and a Plate Holder Is Substituted for the Eye-Piece.

In photographing a star spectrum exposures frequently last a whole night. For photographing the infra-red and ultra-violet portions of the spectrum *quartz* lenses are employed. The spectrograph is the most delicate and accurate attachment of a great telescope.

RADIO ON TROTSKY'S TRAIN.

A Russian refugee who has reached Finland, has given a correspondent of the London *Times* the following details of Trotsky's special train de luxe: "It consists of 14 cars and two powerful engines, being supplied with wireless installation capable of receiving communication from Nauheim, Lyons and London. As soon as a station is reached the train is connected with the telephone system. The wireless outfit never sleeps. One car contains the press that prints Trotsky's paper, called "On the Way."

The Healing Rays of this PAIN RELIEVING Sterling Lamp



make it a welcome addition to all homes, or wherever it is introduced, a practical **First Aid** in the instant relief of aches and pains. The Sterling Pain Relieving Lamp, affords quick and sure relief to all persons suffering from Rheumatism, Lumbago, Sciatica, Neuritis, etc., soothes and induces restful sleep, heals wounds and burns.

Renews Vim Vigor and Vitality
by increasing blood circulation, makes one more efficient. It works along Nature's lines, and follows her laws which accounts for its healing powers.

Heals Like the Beneficent Rays of the Sun
but, unlike the sun, **it always shines when needed**, always ready, day or night, "Sunlight" in a convenient, portable form, its therapeutic properties scientifically worked out, to make it possible to put this wonderful curative agent in the hands of all, for the benefit of all, at all times.

Used and Endorsed by Physicians
because of its great value in cases, where, without it, some powerful drug would have to be used for quick relief of pain, in emergencies, and at other times, in the fight to restore health. An invaluable aid in the sick room.

Send for Illustrated Booklet
You will be intensely interested in reading about the authentic and wonderful cases of healing where this lamp has been used in homes, hospitals, sanitariums, etc., in all manner of cases. So simple that a child can use it. Sold under a positive guarantee of satisfaction or the money back. **Write today.**

STERLING PAIN RELIEVING LAMP CO.
Desk E
546 Garfield Ave.
Chicago, Illinois



STERLING PAIN RELIEVING LAMP CO.
Desk E. 546 Garfield Ave., Chicago

Please send me without cost or obligation, your fully illustrated Booklet, describing the Sterling Pain Relieving Lamp, its uses and benefits.

Name.....

Street and No.....

City..... State.....

Delivered TO YOU FREE



Your choice of **44 styles**, colors and sizes in the famous line of **"RANGER"** bicycles. We pay the freight from Chicago to your town.

30 Days Free Trial allowed on the bicycle you select, actual riding test. **EASY PAYMENTS** if desired, at a small advance over our Special Factory-to-Rider cash prices.

Do not buy until you get our *great new trial offer* and low Factory-Direct-To-Rider terms and prices.

TIRES LAMPS, HORNS, pedals, single wheels and repair parts for all makes of bicycles at half usual prices. **SEND NO MONEY** but write today for the big new Catalog.

Rider Agents Wanted
Boys make big money

MEAD CYCLE COMPANY Dept. S-107 CHICAGO

Electrical Engineering men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete

In One Year

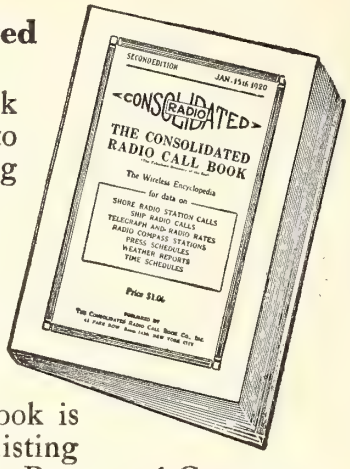


Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 28th year opens Sept. 29, 1920
BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

The Second Edition of the Consolidated Radio Call Book

Has Been Unavoidably Delayed

owing to the vast amount of work involved in bringing it right up to date and in compiling the big amateur section that will be a special feature. We urge all those who have placed their orders to be patient—you'll be glad you waited when you receive your copy, which will be very soon.



The Consolidated Radio Call Book is the only book in print officially listing all the radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.

All Amateur Calls Also Listed

SPECIAL
Given Free with Each Copy

A Wireless Map of the World **in colors** is given absolutely free with each copy. This map shows the locations of all the high powered RADIO stations in the world, including the time signal stations. In addition it tells at a glance how far away any of these stations are. Of greater interest are the time zones, which enable the amateur to compute instantly the correct time for the zone in which he is located from any time signal station.

Price $1.00 Prepaid

Either Direct from us or for sale by the following responsible Dealers:

American Electro Technical Appliance Co.
235 Fulton St., New York, N. Y.
Atlantic Radio Co.
34 Batterymarch St., Boston, Mass.
L. Bamberger & Co.
Newark, N. J.
Cutting & Washington Co.
6 West 48th St., New York City.
L. W. Cleveland Co.
441 Congress St., Portland, Me.
J. H. Bunnell & Co.
32 Park Place, New York City
Doubleday Hill Electric Co.
719 Liberty Ave., Pittsburg, Pa.
Lester J. Jenkins
923 Purchase St., New Bedford, Mass.
A. T. Hovey
61 Belvidere St., Boston, Mass.
Klaus Radio Apparatus
Eureka, Peoria, Ill.
Manhattan Electrical Supply Co.
17 Park Place, New York City
114 S. Wells St., Chicago, Ill.
1106 Pine St., St. Louis, Mo.
604 Mission St., San Francisco, Cal.
McCarthy Bros. & Ford
75 W. Mohawk St., Buffalo, N. Y.
E. P. Noll & Co.
21 N. 7th St., Philadelphia, Pa.
Nola Radio Co.
134 Chartres St., New Orleans, La.
Newman-Stern Co.
1874 E. 6th St., Cleveland, Ohio
National Radio Supply Co.
1405 U St. N. W., Washington, D. C.
Pioneer Electric Co.
137 E. 5th St., St. Paul, Minn.
James W. Poole, Inc.
16 Columbia St., Boston, Mass.
F. D. Pitts Co.
12 Park Square, Boston, Mass.
Precision Equipment Co.
2437 Gilbert Ave., Cincinnati, Ohio
Radio Distributing Co.
4 West Park St., Newark, N. J.
Reuter Electric Co.
34 E. 6th St., Cincinnati, Ohio
Radio Equipment Co.
630 Washington St., Boston, Mass.
Southern Electrical Co.
3d and E Sts., San Diego, Cal.
H. E. Williamson Electric Co.
316 Union St., Seattle, Wash.
Jos. M. Zamoiski Co.
Baltimore, Md.

Published by

Consolidated Radio Call Book Co., Inc.
41 Park Row, New York City

X-Rays of Unprecedented Hardness

By DR. ALFRED GRADENWITZ

(*Continued from page 25*)

glow cathode even at the highest obtainable vacuum, to be endowed with any desirable speed. Physical investigation on the increase of hardness in terms of the voltage applied was resumed after the adoption of these cathode tubes, and was driven as far as the highest voltages then obtainable, viz., about 170,000 volts, the remarkable result being obtained that from about 145,000 volts on; no further increase in the hardness of X-rays was noted on augmenting the tension. It may be said that in connection with such researches the hardness of X-rays is measured by their *absorption* in well-known metal layers, the intensity of radiation being ascertained, on the one hand, directly as it issues from the tube, and on the other, after traversing a known layer of absorbing metal, mostly aluminum or lead. The figure characteristic of the radiation is termed the *coefficient of absorption.*

In order to ascertain whether the above maximum actually corresponds to the end of the X-ray spectrum or whether the limit is only accidental, due to the conditions of the test, transformers producing even much higher tensions had to be constructed. While the outfits so far in use had proved quite satisfactory for many medical purposes, they would unavoidably break down in the case of continued operation, the risk of puncture increasing far more rapidly than the voltage.

Dr. F. Dessauer, of Frankfort-on-Main, has set himself the task of closely investigating the case and placing the construction of transformers on a radically new basis.

The cause of breakdown was found to be in the fact that there are no insulating materials able in the long run to stand such enormous tensions, unless, in fact, they be given excessive dimensions. If the secondary coil of a 100,000-volt transformer be grounded exactly in the center, thus producing there a tension = zero, there will be a tension at the two terminals of + 50,000 volts and — 50,000 volts respectively. A 200,000-volt transformer would in a similar manner have to stand but 100,000 volts at each terminal.

The solution suggested by Dessauer involves the designing of the transformer in such a way that, while the voltage supplied is as required, insulating material will not have to stand the stress corresponding to this high voltage, this stress being absorbed by special auxiliary transformers, which, having to generate low tension, are quite equal to that task.

The transformer is thus split into two halves, each of which has the ratio required and with each of which an auxiliary transformer is connected in series. These auxiliary transformers need not have any ratio differing from 1, serving as they do exclusively for subdividing and, accordingly, reducing the puncture stress, while the actual transforming is done exclusively by the split main transformer. The high-tension coils being grounded at the juncture in the center, there are at any moment at the two terminals opposite tensions of the same absolute magnitude. The center of each of the secondary half-coils is at a potential one-fourth the transformer tension and is connected with the corresponding primary coil. The primary coils, being insulated from one another and from the ground, the maximum stress is reduced to one-fourth the transformer tension. The following will serve to make this clear:

The task of the primary coil in a transformer, of course, merely consists of converting the electrical energy into a pulsat-

RADIO APPARATUS

Distributors of Reliable Experimental and Laboratory Radio Apparatus for High Schools, Colleges and Individuals.

More than a store — **Try our service**

At F. D. Pitts Co., Inc., you will find an exposition of reliable radio apparatus and supplies from the foremost manufacturers of the country. No other store has such a complete line of equipment, nowhere else is such an opportunity to choose from the products of so many radio manufacturers. A feature which must appeal to experimenters is that we keep things in stock. Immediate delivery! Give our service a trial! Send 6 cents in stamps for new catalog. Every experimenter should have it.

F. D. PITTS CO., Inc.
Dept. D
12 Park Square, Boston 11, Mass.

RADIO OPERATORS

$125.00 per month and upward plus all expenses.

Modern Equipment—
Special Short Course
Individual Instruction
Finest Staff of Teachers Available
Dormitory—Swimming Pool

Call or write for illustrated booklet

Y. M. C. A. Radio School
Dept. R
152 E. 86th Street New York, N. Y.
"BEST RADIO SCHOOL IN THE EAST"

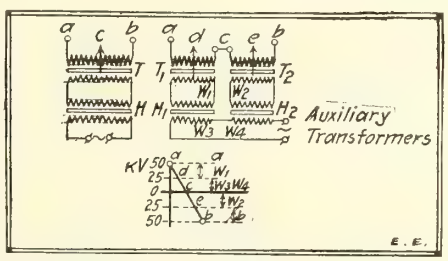
ORDER IT TO-DAY
See page 7

Universal Radio System
Up to the minute radio apparatus for progressive users who can recognize quality.
Send stamp for catalogue.
Universal Radio Mfg. Corp.
Dept. W Elmira, N. Y.

ing field of energy, so that this, in its turn, may in the secondary coil set up a high tension. In the case of ordinary transformers, the flux comes forth from primary coils, which, being directly fed from the mains, are approximately at the potential of the ground. However, it is by no means necessary that the primary coils should be fed directly from the mains, thus being at the potential of the ground. In fact, in the case of Dr. Dessauer's transformer they are no longer fed from the mains, but from another source of current, the potential of which can be controlled at will. Apart from the subdivision of the coils, as above described, the novelty of the transformer lies in the fact that each primary coil receives its current, not from the mains, but from a special source of current, viz., each from the secondary coil of an auxiliary transformer. These auxiliary transformers have no other task but transmitting the energy of the current in the mains to the primary coil of the high-tension transformers, without these being connected to the mains. In fact, the high-tension transformers are only indirectly fed from the mains, which indirect feeding allows the primary coil voltage to be controlled at will, thus reducing the stress.

The same system can, of course, be developed for a greater number of auxiliary transformers, thus reducing even further the stress to be dealt with. Some transformers may, in this case, be dispensed with, the auxiliary transformers constituting, as it were, the corner-pillars of the system, and being given larger dimensions.

The apparatus so far constructed on this system supply an X-ray radiation reduced to half its initial value on passing thru an



Arrangement of Auxiliary X-Ray Transformer for Producing Ultra-High Potentials.

aluminum layer 3 cms. thick. The most efficient apparatus used in actual practise, truth to say, only have a maximum potential of 240,000 volts, the hardest radiation being reduced to half its initial value on passing thru 2 cms. of aluminum. Some machines of the most modern type (producing X-rays with 1.75 cms. aluminum half-value), have for some time past been used with satisfactory results at certain Berlin hospitals. The hardest X-ray radiation above mentioned is only slightly softer than the rays given out from "Radium-C," tho there are no material differences as to the absorption in water and in human flesh.

These extra hard X-rays are, accordingly, to be used as a substitute for Radium rays, it being hoped that the treatment of malignant tumors will be facilitated by their use. There is no objection to constructing machines of up to 400,000 volts; in fact, Dr. Dessauer at present works with an experimental machine of 450,000 volts maximum tension.

$50.00 In Prizes
See Page 38

Big Money for Boys!



Learn ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into positions just as soon as they are ready. Good salaries are offered to start with splendid chances for rapid promotion.

For 28 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6233, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name _____
Present Occupation _____ 7-28-19
Street and No. _____
City _____ State _____

Check the Job You Want!

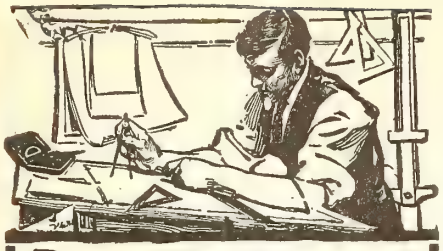
Thousands Men—Women, Wanted!

....Railway Mail Clerk $1300 to $2125	....Customs Positions $1000 to $1500
....Postoffice Clerk $1200 to $1650	....Internal Revenue $1600 to $1800
....Postoffice Carrier $1200 to $1650	....Stenographer $1200 to $2000
....Rural Mail Carrier $800 to $2360	....Clerk at Washington $1100 to $1500

Name .....
Address .....

Sign your name and address and send us this coupon immediately. We will immediately send you (1) a full description of the position checked, (2) a list of many U. S. Gov't Jobs now open and directions telling how to get free coaching for the position checked.

Franklin Institute, Dept S101 Rochester, N. Y.



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada. **Free Membership in This Society.**—A Consulting Membership **given free** with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-255 Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D-255
Chicago, U.S.A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $2 a month until $16.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name.....

Address.....

Reference.....

"EARN WHILE YOU LEARN"



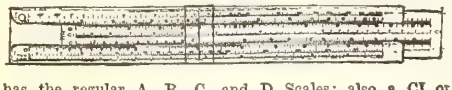
If you are earning less than
$50.00 PER WEEK
and like to draw—you should study

Commercial Art

Leading Art Managers—the men who know — recommend us and employ our students. We will guarantee to make you successful—Learn at home in your spare time—or in our resident school—Day or evening. Many of our students earn money by the sale of their drawings while learning. Write for FREE illustrated catalogue.

COMMERCIAL ART SCHOOL
708, 116 So. Michigan Avenue, Chicago, Ill.

RICHARDSON'S POLYPHASE SLIDE RULE



has the regular A, B, C, and D Scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book which teaches all there is to know about slide rules, is sent with each order.

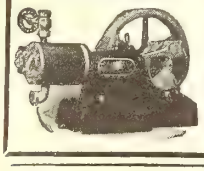
Price of the Richardson's Polyphase Slide Rule, in case with 100 page Instruction Book $2.00.

An ideal Slide Rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10. each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO. NILES, MICH.

Small Steam Engines and Boilers



Gas and Gasoline Engines, ⅛ H. P. up; Tanks, Pumps, Gears, Model Maker's Supplies. Get our Big Catalogue, sent postpaid for 15c (coin preferred) or stamps. Refunded first order. 192 Pages—over 200 Illustrations.
MODERN ENGINE & SUPPLY CO. 346 Monadnock Block, CHICAGO.

Largest High Frequency Laboratory

(*Continued from page 37*)

(Note: The voltage required to maintain high frequency corona is much less than that to start it.) Time of exposure, 10 minutes.

Radio and electrical experimenters will be particularly interested in this remarkable high frequency, extra-high potential testing laboratory and the results obtained with it. Some of the spectacular high potential discharges obtained at this laboratory were shown in the November issue. The average electrical experimenter thinks he has a very powerful apparatus if he obtains a Tesla or Oudin high frequency spark discharge of 36 inches to 48 inches in length, and certainly, when he produces such a discharge in his home laboratory, he has really something to be proud of, but when it comes to discharges such as produced at this laboratory and by such powerful apparatus as developed by the Federal Company's engineers, such small discharges pale almost into oblivion. The discharges obtained at the Federal laboratory approximate those developed by the famous Tesla high frequency, high potential laboratory in Colorado about twenty years ago.

By stringing a wire at a height of 10 to 15 feet above the ground for a distance of even 100 feet, and then exciting the high frequency coil shown, a tremendous corona or brush discharge between the wire and the earth occurs, and at night it yields a most startling and surprising effect, especially interesting to those who have never seen it in operation before.

Such a plant would be capable of electrifying many acres of agricultural ground for the purpose of intensifying plant growth, while the cost of operating such a plant is not so unreasonable as it might first seem, considering the tremendous amount of high frequency energy thus rendered available.

An Electromagnetic Galvanometer

By HANS O. STORM

(*Continued from page 50*)

paper should be translucent, so that it may be read from either side, while the spot of light is thrown on the side nearest the instrument. The sun-mirror or other source of light should be placed so that the light strikes the instrument at a slighly downward angle. Then, if the galvanometer is mounted on a level with the operator's eye, his shadow will not be cast on it, and neither will the spot of light reflected by the window, which is fully as bright as that from the mirror, be thrown on the scale to cause confusion.

If desired, the scale can be made very large and drawn upon the opposite wall of the room. The two methods give about equal accuracy. Equal divisions of the scale will approximate equal current increments more closely than any laboriously calculated function of the angle of deflection of the coil.

When calibrating the instrument, it is well to obtain calibration curves showing the sensibilities and deflection constants with varying field currents. It will be found that, with the coils placed as they are, close to the air gap, there will be no definite point of saturation. A more marked saturation point, with greater uniformity of the values lying above it, might be obtained by placing the coils on the sides or back of the magnet, but this would mean a considerable sacrifice of flux thru the air gap.

The positive terminal of the field should be plainly marked, and the current never be reversed, because this would introduce an error due to hysteresis.

Radio Diagrams and Formulae in Loose Leaf Form

The publishers of the CONSOLIDATED RADIO CALL BOOK have completed the preparation of diagrams and instructions on:—

Measurement of Capacity of a Condenser. (Substitution Method.) Calibration of a Variable Condenser. Two Diagrams and Curve.....No. 1
Measurement of Inductance of a Coil or Circuit. Two Methods—Two Diagrams.....No. 2
Measurement of Distributed Capacity of an Inductance. Diagram and Curve.....No. 3
Measurement of Fundamental Wavelength of an Antenna. Three Methods. Three Diagrams.....No. 4
Measurement of Wavelength of Distant Transmitting Station. Two Methods. Calibration of a Receiving Set. Two Diagrams....No. 5
Measurement of Effective Antenna Capacity. Two Methods. Two Diagrams.....No. 6
Measurement of Inductance of Antenna and a Third Method of Measuring Effective Capacity of Antenna. One Diagram.....No. 7
Measurement of Antenna Resistance. Substitution Method.....No. 8
Schematic Wiring Diagram of Regenerative Audion Receiving Set Suitable for Receiving High Power Undamped Wave Stations. Connections shown are those used in most Navy and Commercial Receivers.....No. 50
Table giving the value of LC (Product of Inductance and Capacity) for wavelengths from 300 to 20,000 meters. Inductance in Microhenrys.....No. 100
Table same as above but with Inductance in centimeters.....No. 101
Schematic Wiring Diagram of Signal Corps Type SCR-68 Radio Telephone Transmitting and Receiving Set.....No. 51
Schematic Wiring Diagram of Type CW-936 (Navy Submarine Chaser) Radio Telephone and Telegraph Transmitter and Receiver. No. 52
Schematic Diagram of Type S.E. 1100 (Navy Flying Boat) Radio Telephone and Telegraph Transmitter.....No. 53

These diagrams and instructions are the most CLEAR, CONCISE, COMPREHENSIVE and CONVENIENT form of instruction that has ever been presented. They are printed on pages size 8½ x 11.

Complete Set of 14 Sheets as described, sent postpaid 75c

CONSOLIDATED RADIO CALL BOOK CO., Inc.
41 Park Row, New York, N. Y.

A Bird in the hand

A ACE E

—is worth two in the bush. Yes, Boy, and one readable signal is worth two unreadable signals.

Why not have readable signals? Using an antenna, 2 wires 100' long, 30' high one end and 25' other end, amateur signals *readable every night* are received in Cincinnati from Connecticut to Texas. No amplifiers used.

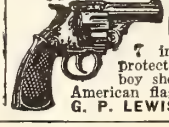
The Ace Regenerative Tuner does the trick. Range 150 to 2750 meters. Price $55 F. O. B. Cincinnati.

You may pay more, but you can't buy better.

The Precision Equipment Co.

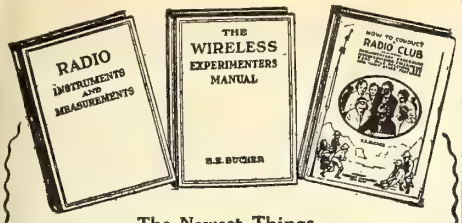
Dept. E
2437 Gilbert Ave., Cincinnati, O.

BE AN EXPERT
Penman
Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. Complete outline FREE. Write C. J. Ozment, Dept. 44, St. Louis, Mo.



BLANK CARTRIDGE PISTOL Sent Prepaid **ONLY $1**

7 inches long, real revolver style. For protection and sport, every man, woman and boy should have one. Order at once. Get an American flag **FREE.** Money refunded if desired.
G. P. LEWIS CO., 1402 Broadway, New York City



The Newest Things
IN WIRELESS
Are in These Three Books
Now ready for delivery

RADIO INSTRUMENTS AND MEASUREMENTS
Every amateur should have this book as it answers the questions you want to ask and covers all phases of the subject matter indicated by its title.
Cloth Bound, 320 Pages. Price $1.75

THE WIRELESS EXPERIMENTERS' MANUAL
By E. E. Bucher
Mr. Bucher's latest book. The only one that comprehensively covers all phases of wireless work, including the latest practices in both Radio Telegraphy and Telephony. Most complete text book on these subjects yet published.
Cloth Bound, Approximately 300 Pages. Price $2.25

HOW TO CONDUCT A RADIO CLUB
By E. E. Bucher
One of the most popular wireless books ever published. Covers parliamentary procedure, indoor and outdoor experiments, 5,000-mile receiving sets, use of vacuum tubes and many other subjects.
Paper Cover, 148 Pages. Price 75c

THE WIRELESS AGE
A monthly magazine that will keep you posted on the up-to-the-minute things in wireless communication. Official organ of the National Amateur Wireless Association.
Price Per Year $2.00

SPECIAL COMBINATION PRICE
All Four for Only $6.25

WIRELESS PRESS
62 Broad St., New York

3-INCH DIAL INDICATOR



Black Composition with Brilliant White Filled Engraving

No. 66 Dial only.....75 cents
No. 67 with Bakelite knob, $1.30
For sale at all RADISCO Agencies
Sent postpaid.

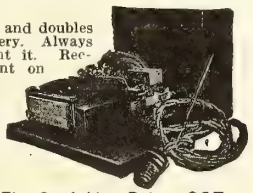
NEW CATALOG JUST OUT, ready for distribution at once. Contains News, Illustrations and descriptions of all standard radio parts.
Sent anywhere upon receipt of 10c.

A. H. CORWIN & CO.
4 West Park St. Newark, N. J.

Charge Storage Batteries
For Convenience or Profit

From any alternating current lamp socket with the Cambridge Rectifier. For home or garage use. As simple as turning on a lamp and fully guaranteed.

Quickly saves its cost and doubles the life of your battery. Always ready when you want it. Rectifier Bulletin R sent on request.



Bulletin Y of Wireless Telegraph Apparatus sent for 3 cent stamp.

Clapp-Eastham Co.
131 Main St.
Cambridge, Mass.

The Cambridge Battery Charger, Price **$25**

HANDY BINDER
for the Electrical Experimenter

Holds and preserves 12 issues, each of which can be inserted or removed at will, without tools. Will keep your magazines perfectly for all time or just preserve them like new till you bind them permanently. Made of heavy material, extra strongly reinforced at the back and covered with handsome green cloth, suitably lettered in gold. **Add postage for 2 lbs.**

65c

Experimenter Pub. Co., Inc. Book Department, 233 Fulton St., N.Y.

Radium the Mother of Ions

By HAROLD F. RICHARDS, M.A.

(*Continued from page* 51)

RADIUM DISCHARGES AN INSULATOR.

A simple experiment showing the production of ions by radium can be performed with an ordinary electroscope and a piece of glass or hard rubber. A metal can is attached to the rod which bears the charged gold leaf. If now any piece of non-conducting material, such as dry glass, rubber, or amber, be suspended by a string within this hollow vessel, the movement of the gold leaf will show that the insulator is electrically charged. This is because an insulator *holds* any charge which is may receive by friction or other means, and it is difficult to remove this charge by ordinary agents. If a piece of hard rubber is rubbed with silk, cat fur, leather or, in fact, any dry material, a large electrical charge will be produced upon it. If it is suspended in the electroscope chamber, see figure 3, deflection of the gold leaf will reveal the presence of this charge. But if the rubber is withdrawn, exposed to the radiation from radium or other radioactive substance, and then replaced in the electroscope, the gold leaf does not move. This shows that the radium has removed the electricity of the insulator. If the rubber possest a negative charge, the positive ions produced in the air by the radium were attracted to its surface, and there neutralized its charge.

X-rays or ultra-violet rays will produce the same effect, thus showing that they also ionize the air. The electrified insulator can also be discharged by passing it rapidly thru a flame, as of a candle or gas jet. This is because the combustion of gases in the flame produces ions, just as do the rays of radium.

In a succeeding article I wish to describe a speedometer for these gaseous ions. The apparatus automatically starts and stops the experiment in the space of seven-thousandths of a second, and tells how fast the ions traveled in the meantime. I shall also describe a means by which a *single alpha particle* can be made to register its arrival with pen and ink on paper, very much as a traveler signs the book at a hotel. Science will soon beinducing these infinitesimal particles to walk up to the front door and ring a bell.

A Bench-Lathe from Pipe

By A. NOAH HARRINGTON

(*Continued from page* 48)

shafting, halved out at the ends. The supports for the ends of the shafts are made from pieces of one-quarter inch pipe; FF, are two pieces of one inch pipe, 3½ inches long, fastened to the plate G with machine screws. They are placed on the shafts DD, Fig. 2, and babbitt poured in them around the shafts, first wrapping a piece of thin tissue paper around the shafts, so they will not bind. The plate G, Fig. 2, is 3½ x 3 x ¼, with a one inch hole in the center for the tool holder or post. The tool holder A, is made from a piece of one-half inch pipe. A slot is cut in it to hold the tool and a cap is screwed on the end thru the center of which a hole is bored and threaded for a ⅜ cap screw. It is fastened to the plate A with two lock nuts, one above and one below the plate.

A curved piece of iron, B, is placed under the tool to raise and lower it. The feed screw is shown at H, Fig. 3.

Be an Electrical Engineer

A HIGH grade, well-paying profession is open to you right now. It is not overcrowded, and the "live wire" can assure himself of limitless opportunities for advancement and success.

Bachelor of Science Degree in 3 Years

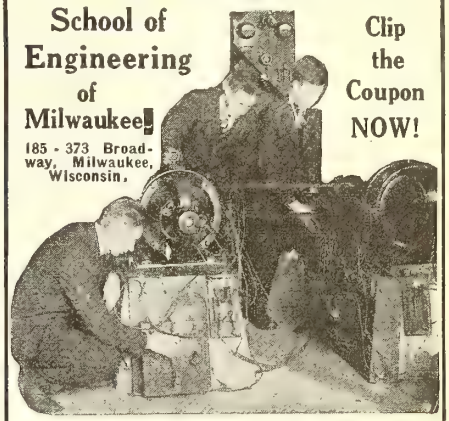
can be secured if you train in our splendidly equipped laboratories, classrooms and testing rooms under the expert direction of a faculty of 80 specialists. This intensive course thoroly prepares you for entering the promising field of electrical engineering and to occupy a real position at the start.

Spring Term Now Open

Investigate right now our "Earn-While-You-Learn" system and how it will aid you to succeed. Full details and catalog on receipt of coupon.

School of Engineering of Milwaukee
185 - 373 Broadway, Milwaukee, Wisconsin.

Clip the Coupon NOW!



CLIP HERE

School of Engineering of Milwaukee
185-373 Broadway, Milwaukee, Wisconsin.

I want your catalog and full particulars regarding your 3-year Bachelor of Science course in Electrical Engineering.

Name .....
Address .....
Age.....Education .....

BE A REAL MAN!
LOOK LIKE ONE AND FEEL LIKE ONE



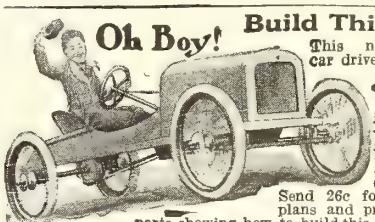
Broaden your shoulders, deepen your chest, enlarge your arms, and get a development that will attract attention. Fill youself full of energy and be powerful.

MY NEW BOOK
"Muscular Development"
Will Explain How

This book is illustrated with 25 full page photographs of myself and of some of the world's finest developed athletes whom I have trained. It will interest and benefit you greatly.
Send 10c (stamps or coin) for a copy NOW, today, while it is on your mind.

EARLE LIEDERMAN, Dept. 220 203 Broadway, New York City

Oh Boy! Build This Car.



This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 26c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO., 156 Sypher Bldg., Toledo, Ohio

BUILD YOUR OWN
Wireless Receiving Set

Think of the pleasure and practical experience you will gain in making your own set, with wave-length range from 170 to 2,500 meters.
We furnish full-sized Blueprint and complete detailed instructions for making this set and price of parts for $1.00.

Write today and get started
K. & G. WIRELESS SUPPLY CO.
152 Chambers St. Dept 15A New York City

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section ten cents a word for each insertion. No advertisements for less than $1.00 accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the July issue must reach us not later than May 22.

The Circulation of the Experimenter is over 150,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Aeronautics.

Ornithopter and gravity flyer, with warping and adjustable wings, 16" x 22". Durable and scientific. The only successful flapping-flyer made. Price $3.00. Adams Aeroplane Co., 252 West 53d St., New York.

Propellers for aeroplane propulsion; small propellers for motorcycle-driven snow and ice sleds; road speedsters and hydroplanes. Can supply hub mountings, bearings, counter shafting and sprockets complete. Pamphlets free. Crawford Motor and Aeroplane Mfgr., 144 S. Ramport St., New Orleans, La.

Compressed Air Motors for model airplanes, 3 cylinders, rotary type, made of steel, aluminum and bronze. Weight 2¼ ounces. Write to Model Machine Shop Co., 415 East 71st St., New York.

100 Model Aeroplanes. Good flyers. 15c brings working Drawings and Prices. F. Bruland, Redford, Mich.

Auto Accessories.

Miller Steam Vulcanizer, good as new. Also Electric Light Plant with Battery. Klaus, Eureka, Ill.

Tires—10,000 miles guaranteed in writing. (No seconds.) At special wholesale direct-to-you prices. Write Washington-McLean Tire Co., 2104 14th St., N. W., Washington, D. C.

Save—All Carburetor Attachment makes Fords run better. Gives more miles, power and speed. Free Trial. Savall Company, 3716 North Clark St., Chicago.

Tires—Direct to you prices. Exclusive representatives wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Bond 8,000 Miles. Sample Sections furnished. Mellinger Tire Company, 980 Oak, Kansas City, Mo.

Battery Charging pays big profits. City current or gas engine operates. Easy terms. Hoberts, Troy, Ohio.

Auto Armature Blueprints. See my add under "Electrical Supplies." Charles Chittenden.

Wanted—Good live selling agents for our garage testing instruments and publications. Write for catalogue and particulars. H. E. Phillips & Company, Service Division, Union City, Ind.

Fords run 34 miles per gallon with our 1920 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all Motors. Runs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee. 30 days' trial. Air-Friction Carburetor Co., 270 Madison Ave., Dayton, Ohio.

Auto Motor Supplies—Buick, Michigan, Stoddard Dayton, Cadillac, Overland, E. M. F. Continental and Buda Motors all types $50 each and up. Special high tension 2 and 4 cylinder Magnetos, $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for late catalogue. Address Motor Sales Dept., 12 West End, Pittsburgh, Pa.

American Made Toys.

We Offer an Opportunity to manufacturer with facilities for large production, also to homeworkers on smaller scale, to manufacture Metal Toys and Novelties. Unlimited field and enormous business open for ambitious people. No experience required. No tools needed. Our castingforms turn out goods complete. Since the different Toy Expositions, manufacturers are covered with orders until December. You can enter this field now, by manufacturing "American Made Toys." We furnish castingforms for Toy Soldiers, Army, Navy, Marine, Cannons, Machine Guns, Indians, Cowboys, Warships and other novelties. Castingforms, complete outfit, $3.00 up. We buy these goods, direct from manufacturers. Yearly contract orders placed with reliable parties. We pay very high prices for clean painted goods. Samples furnished. "Bird-Whistles," great seller, just added to our stock list. Booklet, Information, Instruction free, if you mean work and business. No others invited to write. Toy Soldier Manufacturing Co. 32 Union Square, New York.

Salesmen Wanted.

Salesman, side or main line, to sell low priced 5,000 mile guaranteed automobile tires; 30 x 3½ non-skid sells for $12.95, other sizes in proportion. Good money-making proposition for live wires. Consolidated Tire Co., 616 So. Michigan, Chicago.

Salesmen Wanted—Gun Peanut Vending Machine combinations collect $2.50 to $8.00 commissions each sale. $10.00 to $20.00 daily easy. Commissions on refills. "Sanichu," 3624 Cottage Grove, Chicago.

ELECTRICAL EXPERIMENTER,
New York City,

Gentlemen:

You certainly have a very creditable magazine. Our office receives fifty or sixty different magazines each month. Only two or three of these magazines are taken home by the Manager of our Bureau to be thoroughly read. The ELECTRICAL EXPERIMENTER is always one of the magazines which is carried home for this purpose. It is really a grand magazine. We certainly wish you the very best of success, both with the magazine and with your advertising department.

WE might also add, that our copy in your magazine is producing very satisfactory returns. Your magazine seems to place us in contact with a superior class of people; people who mean business, who have the money to carry out their desires and not mere curiosity seekers.

The Nat'l Literary & Publishers' Service Bureau, Security Building, Hannibal, Missouri.

Personal.

The Salesman Win$. Thousands of positions open. We teach traveling salesmanship by mail and guarantee offer of position or refund tuition. For interesting particulars address Kansas Vocational Bureau, Miltonvale, Kansas.

Pictures.

High Art Photographs—Posed from living models. Suitable for dens, clubrooms and private collection. Send 10c. for illustrated miniature sheet and price list. United Sales Co., Springfield, Ill.

Printing.

3000 two color labels, $1.25. Irvin J. Wolf, Station E, Philadelphia.

Patriotic Novelties.

A. E. F. pillows and pennants, honor rolls. Dept. E, Military Supply, Aurora, Ill.

Rubber Stamps.

Rubber Stamps made to order. McCaddon Company, Zanesville, Ohio.

Help Wanted.

Detectives and Investigators are in demand. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. American School of Criminology, Dept. E, Detroit, Mich.

Detectives Earn Big Money. Excellent opportunity. Particulars free. American Detective System, 1968 Broadway, New York.

Be a Mirror Expert. $3-10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Men Wanted. Be Automobile Experts, $45.00 week. Learn while earning. Write Franklin Institute, Dept. S, 806, Rochester, N. Y.

Detectives Make Big Money. Travel, be your own boss. Either sex. We instruct, small cost. Write Johnson's Detective School, 232 Sheldon Ave., Grand Rapids, Michigan, Dept. A.

Dollars Saved. All kinds of used correspondence courses sold. (Courses bought.) Lee Mountain, Pisgah, Ala.

Railway Mail Clerks. City Mail Carriers wanted by government. Commence $100 month. Men, 18-45. List positions free. Write immediately. Franklin Institute, Dept. S 26, Rochester, N. Y.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Firemen, Brakemen, Baggagemen, $140-$200. Colored Porters by Railroads everywhere. Experience unnecessary. 897 Ry. Bureau, East St. Louis, Ill.

Instruction.

Crystal Gazing—The Craze. Send self-addressed stamped envelope for Free instructions. Zancigs Studio, Asbury Park, N. J.

Cartooning Comics and Lettering. Complete Course only $5, postpaid. Over 300 illustrations. Stamp brings easy lesson. Cartoonist Ernie, Elyria, Ohio.

Electrical Supplies and Appliances.

Blueprints, motor connections; 236 A.C. Single, two and three phase, including voltage, cycle, phase, speed changing; 123 D.C. diagrams. Voltage changing, testing, etc.; 120 Transformer diagrams; 170 Rheostats, controllers, compensators, etc., with both internal and external connections; 175 connections for automobile starters and generators; 10 samples A.C., 25c. Catalog upon request. Charles Chittenden, Dept. A, 3024 Matthews Ave., Kansas City, Mo.

Battery Charging pays big profits with HB Equipment. Electric Light Generators and Motors can also be furnished on easy payments. Full information free. Hobart Brothers, Troy, Ohio.

Switchboards built to order for Radio, Farm Lighting plants and experimental purposes; 12 volts to 250 volts, A.C. or D.C. Chas. Waechter, R. F. D. No. 7, Box 224, Bellevue, Pa.

Storage Batteries. Learn to make them for Automobiles; we furnish everything. Sample plates, 40c. Windsor Specialty Co., 5419 Windsor Ave., Chicago, Ill.

Inventors: Models, Dies, Tools, 28 years' experience, work guaranteed, lowest price. Manufacturing of specialties our hobby. Peerless Die & Tool Co., 121 Opera Pl. D. B., Cincinnati, Ohio.

Mansfield's Automatic Water and Oil Finder a proved success, silver medal awarded. Particulars from Edwin A. Mansfield & Co., 94 Victoria Road, New Brighton, England.

Welding Instructions for operating Oxy-Acetylene apparatus on all metals; sent postpaid fifty cents. Address E. E. Bertschy, Cedar Rapids, Iowa.

9345

ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

Vol. VIII. Whole No. 86 June, 1920 No. 2

LIBRARY JUN 7 - 1920 U.S. PATENT OFFICE JUN 22 1920

Signal Buoy for Ocean Ships

By EDWIN F. LINDER, M. E.

A Radio And Searchlight Buoy to be Carried By Ocean Ships

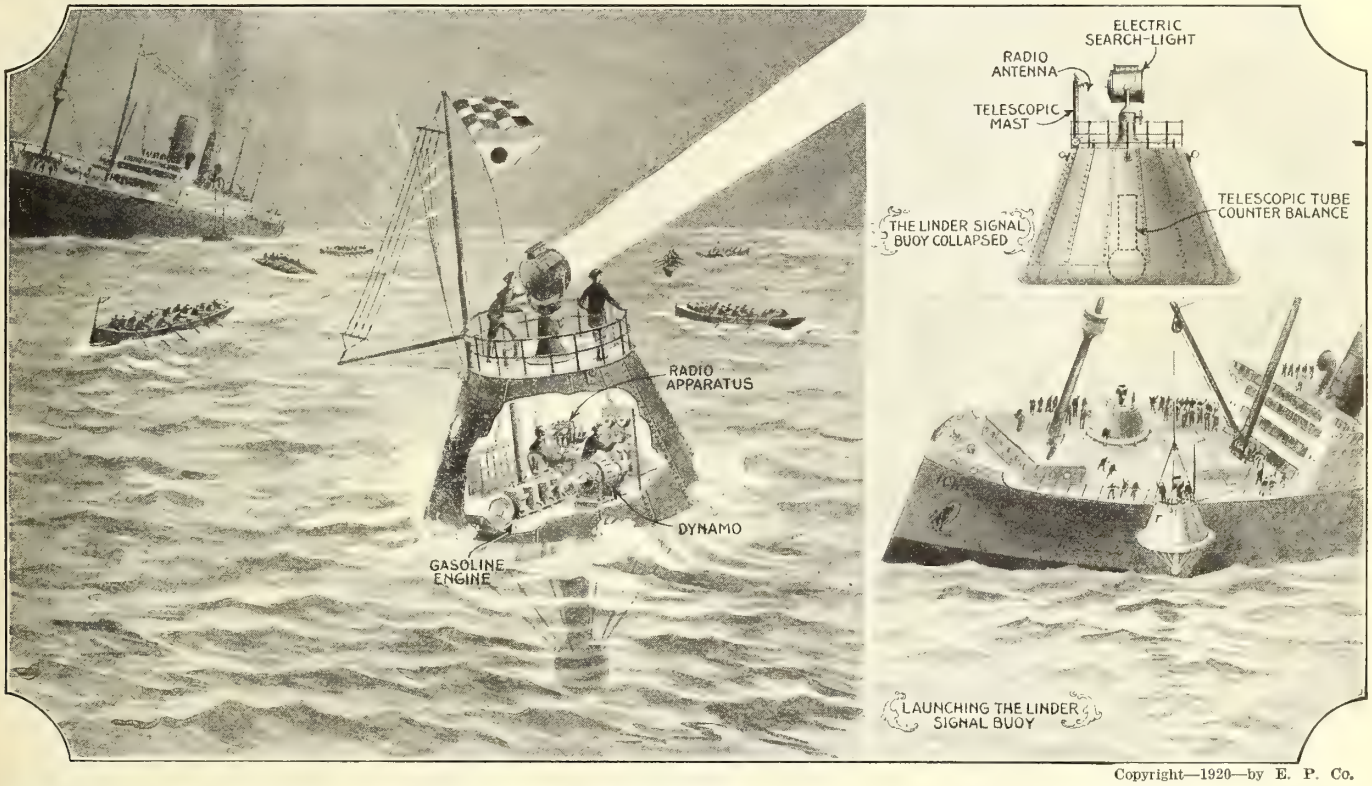
THE searchlight signal buoy is primarily a life-saving device; however, it is not designed to replace the customary lifeboats and rafts with which all modern ocean-going steamships are equipt at the present time.

A hollow double bottom ring about twenty feet in diameter serves as the float of the buoy. Upon this is constructed the housing and the bridge on which the powerful electric searchlight is mounted. The entire construction is light sheet steel reinforced with angle iron. Underneath the float on its axis is a telescopic counterbalance, so weighted that it prevents the buoy from being overturned when in a rough sea. This counter-balance is extended on lowering the buoy over the side of the vessel when it becomes necessary in the case of accident at sea, and when it has reached its full length it is locked by the operator from within. Wire rope stays, made fast to the outer surface of the float, take the tension and hold it firmly in a central position.

In the machinery compartment a gasoline engine furnishes power for the electric units necessary for the operation of the searchlight and wireless apparatus. The mast of the aerial for the latter is made up of telescopic pipes so as to be out of the way when the buoy is being lowered from the vessel's deck to the water.

When not in use the buoy (one or more) is carried on the forward deck of the steamer before the mast with wire rope slings attached to the rings fastened around the top of the sheet steel housing for that purpose. The slings come together above the searchlight and at this point are hooked into the usual boom tackle, ready to be put overboard instantly at the word of the commanding officer of the ship. While on deck the counter-balance is telescoped and is flush with the bottom of the float, making a solid flat face for the apparatus to rest on.

(*Continued on page 225*)



Copyright—1920—by E. P. Co.

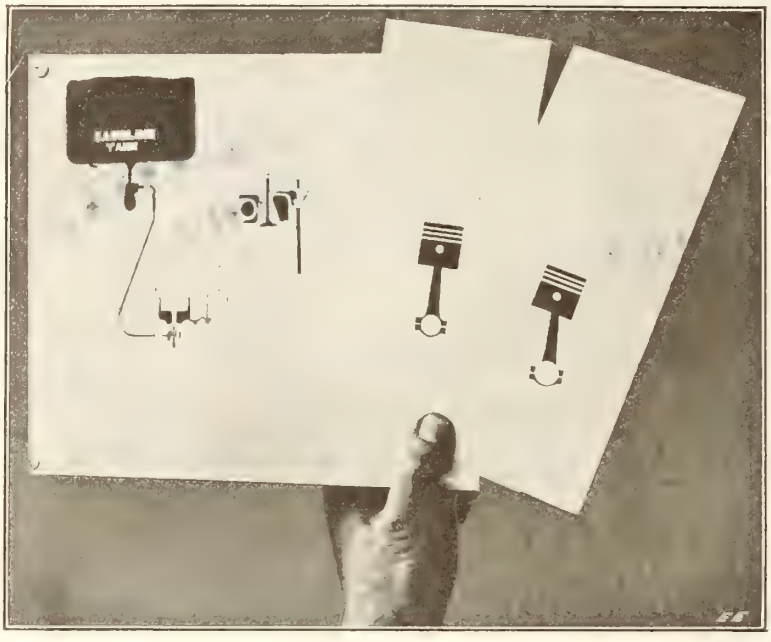
When a Ship Collision Happens at Sea, and Altho Practically Every Vessel Today Carries Wireless Signaling Apparatus, It Has Often Occurred That a Ship's "S.O.S." Calls Have Failed to Bring Assistance in Time, for the Reason That the Dynamo Room Became Flooded Almost Instantly. An American Inventor Here Proposes a Complete Radio and Searchlight Signal Buoy Which Could Be Released From the Ship Instantly, No Matter How Sudden the Ship May Sink, the Buoy Being Released by Push Button Controlled Clutches. The Searchlight, Besides Calling for Aid Over a Hundred-Mile Radius, Helps to Keep the Life Boats Together

How "Cartoon Movies" Are Made

By JOSEPH H. KRAUS

ONE often wonders at the astonishing speed and skill displayed by the cartoonist in drawing so many lines in a short fraction of time, and asks himself how it is all done. Sometimes a pencil is seen to move, sometimes the hand holding the pencil dashes from spot to spot, dabbing a little ink here and a little ink there, and sometimes just the line is seen to expand itself and mould itself into the forms of animated beings which go thru the most realistic motions imaginable.

There is an immense number of parts necessary for the successful delineations of "cartoon movies." By this is meant drawings, celluloids, tones, cut-outs, and fades, and their relation to each other. It must also be remembered that there are 16 distinct pictures to every foot of film and when a cartoonist attempts to make a reel 50 feet long to 100 feet long, or 125 feet long, the latter would be seen in just two minutes and five seconds, and yet no less than 2,000 pictures have been photographed and every picture meant perhaps a different drawing.



Here Are Three of the Actual Drawings Used In Producing the "Movie"—How the Gasoline Engine Works. Hundreds of Them, Each a Little More Advanced, Are Required. The Complete Engine View is Drawn on a Sheet of Celluloid. By Slipping the Successive Piston Drawings Behind the Celluloid, and Photographing Them In Turn, Realistic Action is Accurately Reproduced By the "Cartoon Movie" Expert.

Let us take, for instance, the various angles of cartoon drawings; the cartoonist first draws his picture on paper, it is then traced upon a sheet of celluloid. We are assuming now that the cartoonist is to use his hand in the entire picture and that you will, in viewing the picture, see the hand as in figures 1, 2, 3, 4 of the ship.

DRAWING FIRST MADE ON CELLULOID.

The sheet of celluloid with the complete drawing now upon it, is placed in a frame and another sheet of white paper placed upon it. This frame has a perfectly translucent bottom made of ground glass, and underneath which are placed several electric lamps. A switch is now turned on, which causes this light to shine thru the celluloid sheet, just the same as if a sheet of newspaper were placed up against a window pane and then covered with a white sheet, the lines and reading would be perfectly discernable thru the paper.

The artist then follows the outlines of his previous drawing.

After making a line ½ inch long he turns off the light under the picture, presses a button, at the same time, holding his hand in a stationary position. The shutter of the motion picture camera clicks once, it being in a vertical position so that best results may be obtained. The light under the picture is again turned on, another short line made, it is turned off, and again the camera clicks another picture and so on, until the end of the cartoon, each frame being photographed separately.

In those cartoons where no guiding hand is seen, practically the same procedure takes place, except that after drawing the line, the artist removes his hand from the frame and photographs the picture without the presence of the pencil or the hand. The resulting effect being a line broadening out and extending itself into forms.

Another type of this stationary cartoon is the showing of various objects such as a side of a ship, for instance, the hull of which is black, and then while watching the vessel, a hole in the side seems to peel right off, leaving a space thru which machinery is seen. This is simply done by having all the machinery of the ship drawn upon celluloid, the hull then painted black on white paper, is inserted under the celluloid, so that in the complete blackness so resulting, the lines on the celluloid are lost. This gives us a ship with a black hull. All very simple, isn't it?

A sheet of paper with the blackness removed from one corner, is then placed under the picture, replacing the totally black sheet, and again a photograph is taken. This is continued, the white area growing larger constantly, as each sheet of paper is changed so that eventually, when the "movie" is projected, it seems as tho the skin or outside hull of the ship is rolling up of its own accord, exposing its vital parts.

CARTOONING THE "KAISER."

It takes two photographers working far into the night, under high speed, one solid week to photograph the 2,000 or 3,000 odd drawings required for producing a little five-minute laugh. Let us take an example of one of these animated cartoons in determining how they are made. The one showing the "Kaiser" and the "Crown Prince" gives a good example and the various steps are there clearly depicted.

First, a little of the coat of the "Kaiser" is drawn—photographed—then a little more—photographed again, and so on until we have the "Kaiser" complete. After each drawing of a minute step, the artist must stop to photograph.

He then starts to draw the "Crown Prince". A little of the hat is drawn and the same procedure as before. The artist then draws the "English Lion" until that is completed, but mind you, that each step necessitates an interruption for the photographic operation.

The projected picture then represents the faces in the act of moving and a large "breath spot" appears, the usual indications for speech in comic drawings. Whenever a face or an object starts to move, invariably the work is done by drawing the picture on celluloid, at least all of those parts which do not move, and the moving parts are drawn upon separate sheets of paper, each one about 1/64 of an inch, different or further progrest from the one preceding.

(*Continued on page* 201)

For "July" E. E.

Suspended Electric Railways of Tomorrow; What Chicago and Other Cities Are Doing.

Shafts of Light for Regulating Street Traffic, by Edwin F. Linder, M. E.

Movies of Dynamo and Electro-Magnet Action,—the Generation and Movement of Electric Current Thru Conductors Visualized, by Jerome Lachenbruch.

Are the Martians Signaling via Radio? Specially written by Dr. F. H. Millener.

Alarm No. 18—A Live Wire Story Containing a Liberal Mixture of Fiction, Science and Electric Fire Alarms, by Charles S. Wolfe.

Pursuit of the Elusive Electron, by Walter E. Keever.

My Message to Mars, by Clement Fezandié.

How to Build Water-Wheels and Measure the Horse-Power of Brooks and Streams, by H. Winfield Secor.

Radio Spark Gaps and Oscillatory Circuits, by Pierre H. Boucheron; as well as Part Three of the "Radio Detective" Stories by the same author.

Glass,——How It Is Made and What It Is,—A Popular Illustrated Scientific Story by Prof. F. L. Darrow.

Aurora Borealis,—What Causes It? with beautiful illustrations, by Prof. Lindley M. Pyle.

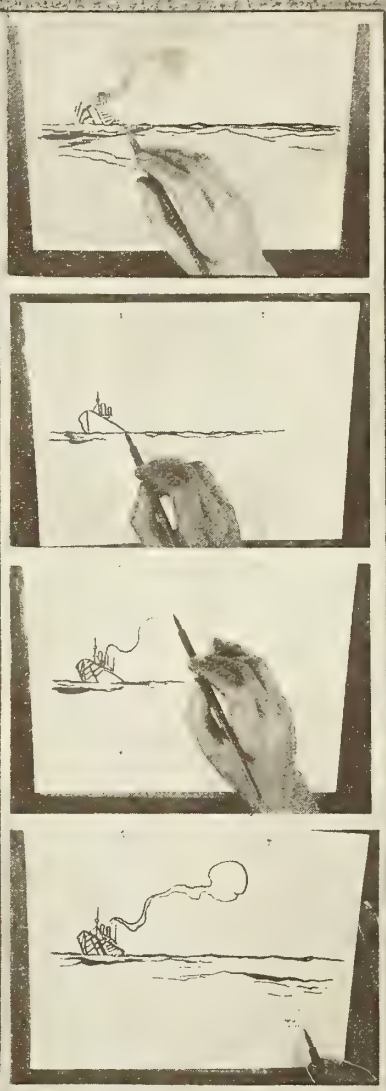
HOW CARTOON MOVIES ARE MADE



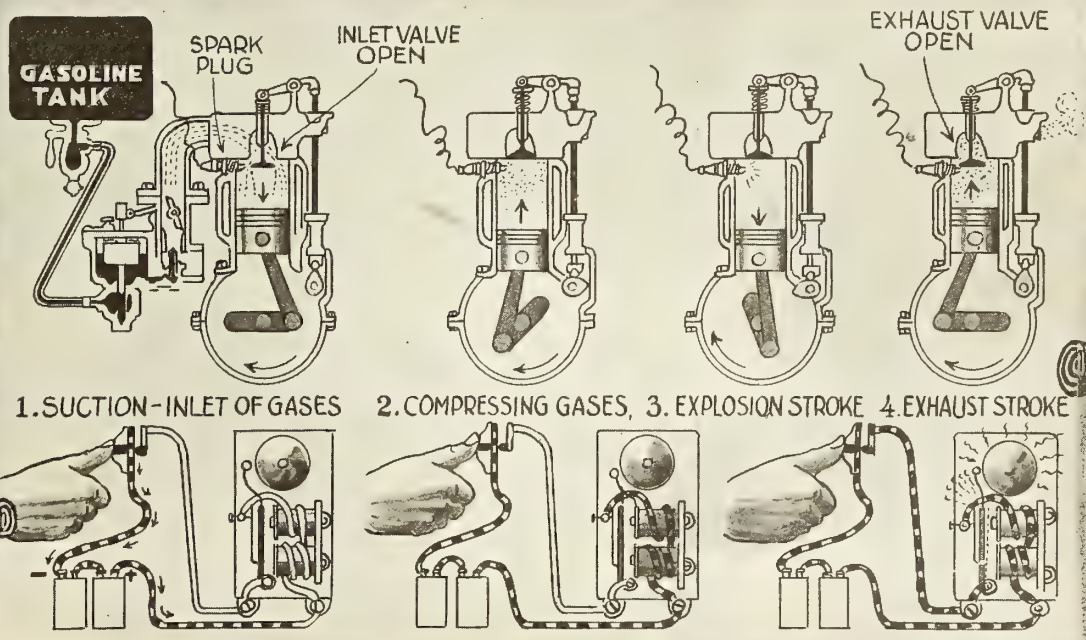


At the Left, Two Photos are Shown of Mr. Bert Green, the Well Known Movie Cartoonist, at Work In His Studio. Note How the Movie Camera is Mounted Vertically Upon the Drafting Table. At His Right May Be Seen the Powerful Electric Lamps, and These are Switched On, as Well as the Shutter of the Camera Opened and Closed for One Exposure, by Pressing a Button Which He is Seen in the Act of Doing. Underneath the Frame in Which the Drawing Is Held, are Other Electric Lights Which are Illuminated While the Successive Stages of the Drawing are Made, as Shown in the Four Progressive Drawings at the Right.

These Drawings, 1 to 4, Illustrate the Following Stages: At the Top, the Complete Ship drawing is Made on a Sheet of Celluloid; 2nd the First Stage of the Drawing is Made on a Sheet of Paper Placed Over the Celluloid Drawing and Illuminated From Behind. After Photographing This, the 3rd Stage Occurs and the Drawing Is Still More Elaborated as Shown. After snapping These With the Movie Camera, Several hundred more are Made and Photographed, and Finally We Arrive at the Complete Autographed Cartoon Shown at the Bottom.



The Action of a Gasoline Engine as Well as That of An Electric Bell are Shown In Part Below. These Pictures, the Actual "Movies" of Which Required Several Hundred Drawings, Are Used In Schools With Wonderful Results



Copyright, 1920, by E. P. Co.

(FULL DESCRIPTION ON OPPOSITE PAGE)

A Stereoscopic "Movie" Screen

By JOHN J. FURIA, A.M.

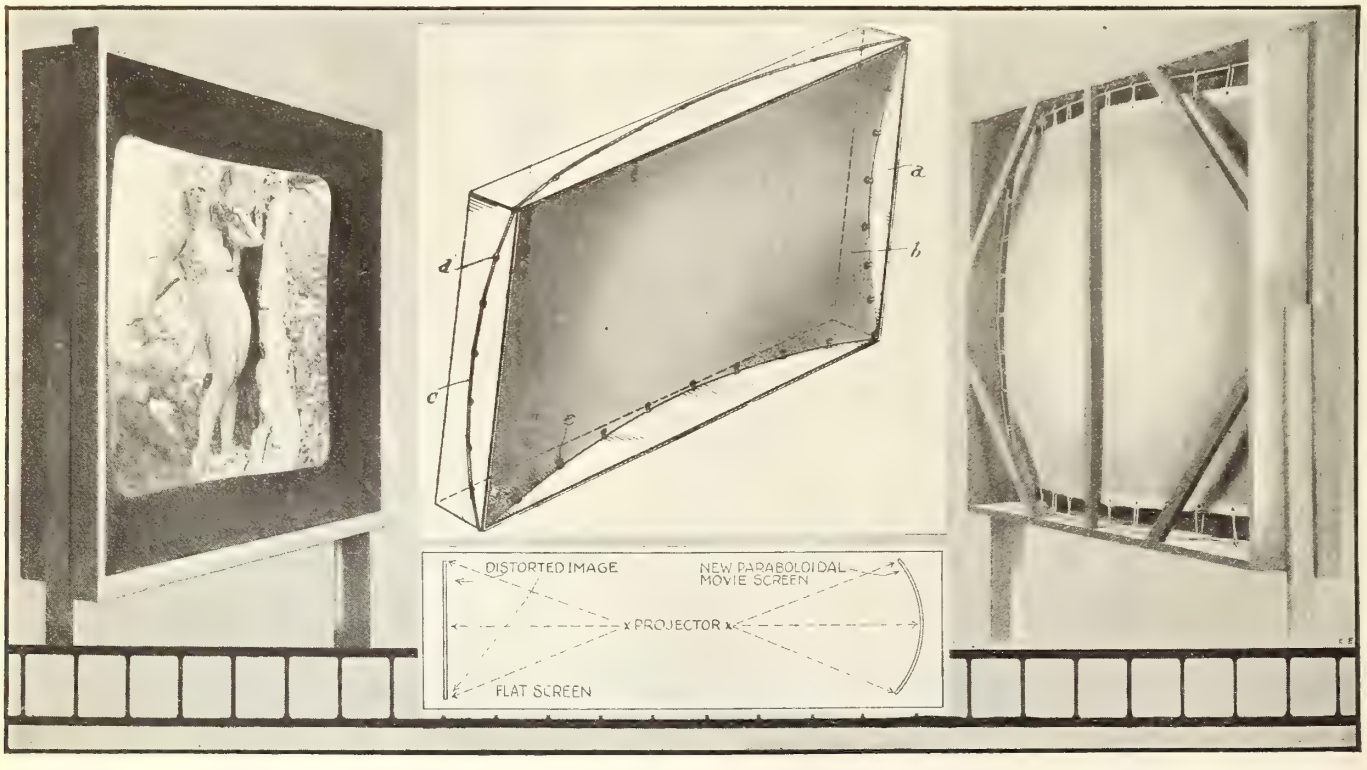
A new invention eliminating eyestrain from movies and giving three-dimensional pictures

EVER since the *motion picture* came into existence, the two outstanding objections against them have been fatigue to the eye (the strain being so great to some people that they have to forego the pleasure of seeing movies), and flatness (no depth); giving the pictures the appearance of painted scenery or billboard posters. From time to time, little improvements have been developed which have tended to reduce these objections. The principal reduction of eyestrain has resulted from the elimination of streaks in the film which produce what is technically known and popularly familiar as "rain." This has been effected by improvements in the manufacture of film, in the camera and projection apparatus mechanism and in the various steps of the chemical photographic processes. The reduction of flatness has been accomplisht by artistic lighting effects employed by the producers [the high grade pictures giving a fair amount of depth and seeming more real (less reel), and lifelike]. At best, even the highest quality pictures are flat and produce fatigue and eyestrain. Fatigue and eyestrain are especially marked at seats up front and off to the side, because of the hideous distortion of the pictures viewed from these positions. The elimination of eyestrain and fatigue is of especial interest to the movie house owner since it restricts him from the sale of seats too far front, and off to the side, causing him financial loss.

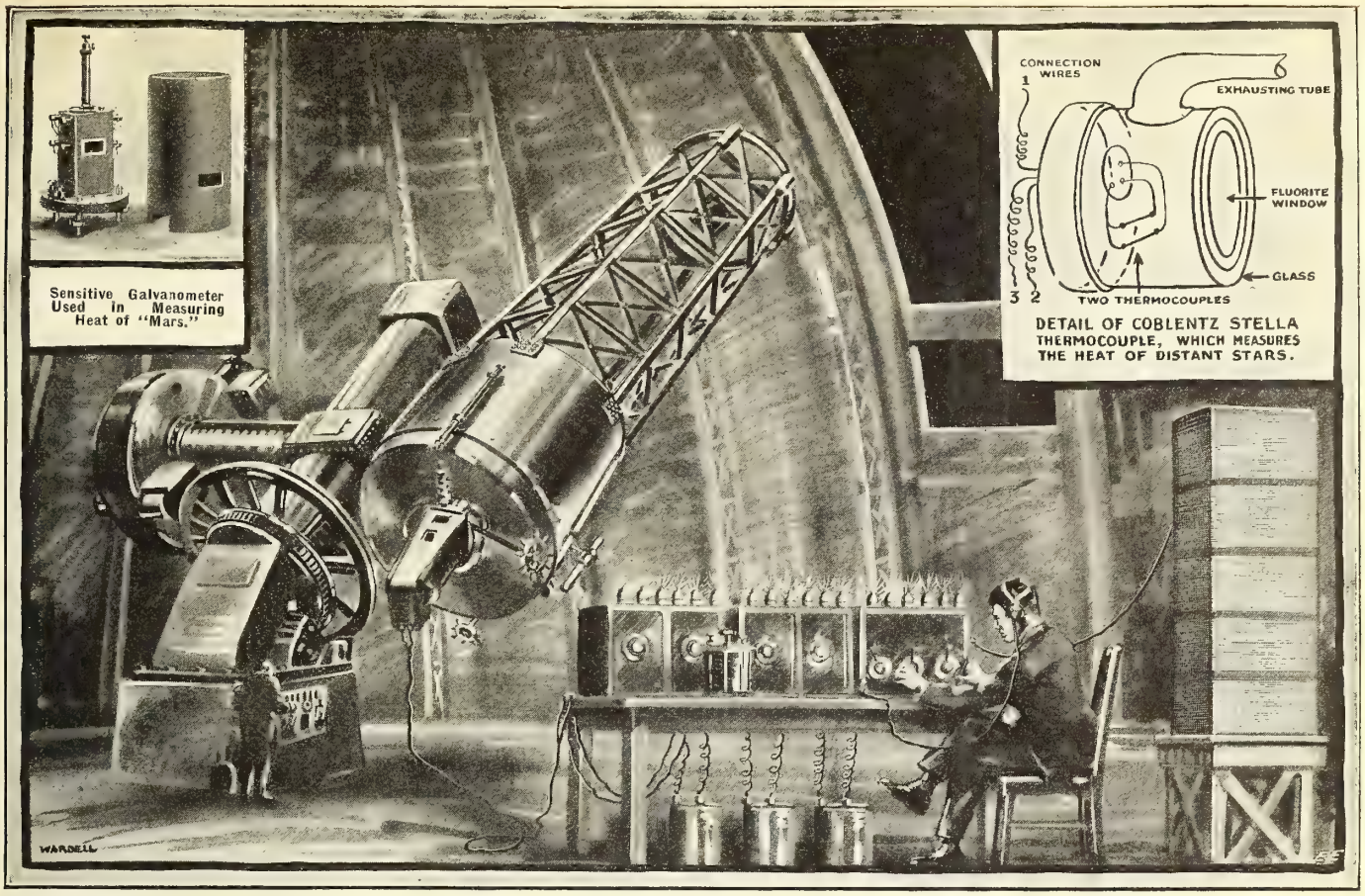
Strangely enough the invention which reduces flatness, distortion, fatigue and eyestrain in movies to a minimum has resulted from the experimenting and theorizing of a man not in any way connected with the movie industry. Dr. Jaques Louis Pech, professor in the faculty of medicine at the *University of Montpellier* (France), has for many years made a study of vision and eyestrain entirely aside from the viewpoint of the movie. The results of his Physiological, Psychological and Physical investigations led him to conclude that a factor of considerable importance and thus far neglected in three-dimensional vision and sense of depth is the distortion of images on the retina of the eye because of the shape of the retina. If the retina were a flat surface, the images produced on it would be similar to those produced on the ground glass, film or plate of the ordinary camera and would give the impression of being flat (without depth) as the ordinary photograph does. Stereoscopic vision is artificial and the depth produced by the stereoscope is exaggerated. If the eye had a flat retina it is quite doubtful whether or not depth could be produced by stereoscope. The argument usually put forth in favor of stereoscopic vision is that when a person loses the use of one eye, he loses his sense of depth. However, might this not be caused by the failure of the eye to accommodate itself to its new conditions? As time elapses it has been found that the person gradually regains his sense of depth to a large extent. A person who has lost the use of one eye during his infancy, is not troubled with lack of sense of depth. It is difficult for us to explain by means of our stereoscopic theory why a solid sphere of homogeneous surface, uniformly illuminated, should have a three-dimensional appearance, *and is a well establisht fact that its three-dimensional appearance is not at all diminished when viewed by one eye.*

Reasoning along similar lines, together with that along highly theoretical lines (not suitable for presentation in an article of this kind) led Dr. Pech to look for a new theory. He formulated the following: *A straight line in space gives a curved image on the retina of the eye.* Also, as the line is brought nearer and nearer it occupies a larger distance on the retina. If the curvature of the retina is such that it changes progressively, the curvature of the image of the end of the line will change progressively as the line approaches or recedes. This change in curvature of the lines which make up the marginal perifery of the image of any object causes, *via the brain,* the impression of distance and consequently depth. Just as the brain interprets the inverted image on the retina to represent an erect object, it also interprets an object, the marginal perifery of the image of which has greater curvature to be nearer than that of one of less curvature, taking into account the interpretation of differences in sizes of object gained thru experience. If the retina is *hyperboloidal* in shape, it meets all the requirements of the new theory. *Microscopic examination shows this to indeed be the case.* If the theory be true, the image of a flat photograph reflected by a concave hyperboloidal mirror should be three-dimensional and should show depth. *This is indeed the case also.* The reader can satisfy himself of the truth of this fact by observing the image of a picture postcard reflected from the ordinary concave shaving mirror. *The image will show true depth, without the artificiality of the stereoscope.* Since the shaving mirror is not hyperboloidal, there will be a slight distortion of the image in proportion to the deviation of the mirror

(*Continued on page* 234)



The Newest Idea in Motion Picture Screens, is That Having a Paraboloidal Or in Other Words, a Screen, Every Spot On the Surface of Which Corresponds to Some Arc of a Paraboloid. The Diagram Shows How the New Screen Corrects the Form of the Image for Every Observer in a Theater, Unlike the Flat Screen Which Distorts the Image. This New Screen, the Invention of a French Professor of Medicine, Gives the True Form of Image At Every Angle, Eliminates Eye-strain and Fatigue, and Further Causes the Image to Actually Stand Out in Relief the Same as Stereoscopic Photos.



A New Idea in Attempting to Pick Up Signals of an Interplanetary Nature Is Here Suggested by the Author. His Plan Is to Utilize Extremely Sensitive Photo-Electric or Thermos-Electric Instruments Such as Bolometers, Similar to Those Employed in Measuring the Heat of Distant Stars, and to Mount These Instruments at the Focus of Powerful Astronomical Telescopes. Signals Which Might Be Extremely Faint and Undetectable by Any Ordinary Wireless Apparatus Could Then Be Amplified by Means of 10 to 20 Stage Audion Amplifiers. Heat Measurements From the Planet "Mars," Have Already Been Made by the Bureau of Standards by Means of the Sensitive Coblentz Stellar Thermo-Couples

Interplanetary Communication

By ALBERT V. T. DAY

IF Mars, or another planet, is inhabited by beings whose sense development, intelligence and applied science, are about like our own, it seems probable they would regard light as the most likely agency of interplanetary communication, being not only the primitive agency which first disclosed the planets to each other, but also the agency most conveniently generated and directed by artificial means for signaling purposes. If these premises are accepted, it follows as a most plausible surmise that one or more of our planetary neighbors are now trying to signal us by light waves, or else endeavoring to detect light-wave signals from us.

All proposals for interplanetary light signals which have come to my notice, have assumed that the signals must be detected by sight, which seems strange, since it would be most natural for the sender to fluctuate his signal light, and there are so many known physical instruments for detecting a light fluctuation. Recently, in particular, the development of the vacuum-tube electrical amplifier has seemed to provide a most fascinating possibility of detecting such a signal by the photo-electric reactions of a selenium detector, bolometer, thermo-electric couple, or equivalent device.

In the focal plane of a telescope may be placed an opaque screen having an aperture coextensive with the image of the planet, or perhaps smaller than the image and registering with that point from which the light signal may emanate. The signal light projected through this screen aperture may be dispersed on the photo-electric detector placed some distance behind the focal plane. The screen will thus exclude from the detector much light extraneous to the signal. However, some detectors having a minimum sensitivity greater than the available signaling light, may require an independent exciting illumination upon which the signal light may be superposed. If necessary the detector may be independently excited by a fluctuating light supplied in any convenient manner and having a definite period, so that its superposed electric reactions may be selectively suppress in the receiving circuits.

Many difficulties may be expected, such as disturbing currents produced by various inconstant light fluctuations finding access to the detector. These might be caused by vibrations or inconstant movements of the telescope, or by erratic atmospheric effects upon the illumination, or by illumination of the atmosphere from variable sources, either natural or factitious. Assuming that the signal fluctuations will have a definite frequency—it would seem that these difficulties must resolve themselves mainly into a problem of electrical selectivity like the problem of eliminating the so-called static disturbances in radio signaling. Much has already been done in this direction.

In the least optimistic view it seems a fair presumption that this method must be capable of detecting the flash or periodic fluctuation of a light too weak to be seen through a telescope.

The idea engenders most entertaining speculations on the possibility of receiving not only code signals, but music and voice messages as well. It is certainly practicable to effect musical or phonetic control of any light power which would be employed for interplanetary signaling, for instance by vibrating reflectors under the control of a telephonic current. If music is indeed a universal language, then who shall deny that most exalted and beneficient inspirations might be thus transmitted to us at once, without the establishment of any other code.

As concerns the mere detection of signals, without effort to transmit reply, the general scheme may be much more feasible than could be predicated upon our own scientific knowledge, for our planetary neighbors may have devised optical means for producing light rays so nearly parallel as to accomplish interplanetary projection with very little dispersion. In any event it would seem that such an equipment for detecting signals could be added to an establisht astronomical observatory for a relatively small cost. If it is undertaken I should much like to participate in the experiments.

Entirely aside from the detection of intelligent signals, a photo-electric detecting and amplifying apparatus of this general character should be a useful adjunct to any great telescope employed in astro-physical research. For instance, it is probable that star-twinkling effects could be recorded on an oscillograph, and their relations to the diameter of the optical objective investigated. Various interesting fluctuations

(*Continued on page* 209)

Searchlight and Mirrors Mark Aero Field

By EDWIN F. LINDER, M. E.

ONE of the most important of the many types of apparatus used during the recent war was the *electric* searchlight. Without the help of these powerful eyes of detection undoubtedly it would have been extremely difficult to repulse night attacks of the enemy with any degree of success, either on land or on sea. Much has been written during the last few years of the many uses to which searchlights were put by the armies and navies, and a great deal has been learned during the period of conflict that can be of vast service to the civilized world in the development of commercial enterprises.

The searchlight, as a medium for outlining safe landings for airplanes at night, is a particularly worthy and useful application which deserves the consideration, not alone of governmental officials, but should be of interest to private individuals engaged in the transportation of perishable goods and all classes of parcels requiring speedy forwarding to their proper destination.

Airplane service for the carrying of mail, newspapers and many other articles, has already been establisht in this country in a limited way, the flights being so timed as to take advantage of daylight as far as possible. Until properly equipt landing fields are constructed and maintained thruout the country, very little progress can be expected along these lines, especially where long distances are to be traversed on non-stop flights during the night.

For transcontinental services, the number and size of such stations would depend on the proposed routes of travel and the location of the cities, the distances between the latter and the number of airplanes that would be placed into operation. In the illustration are shown several parts of the equipment of a field for *day* and *night* use.

The most important feature of this method of marking the boundaries of the field is the searchlight, the beam of which encloses all but the half of one side of the field and by the use of reflectors or mirrors divides it into two sections—one for Eastbound and the other for Westbound traffic. It further shows the aviator his course, it being the intention to have all such fields placed so as to have the final reflected beam projecting to the East. Should it be desired to enlarge the field from time to time, the reflectors can be easily moved to new locations and then secured in position by guy ropes or cables.

In the east and west sections, guide lights are placed in pits covered with heavy glass windows, flush with the ground. These lights are designed to make it safe for the aviator to enter the grounds. In the event of a portion of the field already being occupied by landed planes, the oncoming pilot is warned by these lights, the free part of the field being designated by the ordinary *white* lights and the occupied part blocked off by *red* lights, operated by a man assigned to this duty.

In order to more readily pick out a station at a distance when in low flight, a high tower with a signal light flashing automatically the number or name of the station in code, by means of a vertical beam of light, is built on one side of the field. The tower also can be used for the wireless equipment, with which each station is usually supplied.

For ordinary use, the signal light on the top of the tower will give forth a white beam; however, should some difficulty occur which would make it dangerous to permit a landing, the approaching aviator would be warned far in advance before his reaching the station, by a red beam.

All types of aircraft, especially those cruising in the higher altitudes, would be greatly assisted in their navigation by these light-bounded stations; their pattern being identical with the other stations, would at once make known to the flying pilot his position—the tower signal giving the number of the station which appears on the air-chart and the "east-beam" the direction of the aircraft's course.



Copyright—1920—by E. P. Co.

Why Use Several High-Powered Searchlights to Illuminate and Mark the Outlines of an Airplane Landing Field at Night, When This Simple Scheme Comprising the Use of But One Searchlight and a Set of Mirrors to Reflect the Beam Around the Corners Solves the Problem Equally as Well? A Very Ingenious Scheme Indeed, We Believe, and One That Possesses Complete Flexibility, Allowing the Shape and Size of the Field To Be Changed as Frequently as Becomes Necessary. The Shape of the Field, Owing to Rainy Weather, Etc., and Due to Submerged Portions, May Have To Be Changed Several Times in Twenty-four Hours, and This Scheme Provides the Way to Do It with the Minimum of Labor and Expense.



Photo at Left Shows the German Chess Players in Their Club Room Just Before the Start of the Great International Chess Match, the Progress of Which Was Recorded by Telegraph.

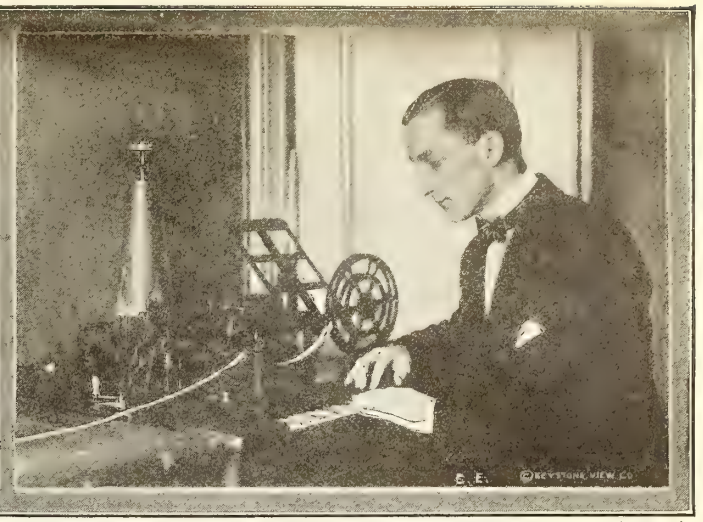


Photo at Right Shows Mr. Albert Hughes, of Berlin, at the Telegraph Receiving Station Where He Transmitted the Scores of the Recent International Chess Game Over the Telegraph Circuit to Holland.

Playing Chess Via Telegraph

The accompanying photographs illustrate one of the most interesting sport events in Europe—when a "chess match" was recently played between a city in Holland and Berlin, Germany. The most famous players of each country participated in the game and the respective "moves" of the players at each end of the line were immediately telegraphed to the opposite players.

One photograph shows the German players in their club room, just before the start of the great international chess match. The second photograph shows Mr. Albert Hughes, of Berlin, at the telegraph receiving station, where he transmitted the course of the game telegraphically over the electric circuit to the city in Holland, where the Dutch players were assembled.

It is interesting to note the double clock arrangement at each player's position which was necessary to keep the tally right, owing to the difference in time between the two cities, one clock registering the local time and the other the time at the opposite end of the line.

Chess matches played by wireless are not so new in a small way, but large matches such as this one are out of the ordinary and attract a great deal of attention whenever they are held. From time to time in the past few years, chess matches and other games of a similar nature have been played *via* wireless, especially in the United States, between various college teams. A number of these matches were played a few years ago between several of the largest American universities with entire success, each successive move of the player at either end being transmitted by the wireless operator to the receiving operator of the opposite contestants.

Wind and Rain to Order

IT is no longer necessary for motion picture directors to await a choice thunderstorm in order to take pictures of several scenes wherein rain is required; nor is it advisable to cover the territory with elaborate pipe systems in or near the settings. Under circumstances such as these, it is obvious that another method must be discovered in order to make good "rainfall" pictures.

Pictures taken during an actual thunderstorm, when the sky is beclouded with heavy dark rifts and accompanied by occasional flashes of lightning which crash across the murky blackness, never produce the same realism on a film as in nature. But the movies and science have a peculiar way of working together, hand in hand, and thanks to science, it is only necessary now for motion picture directors to send in the alarm for a few firemen and the rain carts, and scurry away to the scene where the picture is to be produced. The rain cart is simple, being essentially composed of an automobile truck upon which is mounted a huge airplane engine. The truck is wheeled to the scene of action and the propeller started whirling.

A stream from an ordinary fire hose is now directed up into the air so that when on its downward path the water is broken up into large particles and drops are hurled against the actors and "acterines," completely drenching them. So terrific is the force and the wind produced that it is necessary to incline the body forward while attempting to cope with it.

Wonderful pictures are produced and the exact replica of nature's own rainfall is obtained without the shortcomings of the God Thor's method.

Operating on a plan similar to this rain machine is a sand-storm producing apparatus. It is also a truck equipt with an engine and propeller suitably mounted so that it is capable of churning up the sand all around it. In this way its ability to throw up and create a real Arizona blizzard or tropical hurricane is most complete. In the accompanying photograph is shown the Arizona sand-storm à la airplane propeller.



The Scene at the Left Shows the Latest Movie "Wind" Machine Kicking Up a Deuce of a Fuss on a Sandy Plain so as to Give a Perfect Arizona Sand-Storm Scene for the "Movies." An Airplane Propeller and Gasoline Engine Do the Trick



And Here We See the Boys Who Make That "Realistic" Rain, Which We All Enjoyed so Much at the Last "Movie" Play. Again the Airplane Propeller Does a Good Turn and Breaks Up the Descending Streams of Water Into Millions of Fine Droplets. Result—PERFECT Rain!

Odd Photo Contest

TRIPLE MIRROR PHOTOGRAPHY.

Robert Gordon, who co-stars with Sylvia Breamer in the Pathé-Blackton productions "Respectable by Proxy" and "The Blood Barrier," is shown from three different points of view. The photo is a single view taken by the aid of three mirrors, a Graflex camera, and a good light.

A "HUMAN" MONSTER!

We see here a picture of a boy, endowed with two heads and two pair of legs! Remarkable,—yes, but the effect is produced by double exposure!

Contributed by LESTER WAGNER.

SOME SNAKE!

The snake in the illustration is only a very small one (Garter variety), and the fence pictured is but one foot long, since it consists only of a few twigs arranged to give the desired "forest" effect.

WHAT PART OF A FLY IS THIS?

This view, the section of a fly's wing at the joint where member was torn from body, was taken by a Seneca camera placed in an apparatus of my own construction, so as to be able to take the picture in a horizontal position. The camera, in the apparatus, was then placed over a Bausch & Lomb microscope of 75 magnifying power and the view obtained as you see it. This was the third picture I have taken in this line, and am working with the end in view of being able to photograph disease germs and other things of interest to the experimenter.

Contributed by N. Nushawg.

$1.00 Prize Paid For Each Photo Publisht

THESE BOYS ARE CANNED!

This picture is a double exposure of a number of high school boys who were canned from school for "committing crimes," which did not agree with the faculty.

The boys committed these acts because they were forced to go to school on NEW YEAR'S DAY, 1919.

Contributed by GARET DENISE.

FALLING WATER TANK.

This is a photo of a water tank which was pulled down with ropes, after the timber structure had been partly cut in various places.

Contributed by A. J. VIKEN.

ODD LIGHTNING PHOTO.

There was really no special preparation for taking this picture; the shutter was opened and left open until after the flash, and then closed.

It might appear from this picture, that there was more than one stroke of lightning, but such was not the case, there being only one stroke. The body of water shown in the foreground is the Penobscot River.

Contributed by C. A. KITTREDGE.

HE DEFIES GRAVITY.

Jimmy Aubrey, *Vitagraph* Comedy Star, does a stunt that defies the laws of gravitation. He attracted a crowd of several hundred people to West Lake Park, Los Angeles, all of whom tried to figure out how the comedian could lean over at an angle of forty-five degrees and regain an upright position, apparently without effort. (Shoe clips fastened to the ground solves the mystery) —*Photo courtesy Vitagraph Company.*

SUN'S ANNULAR ECLIPSE.

This photo was taken, Nov. 22nd, 1919, in Havana 8^h 05^m A. M. The seemingly black shadows are clouds, and at the left of the photo are sunspots. Photo taken on telescope of the equatorial type of mounting.

Contributed by MIGUEL GUTIERREZ, Astronomer, Loma de Casa-Blanca, Habana, Cuba.

A WONDERFUL CAKE OF ICE.

This photograph represents a cake of ice, made by the American Ice Company, at one of their plants in Baltimore, Md.

OH, LOOK! HE'S HANGING!?**—!?*

The fellow in the picture is not having the least difficulty in getting his breath, inas much as the rope passes under his arm, as can undoubtedly be seen from the picture, upon close inspection.

Contributed by F. K. LOW.

SEEING HIS DOUBLE!

If it wasn't for the fact that we are denied even 2.75 per cent "fire-water," these strenuous days, Mr. G. V. Seyffertitz, of the "Slaves of Pride" film play, might easely imagine he was seeing his exact double or likeness in this scene from the play. But sh-sh! It's a great secret! It ain't no living likeness or double of Mr. Seyffertitz at all, but the very finest dummy ever constructed. —*Photo Courtesy of Vitagraph Films.*

Electricity Triumphs Over Steam

AT Erie, Pa., recently, one hundred and fifty prominent railway men and engineers from this country and Canada witnest one of the most remarkable and interesting trial tests of locomotives ever conducted in the history of railroading. These tests were made to demonstrate the mastodonic power and efficiency of the new model gearless electric passenger locomotive. Altho several other tests were made before the engineers, the principal event was a test of brute strength between two powerful steam locomotives of the Mallet type, such as those the New York Central Railroad uses to haul its big limited trains, and this new electric giant of the rails, which was built especially to haul trains over the Chicago, Milwaukee and St. Paul electrified mountain route in the western part of the United States.

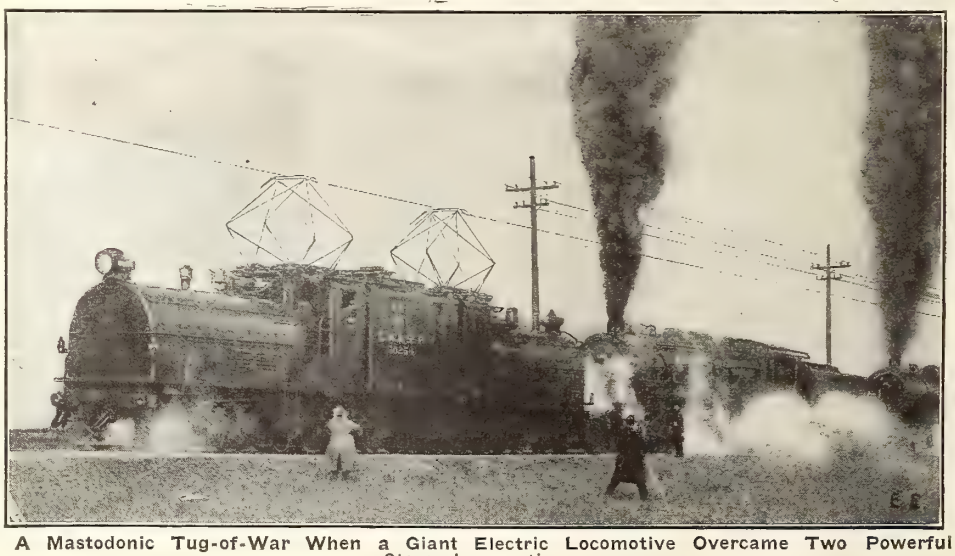
The greatest "tug-of-war" one could wish to see took place with thousands of horsepower let loose in the titanic struggle to prove the supremacy of the successful contestant. To obviate the possibility of pulling out the draw-bars of one or the other of the locomotives, which would probably have occurred if they pulled in opposite directions, the engines were caused to push against each other.

At a given signal the two powerful steam locomotives started pushing the big electric engine ahead of them, the latter having no current on at the start. Then the engineer in the electric locomotive gradually turned on the current and the powerful motors responded nobly. In the meanwhile, the throttles on both steam locomotives were opened up to their full capacity.

What was the surprise of the crowd to see the steam engines slowly but surely lose momentum and finally come to a complete stop, still with their throttles wide open, puffing and chugging as if under an extraordinary strain. Then what appeared to be the impossible happened, and a great cheer went up from the crowd as they saw the steam engines forced backward, first only by inches, but gradually, as the full power of the electric was brought into play, the procession became almost a rout, and when the test ended a few minutes later the steam locomotives were moving steadily backward and the electric locomotive was declared the victor.

Interesting and spectacular as this test was to the laymen present, it was more significant to the engineers of the General Electric Company, who had devoted years to the perfection of this powerful electric locomotive. It was a conclusive test of power between steam and electricity.

This new locomotive is one of the most powerful passenger locomotives in the world. It uses 3,000 volts direct current and its horsepower is 3,240. There are fourteen axles on which are mounted direct connected motors.



A Mastodonic Tug-of-War When a Giant Electric Locomotive Overcame Two Powerful Steam Locomotives.

ODD PHOTO CONTEST



(Full Description on Opposite Page. See if You Can Guess Each One Before Reading Text)



Copyright, 1920, by F. P. Co.

Well, "Folks," the Latest Machinery for Pleasure Torture, for So We May Call It, Is About Ready for Business, Down at the Sea-Side. What Between the New Motor Speedway, the "Soft Spot" or Bouncing Balloon, the "Humpty-Dumpty" Wheel and the Falling (?) Statue, We Apparently Are Going to Be Highly Amused This Summer

The Latest Pleasure Tortures

LUNA Park, at Coney Island, probably the greatest of all amusement places on the east coast and known to hundreds of thousands of pleasure seekers the world over, promises this year to rival any season heretofore held. New novel amusement schemes have been built which will please the gala crowd constantly attracted to that resort, which eclipse any of the wonderful amusement schemes ever before attempted.

A few samples of these ideas are described here. Not by any means complete, but selected, because of their remarkable characteristic features which mark them as being distinctly exceptional.

THE "FALLING STATUE"?!

The *falling statue* itself will be one of the free amusements, which add to the jovial attitude, driving away blues and producing hurricanes of laughter. Mr. Pleasure Seeker, on entering the park with a young lady at his side, is startled when suddenly a magnificent statue, the statue of "Justice" perhaps, starts to wiggle around in the exact semblance of a "shimmy", then suddenly it seems as tho "Justice" has outshimmied herself, and the wiggles are augmented to such an extent that the statue commences to topple forward, the scales in her hand trying their best to preserve their equilibrium. A voice in the crowd is heard, "Hold her up, she's falling," and forty or fifty "honest to goodness" strong men rush to her rescue. But the weight seems to be too great for them as they are rapidly borne down. If once "Justice" falls over, things would come to a very poor end.

The figure continues to decline forty-five, fifty-five and even sixty degrees, and the men who were attempting to hold her up, desert her for fear of being crushed with the weight when suddenly, as tho by magic, it looms up again into an erect position, the scales steady themselves and the laugh is on the crowd. Imagine how Mr. Fun Seeker feels when he returns to his girl friend after having attempted to play the part of a hero in vain.

The statue itself is of massive design, amply reinforced and mounted upon bearing which permits of motion. The ball at the base prevents anyone from seeing that the entire ball rotates slowly, due to a wormgear drive acting upon it in the base. In this way the statue can easily be allowed to topple forward about 60 to 65 degrees without any danger of it becoming injured or creating any injury, and just a word from any individual calling attention to that mechanism suffices to attract the pleasure seekers to the pending danger.

THE MILE-A-MINUTE SPEEDWAY.

A short time later, the couple move along after having recuperated from the partial excitement and step into one of the cars of the novel Speedway. The entire train of three cars is filled with people and the car starts on a slight downward decline toward its driving factors at either end. No motor is in the car nor are they operated over any steep embankment. At both ends of this oval Speedway are two discs about 26 ft. in diameter traveling around at tremendous speed.

The car enters this zone and sufficient momentum is imparted to it due to the friction of this disc which enables it to fly out tangently along the track to the wheel at the opposite end. Friction upon the car by the rapidly revolving disc thru the medium of the wheels again imparts momentum sufficient to give it added swiftness and sends it to the other end of the track from whence it had just come, and so on. One disc throws the occupants across the stretch to the other which plays ball with them, throwing them back. Three minutes ride in this and Mr. and Miss Pleasure Seeker who have just come from the statue are becoming to feel an effect similar to the distressing symptom resulting from imbibing neighbor Smith's home brew, containing two or three beets, an onion, and some garlic to produce the required kick (a horse-shoe sometimes answers the same purpose, especially, when on a good pair of horse's feet). The pleasure seekers eventually manage to escape and proceed from the run-way to another part of Luna.

The speedway, itself, has the two rotating discs mounted upon roller bearings. Guide rails surround the entire runaway and also the discs, to prevent the car from flying off the track except in the desired manner. Both whirling discs are connected by means of cable drives to a motor situated in a pit. The cables themselves travel over pulleys to the driving wheel of the disc. The slight incline in one track allows the car to be started without any difficulty and it glides to the disc at one end. The starting position is likewise, the position of a friction brake which stops the cars for the discharge of passengers.

(*Continued on page* 206)

ELECTRIC ODDS AND ENDS

Children's Underwear and Play Clothes Are Almost Impossible to Clean in Spots. A Brush Screwed Into the Shaft of a Sewing Machine Motor Works Splendidly However.



Here Is a Quick Way of Drying Photo Plates and Prints. An Ordinary Nitrogen Lamp Is Placed in a Bread Pan, and in Front of This an Electric Fan. The Heat from the Lamp Is Sucked by the Fan, and Thrown Against the Plates.





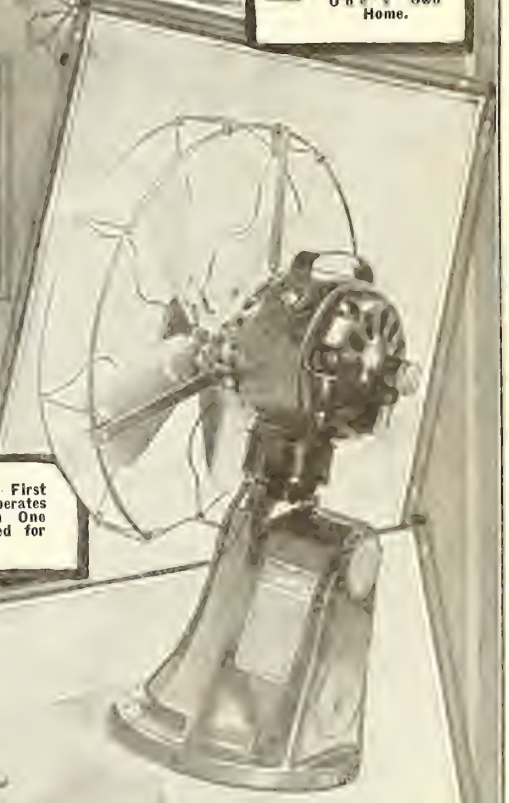
Electricity Causes This Alabama Coon Jigger to Do All the Jigging Steps from A to Z Right in Coon's Own Home.

No Law and Order Policeman Can Stop This Doll from "Shimmying" When She Is Fed with Electricity.

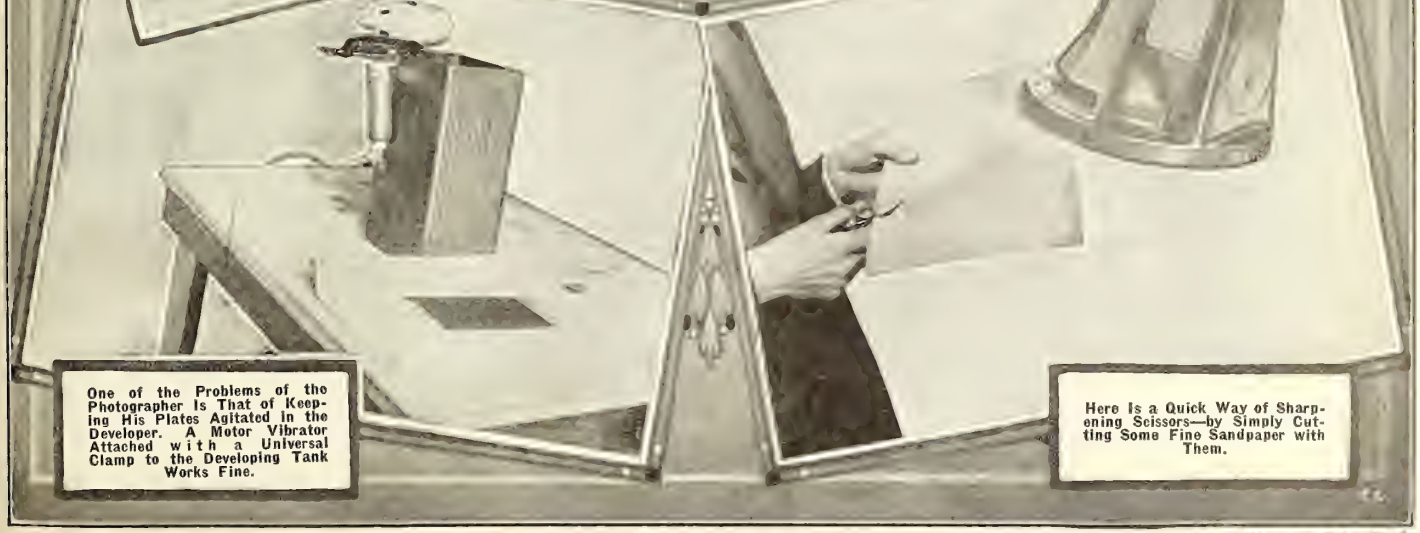




This Electric Rough Edge Remover Saves Much Cursing and Scratching by Wearers of Stiff Collars.



Here Is a Nickel First Fan Which Operates for an Hour on One Nickel. It Is Used for Hotels.



One of the Problems of the Photographer Is That of Keeping His Plates Agitated in the Developer. A Motor Vibrator Attached with a Universal Clamp to the Developing Tank Works Fine.

Here Is a Quick Way of Sharpening Scissors—by Simply Cutting Some Fine Sandpaper with Them.

Photo by Edw. Healy

A Sea-Going

By H. GERNSBACK



Ever Since the Chicago World Exposition in 1893, the Ferris Wheel Has Been With Us to Delight Amusement Lovers At Our Expositions and Beach Resorts. The Latest Improvement On the Stationary Ferris Wheel is Shown Above. It Consists of the Regulation Wheel, Which With Certain Additions is Made to Roll Upon a Track, Out Into the Sea, Lake, or Other Body of Water. The Track Being Inclined Into the Water, the Wheel Rolls Down By Gravity. It is Pulled Back By Means of Two Steel Traction Cables as Shown. The

THE good old Ferris wheel has been with us for many years now, and ever since it was invented by G. W. G. Ferris, who erected the first one at the World's Exposition of 1893 at Chicago it has not been much improved upon. When it first came into use at our sea-shores and amusement parks, it was considered a wonder, but during the last decades the novelty has worn off.

Last year the writer took a trip on one of these wheels and was imprest by the lack of popularity in the device. There was no great crowding, and the writer particularly remembers a remark past by a young girl who refused to take the trip, giving as her reason that "it was not exciting enough for her." This seems to put the finger right on the whole crux. It is not exciting! Hence it has fallen into disuse with the amusement-seeking, merry-making crowds.

Another thing with which the writer was imprest on his trip was the cumbersome way of loading and unloading the passengers of these Ferris wheels. Once the cars are loaded, the wheel may spin merrily, but the loading and unloading is another matter. As each car comes down, the wheel must be stopt to allow one set of passengers to get out and allow another set to get in. Consequently it will be seen that there must be as many such stops as there are cars to the wheel. Loading and unloading thus takes an average of 10 to 15 minutes, which does not improve the temper of the occupants who expect speed and excitement.

For these reasons and various other ones, the writer advances a radically new idea which is shown graphically here, and also forms the subject of our cover illustration. The writer has simply taken a Ferris wheel, and instead of revolving it on its axis, he has placed it upon a steel track and rolls it out into the water as our illustration well depicts. The object is twofold. First of all a new brand of sensation is had, so much craved for by our present amusement seekers. Secondly, the old and well establisht features of the Ferris wheel are kept and improved upon as well.

The idea which forms the subject of a patent is in brief as follows:

The Ferris wheel runs upon a special kind of track, which latter is built right into the ocean, lake or other water body, the tracks being supported by the regulation piling work, similar to that on which our ocean piers are built. The track itself, as will be noted, should be inclined; the slope being inconsiderable. Using a hundred foot Ferris wheel, the track may run out into the water a thousand feet or more, all depending upon the expense the builders wish to go to. At the end of the track there is a concrete safety pier, which stops the wheel should the supporting cables break.

The mode of propulsion is rather simple. You have no doubt seen the principle many a time, particularly before prohibition arrived. Surely you have seen how a beer keg or wine barrel was lowered by means of two ropes down the stairways into the cellar. Two ropes would be slung around the barrel, and two men would play out the ropes as the barrel descended easily and gracefully down the incline stairs and into the cellar. The same principle is made use of in the present invention. As will be seen there are two steel cables, both running parallel to each other, one side engaging a circular sheave of the wheel, while the other side connects to the power house.

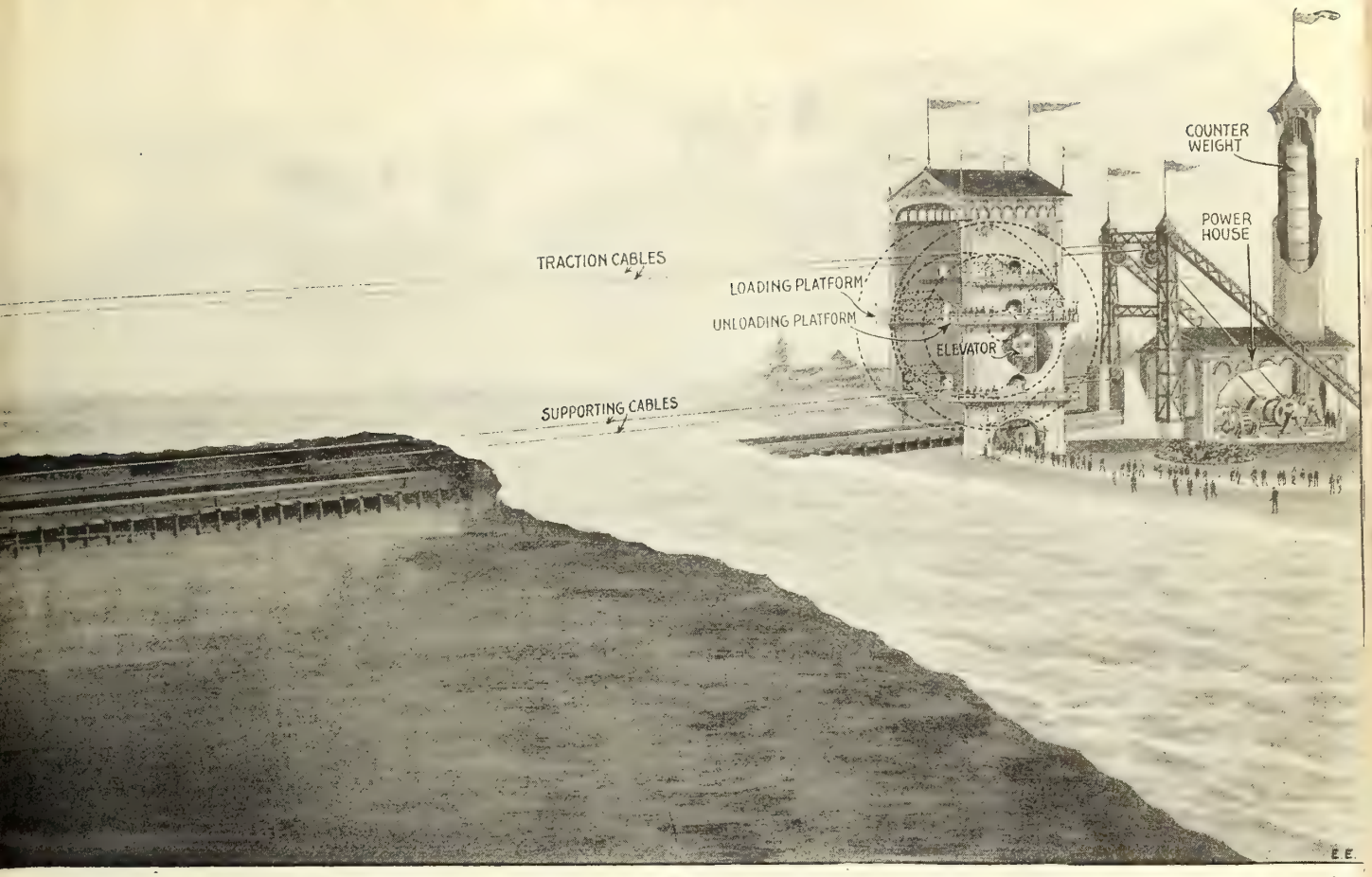
In the position shown in our illustration above, the wheel has arrived at the end of its trip and is now pulled landward again by means of the two traction cables which wind up on huge drums in the power house. Very little power is required inasmuch as big counter weights are used which practically pull in the wheel themselves. Only a small amount of power, let us say a 50 H.P. motor, is required to bring the wheel back to land. On its outward trip practically no power is required, the wheel running down the incline by gravity, the traction cable simply paying out; the action is, of course, under the control of the men at the power house, who will see to it that the wheel does not go too fast for reasons which will be apparent hereafter.

Let us now take an imaginary trip in this future sea-going Ferris wheel, and see what happens.

After paying our fare, we ascend by means of elevators on to a loading platform, and we will find that there are three such platforms. The cars of the Ferris wheel come into a resting position level with the platforms, the top platform and the bottom platform each accommodating one car, while the second and third platforms each accommodate two cars. The device is made so that, inasmuch as there are six cars and the wheel always returning in its same position, the cars will always stop at their assigned platforms and not otherwise.

We now enter one of the steel cars, each car accommodating 24 persons. There is not much room offered us, and every inch of available space has been taken advantage of, as we must not have too much buoyancy, otherwise it will take too great a weight to pull the cars down below the level of the water. For that reason the

Ferris Wheel



Passengers in the Water-tight Cars Experience the Novel Sensation of First Rising Up Into the Sky Only to Be Submerged Into the Water. The Maximum Immersion is About 50 Feet. The Experience Which is Gained in Submarine Building, Makes It Possible for Us to Make the Cars Thoroly Safe in All Respects, Without the Passengers Undergoing Any Risks Whatsoever. A Novel Means for Loading and Unloading the Cars is Shown as Well in the Present Invention, Which Does Away with the Tedious Starting and Stopping of the Old-time Ferris Wheel. The Sea-going Ferris Wheel Will Probably Be Built At Coney Island Next Season.

ceiling or roof of the car is very low.

There is just enough room in the cars to allow people to sit comfortably, and when the car is full there is not much room left.

We note that the windows are made of thick plate glass one inch thick, and that the room can be lighted by electric lamps, fed from a storage battery placed under the seats. It being a hot summer day, several small fans are kept running to circulate the air. We note the thick, massive steel walls of the car, and our particular attention is directed to the steel door which slides up and down like a window in air and water-tight brass fittings. This door is raised and lowered by means of a rack and pinion and forms an absolutely water-tight closure, which does not permit a drop of water to get by. Similar water-tight doors are used on all of our battle-ships and modern steamers, which connect the bulk heads, and which can bear enormous water pressures without allowing a drop of water to leak.

All the cars being loaded simultaneously in less than two minutes, we faintly hear a shrill whistle outside, and we are off. Slowly and majestically the big wheel begins moving, and keeps on moving at a steady gait. The sea-going Ferris Wheel is not intended as a racing device—quite the contrary, it only moves at about three or four miles per hour. Pretty soon the wheel begins to dip into the water, and as our particular car is way up in the sky, we have as yet to experience our first "dip" into the ocean. In a few seconds, we dive into the surf gracefully, and we experience the thrilling sensation of sinking into the green ocean water, while the spray of the big waves break against the thick glass windows, slightly swaying the car. Truly enough, here is sensation and excitement sufficient to please the most blasé. Down, down we go, and we note that the sunlight becomes dimmer and dimmer as we dip further into the water. This, however, only lasts for a few seconds, and suddenly we are aware that we *seem* to be moving backwards. The reason of course is that the car is now going the other way, and soon will dip out of the water entirely. In a few seconds, we are out of the water again, and are soon once more high up in the air, only to dip down still deeper into the water than the first time. As we go down for the last time, we know that we are about 50 feet below the water level, and here it is almost dark, very little sunlight coming down to this depth.

The attendant now turns on a little searchlight, and we can see small and large fish swimming about curiously. At the end of the track, we also make out the dim outline of a stranded steamer buried in the sand many years ago. It gives us a good view of what a sunken steamer looks like, and how it has disintegrated with age. As the wheel only stops for a few seconds, we have not much time to notice all the submarine wonders, for soon the wheel starts rolling back, and we dip out of the water once more.

We note that every time the car dips out of the water, an attendant turns a hand wheel, which is for the purpose of renewing the air in the car. A pipe connects somewhere with the roof of the car, and this pipe lets in fresh air every time the car rises from the water. A funnel-shaped cover prevents the water from entering the car when air is let in, while a suction fan forces fresh air into the car. This change of air is greatly welcomed because there is not too much air in the cars anyway, and while the entire trip only lasts about 20 minutes, and tho the original air would be sufficient to keep everyone comfortable during this time, it is far better that the air should be renewed, giving the passengers a chance to get a breath of clean and fresh sea air.

Soon we are back on *terra firma* once more, and arrive at our unloading platform. The door is slid open, and we emerge to make room for subsequent passengers.

So far for the whole trip. Our illustration shows the other items which the passengers do not see. For instance, there are two pilot houses attached to the hubs of the wheel. Each one of these pilot houses has a semaphore arrangement on top of its little housing, which is used by the pilot to inform the land station in case anything goes wrong, but more for the purpose to start, stop, or accelerate the speed of the wheel or for any other purpose. The passenger cars have a triangular attachment at the bottom for two reasons. If the car was entirely flat, it would have difficulty in making its dive into the water. Secondly, inasmuch as we have a large buoyant body in the form of the car itself, we must weight it down to such an extent that it will not float. If it were floating, then the car would overturn and spill the passengers inside of the car. For that reason, the triangular appendage of the car is weighted with iron to overcome the natural buoyancy of the car. A good percentage of the buoyancy of the car itself has been destroyed by the great weight of the car (built of ⅜" steel), but this is not sufficient to sink it, hence the ballast weight is needed. It is necessary also to have the car good and heavy for if

(*Continued on page* 205)

A Sea-Going Ferris Wheel

By H. GERNSBACK



Ever Since the Chicago World Exposition in 1893, the Ferris Wheel Has Been With Us to Delight Amusement Lovers At Our Expositions and Beach Resorts. The Latest Improvement On the Stationary Ferris Wheel Is Shown Above. It Consists of the Regulation Wheel, Which With Certain Additions is Made to Roll Upon a Track, Out Into the Sea, Lake, or Other Body of Water. The Track Being Inclined Into the Water, the Wheel Rolls Down By Gravity. It is Pulled Back By Means of Two Steel Traction Cables as Shown. The

THE good old Ferris wheel has been with us for many years now, and ever since it was invented by G. W. G. Ferris, who erected the first one at the World's Exposition of 1893 at Chicago it has not been much improved upon. When it first came into use at our sea-shores and amusement parks, it was considered a wonder, but during the last decades the novelty has worn off.

Last year the writer took a trip on one of these wheels and was imprest by the lack of popularity in the device. There was no great crowding, and the writer particularly remembers a remark past by a young girl who refused to take the trip, giving as her reason that "it was not exciting enough for her." This seems to put the finger right on the whole crux. It is not exciting! Hence it has fallen into disuse with the amusement-seeking, merry-making crowds.

Another thing with which the writer was imprest on his trip was the cumbersome way of loading and unloading the passengers of these Ferris wheels. Once the cars are loaded, the wheel may spin merrily, but the loading and unloading is another matter. As each car comes down, the wheel must be stopt to allow one set of passengers to get out and allow another set to get in. Consequently it will be seen that there must be as many such stops as there are cars to the wheel. Loading and unloading thus takes an average of 10 to 15 minutes, which does not improve the temper of the occupants who expect speed and excitement.

For these reasons and various other ones, the writer advances a radically new idea which is shown graphically here, and also forms the subject of our cover illustration. The writer has simply taken a Ferris wheel, and instead of revolving it on its axis, he has placed it upon a steel track and rolls it out into the water as our illustration well depicts. The object is two-fold. First of all a new brand of sensation is had, so much craved for by our present amusement seekers. Secondly, the old and well establisht features of the Ferris wheel are kept and improved upon as well.

The idea which forms the subject of a patent is in brief as follows:

The Ferris wheel runs upon a special kind of track, which latter is built right into the ocean, lake or other water body, the tracks being supported by the regulation piling work, similar to that on which our ocean piers are built. The track itself, as will be noted, should be inclined; the slope being inconsiderable. Using a hundred foot Ferris wheel, the track may run out into the water a thousand feet or more, all depending upon the expense the builders wish to go to. At the end of the track there is a concrete safety pier, which stops the wheel should the supporting cables break.

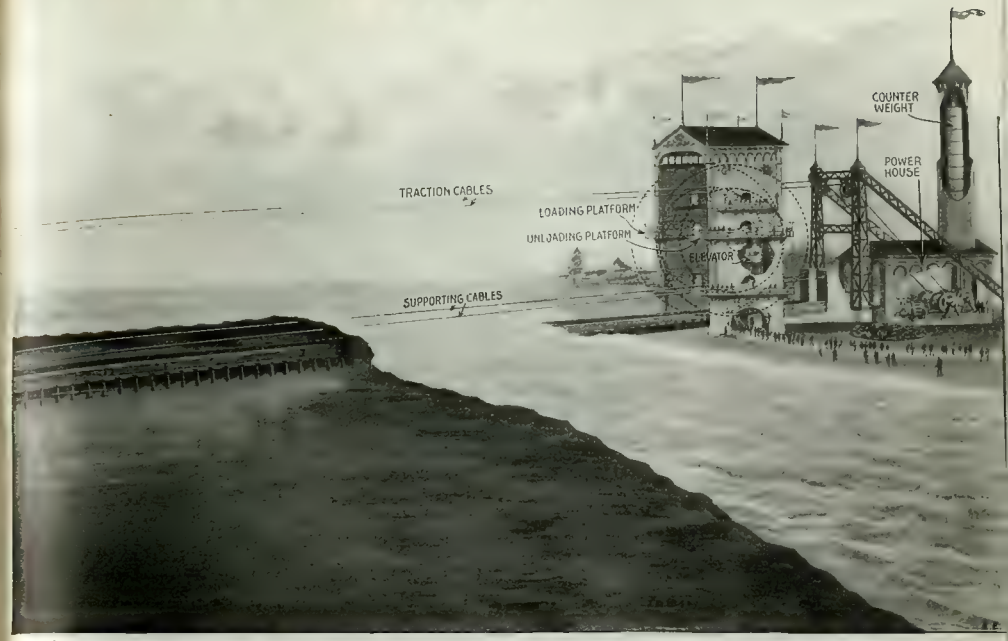
The mode of propulsion is rather simple. You have no doubt seen the principle many a time, particularly before prohibition arrived. Surely you have seen how a beer keg or wine barrel was lowered by means of two ropes down the stairways into the cellar. Two ropes would be slung around the barrel, and two men would play out the ropes as the barrel descended easily and gracefully down the incline stairs and into the cellar. The same principle is made use of in the present invention. As will be seen there are two steel cables, both running parallel to each other, one side engaging a circular sheave of the wheel, while the other side connects to the power house.

In the position shown in our illustration above, the wheel has arrived at the end of its trip and is now pulled landward again by means of the two traction cables which wind up on huge drums in the power house. Very little power is required inasmuch as big counter weights are used which practically pull in the wheel themselves. Only a small amount of power, let us say a 50 H.P. motor, is required to bring the wheel back to land. On its outward trip practically no power is required, the wheel running down the incline by gravity, the traction cable simply paying out; the action is, of course, under the control of the men at the power house, who will see to it that the wheel does not go too fast for reasons which will be apparent hereafter.

Let us now take an imaginary trip in this future sea-going Ferris wheel, and see what happens.

After paying our fare, we ascend by means of elevators on to a loading platform, and we will find that there are three such platforms. The cars of the Ferris wheel come into a resting position level with the platforms, the top platform and the bottom platform each accommodating one car, while the second and third platforms each accommodate two cars. The device is made so that, inasmuch as there are six cars and the wheel always returning in its same position, the cars will always stop at their assigned platforms and not otherwise.

We now enter one of the steel cars, each car accommodating 24 persons. There is not much room offered us, and every inch of available space has been taken advantage of, as we must not have too much buoyancy, otherwise it will take too great a weight to pull the cars down below the level of the water. For that reason the



Passengers In the Water-tight Cars Experience the Novel Sensation of First Rising Up Into the Sky Only to Be Submerged Into the Water. The Maximum Immersion is About 50 Feet. The Experience Which is Gained In Submarine Building, Makes It Possible for Us to Make the Cars Thoroly Safe in All Respects, Without the Passengers Undergoing Any Risks Whatsoever. A Novel Means for Loading and Unloading the Cars is Shown as Well in the Present Invention, Which Does Away with the Tedious Starting and Stopping of the Old-time Ferris Wheel. The Sea-going Ferris Wheel Will Probably Be Built At Coney Island Next Season.

ceiling or roof of the car is very low.

There is just enough room in the cars to allow people to sit comfortably, and when the car is full there is not much room left.

We note that the windows are made of thick plate glass one inch thick, and that the room can be lighted by electric lamps, fed from a storage battery placed under the seats. It being a hot summer day, several small fans are kept running to circulate the air. We note the thick, massive steel walls of the car, and our particular attention is directed to the steel door which slides up and down like a window in air and water-tight brass fittings. This door is raised and lowered by means of a rack and pinion and forms an absolutely water-tight closure, which does not permit a drop of water to get by. Similar water-tight doors are used on all of our battle-ships and modern steamers, which connect the bulk heads, and which can bear enormous water pressures without allowing a drop of water to leak.

All the cars being loaded simultaneously in less than two minutes, we faintly hear a shrill whistle outside, and we are off. Slowly and majestically the big wheel begins moving, and keeps on moving at a steady gait. The sea-going Ferris Wheel is not intended as a racing device—quite the contrary, it only moves at about three or four miles per hour. Pretty soon the wheel begins to dip into the water, and as our particular car is way up in the sky, we have as yet to experience our first "dip" into the ocean. In a few seconds, we dive into the surf gracefully, and we experience the thrilling sensation of sinking into the green ocean water, while the spray of the big waves break against the thick glass windows, slightly swaying the car. Truly enough, here is sensation and excitement sufficient to please the most blasé. Down, down we go, and we note that the sunlight becomes dimmer and dimmer as we dip further into the water. This, however, only lasts for a few seconds, and suddenly we are aware that we *seem* to be moving backwards. The reason of course is that the car is now going the other way, and soon will dip out of the water entirely. In a few seconds, we are out of the water again, and are soon once more high up in the air, only to dip down still deeper into the water than the first time. As we go down for the last time, we know that we are about 50 feet below the water level, and here it is almost dark, very little sunlight coming down to this depth.

The attendant now turns on a little searchlight, and we can see small and large fish swimming about curiously. At the end of the track, we also make out the dim outline of a stranded steamer buried in the sand many years ago. It gives us a good view of what a sunken steamer looks like, and how it has disintegrated with age. As the wheel only stops for a few seconds, we have not much time to notice all the submarine wonders, for soon the wheel starts rolling back, and we dip out of the water once more.

We note that every time the car dips out of the water, an attendant turns a hand wheel, which is for the purpose of renewing the air in the car. A pipe connects somewhere with the roof of the car, and this pipe lets in fresh air every time the car rises from the water. A funnel-shaped cover prevents the water from entering the car when air is let in, while a suction fan forces fresh air into the car. This change of air is greatly welcomed because there is not too much air in the cars anyway, and while the entire trip only lasts about 20 minutes, and tho the original air would be sufficient to keep everyone comfortable during this time, it is far better that the air should be renewed, giving the passengers a chance to get a breath of clean and fresh sea air.

Soon we are back on *terra firma* once more, and arrive at our unloading platform. The door is slid open, and we emerge to make room for subsequent passengers.

So far for the whole trip. Our illustration shows the other items which the passengers do not see. For instance, there are two pilot houses attached to the hubs of the wheel. Each one of these pilot houses has a semaphore arrangement on top of its little housing, which is used by the pilot to inform the land station in case anything goes wrong, but more for the purpose to start, stop, or accelerate the speed of the wheel or for any other purpose. The passenger cars have a triangular attachment at the bottom for two reasons. If the car was entirely flat, it would have difficulty in making its dive into the water. Secondly, inasmuch as we have a large buoyant body in the form of the car itself, we must weight it down to such an extent that it will not float. If it were floating, then the car would overturn and spill the passengers inside of the car. For that reason, the triangular appendage of the car is weighted with iron to overcome the natural buoyancy of the car. A good percentage of the buoyancy of the car itself has been destroyed by the great weight of the car (built of 3/8" steel), but this is not sufficient to sink it, hence the ballast weight is needed. It is necessary also to have the car good and heavy for if

(*Continued on page 205*)

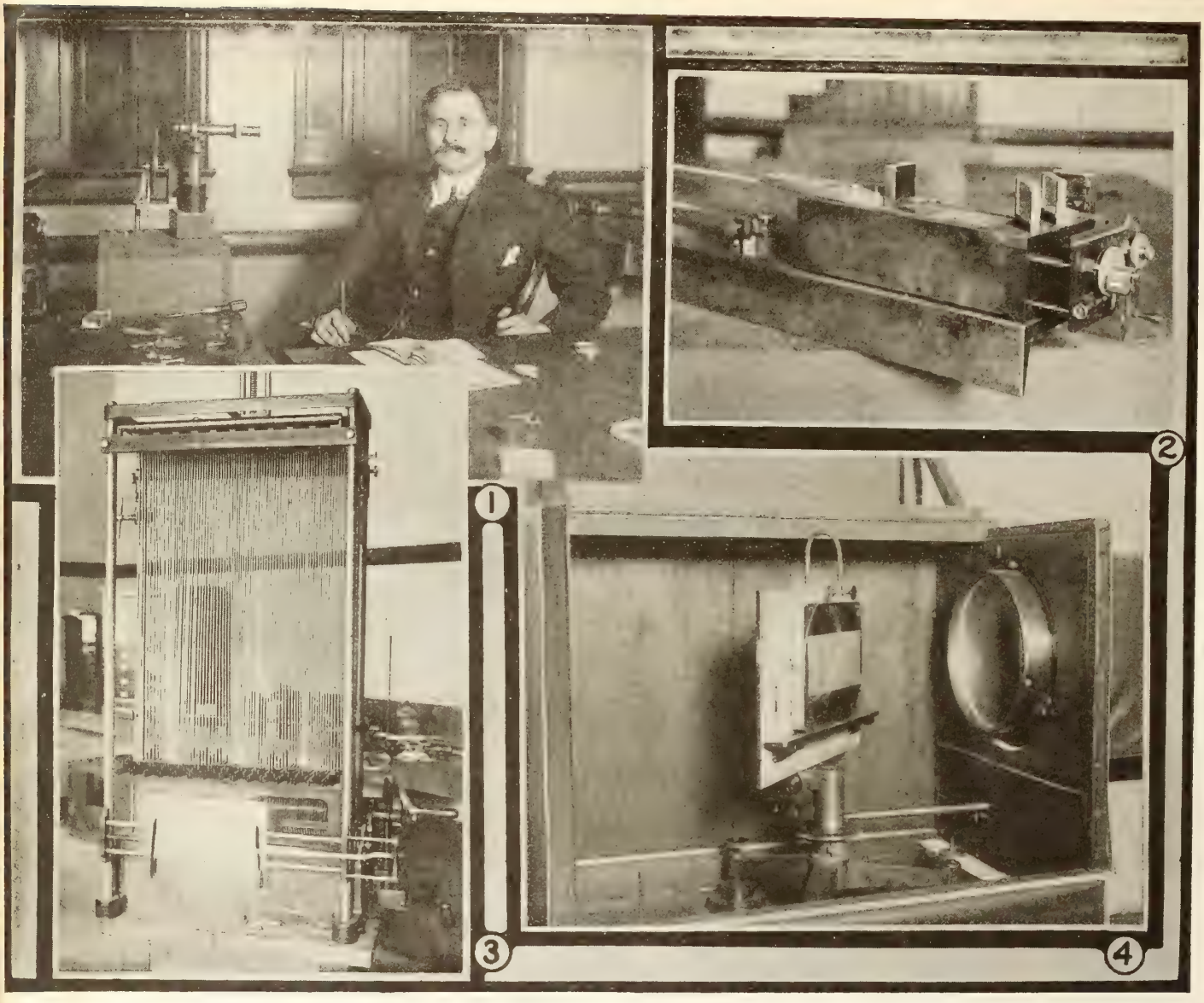


Fig. 1. Dr. Albert A. Michelson, of Chicago, Famous American Physicist, Whose Work Is Said to Have Inspired the Basis of the Einstein Theory. Fig. 2. Dr. Michelson's "Interferometer." In Measuring Small Changes in Distances or Angles, This Instrument Is Fifty Times as Strong as the Most Powerful Microscope Which Can Ever Be Made. Fig. 3. Prof. Michelson's "Harmonic Analyzer" for Analyzing Spectral Lines Into Their Constituent Parts. Fig. 4. Prof. Michelson's "Echelon Spectroscope" Which Has a Glass Grating Containing Fifteen Thousand Parallel and Equally Spaced Lines to the Inch.

Chicago Professor Gave Foundation for Einstein's Theory

By ROBERT H. MOULTON

A UNIVERSE with four dimensions.

Stars that seem to twinkle in one place and really hang in another section of the sky.

Yardsticks that are longer east and west than if lying north and south.

Light with weight that jars the earth when sunbeams fall.

These are bits of the now famous Einstein theory of "The Relativity of Earth-Motion and Ether-Motion." Einstein, philosopher and mathematician, based his profound yet fantastic theory upon experiments performed with a marvelously delicate measuring instrument, the "interferometer," invented by Dr. Albert A. Michelson, of the University of Chicago.

Scientists have long endeavored to determine the absolute motion of the earth thru space. It is known that the earth swings around the sun and that the entire solar system is moving toward the constellation Hercules at the rate of twelve miles per second, or 400,000,000 miles per day. However, as scientists have not been able to measure the motion of Hercules, they still do not know the absolute motion of the earth. In 1880 Professor Michelson attacked the problem of determining the motion of the earth with reference to the ether, the all-pervading medium that fills interstellar space.

He eventually overcame the tremendous experimental difficulties in connection with this problem; but no motion of the earth with respect to the ether was found. This result came as a profound surprise to the entire scientific world. It does not mean that there is no motion relatively between the earth and the surrounding ether; but a number of basic scientific theories must be revised to account for this new condition.

In order to solve this problem Professor Michelson invented the "interferometer." This instrument is fifty times more powerful than an absolutely perfect microscope would be. The microscope's power is limited by the length of a light wave; and the smallest distance it can reveal is one-half a wave length, or one hundred-thousandth of an inch. By utilizing the properties of light in another manner, the interferometer can reveal distances equivalent to *one five-millionth of an inch!* The microscope has been of immense value both in scientific work and in practical life; and the invention of the interferometer, an instrument fifty times more powerful, is in itself an achievement that should win for Professor Michelson undying fame.

He used this instrument to aid him in measuring the standard meter, the foundation of the metric system, in terms of infinite exactitude and in a manner that will make this unit perpetual. The original meter length is a rod of solid platinum carefully preserved in Paris; but scientists have long worried over the possibility of its destruction. In 1893 an international commis-

(*Continued on page* 231)

Master "Movie" Thrills

IT is really remarkable, in fact astounding, to what extent motion picture actors and actresses will go in order to furnish the "Movie" thrillers which we so delight to view from a nice cosy box seat. While we take life easy the "cast" works overtime to send us thru all kinds of imaginary feelings of torture, suspense and mystery. There is no branch of science which is not used in some way or other to furnish the jaded theatre-goer with these remarkable hair-raising adventures. Spiritualism being one of the paramount topics of discussion all over the world at present, this 4th dimension scientific theorism is brought into play in making the thrilling Vitagraph photoplay "Smashing Barriers" a success.

William Duncan, playing the leading rôle, is an athlete of exceptional merit and is ably supported by the leading lady, Edith Johnson, who willingly attempts some of the most daring, hair-raising stunts imaginable, whereby, aided by good fortune and a sure hand, her life is saved time and again. Don't think for a moment that these scenes are "faked," dear reader! The realistic photoplay must combine with it the *actual* daredevil and reckless stunts in order to have the true gripping effect required by the serials. Some of these serial film plays have been so ably staged that they exercise such a hold upon the public that the installments of the serial are never mist, from Little Johnny to Old Grandad.

This is particularly true of the photoplay just mentioned. Take, for instance, the three scenes showing the "Crystal Gazing" and subsequent acts, which clearly demonstrate the elaborateness of such a display. The chair made to order and the immense revolving floor alone present mute testimony as to what extent a modern photoplay producer will go in order to furnish something strange, something with that ever-sought-for "thrill," and at the same time hold both the newcomers and those who have mist the first few installments. So in this case, after fabulous sums were spent in order to construct a revolving floor the chairs of which were bolted down, the mechanism for revolving the floor had to be built strong enough to withstand the abnormal condition that it was put to, and the chairs themselves constructed in such a manner as to firmly lock the occupants in place so that when the floor was revolved there would be no danger of them slipping from their bonds to go crashing down into the room below. By what miraculous power the occupants in the chairs maintain their position is not known particularly, inasmuch as the chair itself seems to be quite weak, but the fact remains that they revolve completely until they are in an inverted position and photographs of them suspended from the ceiling of the room below are shown in the serial.

The story itself is one in which countless wrecks, tons of dynamite and T.N.T. and scores of hair-breadth escapes figure and were it not for the wonderful physique of the actors it would be utterly impossible to conduct a serial so rich in ideas as this one. The three photographs show the spiritualists in the den of the treacherous clairvoyant.

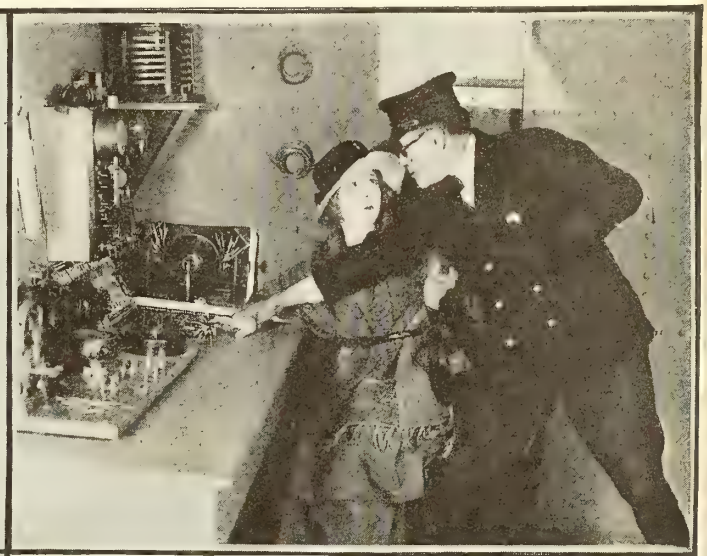
Then the exceptionally clever Vitagraph photoplay serial, "The Invisible Hand," starring Antonio Marino and Pauline Curley, is found to be equally as elaborate as the one just mentioned, and with as many "thrills"—featuring submarine caves, poison gas, dynamite, airplane and submarine activities and in fact every thrill that can possibly be produced on land, sea, in the air, or in the water.

This story is a detective serial of the very unusual high-class type in which the heroine does some exceedingly thrilling and strength-daring, daredevil stunts. There are very few heroines who can run, jump,

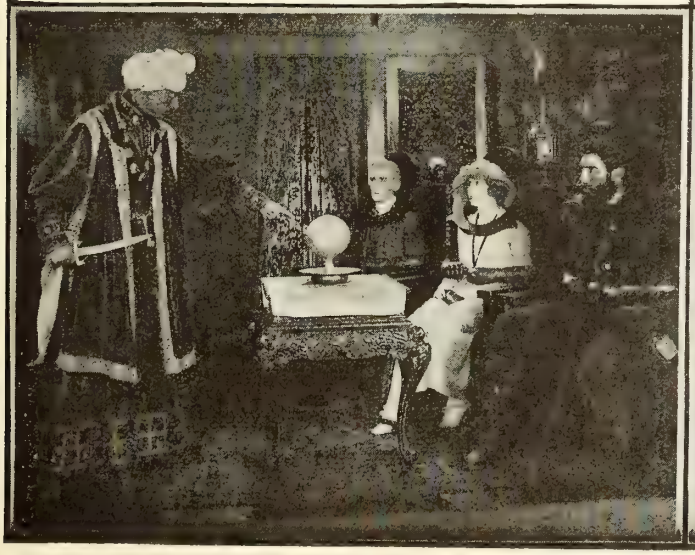
(*Continued on page* 235)

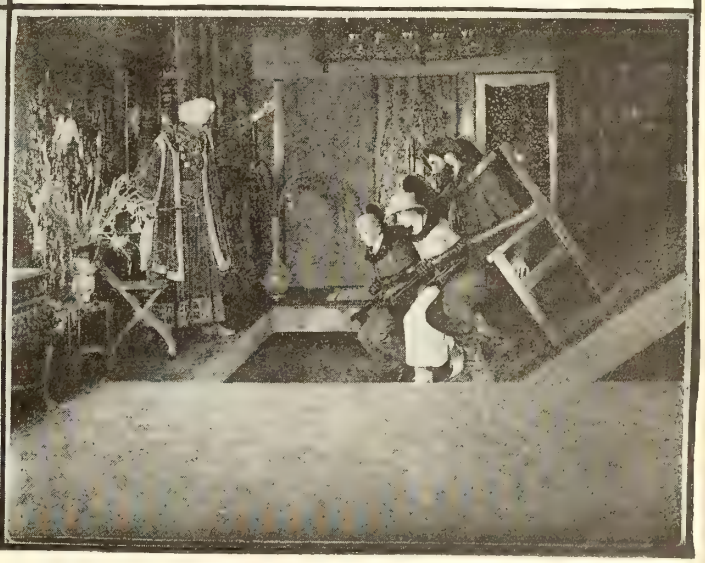


The First Scene of the Vitagraph Serial "Smashing Barriers." By the Press of a Button on the Table Automatically the Chairs in Which They Are Sitting Become "Alive," and They Are Imprisoned by the Bonds.



When the Hero Enters He Finds the Room Empty, While the Poor Victims Are Hanging in an Inverted Position from the Ceiling of the Floor Below. Above—an Elaborate Radio Station in Vitagraph Serial, "The Invisible Hand."





Eliminating the "Hello Girl"

By H. E. CLAPHAM*

THE announcements made during recent months concerning proposed installations of automatic telephone equipment in several of the larger cities of the United States have come with rather dramatic suddenness to those who have been unacquainted with the trend of affairs in the telephone world. To men who have been intimately associated with the telephone industry it has been no surprise at all, but rather the logical outcome of the events of the past few years.

Automatic telephony is by no means an innovation. The advantages of machine made connections have been recognized almost from the beginning of the telephone art, and it is now almost thirty years since the first public automatic exchange was installed. In the early years of the art, the apparatus was necessarily crude and its adoption for public use gradual. At the time that it was first put into use, telephone service consisted of hardly anything more complex than simple party-to-party calling and it was to relieve the operators of this burden that the automatic system was originally conceived. The development of the telephone during the last thirty years has been phenomenal. That the automatic system has met every requirement that has been demanded of manual systems would not be stating the case fully. The automatic system has been developed to a point where it can do anything that can be done with a manual system, and most things better and more economically.

ADVANTAGES OF AUTOMATIC TELEPHONE SYSTEM.

The advantages accruing from the elimination of the operator alone are many and are too well known to need enlarging upon here. There are, however, many other advantages not so generally known. Chief among these are: Absolute privacy; rapidity of connections; immediate signals indicating condition of called line; instantaneous release of connections upon replacement of receiver; constant and uniform service day and night. To the operating company also the system has decided economical advantages, as follows: Saving of operators' wages, training expenses and accommodations; economy of space; economy in line construction; low maintenance charge and long life.

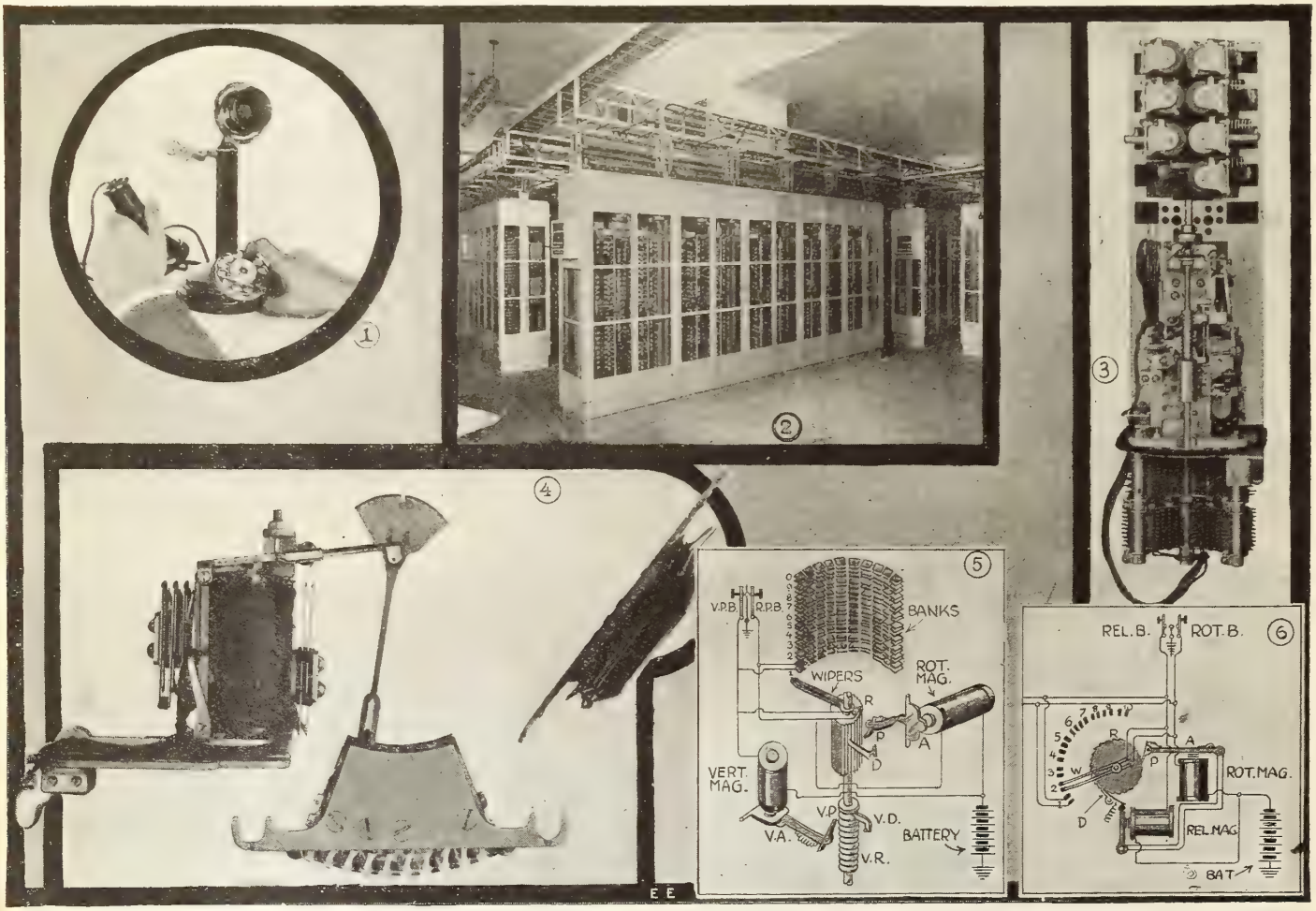
The matter of economy in building space can be easily appreciated when it is considered that often, when a manual exchange is converted to automatic, it has been found possible to install the complete automatic unit in the space that, up to that time, had been used for operators' recreation, lunch and locker rooms.

Great economy in line construction is made possible because of the flexibility of automatic equipment. While the size of a manual office has definite limitations, there is no limit to the number of lines that may be placed in one automatic office. On the other hand, the nature of automatic equipment is such that in communities where the telephone traffic is distributed over a considerable area, it may be subdivided into small units and operated advantageously in a number of widely separated offices.

The general plan of an automatic exchange divides the number of lines into groups and sub-groups, and 100 lines form a minor group or unit. A thousand line system is built up by grouping together ten 100-line units and providing means to select the particular unit desired. Larger systems are built up by grouping a number of 1,000 line systems together and providing means to select the particular 1,000 line system containing the desired line.

Almost from the beginning automatic telephony has followed this plan of *trunking by groups*. The process of selecting a

(*Continued on page* 225)



The Above Illustrations Show, 1—Calling a Number on the Automatic Telephone by Placing the Finger in the Ring Over Each Desired Digit, Rotating the Ring to the Fixt Stop and Releasing the Ring for Each Successive Number.

2—Large Automatic Telephone Exchange—Not a Girl in Sight!

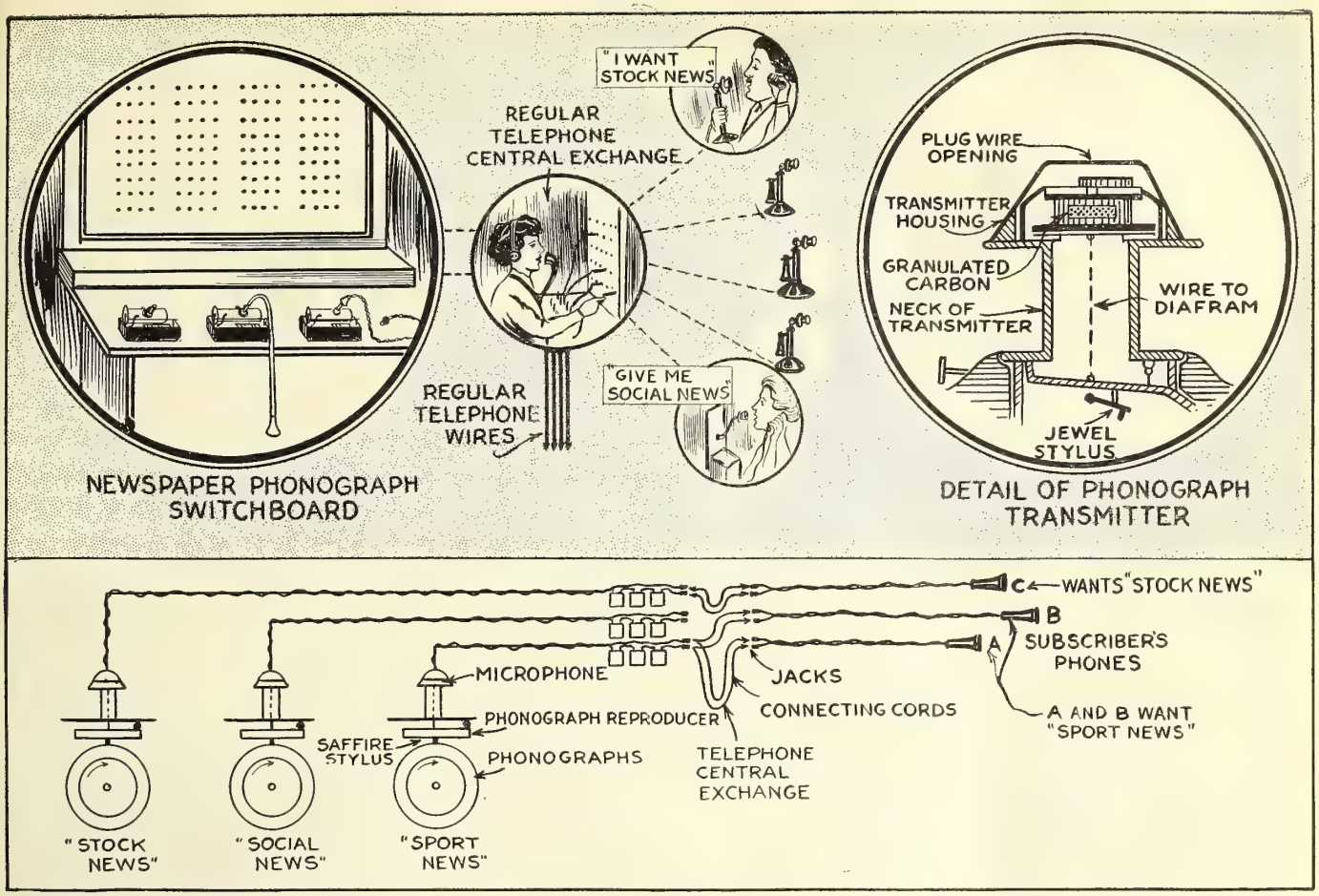
3—Close-Up of One of the "Connector Switches" Which Help to Select the Called Subscriber's Telephone Circuit. The Switch Arms May Be Lifted to Any Desired Tier of Contacts and Rotated at Any Level, All by Sets of Electro-Magnets, Operated by the Calling Subscriber's Instrument. If the Line Is Busy You Hear the "Busy Tone" in Your Receiver.

4—The "Line Switch"—the First Selecting Mechanism Actuated by the Subscriber Calling Thru the Agency of His "Dial-Switch" on His Instrument. The Electro-Magnet at the Left Actuates the Switch Arm. In Spite of the Several Switches Thru Which a Party Is Called, the Total Time for Called Is But 8 to 10 Seconds Usually, Which Compares Favorably and in Fact Surpasses Most Manually Made Calls.

5—Showing 100 Subscribers' Lines Arranged in Banks with Selector Switch Arm, Raised and Lowered as Well as Rotated by Magnets and Pawls.

6—Simple Circuit Finder, or Automatic Selector, for Exchange of 10 Subscribers.

* Of the Automatic Electric Company.



Instead of Reading a Newspaper We May Tomorrow Call Up "Via Telephone," and Ask for the Latest "Social," "Sport" or "Financial" Information and Hear the "News" Spoken Over the Telephone from a Phonograph. This Invention Will Be a Great Boon to the Blind in Many Ways, and Instead of Having to Read by Raised Letters, Besides Missing the Latest News, Those Whose Sight Is Deficient May *Hear* the Latest News When the *Newsophone* as Its Inventor Calls It, Is Put into Service.

"Newsophone" to Supplant Newspapers

Latest Electrical Invention to Provide "News" via Telephone at Low Cost

INSTEAD of chasing out "Bill" the office boy for a copy of the latest "Uxtre-ee-e" detailing with horrible fidelity, the latest murder, scandal and I. W. W. outrage, you will in the near future, with the "Newsophone," the latest scientific distributing idea created by Mr. Lewis Yeager of Spokane, Washington, simply call up on your regular telephone and ask for the specific *news wire* you are interested in.

The present plans call for a comparatively simple arrangement of the *news wires* which may be centralized at either the newspaper headquarters, or at the offices of some large news distributing syndicate such as the Associated Press offices in the larger cities. The telephone subscriber who wishes the latest Social, Sport or others news will simply call "Central" and ask for the *news wire.* In a moment, the operator at the news headquarters will ask which news the subscriber desires, and having ascertained this, will immediately connect his line with the proper *Newsophone* instrument, and the newsophone is nothing more or less than our old friend the phonograph brought forth with a new dress,—in other words, the news that you now read is recorded vocally on a wax record so that when you want to hear all about the latest suicide, divorce scandal, or what is happening to little Mary Pickford and "Doug" Fairbanks, or how many points B. & O. stock dropt today, it will be *spoken to you,* in a pleasant voice.

Apparatus and plans for voluminous newsophone service have not reached a stage where the particular voice used has been decided upon, but eventually it may be possible to ask for any register of voice you like, tenor, baritone or bass,—with male voices for the ladies and delicately shaded female voices for the "gents."

Think what a boon the newsophone will be, once it is put into regular service during the summer, when the baseball fans pester the life out of telephone operators, and also the fifty-seven other varieties of "telephone bugs" who want to know all the latest doings from what the weather is going to be a week hence, down to the latest gossip on the "Mexican situation."

HOW THE NEWSOPHONE WORKS.

The newsophone as outlined by Mr. Yeager, possesses some very fine possibilities and while the service rendered by it might seem to entail a very large expenditure of money to make the initial installment of the apparatus, distributing switchboards, etc., this is not so gigantic as it might at first seem. This is so for one reason, and that is, that the various kinds of "news" furnisht would be limited to probably a few dozen different varieties such as stock news, social news, steamship arrivals and sailings, accidents, marriages, deaths, etc. Moreover, but one phonograph record containing any of these specific news items is required to supply any number of subscribers with news *simultaneously,* should a number of them call up at the same time.

Simply explained, this can be conceived of in this way: In the old Edison type phonographs, especially when it was first introduced, there were many times when instead of reproducing the music thru a horn, a multiple set of rubber ear tubes was fitted to the reproducer chamber on the phonograph, and each member of the family placed a set of the tubes in their ears. Thus, as many as five or six could listen at the same time and enjoy the music.

The Newsophone is nothing more nor less than a glorified phonograph and which in its final development, will require some of

(*Continued on page* 207)

Sub-Sea Talk Over Bare Wire

By DONALD MAC GREGOR

LATE CAPTAIN, U. S. SIGNAL CORPS, STAFF OF MAJOR GENERAL SQUIER

ORDINARY "bare wires" for carrying telephone and telegraph messages thruout the world, in the place of the present highly expensive and delicate cables—this, revolutionary as it may seem, is the very latest proposal of Major General George O. Squier, Chief Signal Officer of the United States Army.

Major General Squier, whose remarkable developments in the field of cable and radio have attracted world-wide attention in recent years, renders the use of bare wires placed in the sea possible for the transmission of messages thru the application of "wired wireless," which he announced about eight years ago, and which already is in commercial use in the United States. "Wired wireless," popularly described, is a combination of radio and the old system of wire communication, in which the wire is used as the *guide for the radio,* thereby permitting transmission with a minimum of energy and with the fullest extent of secrecy, which radio ordinarily does not possess.

Up to the present time "wired wireless," which some of the Chief Signal Officer's close associates have come to call "Squiered wireless," has been used for telephony and telegraphy on land lines, under favorable conditions. There never was any attempt before to apply it to lines placed in the water—the ordinary type of cable, with its heavy armor to prevent damage to the wires —stood supreme for such long-distance communication.

Vacuum-tube amplifiers, however, make possible the communication over bare wires placed in the water, which has been proven beyond the shadow of a doubt in a long series of experiments that have been going on under the direction of Major General Squier in the vicinity of Washington. The experiments, which have been in direct charge of Lieutenant Colonel J. O. Mauborgne, chief of the engineering division of the Signal Corps, were conducted between Fort Hunt, Virginia, and Fort Washington, Maryland, which are across the Potomac river from each other and which are about 4,000 feet apart.

Using Bare Wires as a Substitute for Ocean Cable and Buried Land Wires

TALKING OVER BARE WIRE IN WATER.

Here telephone communication has been established over a bare wire placed in the Potomac river and weighted down with bricks tied to a clothes line, to prevent it from becoming entangled with river steamers. It has been possible to send and receive telephone messages just as distinctly as over the customary lines maintained under the most favorable conditions.

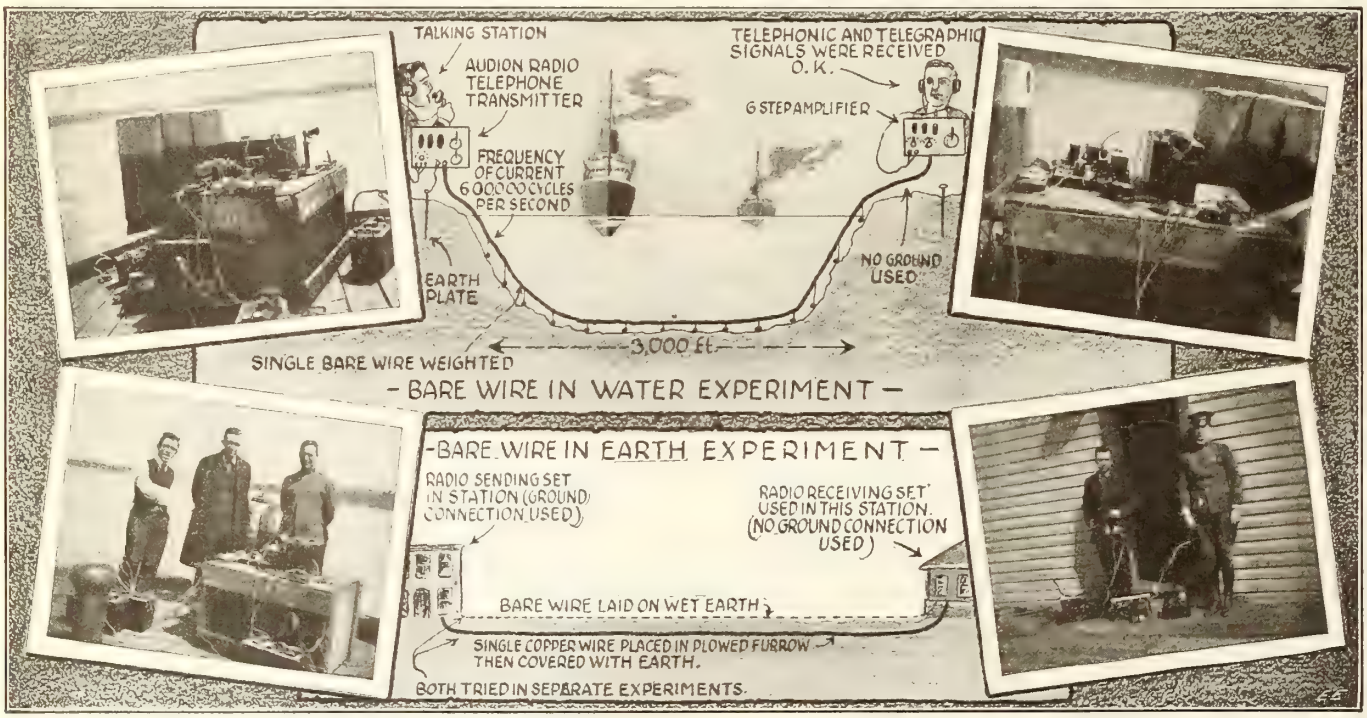
What has been done over this short distance can be done over a longer distance, in the opinion of Major General Squier, who maintains the view that a principle has been established which will have the most far-reaching effect on the future development of cabling. For long-distance communication it merely is a matter of the proper current and sufficiently powerful vacuum-tube amplifiers.

The idea of such an application of "wired wireless" occurred to Major General Squier last December, in studying over the Naval development during the war *which enabled two submarines while submerged to communicate with each other by radio.* It proved to the mind of the Chief Signal Officer that radio currents would travel thru water just as well as thru the air, and it seemed to him to follow that such a current could be *guided* by a wire when placed in the water.

Major General Squier explained the theory to Lieutenant Colonel Mauborgne, who immediately declared his belief that the scheme was feasible.

They realized the revolutionary aspect of the work they had undertaken; they knew that for years ocean cables had been laid at the greatest expense—in excess of $2,000 a mile with prices as they were before the war—and that even the slightest break in a cable put it out of commission, necessitating its repair by a cable ship after a wearying search.

Their experiments brought scant results at first, but they went ahead, firmly convinced that there was a way. They placed the wire in the water, placing a ground connection at either end, but this did not work.



The Latest Thing in "Wired Wireless" as Carried Out Under the Direction of Major Gen. George O. Squier; Telegraph and Telephone Messages Were Transmitted Over a Bare Wire Three-fifths of a Mile Buried Underground, and Also Immersed in the Potomac River, as Shown. Upper Left-Hand Photo Shows Apparatus Used on Pier on River Bank. Lower Left-Hand Photo Shows Members of Signal Corps, U. S. A., With Pier Apparatus. Upper Right-Hand Photo Shows Close-Up of Radio Apparatus Used. Lower Right-Hand Photo, Officer Is Colonel J. O. Mauborgne, With Signal Corps Laboratory Apparatus, and Assistant

NO GROUND CONNECTION USED.

Finally, after numerous trials which did not seem to be sufficient, it happened that Colonel Mauborgne accidentally disconnected the ground connection. Surprising as it may seem, the line went into operation.

On reporting the incident to General Squier, that *the line worked when no ground connection was used,* Colonel Mauborgne learned that General Squier had discovered that the same thing had happened to him while conducting a series of experiments ten years before. He turned to his note books, producing the record of the operation of such a line on land without the use of a ground connection. The scientific reason for this is as yet not altogether clear to those who are conducting the experiments, but it is the subject of study.

With the line working successfully thru the Potomac river, the officers set about to see what might be done with a bare wire buried in the earth. The Signal Corps cantonment at Little Silver, N. J., Camp Alfred

(*Continued on page 222*)



Tele-photography Across the Atlantic Has Seemed Almost Impossible, Even in the Present Day of Wonderful and Startling Inventions. However, Professor Korn, Well Known for His Results in Tele-photography, Has Developed a New System of Building Up a Picture by Dots of Varying Magnitude, Each of Which Has a Special Code Letter, So That Photos Can Be Telegraphed, Cabled or Radioed Practically Any Distance.

Tele-Photography Across The Ocean

By DR. ALFRED GRADENWITZ

ONE of the most remarkable inventions perfected during the war—independently of any strategic considerations, no doubt—is Prof. Arthur Korn's *Transatlantic Tele-Photography.*

Our readers are, of course, conversant with the Professor's *transcontinental tele-photography,* which previous to the World War made part of the routine work of some prominent European dailies, enabling photographic pictures of people and events to be wired from Berlin to Stockholm, Copenhagen, London, Paris, etc., as well as vice versa. This process, because of the enormous capacity of transatlantic cables and the resulting inertia, could not be adapted for transocean service and a new process had to be devised.

In its first stages it resembles the familiar method used for transmission on transcontinental lines. The picture to be transmitted, in the shape of a translucid film, is wound upon a glass cylinder performing a rotation round its own axis as well as a slow forward movement in the direction of the latter. All the elements of the pictures thus pass in turn at the spot where the beams of a Nernst lamp, of very constant luminous intensity are concentrated. After traversing a given film element, these beams will strike a selenium cell, whose resistance, of course, varies in accordance with their luminous intensity; these fluctuations of resistance being converted into corresponding variations of current intensity in the circuit comprising the selenium cell.

Now, whereas in the case of ordinary tele-photography these current fluctuations are transmitted over a telegraph line, in order at the other end, by an inversion of the same series of operations to be reconverted into variations of luminous intensity, and accordingly into shades reproducing photographically the original film at the sending station. This is not feasible in the case of transatlantic tele-photography.

A New Advance Toward Television

Prof. Korn, therefore, designed a most ingenious relay, where all contacts are replaced by electric sparks and arcs, and by the intermediary of which the current fluctuations are made to act on a high-speed telegraph of the Siemens and Halske system where each current intensity, in the perforated strip, produces a given combination of holes. After converting these perforations in the same telegraph into a *series of letters,* where each of those chosen—fourteen in all—*corresponds to a given combination of holes and accordingly to a given current intensity and a certain shade of film element; these letters are, like an ordinary cablegram, transmitted across the ocean.*

What there is received at the other end, then, is only a series of several thousand letters, which at any time and any place desired, can be reconverted into a picture faithfully reproducing the original photograph. Several processes can be used in this connection, the most simple (already employed with satisfactory results) being based on the use of a *special typewriter,* which in the place of letter type *carries at the end of each lever a small circle or square of dimensions corresponding to the shade exprest by the letter in question.* The stronger the shade, the greater will be these dimensions, the intensity of the imprint on the paper thus varying in proportion. The letter "X" indicates the end of a line and the beginning of a new one.

By simply copying on this remarkable typewriter the cablegram received at the distant end the original picture is thus reproduced, element for element and line for line. The typewriter will preferably be operated by electricity or comprest air, thus accelerating operation and rendering it more uniform. By subdividing the cablegram into several portions, each of which is entrusted to another operator, further speed is had.

By augmenting the number of letters composing the scale of shades and accordingly the number of component elements of the picture there are obtained more delicate reproductions.



At the Left a Reconstructed Picture Is Shown, Which Was Telegraphed by Code Letters Over a Long Telegraph Line. The Right-Hand Photo Shows Dr. Korn Reconstructing This Very Picture From a Code Telegram on His Special Typewriter, Each Key of Which Has a Dot of Certain Size on It, Instead of a Letter, These Varying Dots Making Up the Picture.

Musical Electrization

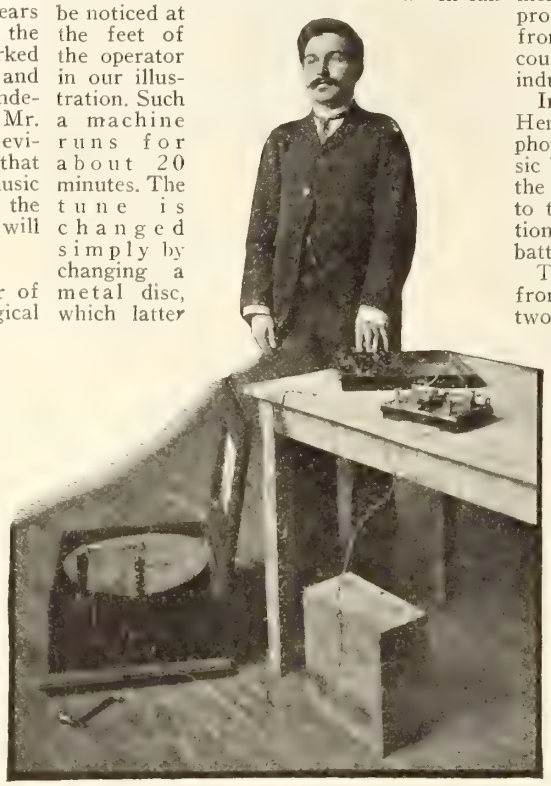
By JACQUES BOYER

While our April issue, containing the article by Mr. H. Gernsback, "The Physiophone" was still on the press, we received the following article from our Paris correspondent, Mr. Jacques Boyer. It appears that Mr. Charles Henry, Director of the Laboratory of Physiology, has worked along the same lines as Mr. Gernsback, and discovered the identical phenomenon independently. It should be noted in Mr. Boyer's article, that Mr. Charles Henry evidently has not come to the conclusion that the apparatus can be used to transmit music physiologically to the deaf. In view of the extraordinary co-incidence, our readers will no doubt be interested in the article.

MR. CHARLES HENRY, Director of the Laboratory for Physiological Sensations of the Sorbonne, Paris, has invented a novel means which he terms *musical electrization* and which he claims will find therapeutic uses. Our readers no doubt know that the d'Arsonval alternating sinusoidal currents are very much superior to the ordinary faradization of the induction coil. Furthermore, such sinusoidal currents are much better suited to the human system, and do not produce pain or great contractions of the muscles.

Also after Fourier's theory and the experiments of Von Helmholtz, one can consider every musical sound as the sum of simple sinusoidal variations which are 1, 2, 3 .....n times less great, and which constitute the harmonics of this sound. Mr. Henry thought that he could obtain interesting results if he could transform into alternating currents these harmonious sounds which the human system now receives by the sense of hearing, and which sounds produce a profound and greatly varied influence upon the human system.

To verify his idea, he rigged up a simple experimental outfit shown in the illustration. As an electrical generator he used a thermo-electric couple of sixty-six elements which furnishes a constant electromotive force. As a sonorous source he uses an old-fashioned music box which can be noticed at the feet of the operator in our illustration. Such a machine runs for about 20 minutes. The tune is changed simply by changing a metal disc, which latter has small metallic projections on the reverse side, and which in turn engage little prongs of a steel harp; thus, giving rise to the music.



Translation of Musical Vibrations Into Electrical Ones for Therapeutical Purposes Is Suggested by a French Inventor Here Shown.

Mr. Charles Henry recognized the physiological influence of the rhythm and compared it with the physiological effects obtained by electrifying his subjects by means of alternating currents. These he produced by means of a siren placed in front of a microphone. The current, of course, was stepped up by means of a small induction coil.

In furtherance of his experiments, Mr. Henry placed a 4 carbon Hughes microphone on the resonant chamber of the music box, and connected the microphone with the battery on one side, the other end going to the primary of a little telephone induction coil, the other wire returned to the battery.

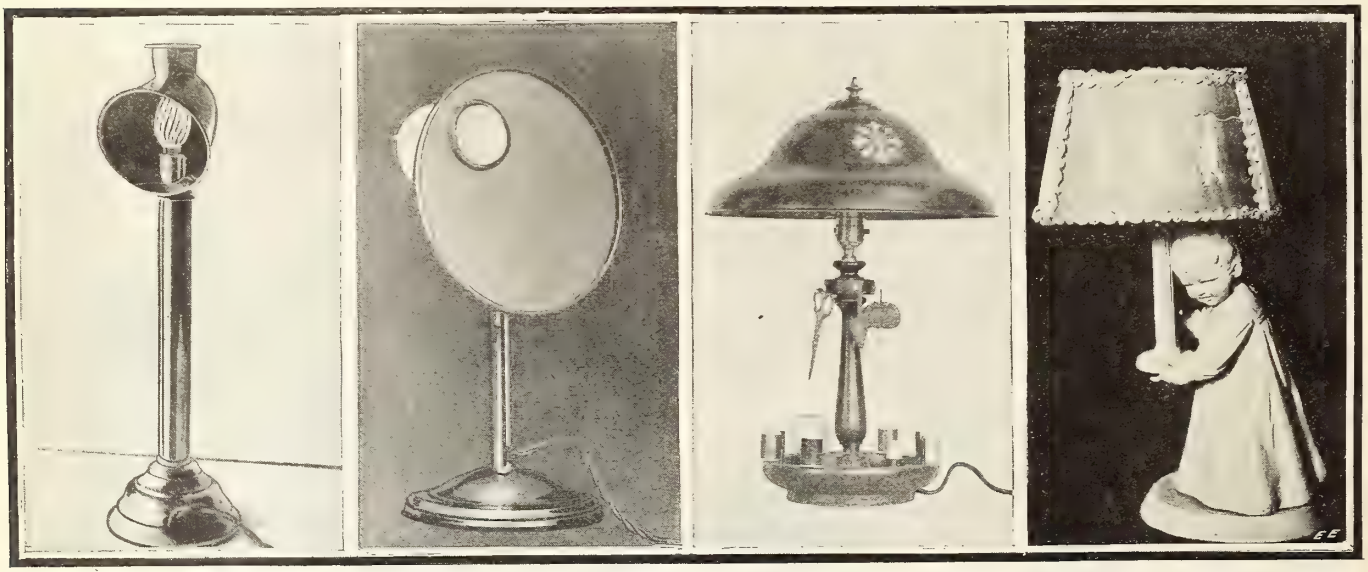
The electrization current was taken off from the secondary terminals by means of two wires, and the regulation electro-therapeutic handles or sponges as used ordinarily were then connected. A rheostat placed in circuit with the microphone regulated the intensity of the primary current.

The vibrations from the microphone interrupt the current of the secondary, and the small continuous shocks received by the muscles naturally reproduce the transformed musical sounds, and one can readily feel all the different variations of the sound.

In his experiments, Mr. Henry has been able to convince himself that all of the musical sounds are transmitted electrically due to the deep and rhythmical electrization of his subjects. The electrization is naturally strong or weak, all depending upon the character of the music. Mr. Henry also found that the intensity is greatest when the music is loudest, but when the musical sounds go above a certain heighth no further sensation is had, as here the currents probably become so rapid that they cannot be felt any longer physiologically.

Mr. Charles Henry also thinks that this original instrument will render great service in psychic medicine.

Unusual Electric Lamps



Here We Have a Nifty Electric Reading Light, Especially Suitable for the Bedside, the Small Reflector of Which Could Be Adjusted to Concentrate the Light Just on a Book, Etc. It is Inexpensive and Constitutes a Great Convenience.

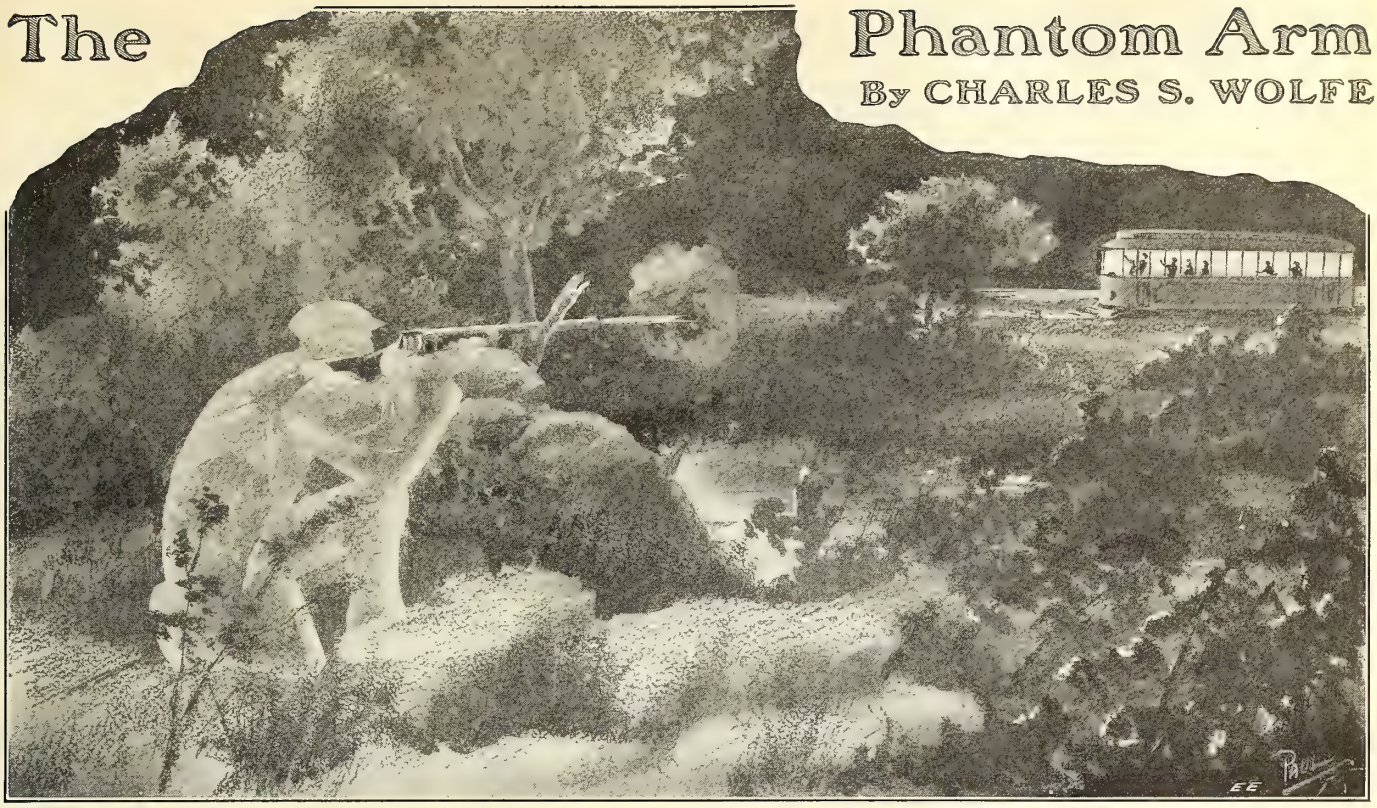
For the Man Who Shaves Himself at Home, There Has Recently Been Brought Out, This Latest Electric Shaving Mirror. A Strong Electric Light Behind the Mirror, Casts Its Rays Thru the Glass Bull's-Eye in the Manner Apparent, Giving a Well Diffused Illumination.

For Mother and the Girls, We Have This Latest Conceit in Electric Lamps—a Sewing Table Lamp. It is Liberally Provided With Hooks and "Catch-Alls" for Holding Spools, Thimbles, Scissors, and All the Other What-Nots to Be Found in the Sewing Room.

And for the Children's Room, We Have This Delightful Little Design of a Small Child Holding the Pedestal of the Lamp, While the Shade is Decorated With the Figures of Little Children. One of the Most Tasteful Bits of Lamp Decoration We Have Seen.

The Phantom Arm

By CHARLES S. WOLFE



"As a Matter of Fact, Coates Had Been Playing Pool Continuously All Evening;—Hadn't Been Out of Sight. The Shot Was Fired About 8:30. Still the Wounded Man Was Certain that Coates Shot Him. Can You Beat That for a Perfect Alibi?"

FENNER and I were seated side by side at the table which held Fenner's wireless set, enjoying a sociable "listen in." Many stations, commercial and amateur, purred and whistled pleasingly in our ears as we browsed up and down the tuner.

Fenner twirled the switch blade over the taps caressingly. I glanced at the profile of his face as he worked. Absorbed in his task, every line in his face relaxed, contentment fairly radiating from him. Fenner hardly looked capable of the things he accomplisht. Things which few dreamed he attempted, things of which I had an inkling since the night I gazed down on the work of the "Educated Harpoon."

To neighbors and friends, a college student in his senior year, dabbler in scientific research. To the police—a mighty useful, and a mighty successful detective.

The clang of a gong sounding right over my head startled me into an involuntary jump. Turning wide-eyed, I found Fenner smiling his amusement.

"Some one has just opened the front gate," he said, quietly. "We are about to have visitors, invited or uninvited, welcome or unwelcome, honest or dishonest, but not unexpected."

Before I could comment on the unusual arrangement, the noise made by some one mounting the stairs rapidly reached us, followed by quick strides along the hall toward us. The door was unceremoniously flung open, and Chief of Police Davidson stood framed in the doorway.

Fenner, apparently unmoved by the dramatic entrance of the head of the city's law enforcing system, grinned amiably. "Welcome to our humble hearth, Chief," he drawled; "Bill, pass our friend an extra pair of 'phones."

"I don't want to listen to any of that stuff," exploded Davidson, irritably; "I'm here to get you to untangle this thing for me."

"Calmly, friend Chief," said the imperturbable Fenner. "What thing? I don't number telepathy among my accomplishments, you know."

Davidson sank into an indicated chair. "Thoughts run ahead of my words," he mumbled gruffly, his way of apologizing. "Mind always full. Bad habit."

"Bad habit is right," gravely assented Fenner. "You know Bill here, I think. Unburden yourself freely."

"I'm completely up against it," confest Davidson. "Right up against a stone wall. Never met anything just like it in my whole career."

"Sounds interesting," murmured Fenner. "Somebody crib the mayor's crown jools, or has some joyous cuss eloped with the auto patrol?"

"There's been a man shot," said Davidson, bluntly.

"Killed?" sighed Fenner. "Murder again, eh? I hate murder cases."

The Chief permitted himself to grin—just a little bit. "Not so fast, young fellow. I didn't say killed, I said shot. He's very much alive, and he's occupying a nice, white bed down in the City Hospital. All he got was a bad flesh wound. But the guy that done the shooting's not to blame for that. He meant well, all right."

"Can't the man furnish any clue to his assailant?" I ventured to horn in.

Davidson actually chuckled. "Clue?" He told us just who he thought did it—and why."

"Then the man you're after has made a remarkable get away and left you up in the air?" queried Fenner.

"Well, not so you could notice it," growled the Chief. "He's down at the Hall right now telephoning for a bondsman."

"Then," said Fenner, politely, "I don't see what has so upset your usually mild and placid disposition."

The chief looked at us both in a sort of a helpless way. "That's the Hell of it," he complained, despairingly. "We've got everything. We've got the motive for the crime, we've got the weapon it was committed with, we've got the guy who simply *must* have done it, but——" He broke off dejectedly. "Well, here's the story, and you can judge for yourself.

"This shooting occurred on the lonely road between the outskirts of the city and Bloomeville, that little village up along the river. The man who was shot is a chap named Johnson. He is a motorman employed by the traction company. He was running his car when he was potted."

Fenner's eyes flickered almost imperceptibly. "Attempted hold up?"

"Nope," said the Chief, decidedly. "Just a grudge being settled. He got the ball right across the bridge of the nose. Talk about your close calls! That fellow shook hands with Death, blindness, and everything else, and got away with it. They got him into the hospital and I took his statement. He says that a few days ago he threw a man off his car because he was drunk and offensive. This fellow threatened to get him. There's about a dozen passengers ready to confirm this. Well, Johnson, it seems, knew the man. His name is Coates. He told me that he was certain that Coates shot at him. We threw out a drag and landed Coates within an hour."

"Yes?" drawled Fenner, as Davidson paused.

"Yes!" shouted the Chief. "Very much yes! We found him in Lowrey's pool room, playing pool with Franklyn, one of my own detectives. And Franklyn swears that Coates had been in that pool room since seven o'clock this evening. So does everybody else in the place. As a matter of fact, Franklyn was off duty, and he and Coates had been playing continuously all evening. Hadn't been out of his sight. The shot was fired about eight thirty. Can you beat that for a perfect alibi?"

"It sounds air tight," admitted Fenner, calmly. "Why not find out if Johnson has been indulging promiscuously in the gentle sport of bouncing intoxicated gentry. Possibly Coates was too busy to shoot him tonight and some rival beat him to it."

(*Continued on page 213*)

Oddities of Sound

By H. WINFIELD SECOR

(Concluded)

HOW THE PHONOGRAPH TALKS.

ASK anyone with a fair knowledge of high school physics how a phonograph talks, and he will tell you the answer in one word, *vibration!* In the language of the classics—

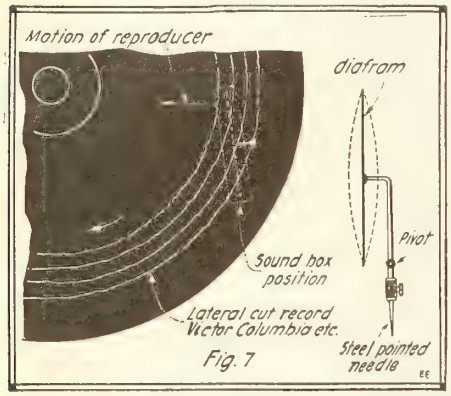


Fig. 7. This Shows How Vibration Gives Rise to "Sound" in the Talking Machine Record. The Record Shown Is the Lateral Cut Such as the Victor Record Embodies. The Undulations of the Grooves on the Record Run Laterally, or Back and Forth, and the Successive Positions of the Diafram Are Shown by the Dotted Lines. These Vibrations in the Diafram Are Transmitted Along Thru the Tone Arm and Out the Amplifying Horn.

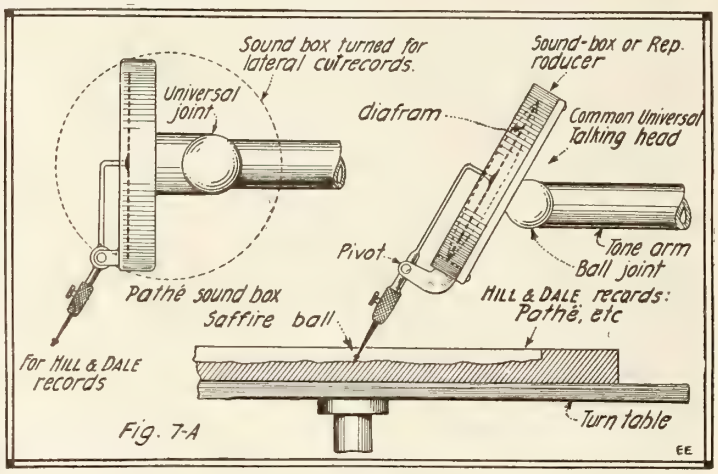


Fig. 7A. Here We Have the Vertical Cut or "Hill and Dale" Record, Such as the Pathé. The Successive Vibrations of the Diafram Are Indicated by the Dotted Lines and the Rise and Fall of the Saffire Ball Is Produced in the Manner Apparent, Which In Turn Causes the Diafram To Be Vibrated To and Fro, and Giving Rise to Sonorous Vibrations or Sound in the Tone Arm.

he "said a mouthful," but the study of phonography is indeed a very profound and complicated one, and in fact we know very little about it yet; altho we are learning more about the artificial reproduction of human speech every day, thanks to the wonderful research work being carried out by such indefatigable research investigators as Prof. Dayton Clarence Miller, of the Case School of Applied Science, Cleveland, O., and the acoustic experts on the staffs of the leading phonograph companies.

Dr. Nikola Tesla was once asked by the writer what he thought of the modern phonographs or talking machine, and his answer was both enlightening and characteristic. He said that the present phonograph was nothing but a very crude mechanical attempt at trying to imitate the human voice, or in other words to reproduce natural speech, and he felt sure that the talking machine of to-morrow would be a very radical and wonderful improvement on what we are pleased to call to-day man's most wonderful acoustic invention.

Inventors are, of course, busily engaged at the present moment, hundreds of them endeavoring to perfect a talking machine which will be free from all artificial sounds and harshness, and it seems certain, without one shade of doubt, that we will never have a perfect talking machine as long as we use any form of scratchy groove and needle arrangement. Not only is this part of the technique of phonography fallacious in its basic conception, but also the crude way in which the sound is reproduced by the diafram is impracticable. This might seem paradoxical, for one might object—is not the diafram sound box of the talking machine equivalent to the human ear? But the answer seems to be that it is *not*, with the accent on the "not"! This is so for a number of technical reasons, and laboratory experiments have proven that it is true that we cannot construct a sound box diafram of a given diameter which is universally suited to the proper and full reproduction of music or speech in all parts of the musical scale.

If you want to reproduce a record such as a bass solo, you need a large diafram. If you have a medium pitch rendition, then you will need a medium sized diafram, and if you have a high pitch selection—such as a tenor or soprano solo—then you will require a small, thin diafram. There has been recently patented an adjustable diafram, the diameter of which can be changed for different selections, but even this does not solve the many diversified problems met with in phonography. Before leaving this interesting subject, however, and its shortcomings—for we are told long and often "how good" the modern phonograph is by the various advertising writers of the respective companies—we might mention that the machine of to-morrow will very possibly be built on a principle similar to that of the *telegraphone,* as pointed out by Dr. Tesla.



Fig. 8. One of the Largest Organ Pipes in the World. This Organ Pipe Vibrates 16 Times per Second by Compressed Air and Is Tuned to Low "C." It Measures 32 Feet Long, and Weighs 1,278 lbs. There Are a Few Organs in the World Having Pipes 64 Feet Long, Which Give Only 8 Vibrations per Second, But Such a Sound Is Hardly To Be Clast as a Musical Tone. The Range of Pitch for the Human Voice in Sound Is from 6 for a Low Bass Voice to About 1,300 for a Very High Soprano. The Piano Has a Range of Pitch from 27.2 to 4,138.4 Vibrations per Second. The Pipe Organ Usually Has 16 for the Lowest Pitch and 4,138 for the Highest Pitch.

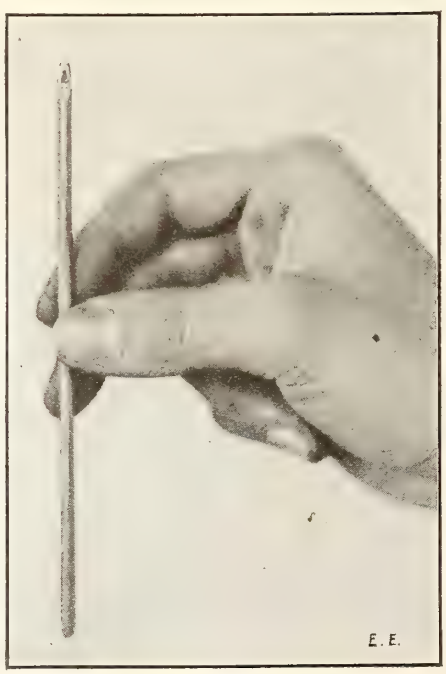


Fig. 9. One of the Smallest Organ Pipes Ever Constructed. The Pipe Itself Appears on the Upper End of the Stem, and Measures ¼" in Length. It Gives 15,600 Vibrations per Second and the Pitch of the Pipe Is B_8.

The telegraphone, invented by Valdemar Poulsen, of Denmark, embodies one of the most perfect principles of speech recording and reproduction ever devised by man, and only requires a little cultivating by some of our acoustic and electrical experts to convert it into a machine which will satisfy our highest aspirations in the production of a perfect talking machine. With the telegraphone you talk into the microphone and the fluctuations in a magnetic field are recorded on a moving steel piano wire, the size of a human hair, or possibly a little larger. To reproduce this speech the piano wire is reversed in its direction thru the machine, passing thru a reproducing coil connected to a telephone receiver. When you listen at the receiver you hear the voice perfectly and beautifully reproduced, but it is low. By the addition of an Audion or other readily available amplifier, this speech could be intensified to any desired strength. Amplifiers cost money and therefore the telegraphone has got to be further improved, i. e., its inherent design

features perfected to make it commercially valuable and acceptable.

The modern phonograph of the present flat disc type reproduces music and speech on the same principle as the first machine devised by Thomas A. Edison. That is, if you talk into a mouth-piece fitted with a diafram, this diafram carrying a stylus will inscribe a certain characteristic mark on a wax or other record. When the action is reversed, that is, when the record carrying this voice impression or groove is moved under a similar stylus fitted to a diafram, the latter will be set into vibration corresponding to the original vibrations of the recording diafram. Thus we obtain speech—after a fashion. The accompanying sketch, Fig. 7, shows the two principal types of flat disc phonograph record now in use, and just how the diafram and stylus reproduces sound from them.

The commonest type of record and reproducer is the *lateral-cut,* such as the Victor or Columbia use. On these records each sound has its characteristic and *different* form of wiggle or groove engraved or molded from the master metal die into the record composition. As the sound box moves over the record, while the latter rotates at about seventy revolutions per minute, the rapid vibration of the needle back and forth vibrates the diafram and causes the sound reproduction as we know it. In the *hill-and-dale record,* such as used by Pathé and other concerns, the groove runs up and down and not sidewise, so far as the irregularities are concerned, as shown in our diagram, Fig. 7. The sound box and the diafram are in this case held above the record in a position at right angles to the direction of rotation, and in the Pathé machine the saffire ball takes the place of the sharp-pointed steel needle used in most machines. This saffire ball point will play 1,000 records without changing, and it rises and falls as the hills and dales pass along beneath it. These rapid vibratory movements are transmitted thru the stylus arm to the mica diafram in the manner apparent.

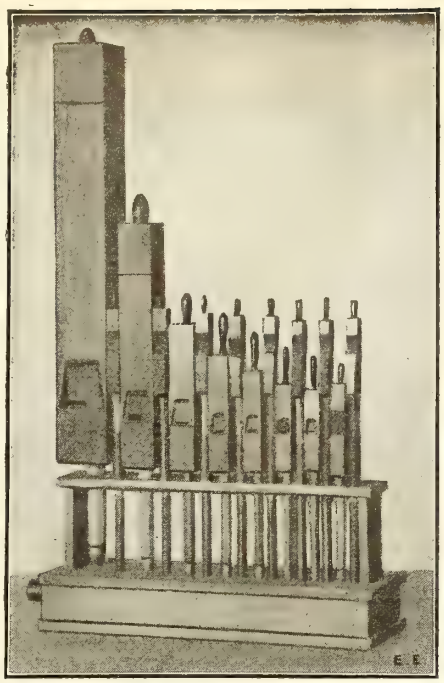


Fig. 10. A Group of Wooden Organ Pipes Which When Sounded Simultaneously, Produce the Vowel a as in "Mat"

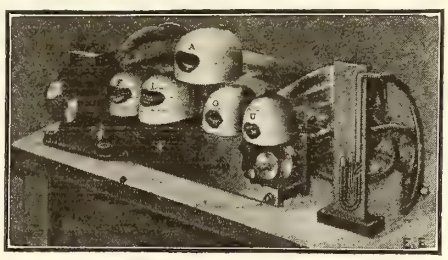


Fig. 11. A Set of Artificial "Mouths" for Emitting the Vowels a, e, i, o, u, by Means of Comprest Air. The Mouths Are Fitted With Artificial Lungs, Comprising a Series of Bellows Driven by an Electric Motor. These Are Used in the Scientific Study of Sound.

"HOLES" IN THE ATMOSPHERE.

A very interesting freak in the physics of sound is that known as "holes" in the atmosphere or vacuum pockets, or at least they appear to be such. It was found quite a number of years ago that when a large fog siren and horns situated along our coastal danger points was blown at a high frequency, a ship would perhaps hear the siren several miles off the coast and all of a sudden "lost it" and did not hear it again until it found itself hard and fast on the rocks but a short distance from the siren station. Much has been written on this subject by experts on sound, and the fact remains that this is a quantity over which man has no control. There seems to be practically no trouble from such freak actions of the atmosphere on radio signals, but these are transmitted thru *ether* and are not affected by air pockets, etc. But it is another question when sound waves such as those which solely rely for their propagation on the condition of the air, etc.

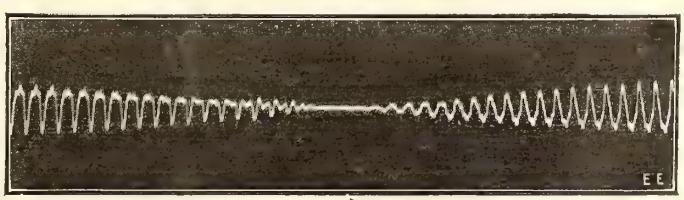


Fig. 12. A Remarkable Grafic Record Made by Prof. Dayton C. Miller of the Bowing of a Violin Showing Clearly the "Reversal" of the Bowing. Many People Have Argued That no Viollnist Can Reverse His Bow But What an Expert Listener or Musician Can Detect It, But This Scientific Record Recorded Photographically, Proves That It Can Be Done, for There Is no Break in the Vibrations.

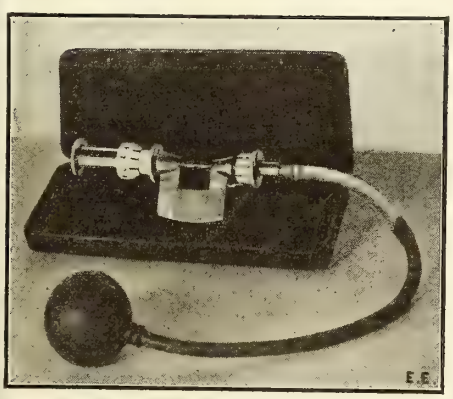


Fig. 13. The Famous "Galton Whistle," One of the Most Interesting Scientific Instruments Used in the Study of Sound. This Whistle Is Blown by Means of Air From a Bulb or Other Source, and by Means of a Micrometer Plug Fitted on the Whistle, the Length of Its Pipe Can Be Changed Accurately and Precisely.

The reason why the fog sirens have not been heard at all times and wrecks caused on account of this effect is claimed to have been due in some instances to peculiar fog disturbances existing between the ship and the siren stations, and as the same phenomenon has occurred in clear weather, it is also thought that some peculiar vacuum or other atmospheric formations have occurred so that the sound from the sirens could not be heard uniformly. The latter day development of the submarine telegraph, whereby signals are transmitted several miles under water by means of a submarine bell, or else by telegraphic dots and dashes, or even speech sounds, is to be highly commended, as these signals are very clearly transmitted thru water, even during storms, and the apparatus is quite rugged and dependable, indeed.

ACOUSTICS IN AUDITORIUMS.

The determination of the acoustic properties of auditoriums is of the very greatest practical importance, and it is also one of the most elusive of problems; the sounds which most interest us are of short duration and they leave no trace, and the conditions affecting the production, the transmission and the perception of sound are extremely complicated, says Professor Miller, in his "Science of Musical Sounds." The difficulties of the work are such as to discourage any but the most skillful and determined investigator. Indeed, the problem has been almost universally considered impossible of solution, and this opinion has been accepted with so much complacence, and even with satisfaction, that it still persists in spite of the fact that a scientific method of determining the acoustic properties of auditoriums has been developt by Professor Wallace C. Sabine, of Harvard University. This method, which is of remarkable practical utility, has been described in architectural and scientific journals. No auditorium, large or small, and no music room, public or private, should be constructed which is not designed in accordance with these principles. Professor Sabine's experiments have shown that the most common defect of auditoriums is due to *"reverberation," a confusion and diffusion of sound thruout the room which obscures portions of speech.* There are other effects, due to echoes, interferences and reflection in general, all of which have to be considered. In many cases these troubles can be remedied, with more or less difficulty in auditoriums already constructed. This is especially true in regard to reverberation which is reduced by the proper use of thick absorbing felt placed on the side walls and ceilings.

A soundboard placed behind the speaker may, in some instances, distribute the sound in such a way as to remedy certain defects as has been shown by the elaborate experiments of Professor Floyd R. Watson, but the more common faults are not removed by this method. An auditorium has been described by Professor Frank P. Whitman, which was practically improved by the use of a soundboard and was later made altogether satisfactory for public speaking upon the removal of reverberation by Sabine's method. The stringing of wires or cords across an auditorium cannot remove acoustical defects.

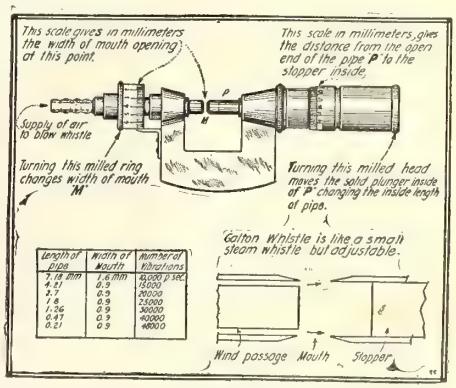


Fig. 14. It Is Very Interesting to Hear This Whistle Gradually Change in Pitch Until It Passes Above the Range of Audibility, About 30,000 Vibrations per Second, the Limit of Audibility for the Average Ear, Altho Some People With Extra Sensitive Ears, Particularly Radio Operators, Can Hear Sounds as High as 35,000 Vibrations or More.

A Gyrocopter That Flies!



Here's the First Vertical Propeller Flying Machine to Actually Get Off the Ground with a Passenger. It Is Known as the Berliner Gyrocopter and Is Driven by an 80 H.P. Le Rhone Motor.

The accompanying illustration shows one of the most remarkable flying machines in the world—it is a picture of the very first gyrocopter, or we might call it a helicopter, to actually fly! To tell the truth, it did not fly very far—that is, not because the machine is not capable of keeping up a sustained flight, but because of the fact that very little is known about flying such a machine, and if the aviator here shown flew very far above the ground—the machine weighing 620 pounds alone—he might break his neck trying to land, for no one has ever yet flown in a gyrocopter type of heavier-than-air machine.

What experience Mr. Henry A. Berliner has had with his new machine, thus far, has borne this fact out, and he has not attempted to fly further than a few yards at a time at a distance of a few feet above the ground. However, there are many other ways of trying out the machine, and further extensive experiments are under way to determine its steering qualities and stability in the air.

It is all very well, as Mr. Berliner has pointed out, for inventors to state that they have had them on the testing table and demonstrated that they could develop tremendous vertical lifting power, but it is altogether a different matter to go up in the air with one of these machines, and perhaps instantly have the propellers stop rotating. No one has ever had this experience, and it must be remembered that the only buoyancy which the usual gyrocopter or helicopter type of machine has, when floating in the air, is that created by the rapidly revolving air, screws or propellers. It seems evident that the only way to make this machine reasonably safe would be to have engines in duplicate, arranged with a quick-acting clutch, so that in case one engine should fail the other could be thrown instantly into action to keep the propellers revolving and thus maintain the normal buoyancy. Otherwise there is some tall risk involved in attempting to fly one of these machines, as it is impossible to gamble your life stakes on any gasoline engine that was ever built. It may stop any minute, and you can't guess when!

In the accompanying photograph is shown the gyrocopter, Henry A. Berliner's new machine, which *when tilted forward will fly horizontally,* the tilting being accomplisht by changing the center of lifting pressure. The weight of this machine is 620 pounds, with a lifting power of 900 pounds. The lifting propellers are 13 feet in diameter and 10 inches in width. It is driven by an 80 H.P. Le Rhone motor. Besides being an independent machine, the system of the gyrocopter could be applied to an airplane and enable the latter to rise from a small area or to descend upon a very small landing field, it is said:

Lecture To Deaf Via Dictagraph

In England recently an interesting lecture was given to a large number of deaf people or those whose hearing was partially affected and who could not very well enjoy a lecture in the regular way. To enable the audience to hear every word clearly, use was made of the well-known supersensitive telephonic apparatus called a *Dictagraph.*

This apparatus comprised a very sensitive microphone which pickt up ordinary speech waves at a distance of several feet.

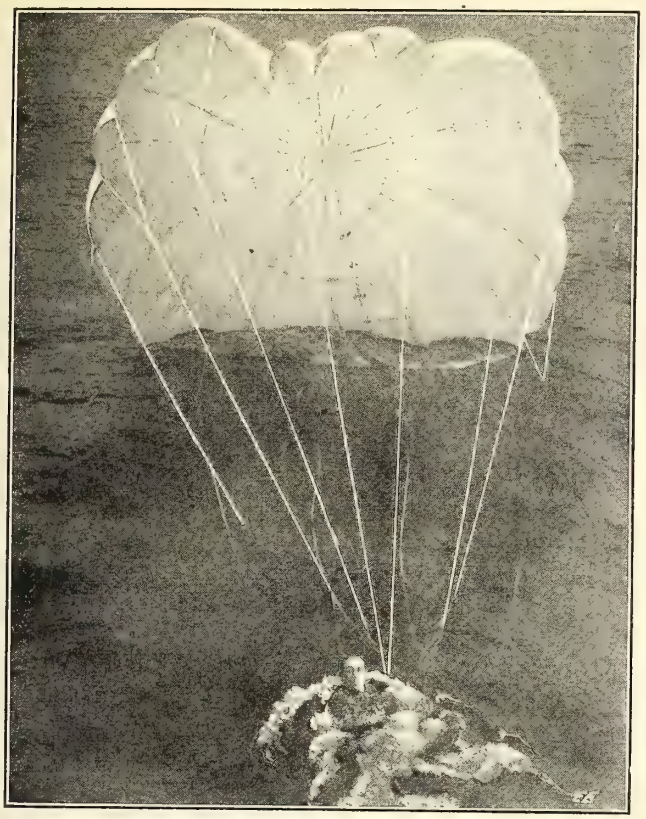
These lectures have become quite *de rigeur* in Europe, and undoubtedly they will come into fashion in America also, as there are many people who cannot hear very well, even tho they possess dictagraphs of their own, as when they do happen to sit fairly close to the lecturer or minister there is still such a great distance separating them that the dictagraph carried on their person cannot operate with the usual high efficiency.

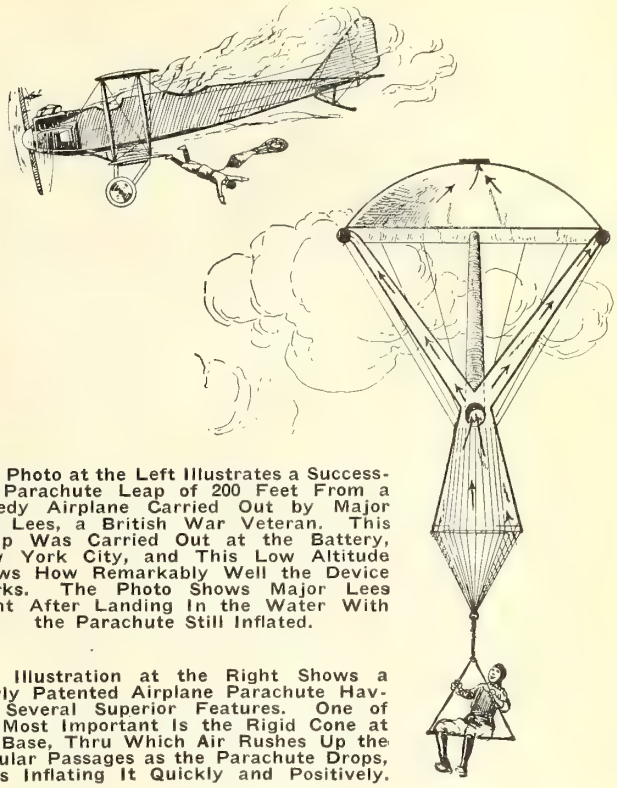
While dwelling on this interesting application of science, to those afflicted with defective hearing, it is interesting to mention that one of the great scientific dreams of the future will be realized on the day when lectures like this can be given and illustrated for the benefit of the blind. This may be accomplisht by developing such an apparatus as that devised by Prof. F. C. Brown, of the State University of Iowa, whereby specially sensitive synthetic selenium cells enable a blind person to read the ordinary printed page, by sound, each letter giving a different sound, in a telephone receiver held to the ear.



A Lecture to the Deaf! The Latest Thing In England Was a Recent Lecture Given to a Number of Deaf People Whose Hearing Was Only Partially Affected, and They Were Able to Hear Every Word Spoken at the Lecture Very Clearly, Thanks to the Highly Sensitive Telephone Transmitter Used in This Apparatus, the "Dictagraph."

Is this Airplane Parachute Practicable?





The Photo at the Left Illustrates a Successful Parachute Leap of 200 Feet From a Speedy Airplane Carried Out by Major Ord Lees, a British War Veteran. This Jump Was Carried Out at the Battery, New York City, and This Low Altitude Shows How Remarkably Well the Device Works. The Photo Shows Major Lees Right After Landing In the Water With the Parachute Still Inflated.

The Illustration at the Right Shows a Newly Patented Airplane Parachute Having Several Superior Features. One of the Most Important Is the Rigid Cone at the Base, Thru Which Air Rushes Up the Circular Passages as the Parachute Drops, Thus Inflating It Quickly and Positively.

MAJOR ORD LEES, late of the Royal Air Force, established a new low altitude jump record with a parachute at New York recently. Major Lee's drop into New York bay from a height of 153 feet near the Statue of Liberty. The previous low record was 157 feet. Experts generally rule that parachute drops at less than a thousand feet are dangerous.

Lt. William McCulloch, of the United States Navy, who was pilot of the NC-3 when it started across the Atlantic, took Major Lees up in a three-passenger Curtiss flying boat. They circled the Statue of Liberty three times and dropt two dummies from a height of 175 feet. The dummies hit the water safely and then Major Lees dropt.

When he left the flying boat he was seated on a trapeze attached to the "Guardian Angel," the name of his parachute. Later he hung from the bar with his knees and as soon as his hands struck the water, he swam out of the way and was picked up again by Lt. McCulloch.

One of the cleverest ideas in airplane parachutes that has yet been suggested is that recently invented and patented by a South Dakota genius, Mr. Knute S. Satre. Mr. Satre, in describing his invention, says among other things that it is a well-known fact that the efficiency of a parachute after it is once opened up can be accurately determined, and that the great trouble in the use of a parachute at all is that it may not always be relied upon to open up; or in other words, to start the opening action at all! He therefore suggests a clever scheme to build a parachute of a quick and sure-opening type, like that illustrated in one of the accompanying views.

The principal feature of the Satre parachute lies in the use of a so-called *charging head*, which is made preferably in the form of an inverted funnel, which has flexible air tubes made out of canvas or other suitable material, which extend therefrom up to the parachute proper. The parachute envelope is provided with a flexible perifer-al tube and the air-charging tubes, extending upward from the charging funnel, admit the air under great velocity to this marginal tube.

As soon as the aviator or balloonist jumps over the side with this parachute in its normal rolled form a powerful initial charge of air is forced up thru the *charging funnel*, which is held diverged or expanded by a metal ring at all times. It will thus be seen that very powerful air currents are forced in thru this charging funnel, and as the parachute descends earthward at a rapid speed, it will be sufficient in any case, so it would seem, to cause the periferal hollow ring surrounding the parachute proper to expand rapidly and positively, thus causing the device to inflate in a very short period and to develop its full buoyancy in a minimum of time.

The main parachute head is provided with a central opening at the top, the size of which may be varied by an adjusting cord placed within the reach of the descending aeronaut. This is claimed by the inventor to increase the stability of the parachute and to decrease its tendency to sway in making its descent.

The inventor claims further that his design of parachute has been demonstrated in actual practise and its efficiency fully proven; and further, that this style of parachute is not subject to any severe vibration while descending.

Plans Trans-Atlantic Airship To Carry 150

Plans for an aerial passenger service which will exceed even the visions of a Jules Verne are being made by the Northern Aerial Syndicate of Great Britain, according to a recent report to the Department of Commerce from Trade Commissioner Henry F. Grady, in London.

Mr. Grady's report says the syndicate is said to be arranging an airship service to New York, the plans providing for craft that will carry 150 passengers in addition to staffs of cooks, stewards, and crew. At Liverpool, passengers from America will be transferred to smaller aircraft and taken to their destinations. Moorings for the large ships, according to the plans, will be provided at leading hotels. The program also provides for a service from England to Perth, Australia, seven days being allowed in the calculations for the trip.

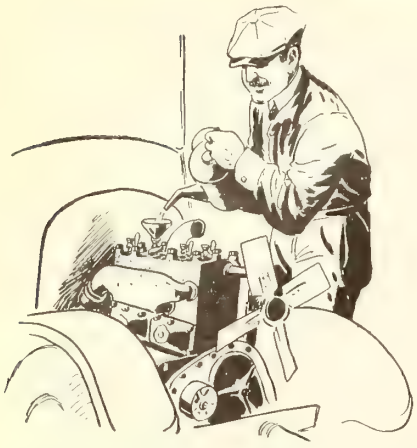
Major W. T. Blake, writing in a London paper, gives the following specifications for what he considers would be ideal aerial cars for pleasure and for commercial purposes. His suggestions for the pleasure cars are:

Length, 22 feet; span, 30 feet; height, 7 feet; engine, 50-horse power, air-cooled, radial; accommodation, two abreast in partially enclosed cabin; top speed, 90 miles an hour; cruising, 75 miles an hour; landing, 40 miles an hour; rising, 40 miles an hour; range, 300 miles; duration, 4 hours; cost, $2,500; upkeep, 24 cents a mile.

His specifications for commercial aircraft are: Length, 45 feet; span, 100 feet; height, 15 feet; engines, two 400-horse power, stationary, water-cooled; passenger accommodations, 20, (plus 2 pilots); top speed, 100 miles an hour; commercial, 90 miles an hour; landing, 45 miles an hour; rising, 50 miles an hour; range, 350 miles; duration, 4 hours; cost, $25,000; upkeep, $1.80 a mile. At present firms are charging $100,000 for a machine of, roughly, those capabilities.

HOW TO KEEP UP A CAR

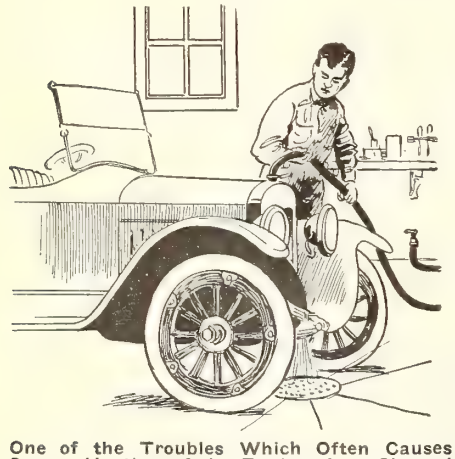
By HAROLD HOLLINGSHEAD



To Keep the Inside of the Motor Free from Carbon, the Valves Should Be Properly Ground, and All Carbon Removed from Inside the Motor, Periodically. A Teacup Full of Kerosene Poured Thru the Pet-cocks Twice a Week, Will Keep the Motor in Good Shape.

SOME people wonder why they are sick when they don't take a bath but once in two weeks, and some people wonder why their car won't run when they don't clean it but once a month, and then never touch the inside of the motor. What we need is not greater motors, but drivers who will study the construction of a car and treat it as tho it were human. As a chauffeur for six years—before I designed a tool of my own—I could drive a car year after year and have very little trouble. There are many mechanics who can repair a car after it is broken, but it takes a good one to keep it from getting broken. There is a great art in handling a car in the right way, and this knowledge is not obtained in one year.

I will state a few technical points which I believe will be profitable to any driver or owner of an automobile. The first one is to keep the inside of a motor *free from carbon.* To start with, this can be done by having the valves properly ground and adjusted, and all carbon burnt out. After this is well done, a teacupful of kerosene put thru the pet cocks twice a week will keep the motor in good shape. After the kerosene is equally distributed thru the various cylinders the motor should be given about ten turns over, either by hand or by using starter. This will soak the entire motor with kerosene. Then apply the switch, giving the motor a medium amount of gas. In cold weather this remedy should be applied after the motor is warmed up or in returning to garage in the evening, otherwise the motor will require some skill to start. After motor is started and gets warmed up, running at a medium speed, open one pet cock at a time, while motor is in operation, and you can notice the fine pieces of carbon coming out. This kerosene can also be applied by using a small oil can, applying the kerosene thru the air adjustment of the carbureter while the motor is warm and running at a medium speed, as it dies down. While kerosene is being applied, keep hand on the throttle of carbureter and increase speed. The reason for using kerosene is that *gasolene makes carbon while kerosene cuts its.*



One of the Troubles Which Often Causes Severe Heating of the Engine, Is a Clogged Water Cooling System. Every Two Weeks, a Stream of Water Should Be Run Thru the Radiator from a Hose, so as to Wash Out All Sediment, Grit and Rust Collected in the Bottom of the Radiator.

$50.00 In Prizes

Beginning with our July issue, we shall print on this page a new automobile department entitled "Automobile Stunts", and we will pay $50.00 in prizes for the three best articles received each month.

A great many of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. Almost every other automobilist some time or other invents a little device or does something to his car to make it better than it was before. "Experimenter" readers want to duplicate these stunts, and that is just what this new department will be for. In other words an exchange of ideas. Note that the idea does not necessarily have to be electrical in any way. You may have a new stunt or trick how to patch a blown tire that was not described before. You may have a new idea how to prevent your spark plugs from carbonizing, and thus short circuiting. You may know of a new stunt how to refill or charge a storage battery. If you have a town car, you may have thought of some simple trick how to signal to your chauffeur, so he will know where you will want to go.

There are hundreds of such ideas, and we will pay $50.00 a month to get them. Of course, we would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. If no photograph can be furnished—altho we would like to have it—a simple sketch will do showing the essential parts, etc.

We will pay the following prizes:

FIRST PRIZE.....$25.00
SECOND PRIZE..... 15.00
THIRD PRIZE..... 10.00

All other accepted articles, which win no prizes will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to "Editor, Automobile Stunts," care of this publication.

The second point is removing the plugs once a week and soaking them in a pail of kerosene overnight, then using a little emery on the points, drying them well, also adjusting all the points accurately to the thickness of a dime, then see that none of the porcelains are broken, which will cause a missing cylinder. Also see that all the porcelains are thoroly tightened by small nuts that are at top of porcelains. After this is done each plug should have a washer, and thoroly tightened in cylinder head.

Most people have trouble with their motor heating up, and it is no wonder when the water that is in the radiator has collected so much rust and grit that it has shut off the circulation of the water thru the various cylinders. This grit is removed by running the front of car over sewer, while motor is in operation. You will find a small outlet plug at the bottom of radiator on all makes of cars, take off cap from radiator water intake and apply hose with running water. Let motor run until water from outlet pipe becomes clear. You can very easily notice the collected rust and grit as it comes out of outlet pipe. Do this while motor is in operation until water becomes clear. This application once in two weeks, together with keeping cooling fan well *oiled* and in perfect running condition, will give you a perfect cooling system. Oil should be drained from crank case once in three months, and new oil applied. The same should be done in transmission and differential cases and these cases should at all times have the proper amount of a good quality of oil and grease. An occasional application of neatsfoot oil to the clutch will keep it in good condition together with keeping the grease cup well filled.



A Good Point to Remember About Spark Plugs Is That They Should Be Removed Once a Week and Soaked in a Pail of Kerosene, Over Night. A Little Emery May Be Used to Clean Up the Spark Points and Also Adjusting Them so That the Spark Gaps Are Equivalent to the Thickness of a Dime. The Porcelain Bushing Should Also Be Carefully Examined for Cracks.

Next the brakes should be properly adjusted and by jacking rear of car up together with running motor in low gear, one man should operate foot brakes back and forth, while another applies kerosene to brake bands. This will remove all grease and grit, and give you perfect action on brakes. If the brake linings are badly worn, and you want to come down a steep hill without relining brakes, apply hose of running water for about five minutes, soaking each brake lining in water. This will expand the brakes and give you quick action for a short time. Keep all parts of machinery oiled, and tires inflated to the proper number of pounds. One drop of oil

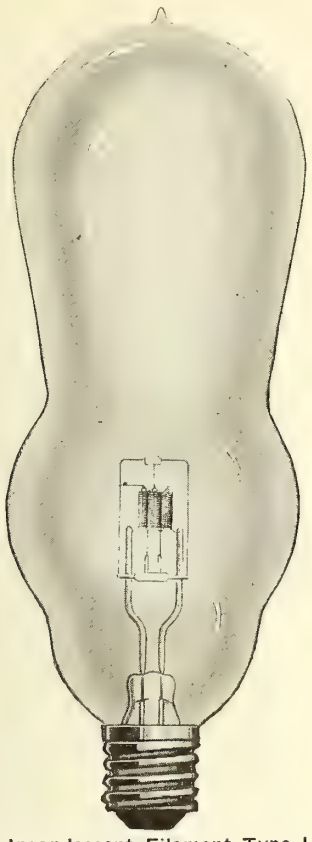
(*Continued on page* 192)



The Top of the Automobile Should Be Watched as Closely as the Other Parts of the Car. A Good Coat of "3 in 1 Oil" Should Be Rubbed in With a Piece of Cheesecloth, Until it is Well Absorbed by the Pantasote.

Curious Movie Lamp

The recent introduction of the gas-filled principle has caused a jump of some seven



The Incandescent Filament Type Lamp Is Rapidly Coming Into Favor for Motion Picture Projectors. The Concentrated Spiral Filament Used Gives as High a Candlepower as the Troublesome Arc. The Lamp is Gas Filled.

fold in the intrinsic brilliancy attainable with tungsten filaments, on a given life basis. The brilliancy of the filament under practical limitations could reasonably be expected to be of the order of 20,000 candle power per sq. in. (30 c.p. per sq. mm.) The crater of the d-c. carbon arc (with cored anode) was well known to have a brilliancy of 84,000 c.p. per sq. in. (130 c.p. per sq. mm.) almost irrespective of the current strength. The a-c. arc was found, as might be expected, to have a lower brilliancy while the limelight showed a brilliancy which was only of the order of 2,000 c.p. per sq. in. (3 c.p. per sq. mm.).

It looked as if the tungsten filament possibilities were quite in the arc class, especially if we could contrive to arrange the filament so as to constitute a light source of extension sufficient for the purpose and averaging up approximately to the brilliancy of the filament considered to detail. When this had been accomplished a trial was made in a projection machine, with results which were very encouraging.

The filaments, which are of thick wire, are wound in helical coils of very small pitch, and the inevitable separations between the coils are taken care of by a systematic arrangement of a concave spherical mirror mounted just behind the lamp. Thus the light source may be viewed in any direction, which is of practical significance; and it will show an almost unbroken assemblage of filament and mirror image. True the mirror image is appreciably less bright than the filament proper, but it should be remembered that much of the surface seen is substantially brighter than a simple tungsten surface at the same temperature. This is due to the high reflectivity of tungsten and what may be called the "perforated" character of the source.

The advantages of the tungsten filament lamp over the arc for motion picture projection are apparently as follows:

Where the a-c. arc is replaced, vastly more uniform screen results are obtained, noise is eliminated and continuous fussing with the light source is avoided.

Where the d-c. arc served by rectified or converted current is replaced there is a considerable gain in uniformity of screen results, the frequent "feeding" is avoided and the auxiliary apparatus is more simple and durable.

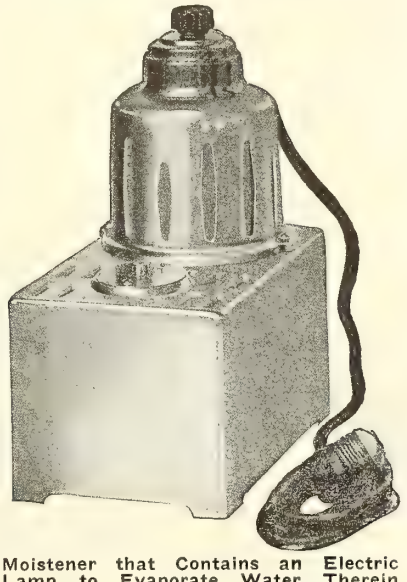
Whatever the style of arc replaced there are further advantages in the markedly reduced running expenses and lower first cost, freedom from cracked condenser trouble, fumes, and the intensely hard dust which comes from electrode cores (and causes film scratching, excessive machine wear and unsanitary conditions).

The color of the light is more nearly what is demanded to-day; the difficulties of the operator are greatly lessened, and the booth is much cooler.

(—Photo Courtesy Illuminating Engineering Society.)

A USEFUL ELECTRIC CIGAR MOISTENER.

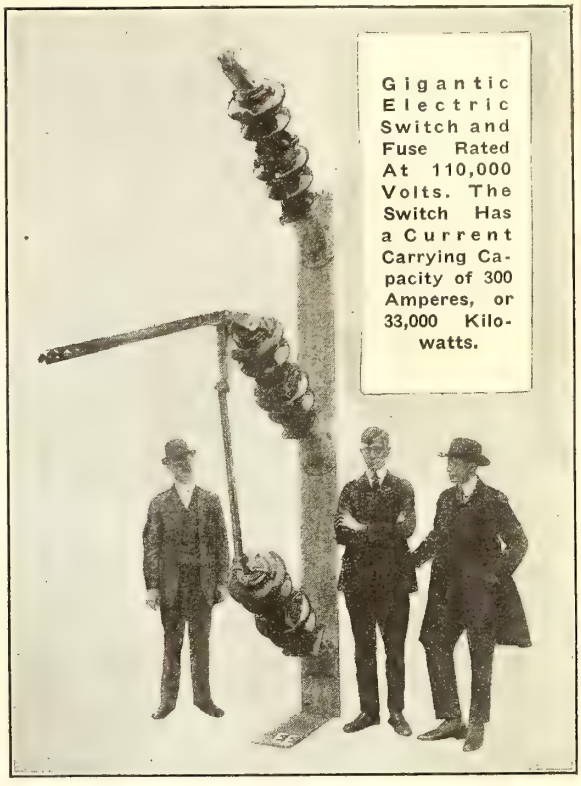
In the accompanying illustration is shown a moistener for use in cabinets and showcases to keep cigars and tobacco in good condition, which depends upon the evaporation of water caused by the burning of an electric light. A 50-watt carbon lamp is mounted in a socket under the dome of the device shown. In the front, a suitable receptacle is provided which contains a small amount of water. When the lamp is burning, the water evaporates and moistens the air uniformly thruout the case. The maker points out that so much moisture is given off when the lamp is in operation that it is only necessary to turn it on occasionally according to requirements.



Moistener that Contains an Electric Lamp to Evaporate Water Therein When Used in Cigar Cabinets.

A Giant Switch

A Chicago electric switch concern has recently designed and constructed several



Gigantic Electric Switch and Fuse Rated At 110,000 Volts. The Switch Has a Current Carrying Capacity of 300 Amperes, or 33,000 Kilowatts.

110,000 volt switching and protective equipments of the style here shown. These equipments consist of a disconnecting switch and fuse upon a common base.

A particular feature of this equipment is the arrangement of the insulating parts. They are made up of two 70,000 volt universal pin insulators stacked one upon top of the other. They are held together by a set of rugged clamps. To the bottom clamp of each insulator a malleable-iron pin is fastened, which is cemented into the pin hole. This type of construction makes an exceedingly strong unit and is far less expensive than a pillar type insulator for the same voltage.

The switch parts proper were made with the double blade type of construction, spring washers being employed to secure proper contacting. The switch was rated at 300 amperes. This unit when in use is mounted in the same position as shown in the cut, that is, with the blade vertical. It measures approximately 12 feet from lower end to top of lock-ring.

USE WIRELESS LAMP

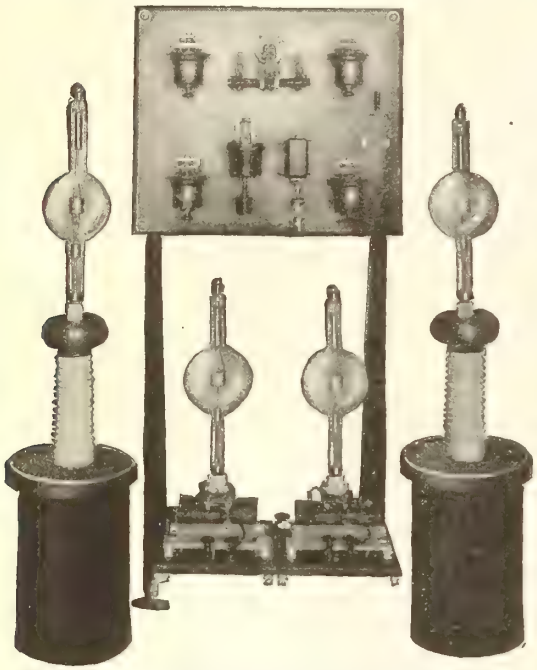
A wireless signal lamp has been devised for various kinds of war work which enables the users to keep up communication under conditions where it would be difficult or impossible to stretch telephone or telegraph wires. A barrage fire, for example, would be no hindrance to signaling by this new apparatus. It can be used between a ground station at the battle front and an airplane a considerable distance away, flying over enemy territory.

Electric light companies in Germany require their lamp trimmers to save scraps of old carbons, which are cemented together for further use.

A nickel-in-the-slot turn-stile has been installed in a New York subway station. If successful they will be adopted in all of the subway stations.

Kenotron Vacuum Rectifiers Stop Smoke

Smoke is one of the outlaws against which modern science has been directing its energies for a considerable time, but it has only been in the past few years that electrical engineers were able to design suitable high tension apparatus with which to precipitate the carbon particles suspended in the hot gases passing up the chimney. The first successful high tension rectifiers used to develop the 100,000 volts direct current required for the purpose were of the commutator type, driven by a synchronous motor in most cases. The high tension current in this class of apparatus is derived from step-up transformers, excited from a low tension alternating current supply.



Switchboard Panel With Protective Devices for Use On Kenotron Precipitation Outfits, With Filament Transformers for Kenotrons.

The latest, highly efficient rectifier for the smoke precipitation process, known as the "Cottrell process," is the *Kenotron* vacuum bulb type here illustrated. This device depends for its operation on the fact that a highly evacuated space containing two metal electrodes, one of which is incandescent and the other cold, possesses a *unilateral conductivity,* current passing thru the tube only when the heated electrode is *negative.* The amount of current which can be rectified by such a device increases rapidly with the temperature of the heated electrode, but remains constant as long as the temperature of the latter is maintained constant.

These characteristics render possible the use of the Kenotron as a rectifier for the production of high-voltage direct-current from an alternating-current source. At present, potentials up to 100,000 volts are secured with standard equipments.

When the Kenotron was first produced several practical applications were predicted for it, and two of these were realized commercially during the past year.

The first of these was in connection with the process of precipitation by means of high voltage direct-current for the reclamation of usable materials in gases or smoke, or the abatement of the nuisance caused by the emission of noxious gases or smoke from flues or stacks. The Kenotron equipment for this service is shown here.

The Kenotron is absolutely noiseless in operation, and the rectification is nearly perfect with maximum voltage fluctuations of less than 15 per cent when delivering *direct current at* 100,000 *volts!*

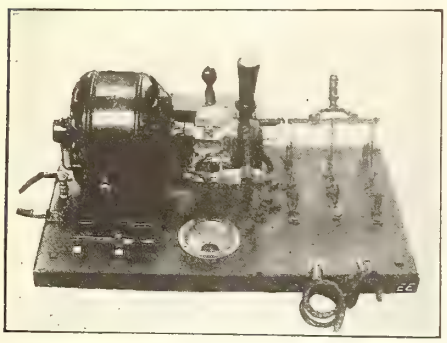


High-Voltage Kenotron, Maximum Voltage 90,000 D-C. On Half-Wave Rectification.

During the past year many installations were made.

New Synchronous Motor Rectifier

It has been found that to obtain the clearest, flickerless motion pictures, the arc should be operated on direct current. In many locations this is not available and recourse must be had to some form of rectifier, motor generator or a rotary converter. All of these are expensive which led to the development of the simple motor-driven rectifier here illustrated. It was perfected by C. J. Quill, of San Francisco.



New Motor-Driven High Capacity Rectifier.

It is said to be a 95 per cent efficient machine which charges your batteries and operates your motion picture machines at low cost. It has no tubes to break and no losses due to low efficiency nor expensive generator outfits. There are no contact points to burn out.

This latest product of science is a rectifier developed on an entirely new principle, consisting of a self-starting synchronous motor using only 75 watts, with a mechanical device for automatically rectifying alternating current for use in arc lights, motion picture machines or battery charging and for other uses of similar character which require direct current.

Different sizes for different classes of work from 10 amperes to 60 amperes are supplied. An auto-transformer regulates the voltage. It is ideal for storage battery recharging.

A NEW ELECTRIC LIGHT DIMMER.

Are you looking for economy in your electric light bills? Then here is a new pull-chain dimming socket which can be used with real economy, because this little attachment makes it possible to turn down electric lights when the full glare is undesirable or not needed, and save a proportionate amount of current.

Think of regulating electric lights, just as gas can be turned, "low or high." Think of the conveniences it affords to soften the lights when desired—to have a small fraction of a candle-power for continuous light in bath and hall, a dim glow in the bedroom or the nursery, a subdued light for cozy corner, fireplace or porch, and at the same time save from 30% to 80% of the full current.

Many electrical men, even experts and engineers, are of the opinion that these dimming attachments are a fake, but actual tests conducted by the U. S. Bureau of Standards, at Washington, D. C., prove that they do save current when the light is dimmed by such means. The following table shows the energy saved by the use of this dimming socket with a 40-watt 109-volt Mazda lamp.

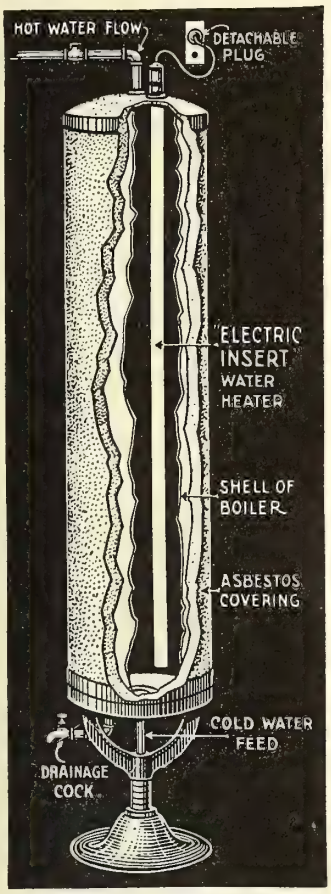


Light Dimming Lamp Socket that Saves Current.

Position	Watts Consumed	Percentage of Saving in Full Watts	Per Cent
1	39.9	100.0	00.0
2	27.7	69.4	30.6
3	10.9	27.3	72.7
4	7.7	19.3	80.7

ELECTRIC INSERT HEATER FOR KITCHEN BOILERS.

On those days in Summer when it is too warm to keep your heating system "going" sufficiently to provide hot water from the boiler; at any time when the heating of water involves distributing heat thruout the house; the *electric insert* water heater performs a service of great convenience at small cost.



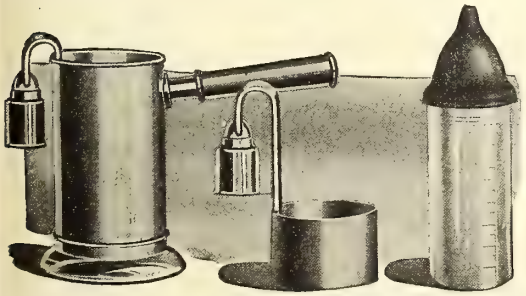
An Efficient Electric Insert Heater for Kitchen Boilers.

This device is an *internal heater,* consequently no heat is lost by radiation, every unit being applied to the heating of water in the tank. It is essentially clean and it is inexpensive in its operation.

This heater is made in several sizes to accommodate a wide range of hot water requirements.

ELECTRIC MILK WARMER A GREAT CONVENIENCE.

The accompanying illustration shows one of the latest electric milk warmers, which should prove a boon to mothers. It consists of a water vessel, a standard eight-ounce Hygeia milk bottle with nipple, a removable immersion type heater, and a detachable connector cord. The complete outfit is well made and neatly finished. The immersion heater connects with a plug and is connected to any lamp or base outlet. It will warm the eight ounces of milk in a few minutes. The container and heating element being separable makes it possible to quickly and thoroly sterilize this apparatus. The electric milk warmer proves one of the greatest conveniences ever provided, especially for cold winter nights, when it is sometimes very inconvenient to heat the milk by other means.

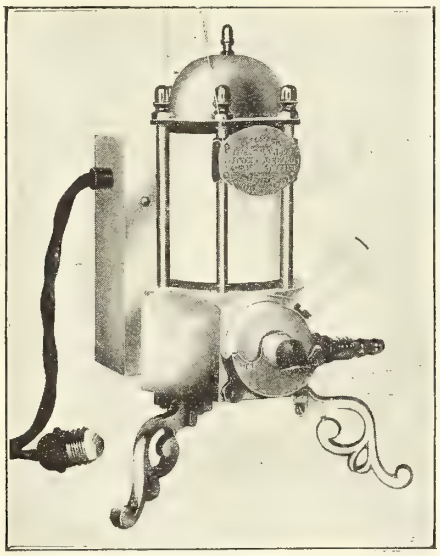


New Electric Milk Warmer, Consisting of a Water Vessel, a Standard 8-Ounce Hygeia Milk Bottle with Nipple and a Removable Immersion Type Heater.

A RAPID ELECTRIC WATER HEATER.

This new electric water heater requires no extra wiring of any kind whatsoever, and can be attached to the ordinary cold water pipe by simply making the connection and screwing the heater on to the cold water pipe.

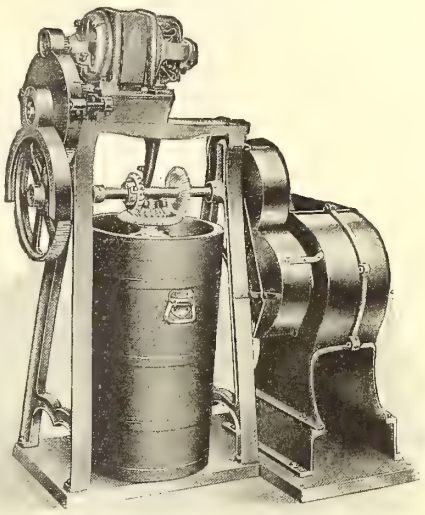
The characteristic feature of this water heater is comprised of a cylindrical body of porcelain, in which are tubular passages from top to bottom; these ducts are connected progressively to each other by porcelain caps placed at top and bottom of cylindrical body. The water to be heated enters the first duct from the house piping (or rubber hose, as desired), to the cylinder in the heater, and passes progressively thru the different ducts, from the last of which it is led to the discharge faucet of the heater. All these ducts are provided with non-corrosive metal coils. These coils are connected in series with each other and the terminals of this group of heating elements are connected by means of a snap switch to the source of the current supply; thus when the water flows thru the porcelain ducts, it passes directly over the heating elements, from which the water is progressively heated.



Instantaneous Electric Water Heater for the Home.

FREEZE ICE CREAM AND BREAK ICE BY MOTOR.

The hot summer days are now with us again, and then the family will want ice cream—but the old back-breaking way of freezing ice cream is not as popular as it was. There's a reason!



Freezing Ice Cream and Breaking Ice by Electric Motor.

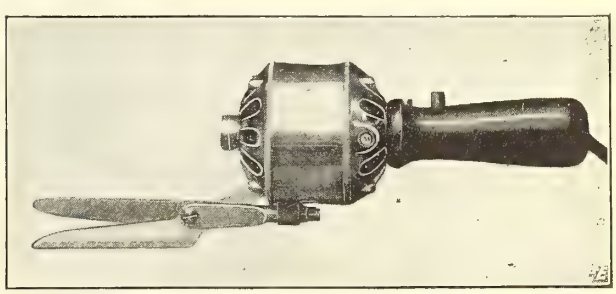
In the accompanying illustration of motor drive arrangement for an ice cream freezer and an ice breaker we have the "reason." Both the freezer and ice breaker are mounted on a solid iron base with a gear drive arrangement which permits the separate operation of either machine. The maker calls attention to the fact that no belts are used and that the outfit is one possessing sanitary features. The freezer has a capacity of 4½ to 10 gallons. An electric motor for operation on an alternating current or direct current circuit is used.

NOW THE "ELECTRIC SHEARS."

There has recently been developed and placed on the market an electric shears or cutting tool which has unique safety and labor-saving features. Several sizes have been developed, all of the hand or portable types are adapted to cutting sheet material from light cloth, netting or silk, up to sheet steel 1/16 inch thick.

The shears is equipt with an up-to-date electric motor of the universal type, adapted to run on either D. C. or A. C. circuits having a normal voltage of 115, which is usual for electric lighting supply.

It has a controlling push button switch in the handle, a separable attachment plug for connection to the ordinary electric lighting socket or a wall receptacle. The flexible cord is seven feet long from the handle to the plug. The shaft of the motor is fitted with an eccentric and connecting link for oscillating or vibrating the upper blade, only, of shears.



The "Electric Shears" the Latest—Cuts Rapidly All Thicknesses of Cloth.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

Of U. S. Naval Observatory.



The Earth as a Magnet

IF a small freely-suspended compass needle is moved over a highly-magnetized *steel sphere*, it will be seen that it constantly changes its position both horizontally and vertically so as to lie always along the "lines of force" of the sphere (as shown in Diagram I).

There will be one point on the sphere which we will call the *North Magnetic Pole* where the *north-seeking* end of the needle will point vertically downward or make a "Dip" of 90° with the tangent plane. At the diametrically opposite point on the sphere, called the *South Magnetic Pole*, the opposite end of the compass, the *south-seeking* end, will point vertically downward; while at a point midway between the magnetic poles of the sphere the needle will lie parallel to the diameter connecting the two poles and there will be no dip.

The total intensity of the magnetic field surrounding the sphere will be found to be greatest in the vicinity of the magnetic poles and least, midway between the poles.

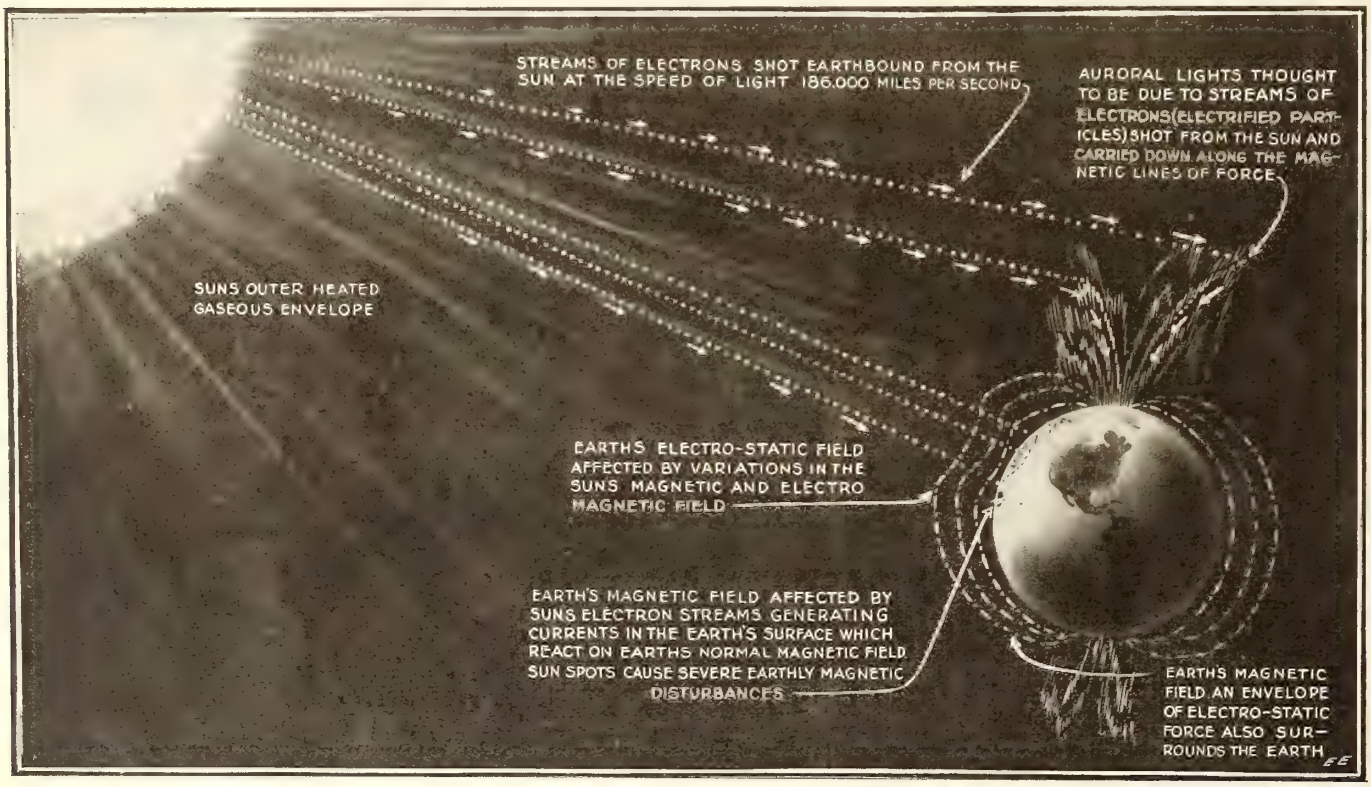
Now, a freely suspended compass needle carried to all parts of the earth will behave very much in the same manner as the needle moved over the magnetized steel sphere. There are two points on the earth's surface, known as the North and South Magnetic Poles, where the needle points vertically downward and approximately midway between is the *Magnetic Equator* where the compass needle places itself in a perfectly horizontal position and the "Dip" of the needle is zero. In other words, the earth acts as a huge magnet and possesses a magnetic field with lines of force converging towards its poles similar to the lines of force of the steel sphere.

There are, however, some very important differences between the sphere of steel and our earth. The matter of which the earth is composed is not homogeneous. It is believed to possess an iron core of considerable size, it is true, but its outer shell is composed of heterogeneous masses that in certain regions cause very appreciable local deflections of the needle. It is surrounded, moreover, by an atmosphere permeated by *electrified particles* of matter shot forth from the sun, which we now know is a still greater magnet, surrounded by a magnetic field that is of the order of 50 gausses at the poles and about eighty times more powerful than that of the earth.

It is now a well establisht fact that the sun's magnetic field exerts a powerful influence over the condition of the earth's magnetic field, and that vast solar disturbances affect very materially the direction and intensity of the lines of force.

It is thus little wonder that this non-homogeneous and rapidly rotating terrestrial globe, surrounded by an electrified atmosphere and subject to the action of a still more powerful magnet, the sun, should not behave in a manner exactly analagous to a uniformly magnetized steel sphere.

The earth's magnetic poles are neither symmetrically placed nor absolutely fixt in position. There is every reason to suspect that they shift about from year to year and possibly fluctuate irregularly in position in the course of a few days or hours under the influence of disturbing forces. The position of the earth's North Magnetic Pole, last visited by Amundsen in 1903, now lies approximately in Latitude 70° N. Longitude 97° W. The position of the South Magnetic Pole as calculated from observations made by Captain Scott in his Antarctic Expedition of 1901-1904 is in Latitude 72° 50′ S. and 153° 45′ E. It is evident, therefore, that the magnetic poles of the earth are not symmetrically placed and that they lie fully 30° from the *geographical* poles. The chord connecting the magnetic poles passes 750 miles from the earth's center and it is about 1200 miles from the geographic pole to the nearest magnetic pole (see diagram). Plainly the earth is not a *uniformly* magnetized sphere. There exist, moreover, in high latitudes local magnetic poles due possibly to heavy local deposits of ore. One such pole was discovered at Cape Treadwell near Juneau, Alaska, by Dr. L. A. Bauer's observations there in 1900 and 1907. In the center of the observing tent at this point the needle

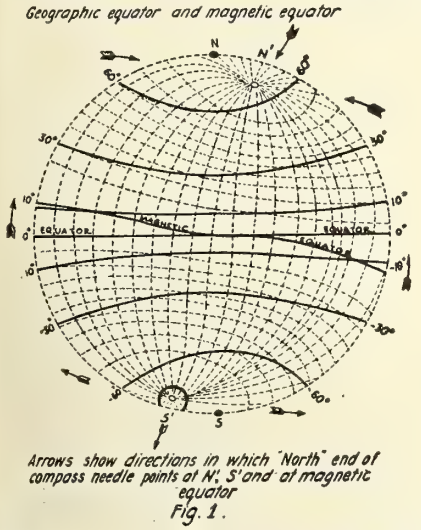


Copyright, 1920, by E. P. Co.

In This Picture of a "Corner of the Universe" We See How the Radiant Electrical Energy of the Sun Is Propagated Thru the Ether In All Directions, and How It May Affect the Magnetic Field As Well As the Electro-static Envelope or Field Surrounding the Earth. When the Charged Electric Particles Strike the Earth, It Is Thought That They Cause Currents To Be Set Up In the Crust and Core Of the Earth As Well As In Its Outer Gaseous Envelope Or Atmosphere As Shown By the Dotted Circular Lines. These Currents When Set Up React To Cause Changes in the Normal Magnetic and Electro-static Fields. It Is Even Thought That the Aurora Borealis Is a Periodical Discharge of Electrified Particles Shot from the Sun, Which Assume Very Fantastic Shapes Which We Know as "Northern Lights", By Following the Lines of the Free Magnetic Field Emanating from the Poles of the Earth As Shown By the Dotted Lines and Arrows in the Present Diagram. The Inset Cut of Ship Is That of a Non-Magnetic Craft Sent Out to Map the Magnetic Variations.

pointed vertically downward and the compass *reversed* its direction when carried from one side of the tent to the other.

It is a well-known fact that there are very few points on the earth's surface where the compass needle points either to the true geographical pole or to the magnetic pole, and if it does chance to do so, it is a transient happening. The "variation of the compass" or the declination of the needle as it is called is the angle that the compass needle makes with the true north and south line or the meridian. It is an angle of greatest importance to navigators and explorers, for it gives them their bearings yet it is unfortunately subject to ceaseless variations of a most complicated nature, since it depends on the constantly pulsating and never ceasing magnetic changes that sweep over the surface of the earth and thru its crust. It is affected by long periods or secular changes, as they are called, progressing more or less regularly in obscure cycles of unknown period. It is subject to a diurnal change that depends on the position of the sun relative to the meridian, and that varies with the



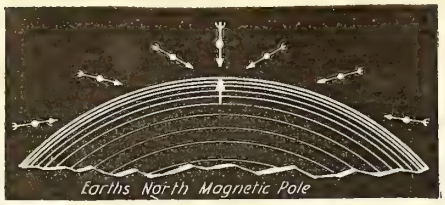
Arrows show directions in which "North" end of compass needle points at N', S' and at magnetic equator

Fig. 1.

Diagram I Showing Geographic Poles of Earth N, S and Magnetic Poles N' S'. This is Duperrey's Chart of the Magnetic Meridians for 1836. The North and South Lines Are the Lines of Horizontal Magnetic Force on the Earth's Surface and Show the Directions in Which the Compass Needle Points. The East and West Lines (Not Numbered) Show the Lines of Equal Dip. The Numbered Lines Are Parallels of Latitude. The arrows Show Directions in Which North End of Compass Needle Points at N' S' and at Magnetic Equator.

seasons and with the hour of the day. It is affected by the sun spot cycle of 11.3 years which has a direct effect upon the intensity of the earth's magnetic field. The intensity of the magnetic field in sun spots is, according to Abbot, sometimes as high as 4,500 gausses or 9,000 times the intensity of the earth's field. At times of maximum spottedness of the sun the intensity of the earth's magnetic field is reduced.

Moreover, when great and rapidly changing spots appear upon the sun, electrified particles are shot forth from the sun with great velocity and in great numbers and are drawn in towards the magnetic poles of the earth. Meeting the rarefied gases of the earth's upper atmosphere, they illuminate them as electric discharges illuminate a vacuum tube. Some of these electrons are absorbed by gases at high elevations, other descend to lower levels. The most penetrating rays have been known to descend to an altitude of twenty-five miles which is about the lowest limit yet found for auroral displays. It is the passage of these rays thru the atmosphere that cause the magnetic disturbances known as *magnetic storms,* that are always associated with the appearance of great sun spots and auroral displays. At such times sudden changes take place in the intensity of the



Showing How the Compass Needle Dips More and More as the Region of the Earth's North Magnetic Pole is Approached.

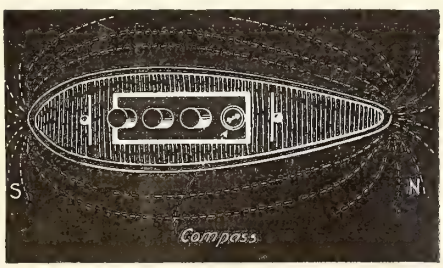
earth's magnetic field that cause the compass needle to shiver and tremble and temporarily lose its directive value. These *magnetic storms* have been known to produce great temporal changes in the intensity of the earth's field. According to Bauer the earth's intensity of magnetization was altered by about one-twentieth or one-thirtieth part by the magnetic storm of September 25, 1909, which was one of the most remarkable on record, and the earth's magnetic condition was below par for fully three months afterwards as a result.

In addition to these various regular and irregular changes in the variation of the compass, or declination of the needle due to changes in the earth's magnetic field *as a whole,* there are local effects due to restricted regional disturbances of the earth's magnetic field or to local deposits of ore or to volcanoes or other local causes. The effect of all these disturbances upon the declination of the needle must be determined by continual magnetic surveys of all portions of the earth's surface.

As a whole the earth's magnetic field is more uniform over the oceans than over the land, with all its disturbing topographical features. Yet this advantage is offset largely in navigation by the fact that every steel ship that sails the seas is a *magnet,* with its two magnetic poles and its neutral line where the two opposite magnetic forces are neutralized, as is the case with every magnet. The direction in which a steel ship lies with reference to the earth's magnetic field while it is being built determines the position of the magnetic poles in its hull and the position of its neutral line and this distribution of magnetism over a ship's hull must be taken account of in the installation of its standard compass. Every piece of horizontal and vertical iron aboard ship has an effect upon the variation of the compass and compensation must be made for such disturbing forces. The direction of sailing, the position in which a ship lies at dock, storms encountered at sea, the firing of batteries (on warships) are some of the factors that are operative in producing changes in the variation of the magnetic compass aboard a ship.

Every ship must undergo at frequent intervals magnetic surveys for the purpose of determining its magnet constants and its "Table of Deviations of the Compass."

The direction in which the compass needle points aboard ship is the *resultant* of the effect of the earth's magnetic field and the magnetic field of the ship, and both fields are subject to continual and complicated variations from year to year, from



Every Steel Ship Has a Magnetic Field of Its Own, and Which Has to Be Checked and Compensated for in Its Effect On the Ship's Compass.

day to day, *and even from hour to hour!*

The elements of the earth's magnetic field are determined for any one epoch by long continued magnetic surveys carried on to a greater or less extent by the various nations of the world and the results are publisht in the form of *magnetic charts* for land and sea showing the values of the three magnetic elements, declination of the needle, dip or inclination and horizontal intensity of the earth's field for a definite period. So rapid are even the long-period changes in the earth's magnetic field that a magnetic chart can be relied upon for only a very few years and fresh data for the construction of these charts that are so valuable to navigators and explorers must be gathered continually.

NON-MAGNETIC SHIP MAKES MAGNETIC SURVEYS.

The *Bureau of Terrestrial Magnetism* of the Carnegie Institute under the directorship of Dr. L. A. Bauer is engaged in con-

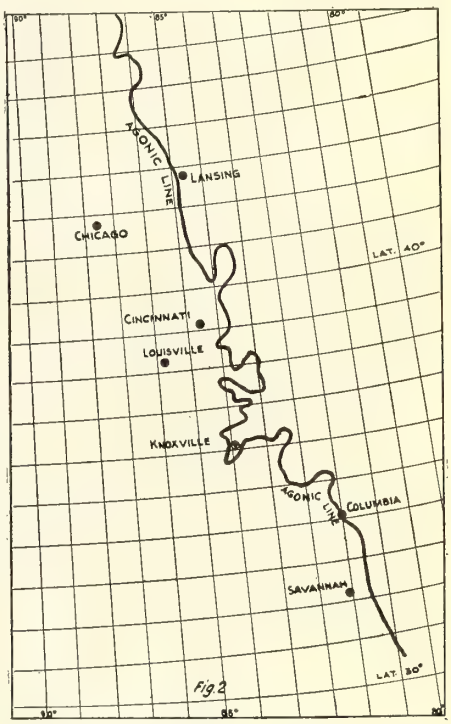
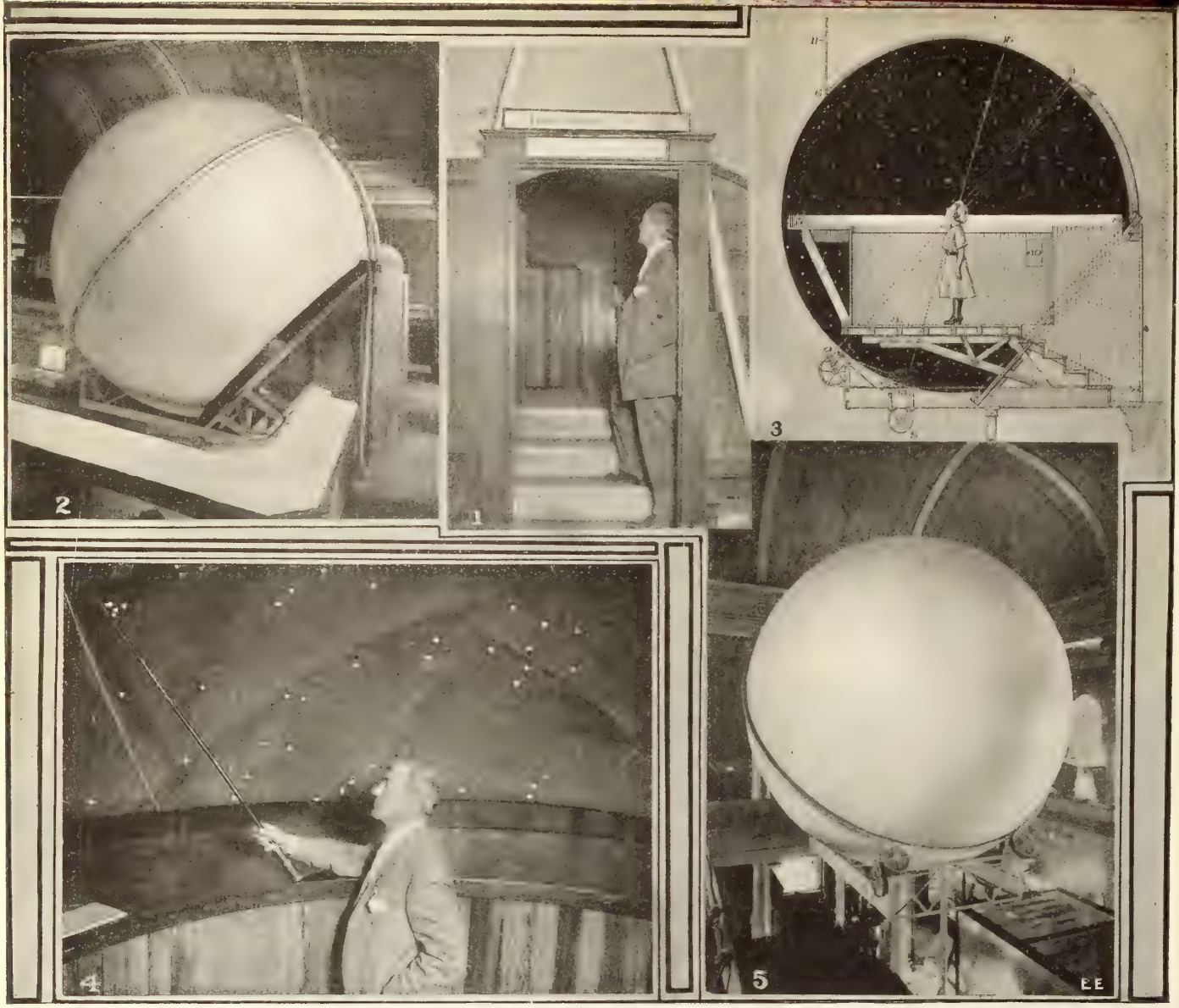


Diagram II Showing the Agonic Line (Line Where Compass Needle Points Due North) in the United States for Year 1905, as Shown by Magnetic Surveys of U. S. Coast and Geodetic Survey. This Line Shifts Slowly From Year to Year.

tinual magnetic surveys of the earth by land and sea that are of the highest value not only to navigators but also to scientists interested in solving the great and mysterious problem of the underlying causes of the earth's magnetism.

To give an idea of the extent and scope of the work of this department it may be mentioned that its non-magnetic ship *"Carnegie"* made in the period 1909-1918 a total run of 189,137 nautical miles, nearly nine times the earth's circumference, with an average day's run of 119 nautical miles. Magnetic observations were made practically every day at distances of 100 to 150 miles apart. In this nine-year period five cruises were made. On her first cruise the *Carnegie* sailed from St. John's, Newfoundland, to Falmouth, England, over practically the same course followed by the famous astronomer, Halley, in the *Paramour Pink* two centuries earlier to determine the variation of the compass. In her fourth voyage the *Carnegie* circumnavigated the world in sub-antarctic regions in

(*Continued on page* 194)



1—Entrance Door to the Celestial Sphere, and Step Leading to Observers' Platform. 2—Side View of the Celestial Sphere. The Black Panel Running Around It at an Angle of 45 Degrees, Represents the South Polar Ring, and Includes That Part of the Sky Which Is Never Visible to an Observer in the Latitude of Chicago. 3—Cross Section View of the Celestial Sphere. 4—Interior of the Celestial Sphere. The Observer's Arm Is Rested on the Horizon Table, Which Corresponds to the Surface of the Earth. 5—The "Miniature Sky" as It Appears in the Chicago Academy of Science, Showing Wheels on Which the Sphere Revolves.

A Miniature "Sky"

By ROBERT H. MOULTON

TO give Chicago people a simple and vivid instrument for studying the heavens, Wallace W. Atwood, secretary of the Chicago Academy of Sciences, has constructed a miniature universe on the inner walls of a fifteen-foot sheet-iron sphere. This big hollow globe, placed in the museum of the academy, exactly and ingeniously depicts all the celestial phenomena regularly visible to Chicago.

The purpose of the Celestial Sphere is to arouse an added interest in the study of *Astronomy,* and by having the first one ever built installed in its museum, the academy has taken a new position among the museums of the world, for it has seemed impossible for such scientific institutions to make exhibits which had practical value in promoting an interest in this science.

All of the stars of the first, second, third and fourth magnitude, and a selected few of the fifth magnitude, are shown in the sphere. The full number of fixt stars thus shown is 692. Included in the exhibit are representations of the sun, the moon, and

A Wonderful 15-Foot Universe with Moving Stars, N'everythin'

four planets, Venus, Jupiter, Mars, and Saturn, all of which are visible to the unaided eye. The *celestial equator* is also clearly marked in the interior of the sphere, and the *ecliptic,* or apparent yearly path of the sun among the stars is also shown.

The impression gained by looking out at night upon a clear sky is that of a hemispherical dome of infinite size, studded with stars. The Celestial Sphere gives a miniature reproduction of this surface which we call the "sky" and in which the stars are commonly supposed to be placed. Necessarily, the sphere is of almost microscopic size, as compared with the universe. If the earth were represented in proportion, it would be an infinitesimal ball located in the center of the sphere, while an observer standing on this ball would be correspondingly tiny.

The earth, as we all know, looks *flat* to anyone standing on its surface, and we can see only one-half of the heavens at one time; the half which lies above the plane bounded by the horizon. The same effect is gained in the Celestial Sphere by providing it with a so-called horizon table, which extends out from the inner surface of the sphere almost to its center, surrounding the observer and lying in the same plane as the center. There is thus exposed to a person standing in the center of the sphere a complete hemisphere, corresponding to the one we see above the surface of the earth, the other hemisphere being hidden by the horizon table, just as the earth conceals the other celestial hemisphere.

Not only is the Atwood Celestial Sphere a perfect pattern of the firmament, but in every other respect, with the possible exception of shooting stars, the idea is carried out in detail. In it the sun, moon and stars rise in the East and pass overhead, following certain definite paths, just as the real stars do in the real sky. Fortunately for the

(*Continued on page* 232)

The Amateur Magician

By JOSEPH H. KRAUS

The Mystic Roulette Wheel

SPRING had come, but very late, it being toward the latter part of May when I decided to take an unannounced trip to Professor Hargrave's home. Generally he was not to be found there, except by appointment, but this time I was willing to risk it.

The butler at Prof. Hargrave's home knew me by this time, so it was unnecessary for him to announce me when I eventually arrived at the Professor's estate. I was ushered into a room which had been changed somewhat since my last visit, and immediately my attention was centered upon a group at a pretty checkerboard-like table. Their attention was riveted to the center of the table where a roulette wheel was merrily spinning. Little had I ever thought or even dreamed that Professor Hargrave's home was used as a decoy to harbor roulette fiends.

Looking around the room in an attempt to find the Professor with his hypnotic smile, I could notice him nowhere, neither was my entrance observed by those at the game. A few minutes later I found myself just as interested in the merry spinning of Dame Fortune's wheel, perhaps even more so than my companions around me; so wishing to be in style, I placed my money on various numbers and took a chance with the rest, sometimes winning, but more often losing!

A few minutes at this and the Professor entered, altho I was not aware of his presence. Patting me on the back, he exclaimed, "So, there you are, old timer, why didn't you announce your coming? You see, now I have nothing ready for you. I cannot show you a thing and am attempting to entertain my guests, so I think you had better stop in tomorrow or perhaps the day following at this hour."

Wondering if this was a polite way of getting rid of me or whether he didn't want to see me lose my money, I answered, "All right, Professor, I will be very glad to see you on the morrow; I guess I will be going now". "Oh, no," he added, "you might just as well stay, now that you are here, and enjoy yourself for the rest of the evening. I did not mean that as a polite retreat." Then leaning over to the roulette wheel, he placed his money on number nine as winner, but much to his apparent dismay, he lost, and continued to do so until he became a very heavy loser. Meanwhile, I had begun to reap the benefits of his and the other guests' losses.

Later as the game progrest, the Professor won one round and then lost two again in succession. After that fate seemed to travel in his direction; every time he played, it seemed as tho the numbers would come out expressly for his benefit; until even I. O. U's were being past around the table.

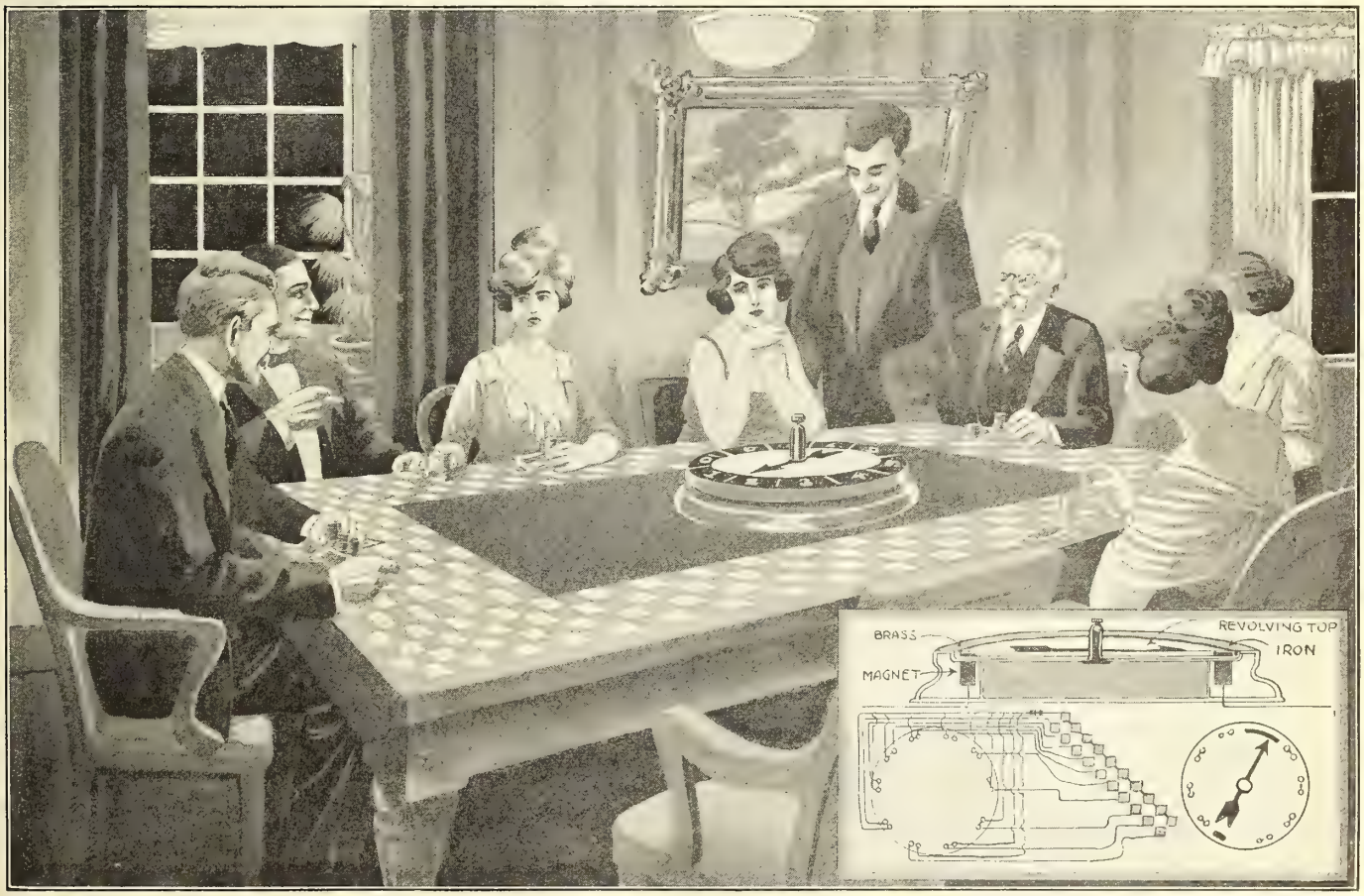
All the good luck which had beset me until this time, suddenly melted and I was only contributing to the popularity of the Professor's coin, heaped high at his corner of the table. At last to break the monotony of the silence which had ensued, the Professor said: "Come, we've had enough of this," and alloted to each one the same sum of money they had at the beginning of the game. We wondered what had happened, open mouthed with amazement, all refusing the money, claiming that he had won it and therefore had a perfect right to keep it, but our requests only fell upon deaf ears.

"You have all been a bunch of fools, dupes, easy victims to a clever contrivance," the Professor began. "Why, that table is faked, and I can make it stop at any number I desire. In order to prove it to you—you see that the disc now is absolutely stationary, yet by wafting a little air, like this, across its surface, (an appropriate movement of his hand reinforced his statement) I can make it move just as I desire."

We were awed by the disc moving, seemingly of its own accord. Immediately, I thought of strings, springs, or electricity, and lifting up the wheel, I examined it carefully, but there were no *two electrical contacts* anywhere similar to those in his other features. Replacing the wheel and spinning it, I requested that he stop it at figure "1." A short time later, when its momentum had died down sufficiently, it came to a stop at the number "1" desired.

On hands and knees, I crept under the fancy table to look for push buttons or other things which might give me a clue as to the operation of the mystic roulette wheel. Not a sign! A rapid scout thru the rooms skirting the one we were in convinct me that there was no external operator. How then could it work? I surely should have known enough of the Professor's apparatus by this time to attempt to see thru the thin veil of disguise which he used to conceal his instruments, but no such luck this time.

(*Continued on page 202*)



The Mysterious Roulette Wheel Kept Professor Hargrave's Guests On the Alert for Many Hours. Finally, After they Had All Lost Their Piles of Gold He Explained How He Could Stop the Wheel At Any Point Desired and Then . . . Returned Their Money.

The Secret of the Magnet Poles

By WALTER E. KEEVER

"UNLIKE poles attract; like poles repel." So reads the first law of magnetism—and the ordinances of the Medes and Persians were unstable compared with the laws of Nature. However, a few experiments with permanent magnets will arouse serious doubts in the investigator's mind, until he solves the mystery to the triumph of the law, when the letter will be more firmly fixed in mind than before it was seemingly violated.

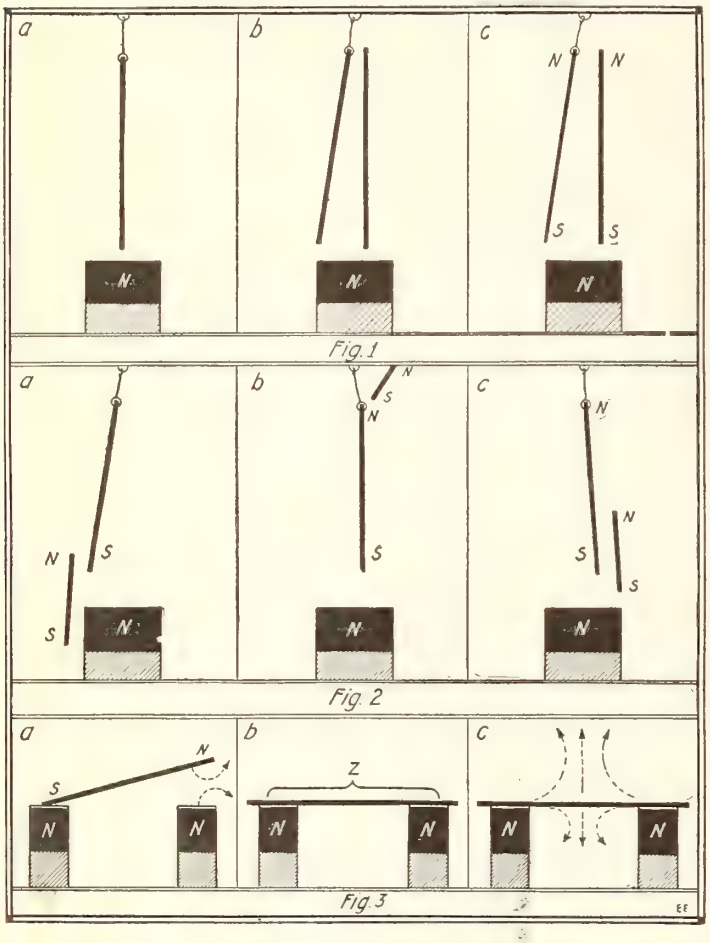
Take a piece of soft iron wire about four inches long and fasten one end with a thread to an upright, allowing the free end of the wire to reach within one-quarter inch of the N-pole, say, of a strong permanent magnet. The wire is now floating in a magnetic field (fig. 1, a). Now take another piece of soft iron wire and hold it parallel to the floating wire; one end close to, but not touching, the exciting magnet. When the wire you hold is moved toward the floating wire, the latter is repelled (fig. 1, b). In picking up iron filings or tacks with a magnet you have learned to expect mutual attraction between the induced particles, yet here is repulsion between two soft iron wires influenced by the same pole.

No, the law is not violated. As shown in (c), fig. 1, *like poles are induced* in the two parallel wires; and "like poles repel." Very well. Next, hold the free wire in position shown in fig. 2 (a). The floating wire is now *attracted*. How can this be, when we have just proved that two wires attracted by the same pole repel each other? Note polarity. S-polarity is induced in the end of a soft iron wire brought near the N-pole of a magnet, or N-polarity if brought near the S-pole. When polarity of either kind is induced in one end, opposite

Laws of Motion Applied to Magnetism—

polarity simultaneously appears at the other end. Trace the induced polarities shown in fig. 2 (a), and, bearing in mind that "unlike poles attract," the reason for attraction in this case is apparent. Once more the law is upheld. In (b) and (c), fig. 2, other instances of attraction are shown, illustrating the "sticking together" of small objects picked up by a magnet. In (b) the free wire is magnetized *through* the floating wire; in (c), partly through the floating wire and in part directly from the exciting magnet.

Our next experiment requires two permanent magnets, for convenience, though one with a double branched pole-piece would serve. Lay one end of a soft iron strip on one N-pole. It sticks. Approach the other end of the iron piece with another N-pole; you would naturally expect the strip to be repelled. Well, it is—"to a certain extent," as Professor Fox used to say when not desiring to commit himself irrevocably. The condition is shown in fig. 3 (a), with polarities indicated. Broken arrows illustrate opposition of the magnetic forces. But when the free end of the iron strip is pressed down close to the second N-pole, at a certain critical point repulsion is *changed to attraction,* and in a trice we have *both* ends of the strip sticking fast to N-poles! (Fig. 3, b.) Now where is your law of like polarities? Aha! A mutual S-pole induced at the middle of the strip? Not so. *Test with a compass and the iron strip is found to possess N-polarity throughout.* Diagram (c), fig. 3, shows what has occurred—the strip has become a hub, from which the lines of force radiate like the spokes of a wheel, seeking S-polarity at the far ends of the permanent magnets. The mechanical principles involved will be dealt with further along in this article.



"Unlike Magnet Poles Attract; Like Poles Repel" — So Reads the First Law of Magnetism, and Several Interesting Variations of This Law Are Here Exemplified. What Is This Magnetism Anyhow? Magnetism Is Undoubtedly a Resultant of Continuous Ether-Movement; There May Even Be a Progressive Movement Outward, But the Author Believes This Flow Is Only a Consequence, More in the Nature of an Electric Current, and Not a Constituent Principle. Magnetism Is the Contraction Upon Its Axis of the Ether Vortex. This Article Opens Up a New Avenue of Reasoning As to the Real "What Is It?" of Magnetism.

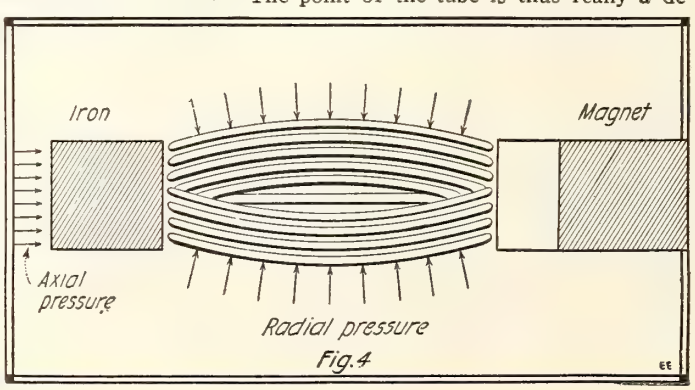
What *is* this magnetism, anyhow? Conventional representations indicate streams or trains of ether-corpuscles issuing from the N-pole, circling around and re-entering the magnet of the S-pole—each stream a "line of force." Magnetism is undoubtedly a resultant of continuous ether-movement; there may even be a progressive movement outward, but in the writer's opinion this flow is only a consequence, more in the nature of an electric current, and not a constituent principle. Hear ye:

MAGNETISM IS THE CONTRACTION UPON ITS AXIS, OF THE ETHER VORTEX. The free ether in its normal, static condition, is very much like an exceedingly dense monatomic gas, whose particles are vibrating rapidly in all directions—a condition of repulsion or expansion. This condition is continually subject to local modifications due to solar rays, wind-friction, evaporation and condensation of moisture, etc., but it always exists between electrons free to vibrate. Discordant vibration is always repellent. Now, in the pores of magnetic substances like iron, there is no room for sustained vibratory motion, but there are narrow channels permitting circular motion. So the ether corpuscles lose their reputation, "join hands around," and go circling in rings.

Weak magnetism can be regarded as relatively few vortices; when there is one vortex-tube for each channel the iron is said to be "saturated" and its magnetic strength cannot be increased except by cooling (suppressing vibration of molecules), which allows greater freedom to the vortices.

Let us consider one unit vortex, as typical of the whole. In union there is strength: aggregate mass of its component rings gives the vortex tube such momentum that its effect extends some distance from the end of the iron channel. Farther from the iron, resistance of the free ether retards the whirl; the tube shrinks in diameter, tapering to a point; while *friction between succeeding rings* (due to retardation) causes a slight progression on the axis. The point of the tube is thus really a de-

In the Case of the Ether-Vortex, Centrifugal Force Counteracts the Pressure Upon the Radius, While at the Ends or Poles There Is No Centrifugal Force; Therefore the Ether Vacuum Can Be Closed Up Only By Shortening the Expanded Vortex Tubes.



creasing spiral, disappearing where centrifugal force becomes too feeble to resist the battering of the "free electrons."

The projecting vortices thus vanish "in thin air." But let a piece of soft iron be brought within their field and the "lines of force" find allies in the enclosed electrons, which join the whirls, further increasing momentum. With flywheels at each end, so to speak, the vortex tubes reach across the gap without deminution. Centrifugal force, limited in the rigid confines of the iron channels but free to act in the gap, causes the bridging tubes to expand against the elastic pressure of the surrounding ether, creating an *ether-vacuum* within the tubes. Nature "abhors a vacuum"—or, in other words, a container deprived of any part of its equalizing internal pressure tends to collapse under external pressure. In the case of the ether-vortex, centrifugal force counteracts the pressure upon the radius, while at the ends or *poles* there is no centrifugal force; therefore the vacuum can be closed up only by *shortening* the expanded tubes. (Fig. 4.) The metal pieces at each end of the tubes are thus *forced* together, not "attracted."

Wherefore we repeat, magnetism is the contraction upon its axis, of the ether-vortex.

Polarity is very easily explained under this conception: it signifies simply *direction of rotation.* Take a piece of flexible rubber hose and consider it an ether-vortex. Have a friend rotate the tube in one direction while holding it horizontal. Face one end and you see it turning, say, right-hand or clockwise: call this the S-pole. Go around and look at the N-pole and you find it turning left-hand. It is the point of view that has changed—the tube is still rotating in the same direction as before.

Now take up a tube similar to the first; hold it parallel to the other, and rotate it in the same direction. The N- and S-poles of the two tubes are adjacent—like poles side by side. When the two rotating tubes are prest together, friction is felt. Two wheels revolving in the *same* direction *repel* each other when brought rim to rim (Fig. 5, a).

Join the S-pole of one tube with the N-pole of the other (Fig. 5, b). *No friction* results, because both are revolving in the *same* direction at the *same* speed. But when one of the tubes is turned end for end, and its N-pole placed against the N-pole of the other tube (Fig. 5, c), friction is experienced, because the two N-poles are now revolving in relatively *opposite* directions. (In performing these experiments the two tubes must be kept rotating in the original direction—both of them either right-hand or left-hand as at first.)

Bend one tube until its ends meet; the direction of rotation is the same for the two ends. Here is a "closed magnetic circuit," or a *closed vortex,* which contracts upon its axis by contraction of the circuit.

From the foregoing it will be seen that when two magnetic "like" poles are brought together the vortices are rotating in relatively opposite directions, causing friction; and when "unlike" poles are joined the vortices are revolving in the same direction, causing *no* friction. Let us see how these mechanical principles agree with the law of polarities. The analogy of the rotating rubber tubes of Fig. 5 is sufficiently clear as regards the experiments illustrated in diagrams 1 and 2. For the mechanical equivalent of Fig. 3, c observe Fig. 6, wherein one pair of the spoke-like lines of force is represented (exaggerated) as typical of the whole. The outer ends of all adjacent tubes rotate in the *same direction*—in this case the N-pole direction (as seen when facing the N-pole). Note rim-friction of adjacent tubes rotating in the same diretcion, causing a tendency for the tubes to spread apart, as becomes clear.

Polarity Is Very Easily Explained Under the "Direction of Rotation" Conception, Shown in Fig. 5. Two Rotating Tubes Are Used to Illustrate This Phase of Magnetism in a Practical Sense. Two Wheels Revolving in the Same Direction Repel Each Other When Brought Rim to Rim, Both Tubes Revolving In the Same Direction Give No Friction Between Them — the Same as North and South Polarity on Two Magnet Poles.

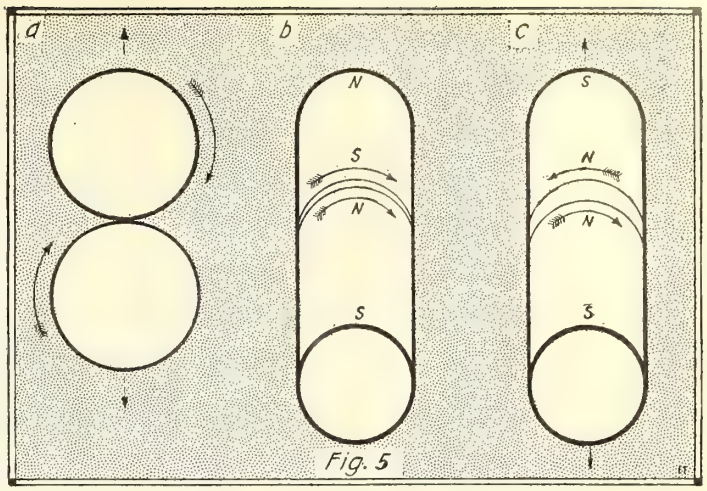


Fig. 5

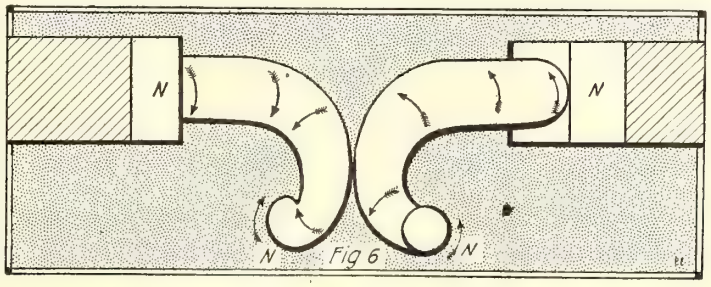


Fig 6

The Mechanical Equivalent of the Magnetic Phenomenon Shown in Figure 3 Is Illustrated Herewith. Note the Rim Friction of Adjacent Tubes Rotating in the Same Direction, Causing a Tendency for Tubes or Vortices to Spread Apart.

It is easily understood how collisions or glancing blows between particles cause repulsion, but how *lack* of friction permits so-called attraction requires some explanation. Here is the startling answer: THERE IS NO SUCH THING AS ATTRACTION IN THE UNIVERSE. What appears to be attraction is merely the removal, decrease or lack of compensating pressure between the seemingly attracted objects, permitting the constant pressure from without to *force* the two objects together and close up the *vacuum.*

Several other physical laws tend to operate upon these vortices, these lines or tubes of force extending out from a magnet. As observed, rim-friction of the parallel tubes rotating in the same direction tends to spread the tubes apart. Opposed to this spreading is fixity of the axis of rotation.* Due to inertia, a body set in motion resists any change in its direction; in a whirling mass this effect is resolved into planestability, or fixity of axis, strikingly manifested by the gyroscope.

Another effect, hardly so well known, is *precession.* When either pole of a spinning gyroscope (spinning in vertical plane, say) is prest down, the gyroscope seeks to turn at *right angles* to the disturbing force, so as to bring the descending side of its rim into the former position of the deprest pole. If the same pole is prest upward, the *ascending* side of the rim is brought around. This turning at right angles is called the *precession* of the gyroscope (Fig. 7). Precession is also a property of the magnetic vortex, which, mechanically considered, is simply a tubular gyroscope.

Applying this theory to the dynamo (Fig. 8), may we not say that as the lines of force are dragged out of their axis of rotation by the sweep of the armature, precession turns them at right angles, impressing the vortices upon the armature wires as a spiral with both rotation and progression — an electric current!

* Note.—But for this stiffness of the tubes, magnetic repulsion would be imperceptible. It is much weaker than contraction upon the axis.

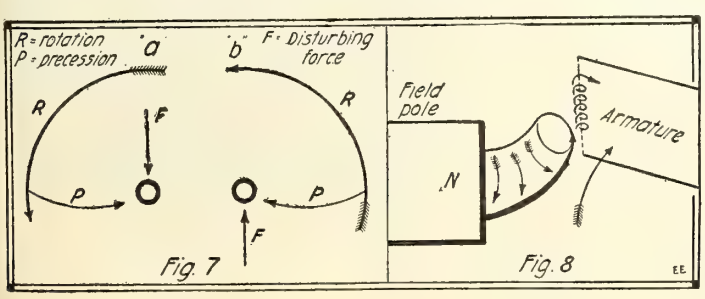


Fig. 7 Fig. 8

In These Two Diagrams the Author Attempts to Show the Comparison Between the Right Angle Forces of Precession Exhibited by a Spinning Gyroscope, and Those Occurring in the Magnetic Field of a Dynamo When an Armature Cuts Thru This Field.

MAGNETIC METALS.

In the October issue of the *Electrical Experimenter* appeared a brief description, contributed by Mr. H. J. Gray, of a non-ferrous magnetic alloy. Mr. Gray gives the composition: 60% copper, 26% manganese, 14% aluminum.

The only simple metals possessing more than mere traces of magnetic property are iron, nickel and cobalt. The atomic weight of iron is 55.8, nickel 58.7, cobalt 59.0. No non-magnetic elements have atomic weights within this range. The nearest metal is manganese (54.9) and this, as Mr. Gray said, is feebly magnetic. Here, then, are narrow limits within which no element is non-magnetic and without which none is magnetic. Surely this is no mere coincidence.

Of course the magnetic alloy has no true atomic weight. A figure representing an *average* atomic weight if I may use the expression, may be easily derived by simply multiplying the atomic weight of each constituent by its percentage and adding. Thus:

Copper	60% :	63.6 × .60	= 38.2
Manganese	26% :	54.9 × .26	= 14.3
Aluminum	14% :	27.1 × .14	= 3.8
"atomic weight":			56.3

DAVID CLARKE COX, M.A.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

EXAMINATION OF WATER.

WATER is the universal solvent. It dissolves more substances than any other one liquid. Therefore, water is never free from dissolved mineral and organic matter. Even rain water contains gases washed

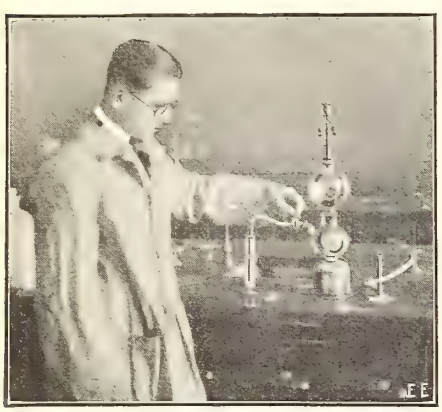


Detecting the Presence of Lead by Passing Hydrogen Sulfid Gas into a Concentrated Sample of the Water.

from the atmosphere, as it descends, and if it has fallen upon roofs, it will also be discolored from other substances in solution. But for industrial purposes, water must be free from many objectional compounds. Thus, iron in any form is very bad for dyeing, tanning, paper making, bleacheries and laundries. Hard water cannot be used in laundries, without softening, and is the chief cause of boiler scale. Highly colored water is objectionable in the textile industries. Chlorides are harmful in sugar refining and in the tanning of leather. And the list might be extended, for there is scarcely an industry that does not have its special requirements for the water that it uses. It will be seen, however, that the chemical examination of water with a view to determining its fitness for industrial purposes is a matter of great practical importance. It is also a matter of great commercial importance to determine methods of purifying water and to design plants for this purpose.

REMOVAL OF COLORING MATTER.

Water is frequently highly colored from having past thru peat beds or masses of decaying vegetation. Such water, however,



Preparing a Sample of Temporarily Hard Water by Passing Carbon Dioxid Gas from a Kipp Generator into Limewater.

never comes from great depths, for if it did such coloring matter would be removed by natural filtration. And this fact suggests a means of removing the color substances. For this purpose sand filters are in common use. They are called mechanical filters and contain a bed of sand mixed with lime and alum, thru which the water is forced under pressure.

To learn the action of such a filter prepare a dilute solution of "alum" by dissolving 20 grams of aluminum sulphate in a liter of water. Also have at hand limewater, made by shaking slaked lime with water in a stoppered bottle and allowing it to stand for several hours. Pour off the clear solution. Now to one-sixth of a test tube of the alum solution add twice that volume of limewater, warm gently and note the white gelatinous precipitate that forms. The precipitate may be formed in greater quantity by substituting ammonia water for the limewater.

To show the effect of this precipitate of aluminum hydroxide on coloring matter prepare solutions of logwood or alizarin. Then to one-sixth of a test tube of aluminum sulphate solution add some ammonia water and follow it with a little of either the logwood or alizarin solutions. Shake the contents and set the test tube aside. After it has stood for an hour, examine it again and you will find that the coloring matter has been carried entirely to the bottom, forming what dyers call a "lake". See Fig. 1. In just this same way the alum and lime in a mechanical filter unite to form the gelatinous precipitate aluminum hydroxid, which removes any organic coloring matter.

MAKING A SAND FILTER.

A sand filter that will illustrate this beautifully may be easily made as follows: Obtain a large jar of several gallons capacity, preferably of glass, altho an earthenware jar will be perfectly satisfactory. In the bottom of this jar place 9 small inverted beakers of about 150 cc. capacity to serve as supports. See Fig. 2. Over these beakers fit a piece of fairly fine iron wire gauze, or better still, copper gauze. Cover the gauze with filter paper. Before introducing the sand, bend a large sized glass tube into the shape of a siphon by softening in the flame of a fish-tail burner and bending in the usual way. On the outer end of this, place a short piece of rubber tubing and a pinch cock. Thru a previously made hole in the gauze insert the short arm of the siphon, and it should reach to the bottom of the jar.

Now put in a layer of sand and sprinkle over it a small quantity of slaked lime, mixed with pulverized alum. Continue this procedure until the jar has been filled within two inches of the top. Then pour enough water thru the filter to wash it out well, drawing it off with the siphon. Next prepare a gallon of colored water by dissolving a little of some soluble dyestuff, as alizarin or magenta, in it. Pour this thru the filter and you will find that the color has been completely removed. This makes a very striking demonstration.

Another Method of Removing Color: Set up a distilling apparatus similar to that used in the distillation of alcohol and place in the boiling flask a dilute solution of copper sulfate. Upon distilling this the deep blue copper sulfate will be left behind and the water will come over pure and clear. If it were not so expensive this would be the ideal method of purifying all water.

Removing Sediment: Natural water very frequently contains large amounts of solid matter held in suspension. To remove this by natural settling would take a long time. But the same substance that removes color-



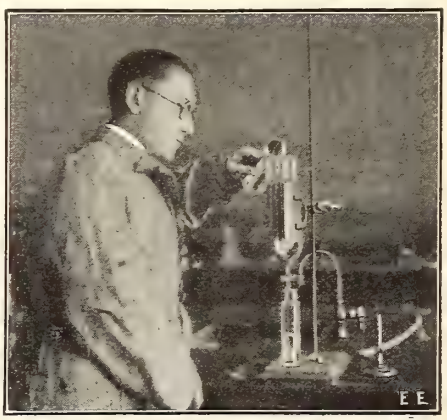
Making the Soap Test for Hardness by Pouring Soap Solution from a Dropping Bottle, into the Sample of Water.

ing matter also carries down the sediment with it. To show this fill a tall cylinder with water made turbid by the addition of a little fine clay. Then add a third of a test tube of the aluminum sulfate solution and mix it by thoro stirring. Follow with two-thirds of a test tube of lime water without stirring. Prepare for comparison another cylinder of water leaving out the alum and lime. Allow these cylinders to stand for several hours. The value of lime and alum as coagulums in city water reservoirs will be readily apparent.

HARDNESS IN WATER.

The terms "hard" and "soft" as applied to water originally referred to the difference in the "feel" of various kinds of natural water. Rain water, as everyone has experienced, feels soft and smooth to the touch and if used for toilet purposes will leave the skin in a similar condition. But much of the water from deep wells and springs has directly the opposite effect. Not only does it feel harsh to the touch, but it roughens the skin and makes necessary the use of large quantities of skin lotions.

One of the most noticeable and important



Pouring a Sample of Exceedingly Hard Water Thru a Permutil Filter. It Comes Out With Zero Hardness.

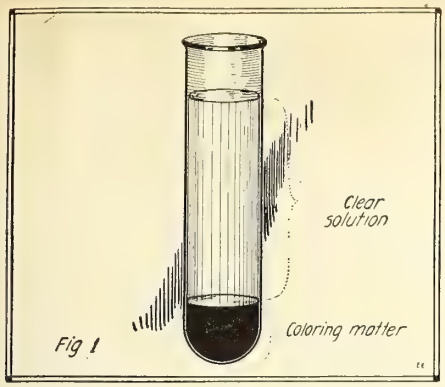


Fig. 1. Aluminum Hydroxid and a Solution of Logwood Demonstrates the Formation of a Dye "Lake". The Coloring Matter in the Latter Solution Falls to the Bottom.

effects of hard water is its soap consuming power. Therefore we make use of a soap solution in testing for hardness.

Testing for Hardness: First obtain some good liquid soap, as free from color as possible. Formerly an alcoholic solution of soap was used in these tests but a good quality of liquid soap will serve our purpose just as well. Obtain a dropping bottle, or make one by cutting a small notch in each side of a cork stopper and fit it into a small bottle. From such a bottle the soap may be poured in drops.

The softest water possible to obtain is distilled water. To learn the effect of soap upon such water, fill a test tube two-thirds full of it and pour in a few drops of the liquid soap. Note that no cloudiness appears and upon closing with a stopper and shaking a copious suds at once forms and does not disappear with standing. The suds are permanent. This is the test for soft water.

To learn the test for hard water add one or two cubic centimeters of a solution of calcium chlorid to half a test tube of distilled water and add soap. Note that a cloudiness at once appears and that large pieces of white precipitate separate out. Upon shaking no suds are formed. There may be froth and bubbles but no suds. This is typical of hard water, but of course no natural water is as hard as this sample. The white precipitate is insoluble calcium soap, useless as a cleanser, and which behaves as so much dirt. Not until all of the calcium salts in solution have been precipitated as calcium soap, can the cleansing action of the soap become effective. That is, the soap must soften the water and this is an expensive process.

Temporary Hardness: There are two kinds of hardness—*temporary* and *permanent*. One may be removed by boiling while the other requires the addition of some chemical, or distillation.

Prepare a sample of temporarily hard water by passing carbon dioxid gas into limewater for several minutes. (The carbon dioxid may be generated by the action of hydrochloric acid upon pieces of marble in an ordinary hydrogen generator) see Fig. 3. At first you will observe the formation of a white precipitate of calcium carbonat, but this very quickly disappears and a clear solution of calcium bicarbonat results. Divide the solution into three parts. To one add soap and note the formation of a precipitate and the absence of suds. Heat the second portion gently and at the same time hold over the mouth of the test tube a glass rod having on the end a drop of limewater. Note that the limewater becomes turbid, showing that carbon dioxid escapes. Then boil the contents of the tube and a white precipitate is formed. This is calcium carbonat. Filter off this precipitate and test the filtrate with soap. You will find that the water is very nearly as soft as distilled water. Because such hardness can be removed by boiling, it is called *temporary*.

In nature water always contains carbon dioxid and if it flows over limestone rocks, the limestone dissolves, forming calcium bicarbonat, held in solution by the excess of carbon dioxid. When this water is boiled in a tea kettle, the normal carbonat is precipitated and, since the calcium is removed from solution, the water is softened. Magnesium carbonat also behaves in the same way and is a cause of hardness.

Remove from the inside of a tea or water kettle some of the flakes of mineral matter that have been deposited there. Place them in a test tube and add a little hydrochloric acid. The very vigorous effervescence that results proves the presence of carbonat precipitated in the foregoing way. This is a common cause of boiler scale too.

To the third portion of the above solution add a little limewater and note that a white precipitate of calcium carbonat results. In the industrial use of water, temporary hardness is frequently removed by the addition of just the right amount of limewater.

Permanent Hardness: The more important kind of hardness and the most troublesome, because the most difficult to remove, is permanent hardness. This is due to the presence in water of calcium and magnesium sulfates and chlorides.

Shake a little of Plaster of Paris (calcium sulfate) in a test tube two-thirds full of water. Filter it and make the soap test. You will find it very hard. Now prepare another test tube of hard water in the same way. Divide into two portions. To one add a fairly strong solution of sodium carbonat—ordinary washing soda—and heat gently to nearly boiling. Filter off the precipitate that forms and test the filtrate with soap. You will find that the water has been almost entirely softened. This is the method by which water is most frequently softened in the household. See Fig. 4.

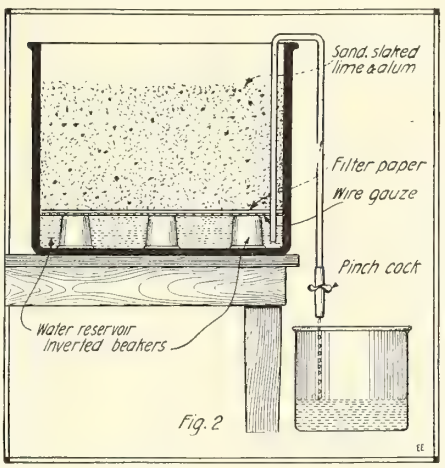


Fig. 2. A Sand Filter. Nature Uses a Similar Method of Giving Us Relatively Clean Water for Drinking Purposes.

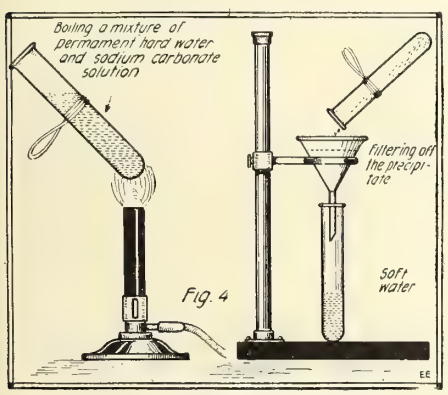


Fig. 4. Removing Permanent Hardness with Sodium Carbonat Solution.

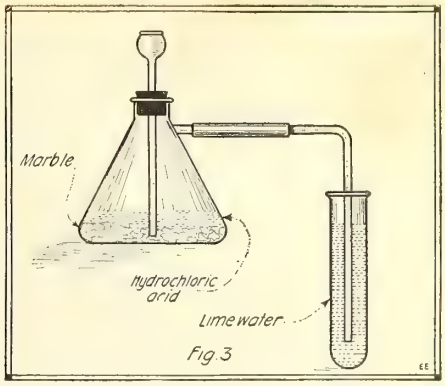


Fig. 3. Preparing Temporarily Hard Water By Passing Carbon Dioxid Into Limewater.

Heat the other portion of the hard water to boiling and note that a precipitate forms. Filter and test for hardness. The water will still be found hard, altho, owing to the fact that calcium sulfate is less soluble in hot water than in cold, some of the sulfate is thrown out of solution. This is a second very common cause of boiler scale.

A New Method of Removing Hardness: In recent years a unique and exceedingly efficient process of softening water for use in textile mills, private homes and wherever soft water is a necessity, has been placed upon the market. Large filters containing an artificially prepared sodium aluminum silicate are employed, and the water comes from them with absolutely zero hardness. The substance is called Permutit and the company handling it doubtless would be glad to give you a sample for experimental purposes. In using it, first prepare a sample of very hard water by adding to ordinary tap water some calcium chlorid solution. Pour it thru the Permutit filter and test with soap. The water will be found to have been entirely softened. It seems to be even softer than distilled water. What happens is this: The calcium *ions* in the hard water exchange places with the sodium *ions* in the filter, leaving the water soft. When the filter has become full of calcium ions and will no longer work, it may be regenerated by allowing a 10 per cent solution of ordinary salt to stand in it over night, followed by washing a few times with water.

TESTING TAP WATER.

To test tap water, or any other water, for hardness it is best to use a large sized test tube and measure out exactly 50 cc. of the sample. Then add soap drop by drop with shaking until a permanent suds results, counting the number of drops as you do so. Note, too, whether a cloudiness

(*Continued on page* 197)

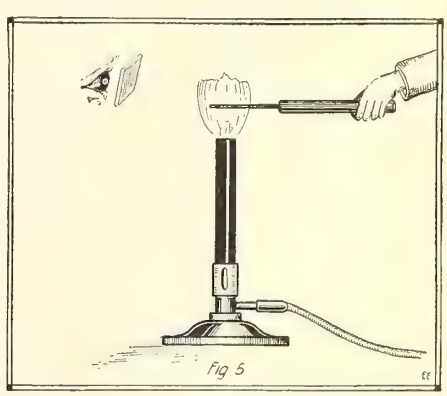
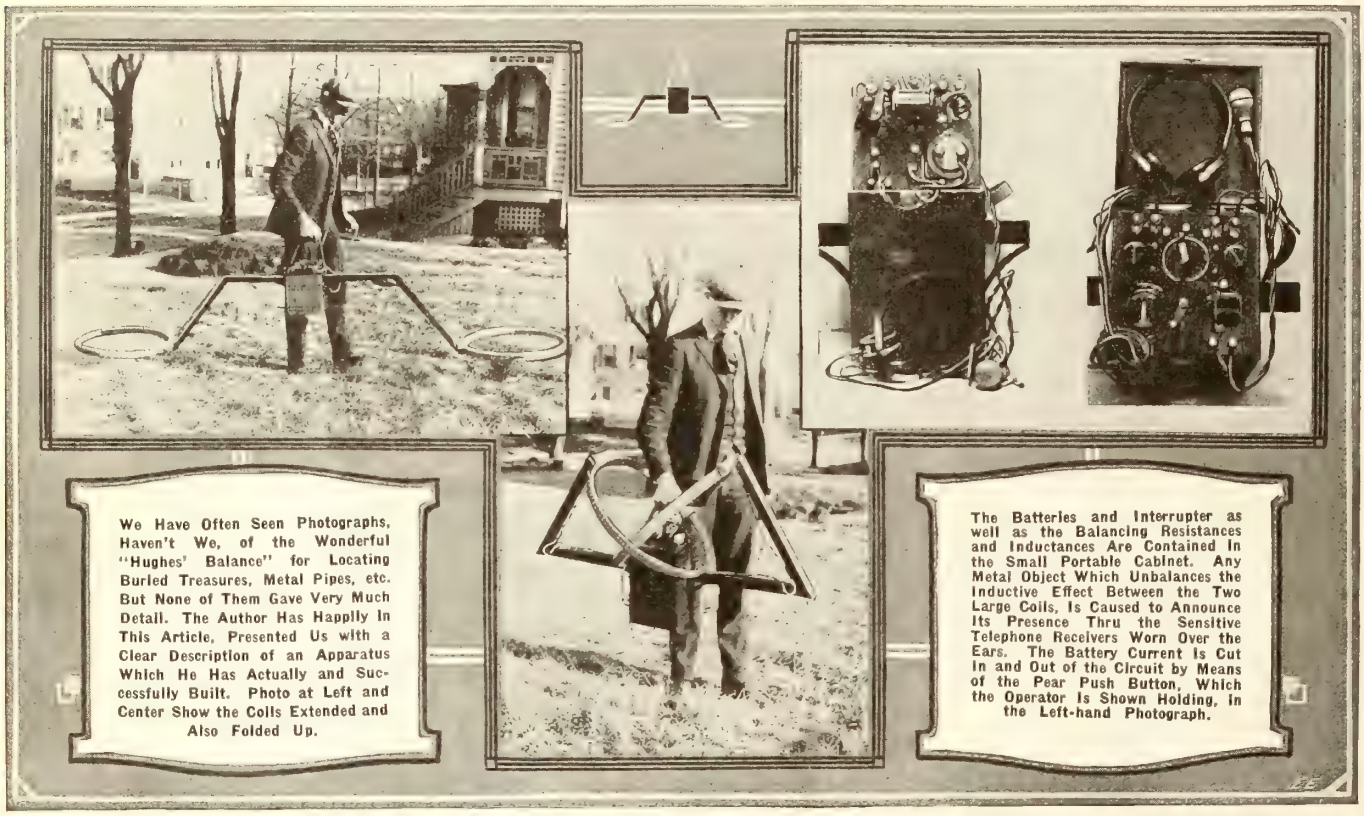


Fig. 5. Flame Test for Potassium. The Flame is Viewed Thru a Piece of Cobalt Glass. A Sodium Test is Made in a Similar Manner, But No Glass is Used.

Have You a Buried Treasure?

By VICTOR H. TODD

Consulting Electrical Engineer



We Have Often Seen Photographs, Haven't We, of the Wonderful "Hughes' Balance" for Locating Buried Treasures, Metal Pipes, etc. But None of Them Gave Very Much Detail. The Author Has Happily In This Article, Presented Us with a Clear Description of an Apparatus Which He Has Actually and Successfully Built. Photo at Left and Center Show the Coils Extended and Also Folded Up.

The Batteries and Interrupter as well as the Balancing Resistances and Inductances Are Contained In the Small Portable Cabinet. Any Metal Object Which Unbalances the Inductive Effect Between the Two Large Coils, Is Caused to Announce Its Presence Thru the Sensitive Telephone Receivers Worn Over the Ears. The Battery Current Is Cut In and Out of the Circuit by Means of the Pear Push Button, Which the Operator Is Shown Holding, In the Left-hand Photograph.

HERE is another one of those buried metal locaters which have been described in the ELECTRICAL EXPERIMENTER from time to time, this particular device however being designed to locate a buried treasure supposed to be resting peacefully somewhere in an island in Florida. Some months ago an advertisement appeared in the classified columns of the ELECTRICAL EXPERIMENTER asking for a mechanical or electrical device for locating a buried treasure. The writer answered this and the very sensitive piece of apparatus shown in the accompanying illustrations is the result.

In the past there have been many fake inventions for this purpose, but when prest for their principle of operation, their inventors would always say, "I can't tell why it works, but it does!" Unlike these, however, this instrument operates on sound, basic principles of electricity and its theory is in keeping with the latest principles of electrical engineering; nothing mysterious, magical or supernatural about it.

There are two large coils about two feet in diameter wound with copper wire and both coils are identical. These coils are connected in parallel, but each one is in series with a primary winding of a differential current transformer, the secondary of which goes to the telephone receivers. This is shown in the rear view of the instrument board. There is a buzzer which has two heavy silver contacts and these open and close the main circuit. As will be seen from the diagram of connections, there is a small rheostat for accurately balancing the ohmic resistance of the two coils, and two adjustable inductances for balancing the inductance. The main current is supplied by dry batteries located in the bottom of the instrument box. When the currents are equal in both coils, the two primary windings "buck" each other exactly and no sound is heard in the receivers; but the least unbalancing, as might be produced *by any metal coming under the influence of either coil,* will produce a sound. One winding alone will produce 1200 volts on an open circuited secondary so to balance out the sound, 1200 volts must be "bucked" against 1,200 volts until *no sound* is heard in the receivers. From this it will be realized what an infinitesimal change in the field of either coil is required to produce an audible buzzing in the receivers.

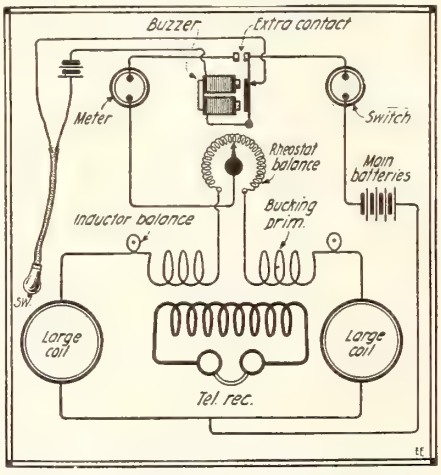


Diagram Showing the Connections of the Electric Treasure Locating Apparatus, Described By Mr. Todd. This Apparatus Was Actually Built and Proved Very Successful, Locating a One Foot Square Block of Iron, Five Feet Underground.

To locate any buried metal, the outfit is merely carried along very closely to the ground, the user listening intently for any sound which denotes the proximity of buried metal.

The apparatus is so sensitive that even a small screw driver placed in one coil will give a sound. *From actual tests, it will detect a quart of metal washers one foot underground; a 2-quart can at 1½ feet, and a block of iron about a foot square, it will locate five feet underground.*

From this it will readily be seen that Captain Kidd's dead men sitting on the chest of gold may well rattle their bones in fear, as they will no longer be safe from detection once the services of electricity are enlisted in the search.

Low Voltage Soldering Irons

By H. H. PARKER

A SOURCE of electric current of low voltage but fairly high amperage, such as supplied by a small step-down transformer or a starting or lighting storage battery may be put to good use in operating soldering "irons" of simple and rugged as well as cheap construction; other heating devices would be equally practicable but will not be discust here. So many articles have appeared describing the construction of small transformers that it seems hardly worth while to bring up the subject again; it need only be said that the building of such a piece of apparatus is not at all difficult and when completed it may be put to a wide variety of work. For soldering, one of about 200 or 300 watts capacity would be plenty large enough; for a resistance heater unit 10 volts is enough and for an arc heater about forty. As the resistance types are the most easily managed they will be described more fully, though the arc type is interesting to experiment with or to use where a large amount of heat is required.

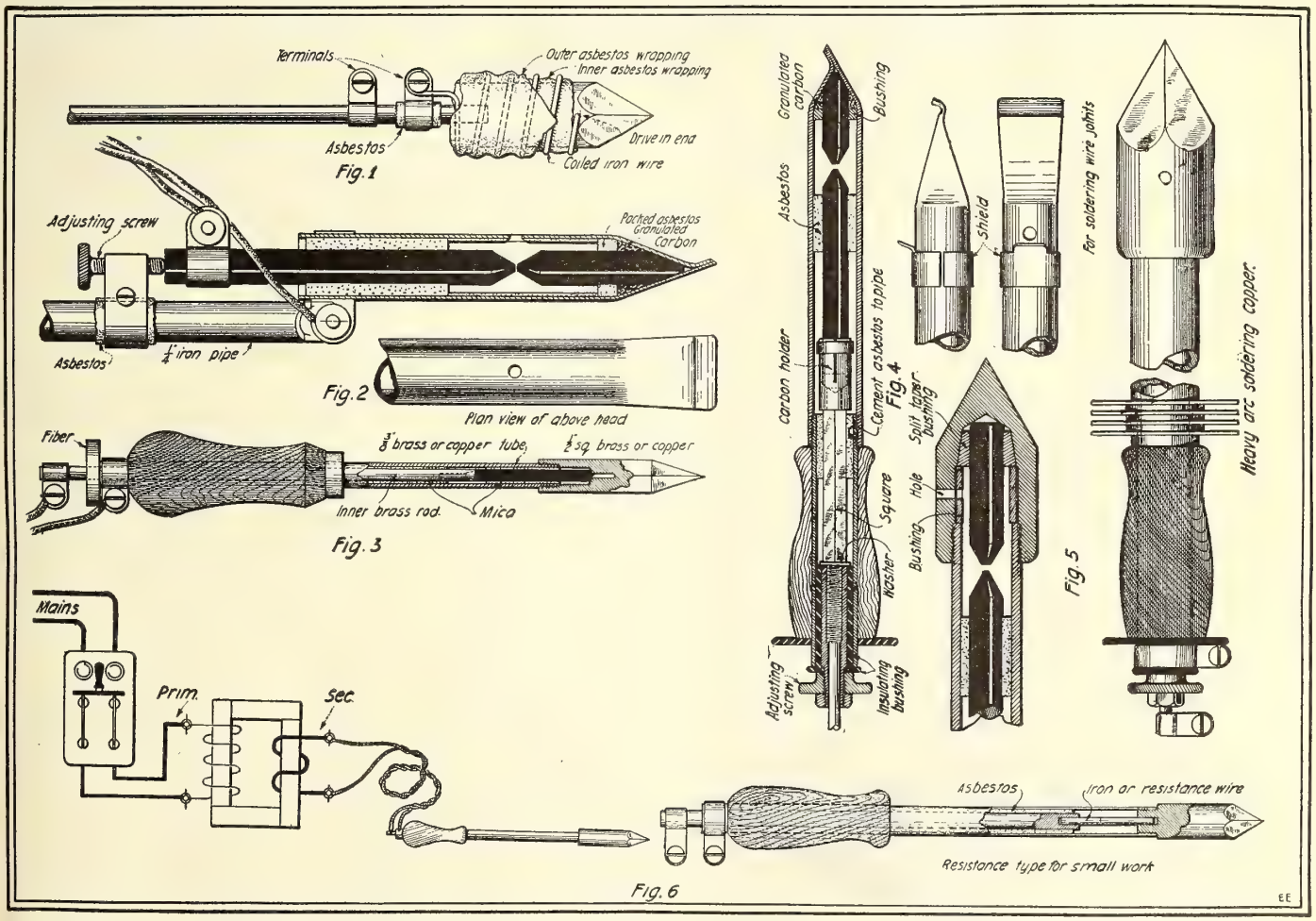
The simplest contrivance is to adapt a regular soldering copper as shown in Fig. 1. Take about sixteen inches of iron telephone wire, No. 12 gage, drill a hole near the point end of the body of the copper and drive in the end of the wire. Then cement a layer of sheet asbestos around the body and wind the wire over this, securing the other end in a brass clip bolted to the shaft of the tool but insulated from it with an asbestos sheet. A similar clip in contact with the shank forms the other terminal. Use heavy flexible cord, preferably asbestos wrapt, to connect the copper to the source of supply. The wire will quickly become red hot and heat the copper; one an inch in diameter and about three inches long will heat enough to run solder at the point in three minutes, using an E.M.F. of ten volts and about twenty amperes. A layer of asbestos around the outside of the coil will conserve the heat and a brass tube slipt over the whole will protect it from mechanical injury.

Fig. 2 shows an experimental appliance built up from brass pipe or tube hammered out to a chisel point; this is good for practical use as well, and is very easily made. A short half inch carbon electrode is bevelled off and driven into the point, inside the tube; it is then packed with granulated carbon and asbestos to hold it in place. A longer carbon electrode fits into the open end of the tube and is insulated from it with a wrapping of asbestos. One brass clip secures the tube to its handle, a piece of one-quarter-inch pipe in the illustration, and also acts as a terminal. The other terminal is a clip around the outer end of the long carbon. A third clip, insulated from the handle by asbestos, holds an adjusting screw. A small peep hole drilled thru the side of the tube is necessary to observe what is going on inside.

This device may be used either as an arc heater, or with the electrodes prest together, as a resistance unit. A small arc at 30 to 40 volts requires but little regulation and the carbons burn slowly; the proximity of the arc to the point of the copper causes it to heat quickly; 45 seconds, on the average, will run solder. At 10 volts, with the electrodes prest together, the ends at the point of contact quickly become red hot and the copper heats sufficiently in less than a minute.

In Fig. 3 is shown a small soldering "copper" intended for light and delicate work, the point being half-inch square brass. This also is of simple construction; a three-eighths brass or copper tube screws into the body and a quarter inch brass rod slips into this, being frictionally held with asbestos wrapping. One form of heating unit could be an inch or two of iron wire, but a carbon unit about five-sixteenths inch in diameter, made by filing or grinding down a flashlight cell carbon, gives as much heat and uses less current. The carbon rod should be from 1¾ to 2 inches long and wrapt in thin asbestos, or preferably mica, to insulate it from the tube. Ten volts and 15 to 20 amperes will cause the carbon to become red hot, and the point will run solder in two minutes from cold. A medium sized pencil lead of about the same length grows white hot immediately and heats the point in less than one minute, but such a resistor is fragile and easily broken. It would, however, be suitable for an extremely small soldering point. A slight dif-

(*Continued on page 235*)

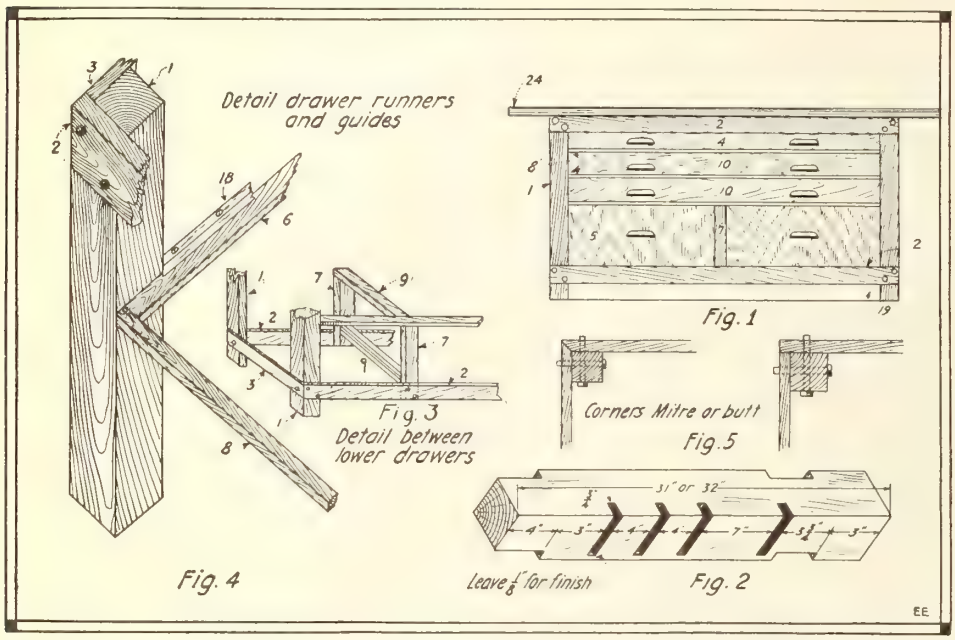


Several Practical and New Ideas Are Here Illustrated in the Realm of "Soldering Irons." Low Voltage Irons of the Arc and Resistance Type Are Described by the Author, as Will Be seen from the Illustrations. Electric Irons Are Gradually Superseding the Gas-Heated Types, In Both Experimental and Commercial Repair Shops.

An Experimenter's Work Bench

By C. R. MULLIN

HERE is a work bench that is large and yet does not take up much space. The tool drawers, instead of being deep and small, are large shallow



Full Details are Here Given for Constructing a Substantial Experimental Work Bench, Fitted with Drawers and Two Lower Compartments for Holding Small Tools, Drills, etc.

trays that keep the tools where they belong, rather than piled a foot deep. At first inspection, it may look rather wide and not very long, but after working on one, you will like it much better than a long narrow bench.

The writer has used one this same size, under a large switch board and found no difficulty in reaching the switches. It gives plenty of room in back to place material or apparatus on, and still leaves space enough in front to work on. The materials needed are as follows:

No. of Pieces	Thick- Width	ness	Length	Name	No.
4	4"	4"	31"	Legs	1
4	4	2	48	Side Rails	2
4	4	2	30	End Rails	3
1	3	1	40	Drawer Fronts	4
2	7	1	19	Drawer Fronts	5
2	4	1	40	Drawer Fronts	10
2	4	1	40	Drawer Backs	11
2	7	1	19	Drawer Backs	12
1	3	1	40	Drawer Backs	13
4	7	1	26	Drawer Sides	14
4	4	1	26	Drawer Sides	15
2	3	1	26	Drawer Sides	16
2	3	1	22	Fillers between end legs on floor	17
2	3	1	32	Fillers between side legs on floor	19
10	2	1	30	Drawer Runners	6
2	3	1	30	Drawer Runners	9
8	1	1	22	Drawer Guides	18
1	1	2	22	Drawer Guides	19
3	2	1	44	Fillers between drawers	8
2	4	2	10	Fillers between small drawers	7
3	12"	2"	5'	Top	24
2	22x20"			Laminated Wood end Panels	
1	42x20"			Laminated Wood Back Panels	
9	5/16"			Lag Bolts 2½" long for top	
4	5/16"			Lag Bolts 3" long for top to frame	
16	5/16"			Carriage Bolts, length according to construction, but about 6" long is about right.	
8				Drawer Handles	
4				Pieces of ¼" Laminated Wood, 42"x 26" for drawer bottoms.	

The above dimensions are approximate, that is ¼ to ½" waste, except rails and legs. 1" lumber means ¾" or ⅞" stock. All tool drawers and small drawers are full size of bench. Bolts are used, as they are cheaper and preferable to lag bolts.

CONSTRUCTION—The legs are cut for lap joints for rails and the notches are cut nearly thru, except for about one-eighth of an inch for finish. These notches take the guide rails and filler strips as per Fig. 4 (6 and 8 of Fig).

The top is cleated together with three 2" x 4" pieces, lagged on from under side, one lag bolt to a piece. The two end cleats should fit snugly between end rails, then lag bolts are placed thru rails into cleats.

When bench is finished it should be given two coats of hot linseed oil.

NOTE: Care should be used in heating this; set vessel containing oil into pan over water and keep bottom of oil container off pan by using a small block. It is better to heat out-of-doors, for a very hot flame is produced from burning linseed oil. Two coats well soaked in makes a good finish, and the surplus should be well rubbed off.

Before bench is used a heavy angle iron, the length of the bench, should be set in flush with top to protect edge.

A "Tomato" Can Ruby Light

It sometimes happens that one suddenly finds himself without that all-necessary dark room article—a ruby light. The usual way out of such a predicament is to wait until one may be purchased, or, if fortune smiles, to borrow one from your neighbor.

But recently I found that no nearby friend or relative possest such a thing, and being in dire need of a dark room light at once, I set about to meet the situation.

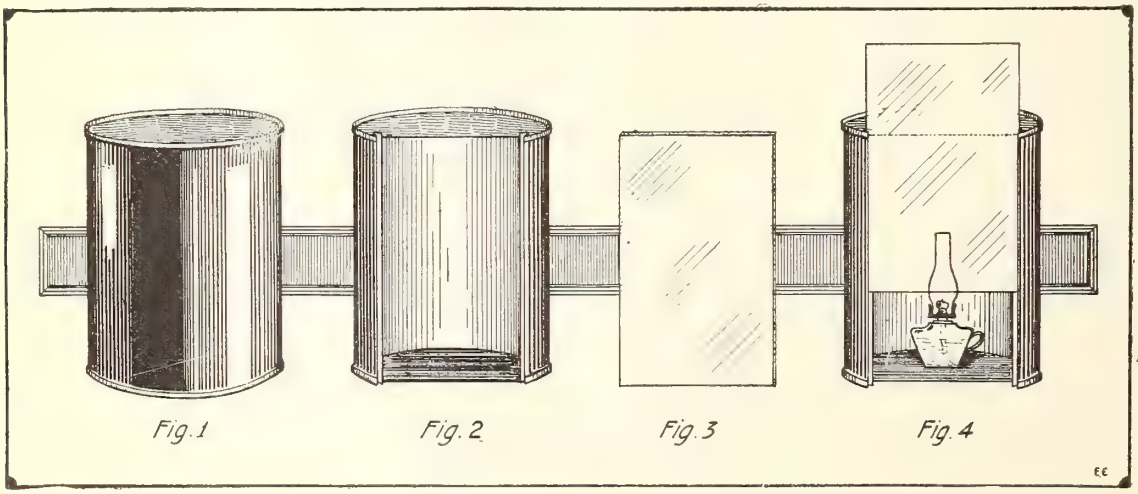
Securing an old tomato can, I melted off the rough open edge, and then cutting an opening in one side, the entire length, I bent the vertical edges to form a groove, after cutting away a small arc of the top, as shown in Fig. 2. I took care to see that this opening was just wide enough to accommodate a four by five plate, and when fitted, it slid snugly in the grooves at either side of the opening.

The glass, Fig. 3, was cleaned with alcohol, or hot water. In this instance I used a length of the red paper which comes in film rolls, and after wetting it, prest it against the surface of the glass. It adhered nicely.

All that was then left to do was to procure a small lamp (one out of my small brother's magic lantern) and "go to it."

I later found that a solution of the red transparent water color, or even red ink, if several coats are applied, will work nicely for the ruby glass.

Long ago I purchased a real light, but this one works so well that I have bought a ruby glass to fit it, and often use it in place of the other one.



Here's How to Make a First Class Photographic Ruby Lamp Out of a Discarded Tomato Can. The Best Ruby Lamps Contain Two Glasses—One Orange and the Other Red.

Contributed by DALE R. VAN HORN.

Radium—The Bad Boy of Science

By HAROLD F. RICHARDS, M. A.

1. AN ALPHA PARTICLE SIGNS ITS NAME.

WHEN Henri Becquerel drew the curtain from a hitherto unknown corner of Nature, and forced the world to admit that the Atoms of Radium are constantly exploding, he caused science more trouble than all the Huckleberry Finn's had made for the psychologists in a dozen decades. Up to that time the scientists had needed to deal only with self-respecting Molecules and Atoms, but now they found that a thimbleful of radium was shooting out high-velocity projectiles of *sub-atomic matter* in such numbers, that if each one were a dollar, a few seconds would suffice to pay the national debts of all the governments of the world! It was quite evident that an atom couldn't explode unless it were composed of parts, so it became necessary to take account of the *parts* of an atom, and that is where the whole trouble started. That was the beginning of the *Electron theory,* and everyone who has followed the course of science during the last twenty years, knows that it has been necessary to reconstruct *almost completely* the theories of electricity, magnetism, heat, light and radiation. Even the foundations of classical mechanics have been swayed and remolded under the pressure of this flood of new ideas. But just as a giant may not realize the extent of his own strength until somebody kicks him on the shins, just so science needed the urge of these baffling new phenomena, and the amazing *practical* developments of wireless, radio-telephony, radioactivity, electrical amplification and X-rays stand as an immortal monument to what science can do *when it is troubled with a new idea.* Multitudes of excessively ingenious and delicate experiments in the research laboratory make possible these practical advances, and it is one of the most beautiful of these experiments that I wish to describe now. A *single alpha particle* shot from radium—a piece of matter *so small that one thousand billion particles like it would have to be collected at one spot in order to make a speck visible to the eye*—this lone *alpha particle* is made to

Two Unusual Experiments

record its arrival with *pen and ink on paper.*

HOW THE AUDION IS USED.

Mr. H. Winfield Secor has given, in the February issue of the ELECTRICAL EXPERIMENTER, a comprehensive account of the possibilities of that versatile instrument, the Amplifying Audion. Recently Kovarik has put the Audion to a new use, and by this means was able to effect the *automatic registration of a single alpha particle.* The apparatus employed in this experiment is fully diagrammed in Figure 1. The alpha particles from the radium enter the brass *ionization vessel* thru a small opening. The brass chamber is kept charged to 2,000 volts by a battery of storage cells, and the insulated metal *needle* supported centrally inside the vessel is charged to 80 volts. Thus there is a strong *electric field* inside the vessel, and when the *alpha rays* break up the molecules of air into *positive* and *negative* ions, the positive ions are driven to the needle, and add their charge to it. The electric force on the ions is so strong, due to the high voltage used, that they move fast enough to produce many other ions by *collision* with molecules of air that have not been directly affected by the rays. Thus the electric effect due to a single alpha particle is enormously magnified. This is the first *amplification.* The needle that receives the charge from the ions is connected thru an insulated battery to the grid of an *audion amplifier.* The voltages on the grid and the plate of the audion are adjusted so that no appreciable current flows between them, when no alpha particles enter the ionization chamber. However, as soon as the voltage of the needle is raised by the ions, an *amplified* current flows in the plate-grid circuit, and this current passes to earth thru a sensitive electro-magnetic relay, as shown in the illustration. This closes the circuit in the magnet of the recording device, and the pen attached to the armature makes a distinct nick in the ink-trace which it is producing on the revolving drum. It is very important to ensure that the electrical charge carried by the ions is not allowed to build up continuously on the needle, for, in that case, there would be a steady current flowing thru the audion, and the recording pen would be unable to oscillate so as to produce a separate nick for each alpha particle that enters the ionization chamber. For this purpose the needle is shunted to ground thru a *high resistance* of one million ohms. A stroke of india ink on paper makes a convenient resistance. This resistance is so high that the charge communicated to the needle by the ions due to a single alpha particle *does not leak off to earth immediately,* but remains long enough to actuate the relay and thus produce a "kick" of the pen. It then leaks to ground, and the pen is ready to receive the impulse of the next alpha particle. By this means many hundreds of alpha rays may be *automatically* recorded in one minute, whereas in the method of counting the particles by the sparks which they produce on zinc-sulfide, only about fifty can be recorded per minute, and this registration is not automatic, but very laborious and trying.

It is interesting to trace the amplifications to which the current due to a single alpha ray is subjected. The first augmentation occurs in the ionization vessel itself, where the ions directly due to the particle produce many others by their collisions with air molecules. This increase of energy takes place at the expense of the electric field between the needle and the walls of the vessels. The second amplification is produced by the Audion, and the third by the *sensitive relay,* which brings into action the energy of the batteries connected to the recording device.

Thus the alpha particle acts merely as a *trigger* to set off the whole train of actions, just as the electric spark causes a mixture of hydrogen and oxygen to explode. There seems to be no limit to the magnitude of the actions which an alpha particle could be made to start. The electro-magnet that operates the writing pen might just as well be used as a relay to operate the *elevator* in

(*Continued on page* 199)

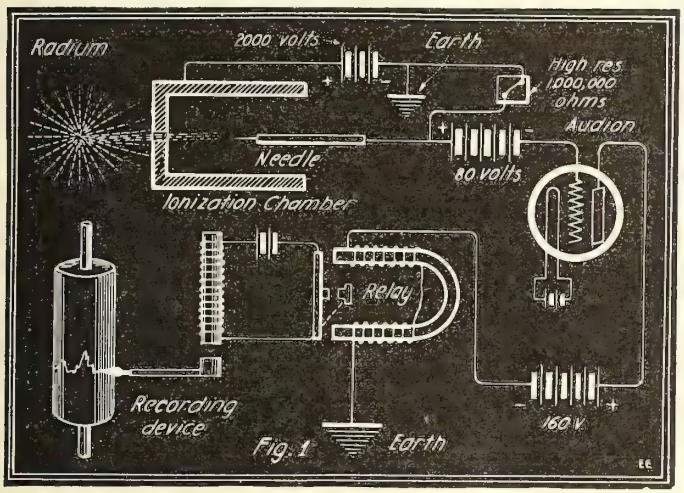


Fig. 1. Automatic Registration of Individual Alpha Particles Shot from Radium. The Audion Amplifies the Ionization Current, and Each Alpha Ray Records Its Arrival with Pen and Ink On Paper.

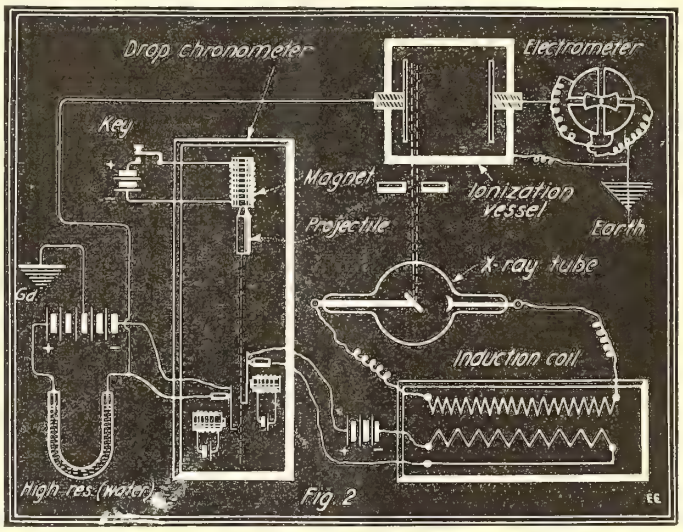


Fig. 2. A "Speedometer" for the Ions Produced in Gases By X-rays. The Apparatus Starts and Stops the Experiment in the Space of Seven-Thousandths of a Second, and Tells How Fast the Ions Traveled in the Meantime.

The Electrical Machinist

By H. WINFIELD SECOR

No. 8—GEARING AND VARIABLE SPEED CONTROL.

THE machinist who does much electrical work will sooner or later find that he has to be familiar to quite a fine degree with the various mechanical and also electrical features of speed control. The majority of electrical machine and millwright work today is connected with motor installations, and practically all large factories are electrically motor-driven at the present time.

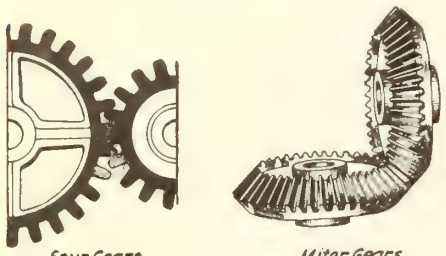


Fig. 1

Typical Spur and Miter Gear Drives. With Gear Drives There Is No Slippage, the Two Shafts Being Locked Together or Synchronized, Owing to the Interlocking Teeth. The Speeds Are Proportional to the Number of Teeth On Each Gear.

In the present article we shall consider some of the features involved in various types of gear, friction and belt transmission, which we started to discuss in the last paper.

VARIOUS TYPES OF GEARING.

Different forms of gear drive are illustrated at Figs. 1-A to 1-D. The commonest form of gear drive between two shafts utilizes what are known as "spur" gears, shown at Fig. 1-A.

To design or determine correctly the proper width of spur gears to transmit any given amount of horse-power, reference should be made to machine design manuals wherein the usual rules are there given. Some of these books contain tables showing the various widths of gears to transmit definite amounts of horse-power at any given speed. The higher the speed of a gear, pulley or belt, the more horse-power can be transmitted, other things being equal, and the slower the speed of these moving parts, the less the horse-power that can be transmitted.

One of the most important things to know about gears in any case, is, of course, the relative speeds of two or more gear wheels meshing together. We have seen in article No. 7 in the May number how the relative speeds of two belt pulleys are calculated. For tooth gearing such as we have here, the relative speeds of two gears, for example, vary directly as the number of teeth in each gear.

Thus, suppose we have a large gear or driver with 100 teeth meshing with a small gear or pinion having but 10 teeth. The speed of the driven or smaller gear is then found by dividing the number of teeth in the larger, by 10 or the number of teeth on the small wheel, and in this case the multiplying factor for the speed ratio is $100 \div 10$ or 10. Thus for every revolution of the large gear we see that the small wheel will make 10 revolutions; or the speed in R.P.M. of the large wheel multiplied by the factor 10 gives the speed in R.P.M. of the smaller gear. Also, if we wish to find the speed of the large gear, when the number of teeth and R.P.M. of the small wheel are known, then we divide the R.P.M. of the small gear by the tooth ratio factor—in this case 10, which gives the relative speed of the larger gear wheel, which in this example is one-tenth the speed of the smaller wheel.

Gears for use on electric motor drives are frequently made of cast-iron and sometimes of steel, but where too much noise is occasioned by such a drive considerable vibration and noise are markedly reduced by putting a rawhide or fiber pinion on the motor. The rawhide gears are usually made with brass flanges on either side, between which the hide discs are tightly riveted.

In making such gears, the brass and rawhide discs are firmly riveted or bolted together, and form a blank drum or cylinder, and this blank is then placed in the milling or gear cutting machine and the teeth milled out.

In emergency, it has often happened that gears have been cut out or rather milled out in the lathe, fastening the gear blank rigidly to the carriage, and with a little care the teeth can be milled out by placing a regular gear cutter on a mandrel mounted between the lathe centers and driven with a dog in the usual way. The spacing of the teeth should, of course, be accurately marked out on the edge of the gear blank before starting to cut the teeth.

At Fig. 1-B a *miter gear* is shown. This is familiar to practically everyone and serves the purpose of accurately driving or inter-connecting two shafts which happen to be placed at right angles. Miter gears may each have the same number of teeth or each may have a different number of teeth. If the number of teeth on each gear is the same, then the speed of both shafts will be alike. If otherwise, then the speed of the shafts will be related according to the ratio between the respective number of teeth on each, as previously explained for the speed of spur gears.

Miter gears are often improperly called *bevel* gears. A miter gear can always be told by placing a steel square or miter on the teeth, which will form an angle of 45 degrees with the shaft on which it is mounted. Beveled gears may have the two respective shafts on which they are mounted at different angles, but in general they resemble miter gears, excepting that they may be of different angular pitch with respect to the shafts, etc.

At Fig. 1-C a *worm gear* drive is shown. The worm gear is extensively used, especially where a smooth slow motion is required. This form of drive permits the motor, for example, to run at fairly slow speed, depending upon the number of teeth upon the wheel. The speed of the worm gear drive is figured as follows:

For a single pitch worm, each revolution of the worm, which is usually mounted on the motor shaft, will cause the worm wheel to advance one tooth. Thus, if the worm gear has 100 teeth on it, one revolution of the worm on the motor shaft would cause the wheel to rotate one one-hundredth of its perifery, or one tooth.

In other words, every time the worm on the motor shaft makes 100 revolutions the worm gear would make but one revolution. If the worm is made of double pitch, then for each revolution it makes the worm gear will be advanced the pitch of two teeth, and if the worm is made of triple pitch, then the gear will rotate the pitch of three teeth.

Or again, if the worm is made of quadruple pitch, that is, having a pitch equal to the pitch of four teeth on the worm gear, then the gear wheel will rotate a distance equivalent to the pitch of four teeth.

FRICTION GEARING.

Friction gearing has been adopted at various times for certain forms of drives where other gearing was not desirable.

In shop work, especially in the mechanical laboratory, friction drives have many excellent features to commend them. The writer recollects one mechanical laboratory with which he was connected, where this form of drive served its purpose perfectly.

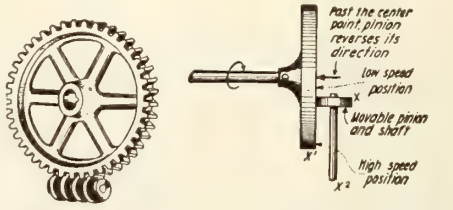


Fig. 1-A

Worm Gear and Friction Drive. The Worm Gear Advances One Tooth for Each Revolution of the Worm. The friction Drive Usually Has Leather Faced Pulleys In Contact, the Speed Varying With the Position of the Pinion.

Referring to Fig. 2, we will take a closer look at this particular friction drive, but before leaving the elemental type of pure friction drive illustrated at Fig. 1-D let us see how the speed is changed by this means. It is usually found the best practise to have the surface of the large disc X-1 covered with leather, but fiber and rubber and finished iron have also been used. The small pinion X can also be covered with leather, but is sometimes covered with fiber or rawhide, and in some cases rubber has been used for the facing.

The shaft X-2 is made movable or else the pinion has a keyway so as to permit the pinion sliding along the shaft under the action of a shifting device, a steel feather or key in the shaft, insuring a positive drive between the pinion and the shaft at all times.

As the smaller wheel is moved toward the outer perifery or increasing diameter of the large disc, the speed of the small disc and its shaft X-2 is increased proportionately. As the small disc is moved toward the center, the speed reduces, and if it is moved past the center then its direction of rotation is *reversed.*

This form of drive was tried a few years ago in the Winton touring car, and has been very extensively used in several small light weight cars, including the Metz runabout and the Metz touring car, at the present time. In any case, ordinary care and inspection should be made of such friction drives to see that the surfaces have not become unduly cut or worn, or low spots developt, which would cause an unevenness in the driving speed.

The small friction wheel is in some cases mounted so close to the large disc X-1 that it will be held sufficiently tight against it, to drive properly; in other cases, the shaft carrying the small pinion is held against the large disc by springs or other means.

(To be Continued)

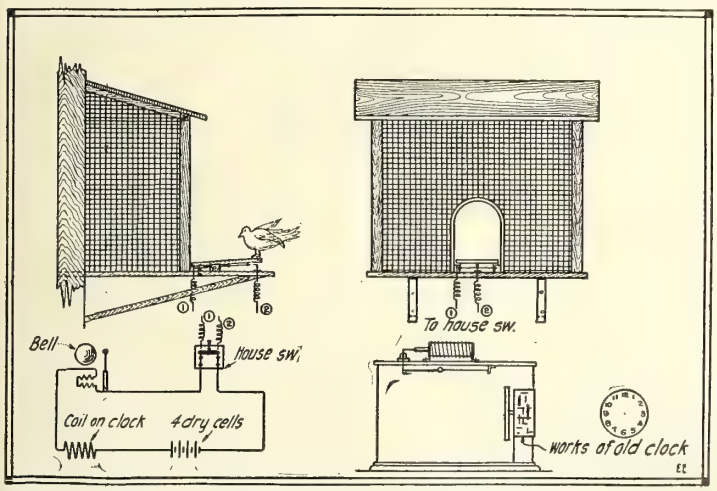
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

ELECTRIC PIGEON RACE RECORDER.

I have used this device for some time, and it has given very satisfactory results. When the pigeon comes in, the time is marked on the clock-face, thus avoiding the trouble of watching the pigeon loft all day. The sketch herewith illustrates how the

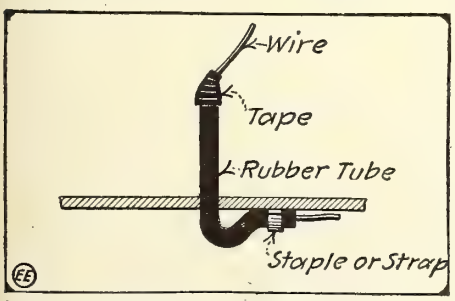


Pigeon Races Are Becoming More Popular Every Day. Here's an Electric Pigeon Race Recorder Which Will Help to Keep Track of the "Homers."

device works. Pigeon flying on platform No. 1, goes thru the hole, and his weight presses down spring, which is made from 1/32 x 1/2 brass, and closes circuit, causing marker coil (A) to release marker, and mark correct time on face of clock, which is made of card-board. It also rings single stroke bell at the same time, telling you how many pigeons pass thru the hole.

Contributed by M. C. KUHN.

WATERPROOF FLOOR LEAD FOR ANNUNCIATOR WIRES.



Those Troublesome Floor Wires—Here's How to Effectually Insulate Them, So That Even Water Won't Phase 'Em.

To overcome dampness slip an eight or ten-inch length of soft rubber tubing over the wires and fasten as shown in the illustration. The tube effectively protects the wires from water and abrasion, any water getting down alongside the tube dripping off the loop.

Contributed by THOS. W. BENSON.

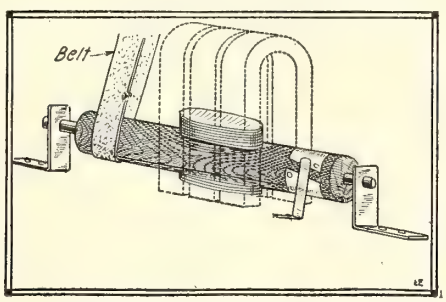
SECOND PRIZE, $2.00

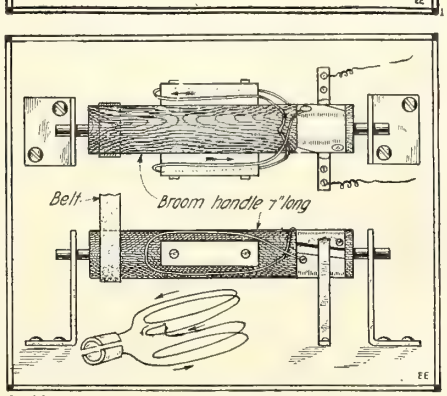
A SIMPLE SHOCKING DYNAMO.

This simple shocking dynamo is easy to construct and costs almost nothing, except the wire and some sheet copper. The armature is made by driving a ten-penny nail in each end of a broom handle 7" long. On this is nailed two tin boxes on opposite sides, each 3" x ½" x ½", filling them with small iron wire about ½" long, or iron filings (see illustration). Next cut two strips of copper 1" wide, long enough to reach around the wood and leave two spaces ⅛" wide where the strips meet. Cut the strips as shown in figure, so the timing can be varied by moving the brushes sidewise. Tack these strips on and wind on the tin boxes about ¼ lb. of No. 22 insulated magnet wire, connect and wind the wire as shown in the top view of the dynamo.

Fasten three or four U-shaped steel magnets over the tin box part of the armature.

Contributed by ARMAND MOTSINGER.



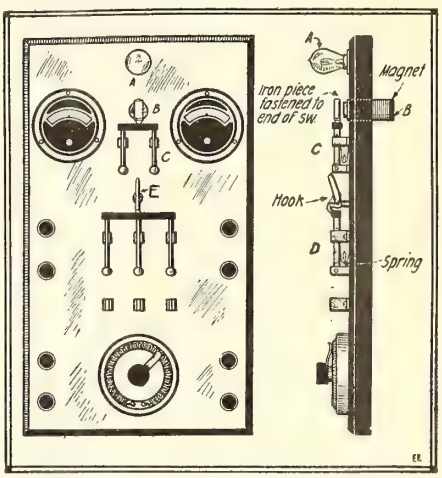


A Shocking Dynamo with a Wooden Armature.

THIRD PRIZE, $1.00

AUTOMATIC TRIP FOR BATTERY SWITCHBOARD.

I have an automatic brake on my engine that runs the battery charging dynamo. The lamp A, is directly in series with the dynamo thru the electro-magnet B. When the brake shuts off the spark for the engine and the current dies down, the magnet is



A Clever Wrinkle for Battery Charging Switchboards. The Magnet Trips the Switch When the Engine Stops, Closing the Battery on the Lamp Circuit.

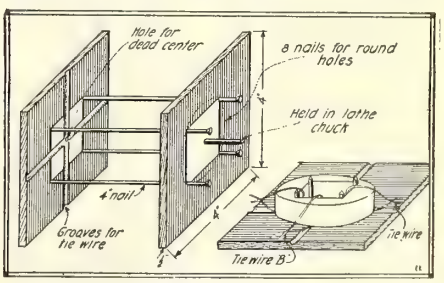
no longer strong enough to hold the switch C. which has a spring tending to disconnect it.

The switch B is for the battery charging circuit and when it falls, tripping switch D the battery supplies the current thru the lower part of D.

Contributed by HENRY KLAUS.

UNIVERSAL WINDING JIG.

In making this jig drill the holes for the nails about 10% undersize, and the form will be securely held at all positions, consequently giving any width. By drilling



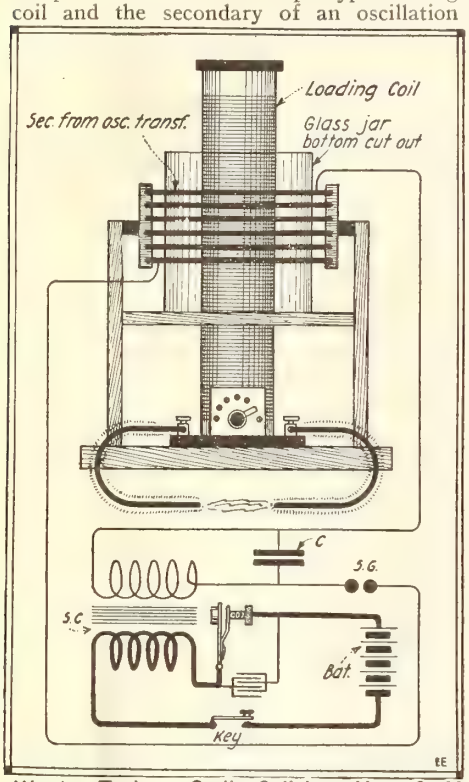
A Universal Winding Jig of This Type Will Greatly Facilitate Coil Building.

other holes, different sizes and shapes can be wound on the same jig. No taper is necessary; just draw out the nails. The big advantage with this jig is that, coils can be wound without waxing. Put on the tie wire (A), remove the side, put on ties (B) and pull out nails. Now the coil can be taped, removing the tie wires of course.

Contributed by H. V. PFEIFFER.

HOW TO MAKE A "SIMPLE" TESLA COIL.

This "emergency" Tesla coil, as will be noted from the accompanying diagram, is composed of the "stand up" type loading coil and the secondary of an oscillation



Want a Tesla or Oudin Coil in a Hurry? If You Have a Discarded Loading Coil Available, the Solution of Your Problem is Easy, as Shown Above.

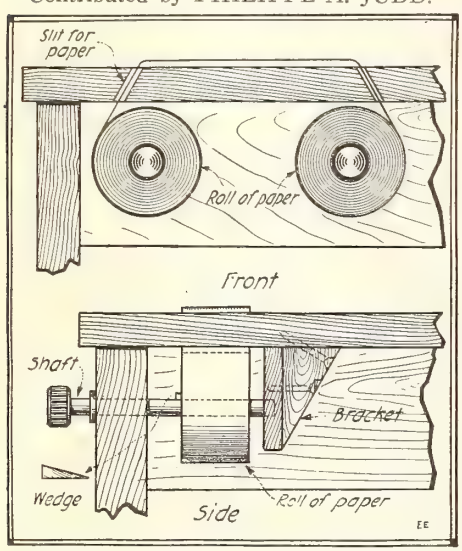
transformer, both of which are found to be included in a great many "dead" radio sets, altho there are *some* sets which lack an oscillation transformer. As to the glass jar, this may, of course, be substituted by hard rubber, a shellacked paper tube, or if the outer coil is very large, there need be no dielectric placed between the coils.

Contributed by ALFRED B. O'HARA.

TABLE MEMO PAD FOR LABORATORY.

While making experiments and doing research work liquids are sometimes spilled on the formula or memorandum. I have found the device shown in illustration very satisfactory. It cannot be misplaced and may be referred to at any time. The drawing is self-explanatory. The paper is the same as that used on cash registers.

Contributed by PHILIPPE A. JUDD.



An Ideal "Memo Pad" for the Laboratory Table. Turn the Knob and a New Writing Surface is Instantly Presented.

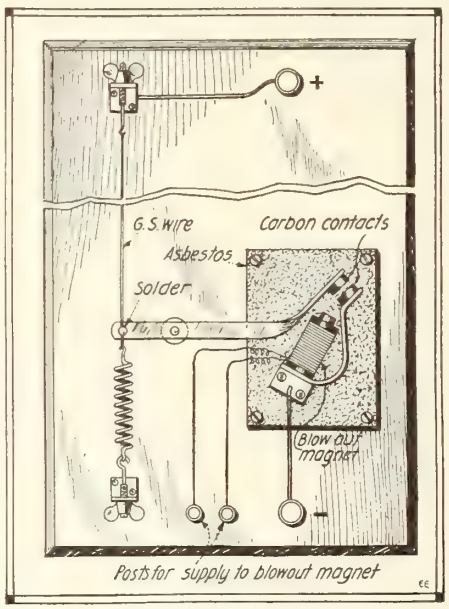
AN INTERMITTENT CIRCUIT CLOSER.

During some recent tests, it was necessary to start a small motor, run it a few seconds and stop it again, for a period of some hours. The following device was rigged up and performed this operation very successfully.

The size of the German silver wire employed depends naturally upon the load to be carried, tho it is quite safe to use a number 20 wire for the average laboratory work. The contact lever is made from strip brass bent as shown, and has a small carbon disk screwed to its extremity. The lever should have about a ten-to-one ratio and the wire should be at least three feet long in order to properly magnify the expansion and contraction. The stationary contact arm is made of sheet brass, carries a carbon contact, and is so bent that it serves at the same time as a support for the *blowout magnet.* This electro-magnet may be operated either from line voltage or from a six-volt battery. In the latter case it should be wound with 400 turns of number 24 S.C.C. magnet wire, using asbestos paper between layers. The spring was of the variety used to suspend canary bird cages.

The period of opening and closing can be regulated within wide limits by adjusting the thumb screws and, if necessary, the blowout magnet voltage.

Contributed by ERNEST ZADIG.



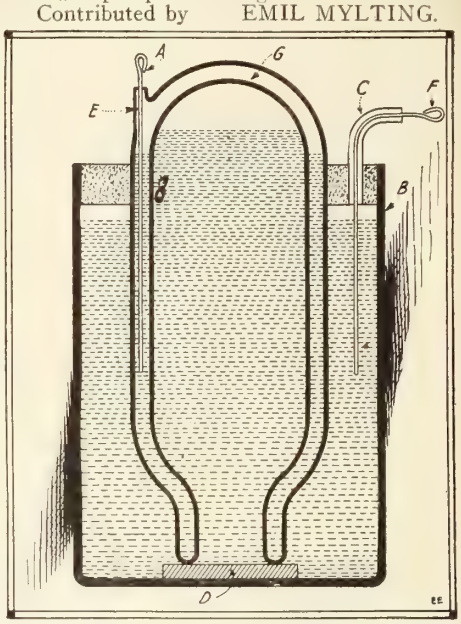
This Intermittent "Circuit Closer" Depends for Its Action Upon the Contraction and Expansion of a Piece of Resistance Wire Thru Which Current is Past. It is Fitted With a Blow-Out Magnet at the Contacts to Reduce Arcing.

A "THERMOS BOTTLE" H. T. CONDENSER.

Procure a vacuum bottle, remove the metal shell and break the tip A off, holding it below the surface of a salt-water solution, thus causing the vacuum G to fill with the afore-mentioned solution. A piece of thick felt D is placed on the bottom of a glass jar, slightly lower than the vacuum bottle and about one inch larger in diameter. Now fill both glass jar and vacuum bottle with salt water, and plunge the vacuum bottle upside down into the glass jar. Remove such a quantity of salt water from the jar so that the level will reach within one-half inch of the top. Place the tube C in the position as indicated in the drawing before filling the space B with a sealing compound. Shake some water out of the jar (after the compound has cooled), leaving an air space between the bottom of the sealing compound and the surface of the salt water. The two copper wires E and F, passing down into their respective solutions, are the terminals.

If any "radio-bug" should have a yearning desire for a variable high-tension condenser, he should be able to fix up some sort of pumping device to draw the water out and pump it back again.

Contributed by EMIL MYLTING.



A Good High Tension Condenser for Spark Coils, Tesla and Radio Outfits, Can Be Made From a Discarded Vacuum Bottle in the Manner Here Illustrated.

PHONOGRAPH BATTERY LIGHT.

The present device consists of a block of wood about 4" long, 1½" wide, a small push-button, a flash-light globe and a small socket to fit it. The latter is mounted on the block of wood as shown in the accompanying sketch. The battery and wires are concealed inside of the phonograph cabinet and in no way interfere with the mechanism of the machine.

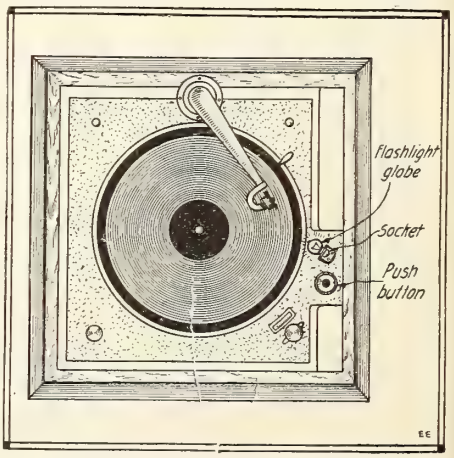
The object of this device is to cast a ray of light directly on the reproducer, thereby enabling the operator to place the point at the beginning of the record being played, also prevent scratching.

The push-button was given preference over the switch for the reason that the operator would quite likely forget to turn it off, close the lid of the machine, and thereby allow the light to burn uselessly. It is just as simple to start the machine and press the button as turning the switch on and off.

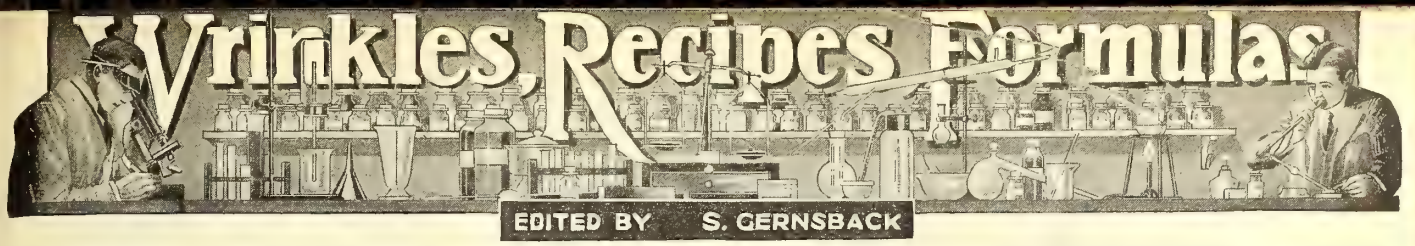
The block of wood lies inside the cabinet, and it is not necessary to put a nail or screw into the cabinet, as the light and button are mounted on the block of wood.

The device can be used on other machines in different ways by "doping it out" to suit.

Contributed by EDWIN KAMUF.



"Another" Electric Light for the Phonograph! This One is Very Neat in Appearance and It Does Not Mar the Talking Machine.



UTILIZING OLD "JUNK"—AND SAVING MONEY.

From personal experience, I can say that the things that eat up the small change in the average electrical-chemical Bug's pocketbook and which prevents him from buying sorely needed apparatus is supplying himself with test bulbs, flasks, fuses, etc. This is where the old burnt out Mazda globes "come back"; likewise old worn-out dry cells, ad lib, ad infinitum.

Presuming that you have on hand a blown-out Mazda bulb—any size—take a file and file the glass where it joins the base, then gently break it off. File the support which holds the filament, also, just below where it flattens out. And there you are. The detached globe is your flask, the filament support, after detaching all wires, makes a small stirring rod, and as for the base, break off the glass, separate the wires, and loop a small piece of tinfoil over them, and you have a fuse. Simple, what? (And, by the way, when you blow out a fuse, don't buy another one; just bend a piece of tinfoil over the outside, so that it touches both contacts, and it is as good as new!)

The long, "skinny" kind of globes that telephone companies use, make quite respectable test tubes, and as for the little battery lamps, just shove them under water, break off the point with a pair of pinchers, and the water will rush in and, presto—a magnifying glass!

And those old dry cells—how they break our hearts. Well, split them open carefully, take out the carbon, and use it in your arc lamp, or make a balanced microphone. Save the binding posts, too. Run the dirty, black stuff in the middle of the battery thru water and wash several times, and you have some manganese dioxid (or peroxid, either) with which to make some wet batteries. In a wet battery you can also use the carbon and zinc. Or if you don't want a wet battery, melt the zinc and run it into rods, or cut it up and use it for making hydrogen. And the manganese dioxid can be used for making chlorin, too.

One more—I almost forgot—use the sealing wax on the top of the battery for making instrument cases, or as an insulator or any other things that it will come in handy for. That's all, fellow "muckers."

And that'll be about all for this time. That's the way to save the spare cash. When you learn to do those things, you'll get along with the efficiency manager swimmingly.

Contributed by FRED C. DAVIS.

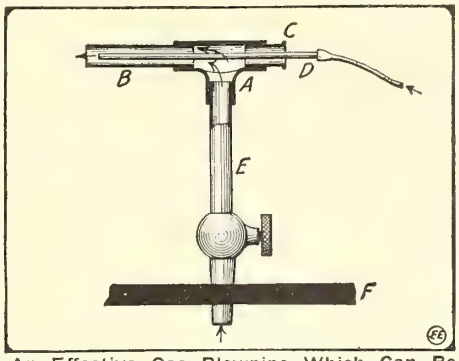
TEST PAPER.

By dissolving the coloring tablet that comes with gelatine in one-fourth ounce of water and spreading this liquid on filter paper and drying, you have a test paper that will turn purple in alkalies and back to pink in acids.

Contributed by EDWARD NEWBURRY.

A SIMPLE GAS BLOWPIPE

A ¾-inch iron T-piece has a 3-inch length of brass tube, B, tapt into one end, and a gland, C, at the other. Thru the center of this latter, and adequately held by the packing—or by a perforated cork—a length of glass tube, D, a quarter of an inch inside diameter, is past. It has been found better to leave the end of this tube that comes inside B as sharp as it is left by the process of cutting to the required length, no attempt being made to remove the sharp edge with a file or flame as is generally done in the case of a glass tube for safety.

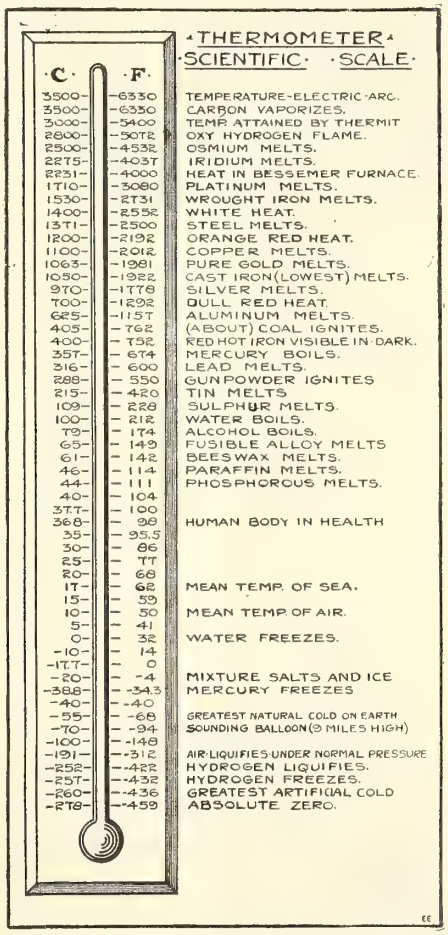


An Effective Gas Blowpipe Which Can Be Easily Made from Odds and Ends Found About the Laboratory.

The other end is smoothed and serves for connection to an aspirator or bellows supplying air by means of a length of indiarubber tube.

The blowpipe is fixt upright to the bench by means of a 6- or 8-inch iron gas tube, E, having a tap or valve at the other end. The gas enters from a tube that passes thru the bench top, F, and is regulated by means of the tap. Moving the glass tube, D, in or out as required, modifies the character of the flame.

Contributed by H. J. GRAY.



A Ready Reference Thermometer Scale Giving the Critical Points in Temperature, Above and Below Zero. Cut It Out and Paste in Your Memo Book.

HARD RUBBER KNOBS—MAKING YOUR OWN.

One day I needed some hard rubber about ½" thick, and not having any on hand I devised the following method to suit my needs. I had some old hard rubber storage battery jars on hand, so I cut them up into flat pieces with a fine saw and thoroly washed them in hot water.

I wanted to make some knobs 2" by ⅜", so I cut several squares a little larger than the desired knob, while they were hot, with shears. When they were dry I sanded each piece and gave one side of several pieces a thin coating of the rubber compound used to seal storage batteries. This may be done by heating the compound in a flame and dropping several drops on the surface of the hard rubber and spreading these with a hot case knife.

The pieces are now built up to the desired thickness by placing the first piece on a flat surface with the coated side up. Another one is put on, and so on until a little more than the desired thickness is reached. The last one should be prest firmly down on the others, but it does not require any coating of rubber compound.

Two iron or steel plates one-fourth to one-half inch thick and somewhat larger than the hard rubber pieces are heated to a temperature that will melt the compound but not hot enough to injure the hard rubber. The surfaces of the plates should be as flat and smooth as possible. One is placed on a hardwood board and the pile of hard rubber is put on next, then the other iron plate, both of them being hot. After putting on another board it is all transfered to a press or vise to put under high pressure. It should be left until cold, when upon removal some of the wax will be found on the edge of the hard rubber, but after this is scraped away the piece of rubber will have the appearance of one solid piece, so well is it cemented together under the combined pressure and heat.

My method of making knobs is to screw an inch piece of hardwood to the face-plate of my lathe and turn it down true. The rubber to be turned is secured to the face-plate by some of the rubber compound. The turning should be done carefully and the rubber may be polished with sandpaper, pumice and water, and rotten stone and oil. The center hole should be drilled before removing the knob.

Moderate sized panels may be made with the sides of large sized rubber jars that have been assigned to the junk shop heap at battery service stations. So get chummy with your local garage men, boys.

Contributed by LEA M. LAFAVE.

FREEZING A TUMBLER TO A BLOCK OF WOOD.

Place a little water on a smooth block of wood and on it set a tumbler. In the tumbler place a little ether. Now blow thru the ether with a glass tube. This will cause the ether to evaporate very rapidly, thereby producing a low temperature and freezing the tumbler to the wood. Pick up the tumbler and the block will cling to it.

This may also be accomplished by placing a little water in the tumbler instead of ether and then stirring into it powdered ammonium nitrat. The solution of the nitrat absorbs heat and quickly freezes the tumbler to the block.

Contributed by FLOYD L. DARROW.

RADIO DEPARTMENT

Secretary Daniels Speaks by Radio

AN announcement of the radio-telephone speech by Secretary Daniels was looked upon with great favor by the editors of the ELECTRICAL EXPERIMENTER, and immediately a reporter was sent to investigate, on the day before the pending speech, so that a good idea of the apparatus to be employed could be obtained.

Mingling with the crowds at the top of the tower in the Times Building, we inspected the instruments intended for the actual work in hand. The room itself about 25 by 30, was cris-crost by web-like antennae and lead-ins, the photograph clearly shows this. On the table are hosts of instruments which would please any "ether dabbler" if they were in his own laboratory instead of littering the tables and shelves of the radio room of the *Times*.

Variable condensers of every size and description, some of them advertised and some perhaps never heard of, were seen in the room. On the table in formidable array, a ten-step audion amplifier, resistance coupled, and right along side, a three-step amplifier with the necessary transformers were in readiness except for the insertion of a few tubes. No wonderful box of beautiful design covered them, the sockets merely being screwed to a pine board and the resistances, grid leaks and grid condensers all mounted upon the same board.

Variometers were connected into one circuit and a small "Magnavox" the lion-voiced telephone, also appeared on the table. Interest centered however, upon a very neat and compact receiving unit, commercially known as the United States Navy Standard and the regular two-step amplifier. On another table and just in the process of being made ready for a test, was the Magnavox, with its incumbent bank of six vacuum tubes for use in amplification.

It was with this Navy set and the Magnavox that the crowd which would naturally congregate on the north side of the Times Building, were expected to hear the Secretary speak as he was steaming up the Hudson River on the deck of the flag-ship, the U. S. S. "Pennsylvania."

A few steps to the door, and we were on the roof looking at the aerial, but we found this quite difficult, as there seemed to be so many of them—down the sides of the building, across to the flag-pole in three or four directions, ad infinitum.

The most admiring aspect of it all being a magnificent loop pivotally-mounted, and about 14 ft., square, the loop itself having a double coil of wire on each of its lateral sides, and truly a work of art, aside from the fact of its great value. It is from this that the Secretary's voice was heard, this being received by aid of the Navy tuners and then amplified by the Magnavox on the following day.

While there, a "pitched battle" raged between the large and small Magnavoxes—and of course the larger one had the decision, even from the start.

The greatest difficulty met with in the test was interference. Invariably signals would be superimposed upon others and tuning out rendered difficult. This was found so in the test carried out on the following day, when the Secretary's voice was actually heard. The Secretary's voice being naturally low, great difficulty was sometimes experienced in hearing it, and music by the band on board the battleship, as the Atlantic Fleet steamed thru the Narrows on its way here from winter maneuvers at Guatanamo Bay, Cuba, was very often interrupted by the incessant da-de-da radio-telegraphic signals of the regular radio stations.

The first effects were received by the radio station at the Navy plant in Rockaway and relayed directly to the Times Building over a special wire, the voice was then intensified by the "Magnavox."

During intermission between signals and voice the hum of the audions was clearly heard above the din of the street crowds and traffic.



Left: View of Loop Antenna Used to Pick Up Secretary Daniels' Wireless Telephone Speech Transmitted from the U. S. S. Pennsylvania, Flagship of the Atlantic Fleet. Center: N. Y. Times Radio Station and Small "Magnavox." Right: Secretary Daniels Talking to the Crowd in Times Square.

Radio 100 Words a Minute

With the cessation of hostilities comes an explanation of transatlantic radio communication which was perfected during the war, but could not be described on account of being a military secret. E. F. W. Alexanderson, of the General Electric Company, told an audience composed of members of the American Institute of Electrical Engineers and the Institute of Radio Engineers recently that the transmitting speed in the future will average 100 words a minute, instead of twenty words a minute.

It is now a matter of history that radio was largely used for communication between the United States and its armies in Europe and that the great war was brought to a close by negotiations conducted by radio which led to the armistice. Now we are ready for an international commerce of unprecedented scope, but lack adequate means for communication. By extending the range of wave lengths down to 10,000 and up to 20,000 meters and following the same system of intervals there would be room for about seven more stations or a total of twelve first-class transmitting stations.

He also said that the selectivity for direction of the waves will multiply by five the number of stations that may be operated on one wave length; and that the selectivity with reference to wave length will be improved so that the wave lengths of messages will be within 1 per cent. of each other, instead of 7 per cent., which is the spacing of the stations at present.

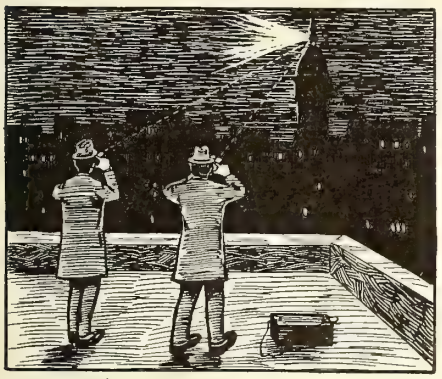
"These prospects, taken in combination, give us an optimistic picture in which the possible capacity for transoceanic radio traffic of the world is 175 times as great as it is with the practice of today," he said.

A War-Time Radio Detective*

Part II

By PIERRE H. BOUCHERON

THE work of the "Radio Detective" was often augmented and sometimes seriously complicated owing to the fact that some of the cases would manage to fall into the hands of newspapers. Particularly was this true during a certain period of "radio hysteria" which prevailed in the Spring of 1918. Here are a few of the glaring headlines which greeted Mr. and Mrs. Average American in the morning papers while they blinked over their first cup of coffee:



The "Singer Building" Signaling Mystery Seemed On the Face of the Initial Evidence—Thoroly Bona Fide—But . . . and More BUTS—the Mysterious Flashes Turned Out To Be Something Entirely Unexpected.

"German Radio Plant Seized by Government Officials."

"Enemy Radio Station Unearthed."

"Secret Wireless Discovered in Old Grist Mill in Catskill Mountains."

"Government Experts Scour Mountains in Search of Radio Outfits."

"Spy Wireless Located on Roof of New York Skyscraper."

The immediate effect of this "newspaper publicity" was that many otherwise conservative citizens would at once set the genius of their own particular imagination at work and such commonplace things as a clothesline, telephone wire, burglar alarm system, or a lightning rod would now take the concrete form of a "secret radio plant." This was particularly so in rural districts, and a few days after these spurts of journalistic brilliancy various governmental departments would receive an avalanche of letters from all parts of the country, describing in detail and enclosing maps and sketches of suspected localities. The larger cities, however, were not without their share, and the following experience is one which caused a master detective and myself to lose a perfectly good night's sleep. I have in mind the case of the Singer Building.

THE SINGER BUILDING SIGNALING MYSTERY.

An observing young man in Jersey City was star-gazing one evening or looking at the Lady in the Moon, I don't know which, when he happened to glance in the direction of downtown New York. Presently he was attracted by what seemed to be a series of short and long flashes at the very top of the Singer Building tower. He noted that these flashes seemed to occur at frequent intervals. Now it happened that this young man had attended a summer naval camp of some sort where he had been taught Morse Light Signaling. This, as some of our ex-Army and Navy readers know, is nothing more than a system of signaling employed at night, whereby the dots and dashes of the Continental Morse Code are flasht with an electric lamp controlled by a Morse key, and it is a rather common method employed at sea between vessels for short distances. This same young man put two and two together and decided there and then, that the flashes on the skyscraper were nothing more, *or less,* than the clever scheme of alien spies, enabling them to send military information to Spanish and Scandinavian vessels lying at anchor in the Hudson; this information, of course, to be eventually transmitted by radio to enemy countries when the vessels went to sea or had reached neutral ports. Incidentally, this same deduction was arrived at by several other persons almost simultaneously, and in a few days our office was furnisht with the "makings" of a typical case.

Three More Unusual Experiences With a Radio Background

In June "Radio Amateur News"

Radio Wrinkles.
By H. Winfield Secor

Development in Radio Receivers.
By R. H. G. Mathews

An Experimental Wave-Tester for Receiving.
By Raymond Evans

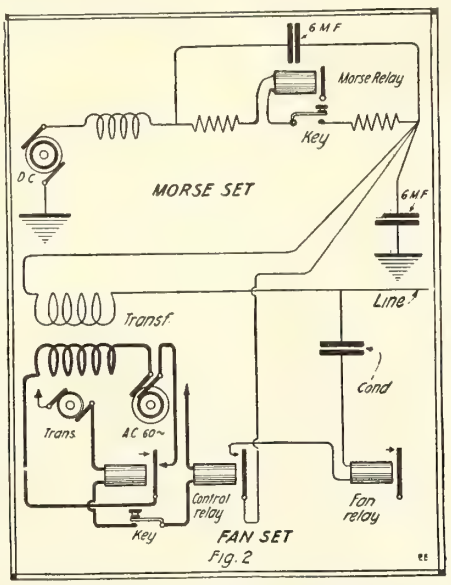
A One Hundred Mile Radiophone and Telegraph Set.
By W. L. Winner

German Radio Instruments.
By Von R. Wilhelmi

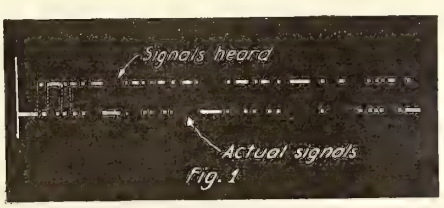
A New Inductance.
By Pierre H. Boucheron

Music by Radio Spark Tones.
By Reverend Georges Desilets

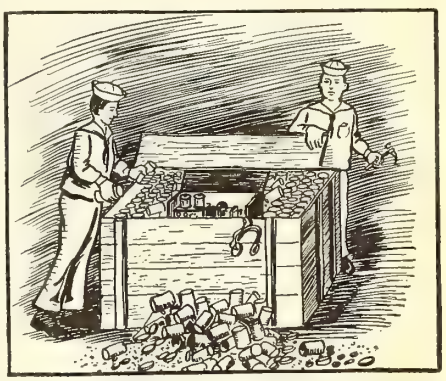
French Application of the Momentous Vacuum Tubes, Part II.
By Capitaine Metz



The "Phantoplex" Circuit As Officially Doped Out After Months of the Most Gruelling Investigation By Naval and Civilian Electrical Experts.



This Code Diagram Shows How, in the "Phantoplex" the Puzzling Signals Heard On Another Circuit, Are the "Opposite" of the Actual Signals Sent. It Looked Like "Spy" Work, All Right!



Medical Supplies Were Being Shipt to Mexico Very Suspiciously At the Start of the War. Finally An Investigation Of One Of the Packing Cases Verified the Suspicion That "Wireless Apparatus" Were Being Smuggled Into That Country.

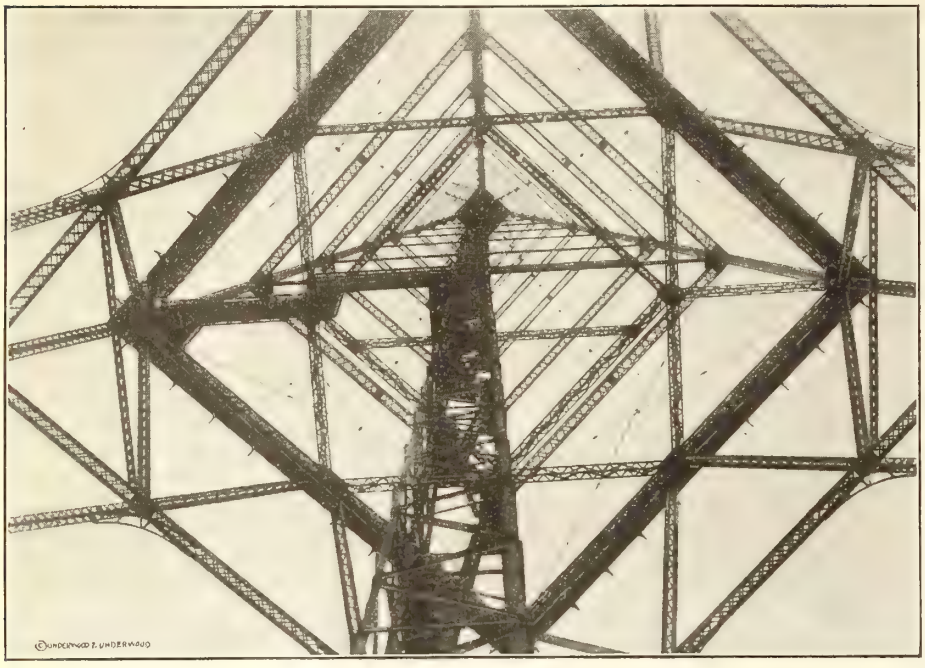
After due consultation we failed to arrive at a satisfactory explanation for the flashes, so a special investigator and myself were assigned to the case. That very night found us on the roof of a structure close to the Singer Building, from which we had an excellent view of the various night lights of New York, as well as of vessels anchored in the two rivers. During the consultation it had been decided that such a method of signaling might well be resorted to by persons unable to reach closely watched neutral vessels, and it was therefore a factor worthy of serious consideration. The reports had intimated that the signals occurred at frequent intervals during the night, so that shortly after nightfall found us keeping a careful watch of the various lights with the aid of two pairs of excellent German prism binoculars.

Up to 11 P. M. no suspicious flashes had yet been noted, so, as usual, I began to have my doubts. Finally the tenseness of the occasion failed to keep my eyes from blinking so we decided one would stay on watch while the other secured "forty winks." I won the toss of the coin, after which I retired to a convenient corner of the roof and finally dozed off. I must have been asleep an hour or so when I was suddenly awakened by my friend with the exclamations, "Look! Look! There they are—read them!" I looked in the direction of the Singer Building and there sure enough were the flashes, but altho I have had considerable experience in the dot and dash line, both oral and visual, I could make no sense or connection between these strange dots and dashes. O-ho, I thought, they are using a code of their own. The flashes continued for a few minutes and then finally stopt completely. After this

(*Continued on page* 203)

*Part I of this series appeared in the May issue.

600-Foot Radio Tower, Looking Skyward



Looking Skyward Up One of Arlington's (N.A.A.) Giant Steel Masts, Towering 600 Feet Into the Ether. No Wonder the Messages Fly Across the Atlantic Ocean.

The accompanying photograph shows a very remarkable view, looking skyward 600 feet, to the apex of one of the giant masts of the United States naval radio station at Arlington, Va. It was from this station that the major portion of all "radio traffic" was handled during the World War.

Increasing interest in the Arlington wireless has been recently aroused by the Senate's approval of a joint resolution to operate naval radio stations for commercial uses. This bill will authorize the Navy to continue its war-time ship-to-shore radio message business, and to accept for transmission commercial news messages at tolls not less than cost. Publishers claim that unless the navy system is continued it will be impossible to get news dispatches from the Far East, Porto Rico and other island possessions of the United States. Thousands of youthful radio aspirants who have rigged up little rival radio stations on parental roofs will be greatly interested in this unusual view of the aerial installation of the great United States naval high-power radio station at Arlington, which they know better perhaps as "N. A. A."—headquarters in the East for standard time, twice daily—at 1:00 P. M. and 11:00 P. M.

One of the old jokes in the radio game, used to be, "How would you like to be a lineman for the wireless company?" Of course, the answer was obvious—for, in the language of the classics, "there wuz no such animile!" but when we come to such wireless stations as that at Arlington where the gigantic steel towers lift their heads skyward 600 feet, the man who fills the job of what we might usually call the "lineman," has no sinecure you can bet. At most high power radio stations where these steel masts are used to support the lofty antenna, there is a steel ladder running up the side of the mast, and when the aerial wires need overhauling or have been broken by heavy winds, the maintenance gang have to climb these ladders to the top of the mast. In some cases, instead of climbing the mast, or up to various positions on the mast where a guide wire or two may need repair, the men are hauled to the top in a boatswain's chair, as it is called, which comprises a small seat or piece of wood with a rope back, or else a small seat made from canvas, and sitting in this, he is hauled rapidly to the top by a mule, engine, or man-power. A young lady radio enthusiast once made a trip in a boatswain's chair to the top of a 400 foot steel mast at the New Brunswick trans-Atlantic station, and described her experience as wonderful! We'll say it was. She couldn't help it.

New Wireless Portable 'Phone

The new wireless telephone instrument shown in the illustration herewith was invented by Mr. F. O. Read. It is said that this apparatus is so small and compact that it could be carried in the hand, as it measures 11 inches by 5½ inches by 4 inches.



New Portable Wireless Telephone With Which It Is Claimed that Messages from a Distance of Several Thousand Miles Can Be Accurately Intercepted and Read. The Receiving Set Shown Utilizes the Electron Valve or Audion.

The instrument is particularly intended for the reception of wireless telephone and telegraphic messages either on the spark system or the continuous wave or undampt system. Experiments are to be tried out presently with this apparatus in an attempt to receive messages in England, which have been transmitted from stations in Africa and Australia. Thanks to the audion or vacuum tube detector and amplifier, such long distances with extremely compact radio receiving apparatus has been made possible.

The experts of the Marconi company have from time to time intimated that in the near future we shall be able to pick up long-distance radio signals, such as the "time signals" from the Eiffel tower in Paris, if we happen to be in Europe, or from such powerful stations as that at Arlington, Va., in the United States, by the aid of a simple little wireless receiving set carried in our vest pocket. Some time ago there was described in the ELECTRICAL EXPERIMENTER a very small wireless receiving set which was capable of picking up the time signals flasht from Arlington, at 2500 meters wave length, at a distance of about 300 miles. This set could be held in the palm of the hand and had inductance coils wound with extra fine wire and especially made switches, with small contact points. A miniature crystal detector was fitted to the apparatus, and it could be used with a wireless 'phone of 1000 to 2000 ohms resistance. The apparatus devised by Mr. Read is said to cost about fifty dollars.

Radio Controls This Torpedo

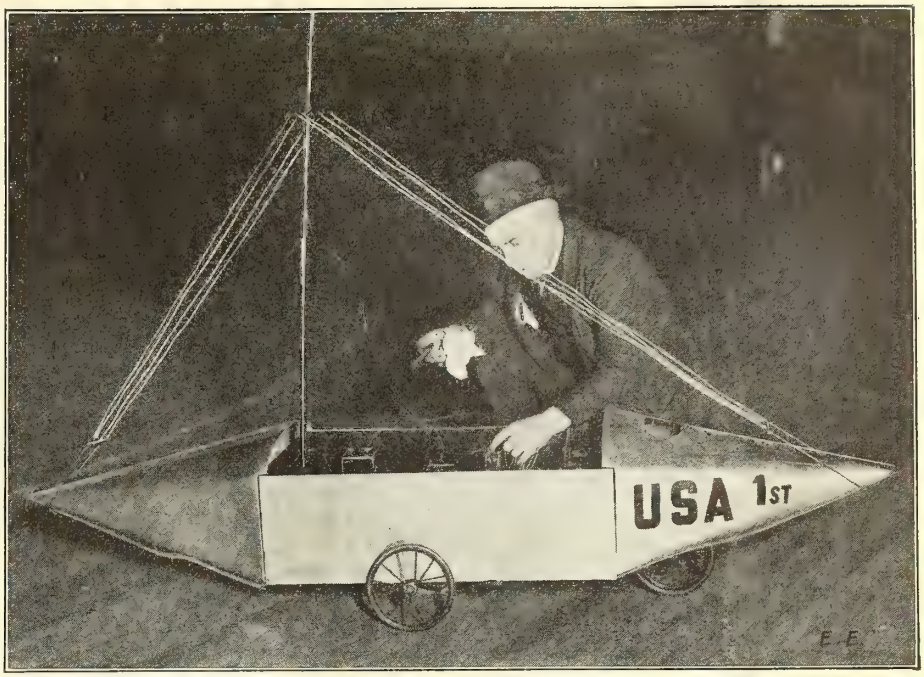
THE accompanying photograph shows a new wireless control torpedo invented by a New York inventor, Mr. E. F. Galvin, who recently demonstrated successfully the operation of this latest engine of war, at the 12th Regiment Armory in that city. The model torpedo used for this demonstration, was mounted on wheels, so that it could readily move over the floor.

By means of a wireless transmitting set, Mr. Galvin, seated at a table, directed at will the course of the model torpedo back and forth over the floor of the armory.

The inventor claims that by using this device, it will be readily possible to retrieve a torpedo that fails to hit its mark or that fails to explode. Mr. Galvin has been working on the details of his invention for the past six years. He is here shown in the photograph, together with the latest model of the torpedo which he demonstrated.

The science of *radio-dynamics* is undoubtedly one of the most interesting in the whole realm of wireless—just as much and even more so than it was in the early days of Dr. Marconi's early researches, when the immortal and always interesting coherer, decoherer and relay held sway.

We have not advanced very much along the line of coherers suitable for working relays and actuating various controls in a device such as this, but, however, due to the flexibility and several other good features of the audion amplifier, it has become possible to use a number of these bulbs, connected in cascade and to thus boost the weak incoming signals on the antenna to such an extent, that they will operate a sensitive relay, so as to close a local circuit controlling any desired amount of power—from a small signal or battery motor up to a 500 H. P. motor, or for that matter, several hundred or thousand horsepower.



New Radio Controlled Torpedo, Devised by a New York Inventor, Mr. E. F. Galvin. The Radio Waves Are Intercepted by the Antenna Wires Supported from the Mast.

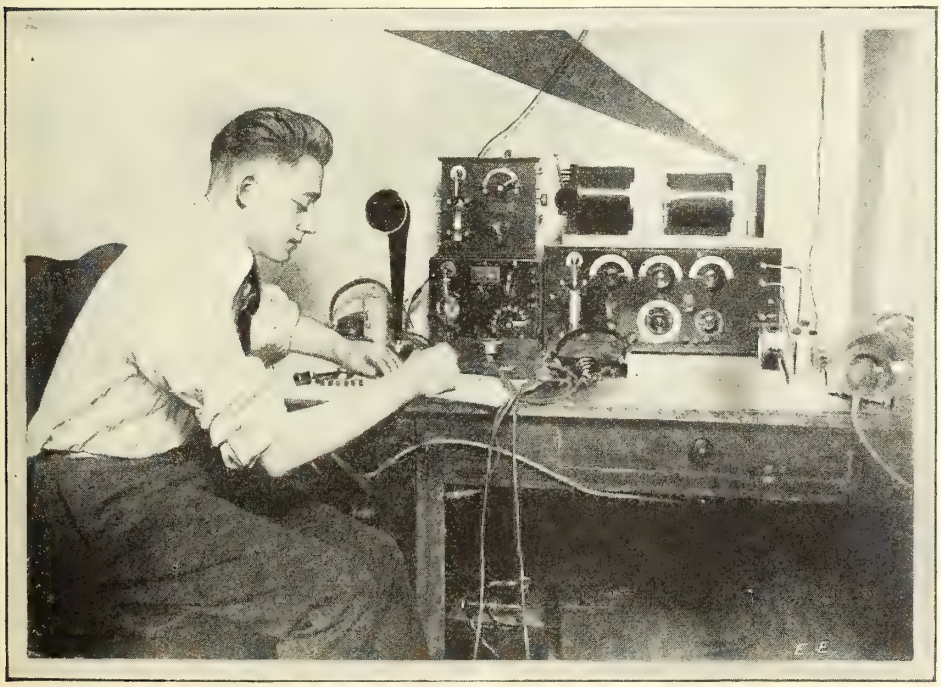
There is still a great deal of research work, however, which can be very well carried on for the benefit of radio-dynamics—toward the development of a reliable and yet sensitive coherer device, which shall be both low in cost and absolutely positive in its results. When confronted with this problem today, every radio expert will howl "*Audions*" to you, and, of course, they are right, but only partly so! They forget that audions cost money and plenty of it, and that the circuits and apparatus associated with audion amplifiers are always delicate and subject to considerable instability, mechanically and eletrically. Audions are a delicate proposition where severe vibration takes place, especially in such a small and rapidly moving object as a torpedo which travels with express-train speed, or sixty-miles an hour, thru the water, pitching and rolling like a teacup on the ocean. A positive coherer should be much more satisfactory than audions for this purpose.

Lost Sister Found By Radio

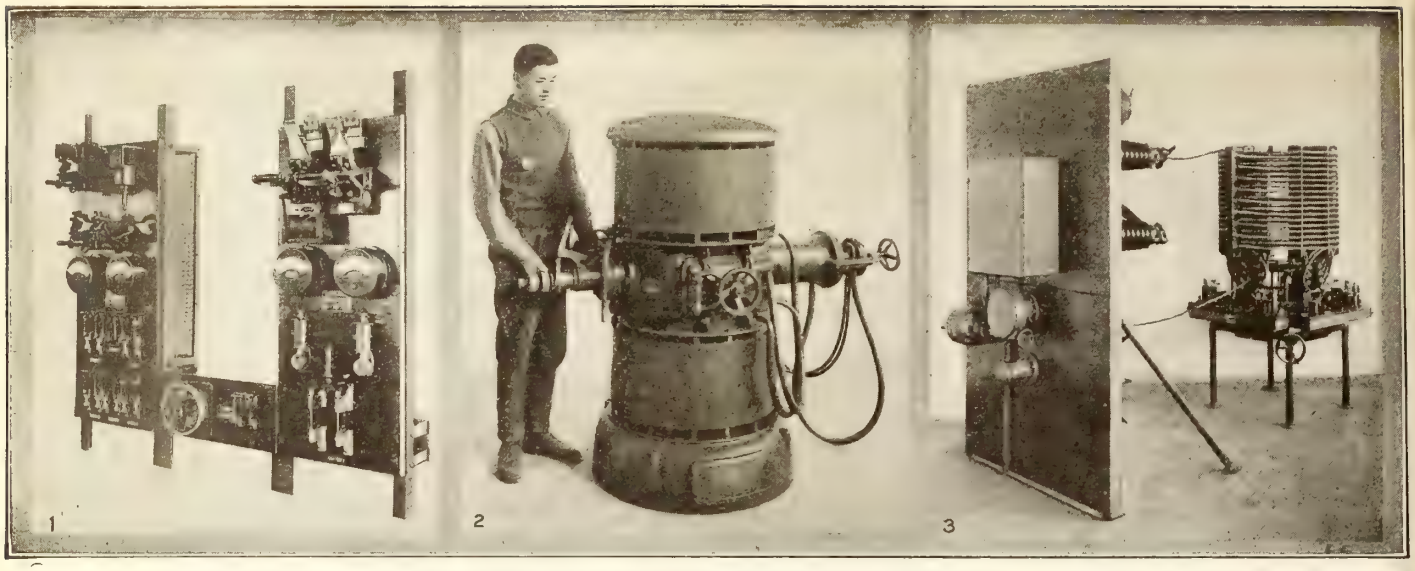
AMATEUR radio has proven once again that it is well adapted to perform deeds of service to mankind in more ways than one. One of the latest exploits of Radio Amateur science, is that of Mr. Lester Leroy Archer of Toledo, Ohio, who recently located his 17 year old sister, Miss Cleo Archer, by wireless calls sent out from his station. Mr. Archer and his mother had been searching for his long lost sister for thirteen years. No trace could be found of the girl since she had been placed in the Allen County Children's Home, near Lima, Ohio, until one of the many wireless appeals of Lester Archer succeeded in locating her. Her identity was established thru the aid of a brother amateur radio operator on a farm near Rockford, Ohio.

The apparatus here shown is Mr. Lester Archer's wireless set, which he has built in great part by himself.

This shows the versatility of radio telegraphy. One amateur delights his family circle by hooking up a "gang of audions" to his receiving antenna, so that they can hear phonograph records being played several hundred miles away, perhaps, while still others rend the nightime ether with their chit-chat talk about their "latest girl" and heaven-knows-what-else! while every now and then we run into a real hero like Mr. Lester Archer, who has shown us not only a new application of radio but also that he possesses originality and initiative in attempting to fling his wireless call over such a considerable territory, bent on what we would usually call an almost "hopeless case," that is, a girl lost for thirteen years, whom no one could hardly hope to identify from a word description or even from a photograph.



Lester LeRoy Archer and His Wireless Station, Located at Toledo, Ohio, Located His Sister Who Had Been Lost 13 Years, "Via Wireless." Great Work, Lester. And When We Get Some New Medals, You Get First Pick.



The Above Photographs Show Some of the Remarkable High Power Radio Arc Telephone Transmitter Equipment, Developed by an American Concern During the War. Passing Beyond the Wireless Dreams of Even Valdemar Poulsen Himself, This Concern Has Developed Powerful Arc Transmitters for Both Wireless Telephony and Telegraphy in Various Sizes Up to 1,000 K.W. Rating. The Triple Panel Switch-board Here Shown, Was Built for Controlling a High Power Arc Transmitter and Served to Control the Circuits of the Motor-Generator, the Arc Converter and Auxiliary Apparatus. The Photo Showing the Man Standing by the Large Arc Transmitter Illustrates the Huge Size of a 30 K W. Arc. The Third Photo Shows an Oscillation Transformer Developed for Tuning the Antenna Circuit of Arc Transmitters. The Signaling Relays Are Also Shown In This Photograph.

High-Power Radio Arcs

WHEN Valdemar Poulsen invented his famous Oscillating Arc, which today bears his name, and which is capable of quickly and very efficiently developing radio frequency currents of undreamt of magnitudes, he probably never thought that arcs rated at several hundred kilowatts, and even up to a thousand kilowatts, would be built some day.

However, as the accompanying photographs show, some very remarkable radio frequency arc generators have been built by the concern exploiting the Poulsen patents in this country. This concern has developt the Poulsen arc into a reliable and highly efficient generator or rather converter of direct or alternating current into a radio frequency current suitable for exciting an antenna such as used in all radio stations for the application of either wireless telephone or undampt wireless telegraphic transmission.

At the present time, there are in use in this country and abroad arc transmitters of the following sizes, which are manufactured by the American concern: 5, 20, 60, 100, 200, 350, 500, and 1,000 kilowatts. These arc radio transmitters are rated according to the normal amount of direct current power supplied to the converter.

The photograph herewith of an arc converter with a man shown standing opposite it, is a 30 kilowatt radio transmitter of this type. It is used to change direct current into radio frequency current as aforementioned, and shore stations of moderate power and the larger naval stations are frequently equipt with arc converters of this size.

Another view of modern arc transmitting apparatus for radio stations, which shows a double deck control switchboard for arc radio transmitting. A motor-generator set is required for converting the alternating or low voltage direct current into direct current of a more suitable and high voltage, averaging 450 to 600 volts, which is best suited for the efficient operation of the arc converters. The three panel switchboard here shown, serves to control the circuits of the motor-generator, the arc converter and auxiliary apparatus.

The third photo shows an oscillation transformer of recent type developt for tuning the antenna circuits of arc transmitters. This switchboard and helix are known as a wave changer and antenna loading inductor, as well as signaling relay system for a 30 kilowatt arc radio transmitter. The modern high-power radio arc transmitter is a very efficient and noiseless piece of machinery. The efficiency of these arc transmitters is surprisingly high, about ⅓ to ½ of the direct current power supplied to the arc being converted into radio frequency energy, in the antenna circuit. The arc flame is rated with a theoretical efficiency of 50%. These arcs much resemble the ordinary street arc lamp with which we are all familiar, but burn in a heavily enclosed chamber, filled with a gas containing hydrogen, and illuminating gas has been used very successfully in the arc chambers.

The two electrodes between which the arc proper is situated, is placed between the poles of two powerful electro-magnets, which produce a strong transverse magnetic field tending to blow the arc out. The negative electrode is usually composed of carbon or graphite, while the positive electrode is constructed of copper and arranged so as to be water cooled. Usually a small motor rotates the carbon electrode in these arcs, so as to cause the arc proper to burn evenly. This appartus has been so carefully and thoroly improved, that the only adjustment of the arc, is that occasionally required to adjust the length of the arc flame, until maximum antenna current is obtained.

With these large arcs and big electrodes the carbon poles are decomposed very slowly, thus making it possible to operate the arc converter for several hours at a time, with but few slight adjustments of the carbon feed mechanism now in use.

There are two forms of magnetic circuit used in the modern radio arc transmitter, the open and the closed type. Where a very strong magnetic field is necessary as in the large size arcs, the closed magnetic circuit is employed. For arc generators rated at 100 kilowatts or less, the open magnetic circuit is commonly utilized in practise, and this is the type used on the 30 kilowatt arc generator here illustrated.

The magnetic field is set up in the open magnetic circuit arc of this type, by two large field coils, situated one below and the other above, the arc chamber. In these latest type arcs, the usual choke coils used in arc circuits, are built as an integral part of this series winding, and help to energize the magnetic circuit.

In the small arcs rated at from 15 to 20 kilowatts, the field coils are wound with cotton covered magnet wire, in layers, with a series of vertical air ducts to properly ventilate the windings and properly carry off the heat from them.

The arcs rated from 30 to 100 kilowatts have magnetizing field windings, formed of a number of pancake coils wound with copper strip, with micanite insulation, placed between turns. The pancake coils are then separated from one another by means of Bakelite spacers, and the coils are provided with both vertical and horizontal air ducts.

The radio experimenter will find the subject of oscillating arcs of extreme interest for the purpose of producing high frequency oscillations for wireless telegraph and telephony transmission. There are also many other wonderful phenomena which are produced by the tuned oscillating arc of Poulsen. One of the most interesting phases of this subject is the "speaking" arc, and in fact, this was one of the first fundamental experiments and facts on which the use of the arc for wireless telephony and telegraphy was developed. The "speaking arc" comprises the usual arc, preferably of the hand-fed type for experimental work, shunted by a large capacity and inductance. Suitable choke coils are placed in the D. C. supply circuit, one choke in each line and the voice currents are superimposed on the arc by means of a microphone and a telephone induction coil or small spark coil. The microphone is connected with several batteries, in series with the primary of this coil, and the secondary is sometimes shunted across the arc with a condenser in series.

As aforementioned, illuminating gas is used in the arc chamber when available, and alcohol is the hydro-carbon used frequently in the small size arc transmitters. Kerosene or coil oil are often used for high-powered, short-wave arcs.—*Photos courtesy Federal Telegraph Company.*

A Long Wave Vertical Coupler

Herewith I present a diagram of a long wave vertical type loose coupler, designed primarily for the comfort of the operator. As it will be noted, all the control elements are as near the table as possible. The great objection in having a long wave coupler is that one has to reach some three feet, either sidewise or vertically, to vary the secondary coil's position.

The primary and secondary are wound with No. 28 and No. 30 wire respectively. However, this does not have to be adhered to by the constructor as a mineral detector might want to be employed. The number of taps to be used lies with the builder.

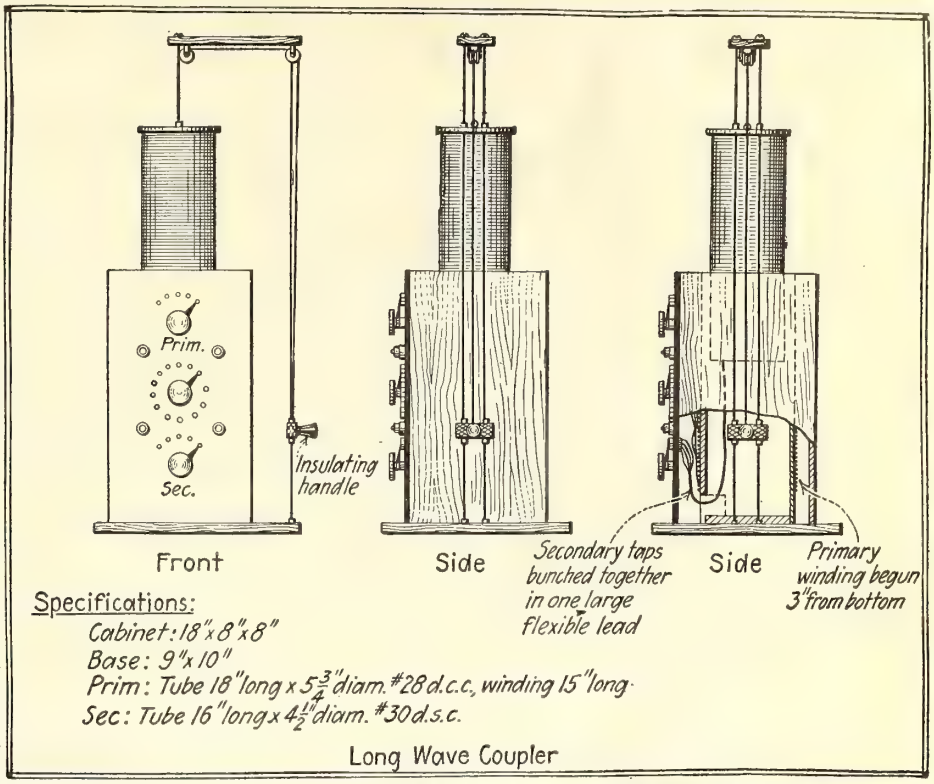
An Ingenious Radio Stunt—Why Not Build a Vertical Type Loose Coupler? The Movement of the Secondary Is Accomplisht by the Change of Position of the Handle, Which Is So Arranged as to Balance Almost Exactly the Weight of the Secondary. The Slight Friction of the Taut Copper Wires Is Sufficient to Hold It in Place.

With a coupler of this sort, all the good merits of the usual affair are preserved but all its disadvantages eliminated.

I hope E. E. readers will benefit by building this design of coupler.

This vertical radio cabinet may be made out of wood, stained and polished, with a bakelite front and may be mounted so that even the sliding secondary may be concealed within. Very large loose couplers may be made in this manner and long wavelength reception easily obtained. A large loose coupler always is far more effective than a small one no matter how many loading coils are added to it. The coil measurements are clearly indicated in the diagram at the right.

Contributed by JOSEPH PIGNONE.

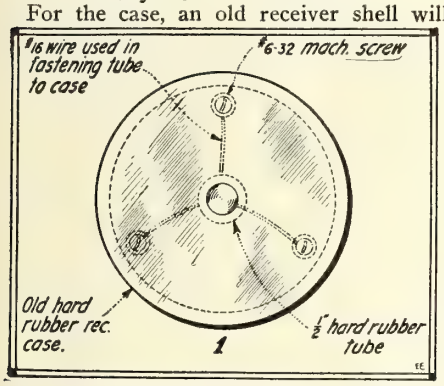


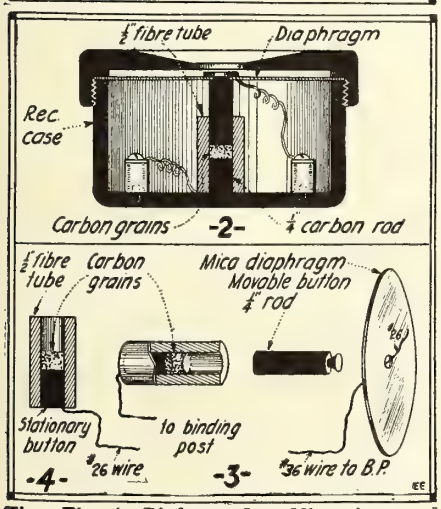
Long Wave Coupler

Building a Mica Diafram Microphone

Many readers have probably heard of mica diaframs being used on wireless receivers. Why not on transmitters?

For the case, an old receiver shell will do, but it should be either hard rubber or composition. First remove the magnets, leaving the binding posts to use for the transmitter. Next a piece of fiber or hard rubber rod will be needed. It should be one-half inch in diameter and one-half inch to three-quarters of an inch long. Drill a one-quarter inch hole thru the middle of this, to hold the carbon grains and the carbon buttons. Two carbon buttons will be required and these can be made from one-quarter inch carbon rod with faces polished.





The Finest Diafram for Microphones Is "Mica," but Very Few Have Mentioned Using This for Such a Purpose. Here Is One which Promises to Have Great Favor With the Amateurs.

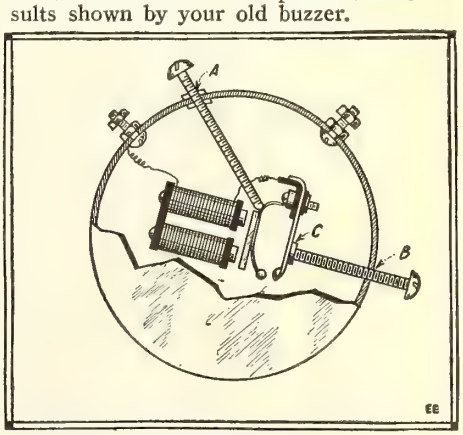
The movable button is attached to the mica diafram and should be ground down slightly on an emery wheel or with emery paper, so that it will move freely in and out of the fiber tube which holds the carbon grains. The mica diafram should be the same size as the tin diafram formerly used on the receiver, and a hole large enough to receive the movable button should be drilled in the center. Diagram 3 shows the shape of the button and method of fastening it securely to the diafram. Insert a piece of No. 26 bare copper wire into the hole in mica diafram and then insert the carbon button into the same hole. Wind the wire tightly around the button and apply a small amount of solder on the wire to keep the carbon from slipping out. The stationary button is fastened tightly in the fiber tube by wedging it in with a piece of No. 26 copper wire, which thus forms the lower connection and should be soldered to one of the binding posts. Fasten the fiber tube to the bottom of the case with cement or glue, being careful that it is in the exact center. After this dries and the carbon grains (best to purchase them; they must be polished) have been placed in the tube, make connections to the movable button and the binding post by a piece of No. 36 insulated wire and place the diafram in its usual place, making sure that the movable button does not stick. Place the cap on the shell and it is ready for use.

Contributed by HOWARD WILLSON.

Making Test Buzzers Adjustable

Many amateurs are now studying the code with their buzzer practise sets. These buzzers in most cases are non-adjustable. I found that the note of these buzzers could be increased one hundred per cent by the following method: Drill and tap holes at A and B in Fig. 1, for 6-32 screws. Insert two such screws at these holes. The one at A should be 1¼ inches long, and the one at B, one inch long. Insert a piece of fiber ½ inch square, at C, between the screw and the brass.

To get the best note, adjust the two screws. You will be surprised at the results shown by your old buzzer.



A Simple Wrinkle for Making Small Test Buzzers Adjustable.

Small test buzzers, particularly, are usually hard to adjust with any degree of precision. This stunt makes it easy to accomplish the desired adjustment in a few seconds. Where the buzzer is noisy and troublesome, as in making wave-meter measurements, it is best placed inside a box filled with cotton or felt. This absorbs the sound of the buzzer and enables sharp measurements to be made easily.

Contributed by ISRAEL WOOLF.

WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER—FRED C. DAVIS

IN my laboratory, the smallest on record (with the most junk in it), there are two hundred different chemicals, for chemical experiments and analysis, followed thru the chemical lessons printed monthly in the ELECTRICAL EXPERIMENTER. I have a four-inch telescope to view the stars, which I use in carrying out the instructions given thru lessons in the "E.E."

The electrical equipment is extensive and practicable. The "Lab." is lighted by five nitro globes. Also, one part is devoted to a photographic outlay where I print and develop all my own photos. An electric printer is another one of the many useful apparatus to be found in my establishment. I also have a red electric light. Four spark coils repose gracefully upon the book case, containing files of the "E.E." and copies of the "Experimental Electricity Course" and "Wireless Course". A loud-talker is connected to the parlor, a step-down transformer at its right. I also have in my possession mechanical spring motors, electric motors and almost everything necessary to complete the "Bug's" gamut of happiness.

It was thru the ELECTRICAL EXPERIMENTER that I obtained help in fitting out my laboratory to the best advantage.—Fred C. Davis, 1018 Vine St., St. Joseph, Mo.

HONORABLE MENTION—WILLIAM LILLY $2.00 PRIZE

THIS is a photograph of my electrical apparatus. I have in my work-shop one induction motor 1/30 H.P.; one Tungar rectifier, with which I charge my friends' storage batteries; a toy transformer fastened underneath the table which operates small lamps of low voltage; small electro-magnets of different kinds; some test lamps and call bells; and numerous other appliances, too numerous to mention here.

I have a small wireless set which I constructed myself, and an Erector set with which I can build many useful things and run them with the electric motor supplied with the set. I also have a very fine set of books, the "Proceedings of the American Institute of Electrical Engineers", the "Hawkins Electrical Guide," and "Standard Wiring for Electric Light and Power".

In my "Lab." can be found a full set of electrician's tools. As you will see in the photograph, there are two wet cells and several kinds of acid and various other materials for performing interesting experiments.—William Lilly, 512 East St., Madison, Ind.



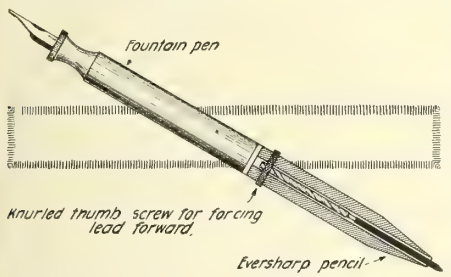
What To Invent

By JAY G. HOBSON

ONE THOUSAND DOLLARS AWARD,

WILL be given in cash for an improved shoe polish box opener if adopted by a large Buffalo, New York, polish manufacturer.*

They want a practical box opener for their shoe polish box. The opener must not perforate the top or bottom of the box, either before or after opening it. This is very important and will not permit of rivets or other holes.



Why Doesn't Someone Invent a Simple and Cheap—We said It, CHEAP—Combination Lead Pencil and Fountain Pen, as Mr. Hobson Points Out, so That When We Want Either a Pencil or Fountain Pen We Have It in Our Pocket and Not Ten Miles Away.

The box must be absolutely airtight. The opener must be easily attached and such as will nest or pack well with the box in the regular one dozen sized cartons.

It should be low in cost and attractive as well. For any such acceptable improvement they will pay $1,000, cash, the inventor to show good title to the improvement and to convey the rights of same to the manufacturer.

Here is a splendid chance for our readers to exercise their inventive talents and possibly win the thousand dollar prize for a simple tin box opener.

Perhaps the accompanying idea will do the trick. One in the shape of a small lever secured to the top portion of the box, and when lifted upward raises the lid easily.

Something similar to this arrangement should prove acceptable and land the bag of yellow gold.

COMBINATION FOUNTAIN PEN AND PENCIL.

Will someone kindly invent a practical non-leak pen and ever-sharp pencil combined as one, about the same size as the popular fountain pen in wide use to-day,

If so, I, for one, will gladly shout his praise from the housetops because (and many will agree), the writing tools are forever becoming separated.

When a "Feller" wants his pen nothing but his pencil is in evidence, and vice versa. Hitch them together in a compact combination like the illustration, and I'll be your first customer, and a walking advertisement for a necessity that will sell like hot cakes. The retail cost of a combination of this kind should run less than separate cost of present designs.

MOTORCYCLE IMITATOR.

Recently I had the pleasure of visiting some friends living in a small Southern town. One little boy, by the name of "Billy," blessed this particular household.

Billy owned a nice red bicycle, with coaster-brake and everything for trimmings, but the ambitious little chap was not satisfied. He would leave his pretty wheel setting on their front porch where the envious eyes of the less fortunate youngsters devoured it as they passed on their way to and from school. He simply was tired of riding it.

But this particular day was a holiday, so Billy, for some personal reason, rode his flyer considerably all forenoon. I was sitting on the porch talking with his father when he came flying up the sidewalk like a red streak. Reaching the front steps he exclaimed: "Daddy! I'm tired riding that old wheel, I wish I had a big, noisy motorcycle."

His father replied that, some day when he was older, perhaps, they could afford to get one.

An idea struck me between the eyes about that time, and I joined in: "Say, Billy, how would you like for me to make a motorcycle out of your bicycle right now?" I suggested as I pulled out my knife, getting up to hunt for a stick. "Oh, gee!! Can you do that, Mr. Hobson?" Billy inquired, somewhat puzzled.

"You bet your boots" said I assuringly. So Billy, his Dad and I went out to the wood house where I soon fashioned an apparatus for imitating the sound of a real motorcycle, something on the order of the illustration herewith.

Billy and I fastened it to the frame of his bicycle about half-way between the seat and the hub, so the point of the imitator touched the spokes of the rear wheel.

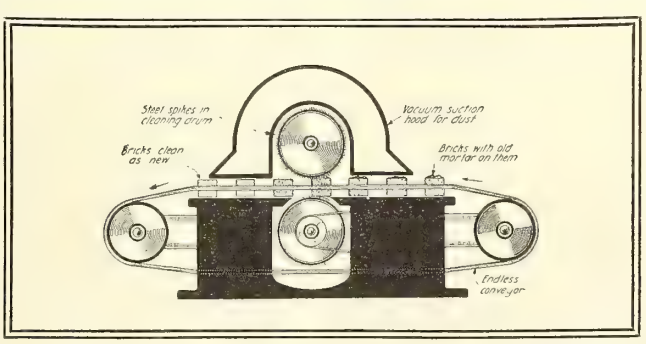
When the wheel turned each spoke hit the prong of the imitator, and this noise sounded very much like the "put-put-put" of a motorcycle engine at high speed.

Billy was delighted with his imaginary motorcycle, and the last I saw of him, before leaving, was a proud boy humming down the main street.

This little device may seem too simple for worth commercially, but I am positive they would sell at 25c to 50c each, to every boy owning a bicycle, if they were attractive in appearance and made to imitate a motorcycle properly.

BRICK CLEANING MACHINE.

A bad fire had gutted the entrails of a large brick store building some months past, but left the tall walls standing in defiance of the hot destructive hands.



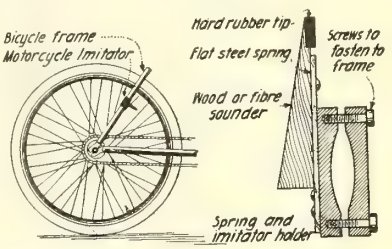
Instead of Hiring a Large Number of Men at a Considerable Wage to Clean the Old Mortar Covered Bricks when a Building is Razed, Why Not Invent a Machine Similar to the One Here Shown Which Would Clean the Bricks Rapidly and Thoroly? A Simple Machine of This Type Could Be Sold for a Hundred or Even a Few Hundred Dollars, to Contractors All Over the Country, at a Good Profit. One Man Could Work It.

The owners having collected the insurance were feverishly razing the remains to make room for a new fire-proof building.

Colored laborers were sitting on pyramid-like piles of old brick pounding the mortar from them, as it was desired to use the best of the old brick on the foundation of the new building. Knocking the hard mortar from each brick with a hammer was surely slow and expensive work.

I was both amused and interested at this procedure, for the dusty workmen sang funny songs, keeping the proper tempo with every blow of their hammers.

While enjoying this bit of comic scenery, an idea flashed aboard, picturing an efficient *brick cleaning machine* similar to the drawings.



While Spending His Vacation With Some Friends, Mr. Hobson Noticed That the Young Son of the Family Had Become Very Melancholy Because His New Bicycle Was Not a "Motorcycle." Questioning Developed the Fact That He Liked to Hear the "Put-Put" of the Latter. With a Little Ingenuity, the Device Shown Was Quickly Made, and Which Produced the Much Desired Noise.

A powerful machine embracing a metal or wooden frame with two large round drums carrying spikes about half inch long on their circumference. A conveyor chain between these drums. This conveyor is pocketed with oblong holes the shape of the brick. Old bricks placed in the conveyor are carried between the two large revolving drums, which cut the mortar from their surface, making them as clean and useful as new.

A practical machine of this description is badly needed by wrecking companies, contractors and brick concerns.

Success for an invention of this nature is assured, and the inventor who gets there first will make an independent stipence or I miss my guess.

A brick cleaning machine, which would probably require half a horse-power to operate it in good fashion, could be driven very nicely from a small gasoline engine, such as those used on large construction jobs by contractors. There are several fractional horsepower gasoline engines available on the market at a low price. In some cases, it might be more expeditious and just as economical to drive the brick cleaning machine with an electric motor, as it frequently happens that current is available on construction jobs, or from a building nearby.

There is plenty of room for several more inventions along this line, having to do with brick and stone work. Several years ago, there was a demand made on a firm of engineering designers, for a brick-crushing machine which resembled the one just described, so far as its size and cost were concerned.

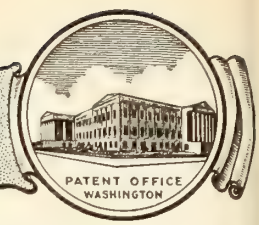
A street repair company wanted to have this machine crush old bricks, etc., and refine them down to a small degree, in fact almost to a powder so that the resulting substance could be mixed with cement and become very efficient mixture for covering holes in street pavements and the like.

*Name sent upon request and stamped envelope.

Copyright 1920, by J. G. Hobson



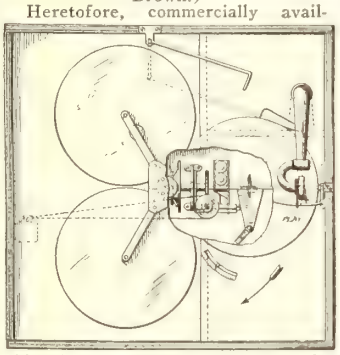
LATEST PATENTS



Multi-Record Phonograph.

(No. 1,334,076, issued to Robert G. Brown.)

Heretofore, commercially avail-

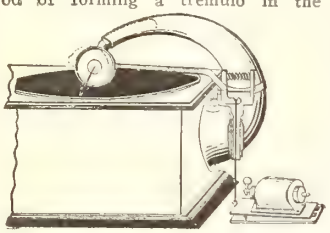


able phonographs using disc records have had no provision for automatically playing a succession of records. The inventor of this device has constructed a machine which automatically plays in succession, any predetermined group of records performing all the functions, such as lifting the stylus, substituting another record and placing the stylus in the proper starting position, so that it may play thru the next record. A magnetic trip turns the tables around, a clutch having released one table then grips another table upon which the second record is placed. Its engagement with this table causes the phonograph to operate without interruption.

Phonograph Vibration Device.

(No. 1,333,726, issued to Mervyn O'Gorman.)

Various means have been tried for producing a definite feeling of expression from phonographic machines so as to modulate the sounds and music. In this recent patent the inventor has originated a method of forming a tremulo in the

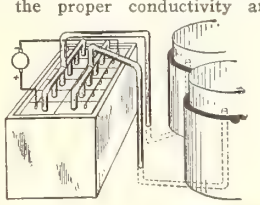


voice, whether this has or has not been produced in the record, and making the tremulo under control of an operator. For producing this, the sound box of the tone-arm is rapidly vibrated back and forth ⅛ of an inch by means of a motor, which motor has an off-balance weight attached to its shaft so as to cause a vibratory action similar to the vibrators on the market at the present day. This is accomplisht thru a system of levers.

Oxygen and Hydrogen Generator.

(No. 1,334,668, issued to Gustave Miller.)

There are a number of cells having suspended electrodes so that one row will have anodes and the other cathodes. This means that one cell will generate oxygen only, and another hydrogen only, due to the electric decomposition of the water, sodium hydrate being added to produce the proper conductivity and

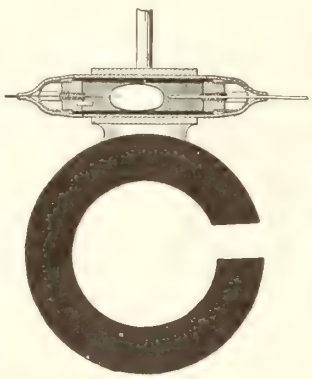


an E. M. F. of about three volts employed. The anodes and cathodes themselves are open-ended pipes, hence providing a maximum area of the electrode surface for the generation of the gases.

Electrically Driven Clock.

(No. 1,334,422, issued to Henry E. Warren.)

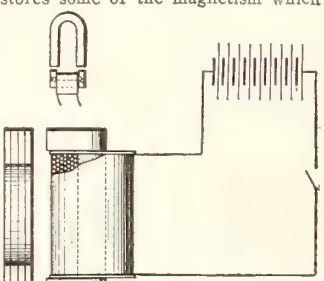
This is an improvement upon Mr. Warren's electrically driven clock described quite some time ago in our magazine. It consists of small hermetically sealed glass tube with two contact-making devices, one in each end. A globule of mercury sliding between the two pins will make contact with them for a greater or shorter length of time, depentent entirely on the extent of oscillation. Another contact has a quenching action so that the oscillations of the pendulum are under constant control, regardless of what conditions of charge or discharge the clock battery may be in.



Controlling Field of Magnets.

(No. 1,334,531, issued to H. S. Folker, & D. M. Birdstrup.)

This is a method for dispensing with the movable keeper now universally in use in connection with permanent magnets used in railway signal work, by placing a solenoid a short distance from the poles of a permanent magnet, so that the poles of the latter will conflict and will be opposite to the polarity of the solenoid. A solenoid with greater magnetic force than that in the permanent magnet is provided. When the solenoid is energized, it deflects the field of the permanent magnet and during such deflection also restores some of the magnetism which

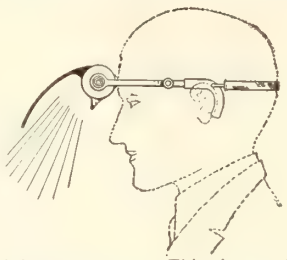


may have leaked out from the permanent magnet, due to the fact that its poles are not joined by a keeper.

Reading Light.

(No. 1,333,830, issued to Charles S. Burton.)

This invention embodies a reading light and eye-shade in one, adapted so that this light can be operated from either the regular current or from a pocket battery. Two pads prevent the device from affecting the forehead of the user and collapsible arms on either side make it resemble a pair of spectacles. An elastic band stretches across the back to hold it in position. A small tubular lamp is used for the

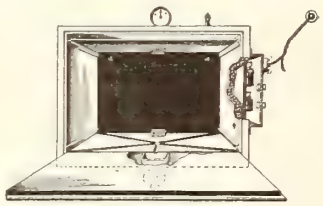


lighting purposes. This is nearly surrounded by a shade which prevents the glare from affecting the eyes and illuminates the material.

Electric Oven.

(No. 1,336,105, issued to Frank M. Sutton.)

Aside from the fact that it is a "fireless cooker," there are many other clever novelties. In the first place, it has an electric thermostat which can be regulated so that a temperature between any practical limits can be maintained. In addition, to this an automatic clock device maintains the current on for a definite period whence it can either be put off and the fireless cooking action of the stove utilized, or the current can be interrupted intermittently by the clock acting as pilot thru a relay. Resistance wire comprises the heater element. A pilot lamp is located on top and a furrow in the base permits any gravy, etc., to run forward into a special receiving chamber.

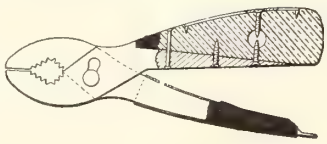


Spark Plug Tester.

(No. 1,333,698, issued to Ernest I. Bass.)

A combined tool which will act as a pair of pliers, also fitted with the usual double pivot hole, whereby the distance between the jaws of the pliers may be changed in order to grip nuts or pipes of larger or smaller diameter, acting as a wrench. Non-conductive material such as fiber is used on one handle, two screws extending to a hole in the center of it so that the spark plug test can there be made. The other end of the pliers constitutes a screw driver. It is not necessary, therefore, to remove the spark plug of an engine to find out if the same is in good condition. The space between the screws in the handle of the tester will have a hot flaming spark fly across it if the plug is not at fault. This test can be made in a few seconds.

Combination tools of this nature always seem to have taking ways when it comes to the motorist's side of the story, as he can make his spark plug test, remove the wire or remove the plug without the necessity of a handful of tools. The design is rugged and the quadruple tool unique, promising a good sale.

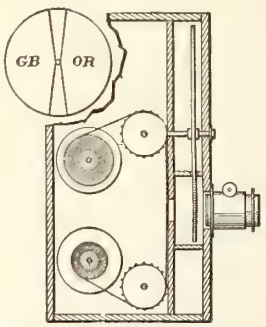


Colored Moving Pictures.

(No. 1,333,730, issued to C. Raleigh & W. V. D. Kelley.)

In various patents for the production of motion pictures in colors, methods are described which utilize a "color filter" made up of the three primary colors, so that the filter is used both in taking and projecting its films. This necessitates about 48 pictures per second, otherwise the pictures become very jerky. In this new invention, however, a screen is divided so that each factor is made up of two colors, such as red and blue, and the next blue and green, etc. This allows for a blending between the two successive images and relieves eye strain, because two of the three nerve color centers will at all times be excited. Simultaneously, it reduces the number of pictures per second to 24.

Of course, when the pictures are projected, a means for synchronizing the color filter with the motion picture films is used, thus one picture will be projected thru the green-blue side of the filter and another thru the orange-red side of the filter. This proceeds rapidly

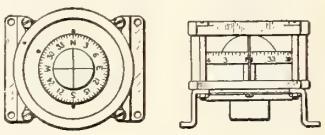


so that the light which is emitted thru the film is simultaneously colored, prior to its exit thru the forward lenses in the projecting camera. Retention of vision, in this case, also making itself noticed, otherwise instead of a perfect blending of colors obtaining by this method, a series of rapidly interrupted flashes would result. The idea of having two nerve centers in the brain continuously affected seems to be quite novel and different from other similar methods of color motion picture projection using filters.

Magnetic Compass.

(No. 1,334,273, issued to Charles H. Colvin.)

A new improvement in magnetic compasses has come to light with this recent invention, particularly to be used in airplane work. Like all modern compasses, it is suspended in a transparent container, and



floated in a liquid to decrease erratic action. Its novel feature being the employment of two separate cards, one to be read from the top and another from any side. In this manner, the horizontal and vertical cards can be observed by several individuals stationed at different points, the latter differing from the former by 180 degrees. The compass therefore can be read from either side, front, back, and from the top. In this way, the pilot and navigator can both see the compass and obtain their own reading for the particular result they are looking for. An expansion chamber is also provided which compensates for liquid expansions, due to temperature changes.

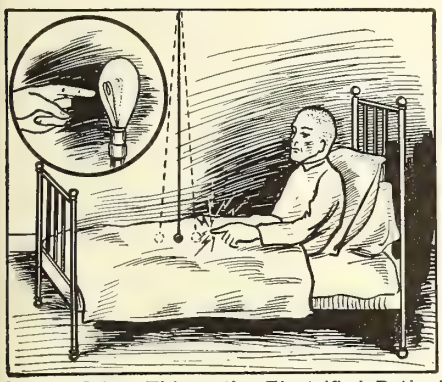
Poisoned Convicts Become "Electrified"!



One of the First of the Phenomena Noted in the Case of "Botulinus Poisoning," Caused By Eating Decayed Canned Salmon, Was That the Body of the Patient Had Become Highly Electrified. He Was Unable, for Example, to Throw a Piece of Paper in the Waste Basket, the High Electric Charge in His Body Attracting the Paper to His Hand.

AS per schedule, the case of the thirty-four convicts at Clinton Prison, Dannemora, N. Y., who became poisoned by eating canned salmon, and thereafter developt remarkable electrified propensities, was fed to us for several days by the ever-busy newspapers, under the captions of "human magnets" and what not. The facts in the glaring case are here persented for the first time.

The following details relative to *botulinus poisoning,* which took place at this institution, February 20th, 1920, are cited in a letter which we have received from the chief physician at Clinton Prison, Dr. Julius B. Ransom. Dr. Ransom says:

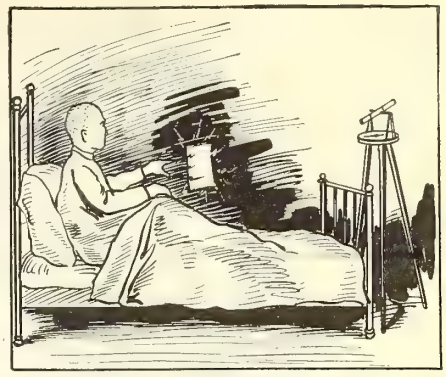


Among Other Things the Electrified Patient Was Able to Move a Suspended Steel Tape Measure and Also to Attract the Filament Of An Incandescent Lamp Towards the Side Of the Globe.

"Dr. Rosneau, of Harvard University, did not make any investigations of the *electric phenomena* and only came into the case with reference to the *botulinus poison,* as it was a rather large group of cases and opportunities for study were unusually good. Of course the newspaper reports were garbled and exaggerated as they usually are when they attempt to report scientific matters. The newspaper accounts were taken from a report made by myself to the Superintendent of Prisons, setting forth the history and development of 34 cases of *botulinus poisoning, due to the eating of canned salmon.*

"During the course of these cases it was discovered by accident that peculiar static electric power had developed in the patients. It was discovered in this manner. One of the patients who was convalescing crumpled up a piece of paper, I imagine in both hands, and attempted to throw it in a waste basket; it absolutely refused to leave his hand. From this time on experiments were made, and the matter was reported to me, and I found that *every* case of *botulinus poisoning* developed this strange power, and that neither the attendants nor nurses associated with them had any such power. All sorts of experiments have been tried and it was found to be a constant condition; that is, that this peculiar power of creating a magnetized (electrified) field by rubbing the hands together, which puts them in circuit, will electrify different objects, so that they will retain that electrification for many hours. For instance forms of paper, such as newspapers, and ordinary correspondence paper when electrified by these patients and thrown against the wall adhered and clung to any object for many hours. By again rubbing the hands together and rubbing the electric light bulb the filament will begin to vibrate very rapidly and follow the motions of the hands, and attach themselves to the side of the bulb with a good deal of sparking at the base of the filament. The compass needle of a surveyor's instrument can be rotated with any piece of paper electrified by these patients. A steel tape suspended, will feel the magnetic field in a remarkable manner and sway from side to side.

"What relation there can be between the botulinus toxin and this phenomena of course is difficult to identify; it has been suggested that it is the *dryness of the skin* which prevents the ordinary passing out or dissipation of the electric currents from the body; *but the patient submerged in bath tub performs the same phenomena as when clothed!* The ability to electrify is proportioned to the severity of the disease; as the patient convalesces he gradually loses this power and when quite well loses it altogether.



Another Phase of the Electrified Paper Phenomenon, Due to the Patient's High Potential Electric Charge Occasioned by Botulinus Poisoning. A Sheet of Paper Electrified by the Patient Would Remain Against the Wall for Hours. He Was Also Able to Move the Compass Needle of a Surveyor's Instrument.

"I might mention further that all these cases were ataxic and developed peculiar reflexes. Many of them were almost entirely blind and had paralysis of the upper lid "Ptosis." Of course, in *botulinus poisoning* the nervous system is about the first to suffer; one thing is quite clear, therefore, static manifestation is closely linked with the disturbance of the central nervous system and represents, no doubt, simply a much higher degree of static storage in the body than is usual."



Electricians Argued That If the Patient Was Placed in a Tub Full of Water, That the Charge Would Disappear, But Strangest of All It Did No Such Thing—and the Patient Was Still Able to Attract a Steel Tape Measure or Other Object By Electro-static Attraction.

Study Astronomy

By Arnold H. Kamiat

Of what value is a knowledge of astronomy? There are those that think it of little or no value to the average man. Their objection is based on the seeming remoteness of astronomic phenomena from the affairs of life. It is not a practical study, they say. "What," they ask, "is there in the subject that any one can put to use in the guidance of his course thru life?"

To these critics, as well as to all who have never studied astronomy, the author wishes to address himself. A study of the subject is of practical value. It furnishes the student with an opportunity for the culture of more than one instrument capable of being used in the pursuit of life's aims. As evidence of this the author submits the following propositions:

First, there issues from the task the benefit of a broadened mental horizon. One is provided with an insight into the nature of the universe of stars and planets. Of what value is a broad mental horizon? Among other things, it bestows upon its possessor a more exact comprehension of the relative importance of things and events.

Thus is made possible the issue of a second benefit, namely, a sharpening or refining of one's sense of proportion. This is a valuable mental acquisition, particularly for the person desirous of co-ordinating into a practical philosophy the numerous and varied elements of his stock of knowledge.

Third, persons of romantic impulse will find a means of satisfaction in the study of astronomy. Absorbingly interesting is the picture of bodies and systems of unthinkable size, poised in the inconceivably vast celestial area. Impressively grand is the spectacle formed by the play of forces most gigantic, traversing vast distances and bridging aeons of time in their interplay. And mysteries—no Sherlock Holmes has faced more mysteries, or more profound mysteries, than those the astronomer is called upon to solve.

Fourth, the person in quest of a proper understanding of scientific concepts will find here a valuable aid. Celestial phenomena present clear and distinct demonstrations of physical law. The flaming stars are scenes of fiery interplay of elements known to terrestial chemists. The student of geology will find light on the question of the earth's origin and growth. Evolution may be studied in the birth, development and death of planets and solar systems. The universality of natural law may be seen clearly manifesting itself in the farthermost regions in space and the most infinite lengths of time.

Begin, therefore, this most pleasant and instructive task.

STUDY ASTRONOMY.

It Is To Laugh

Misfortunes never come singly. No sooner does Mr. Gernsback announce his physiological music, to shock deaf people into feeling silent "music," so that they can dance, than an Indiana Hayseed stuffs his hens full with music, to coax more eggs out of them. Rank imitation we call it.

This Indiana farmer—Habig is his eggs-act name—not only forces his unfortunate hens to listen to the music as the phonograph grinds out its notes in the kitchen, as he used to do, but he has installed the phonograph right into the hen house where 122 Orpingtons and Plymouth Rocks Buff Cochins and Brahmas dwell together in peaceful industry. The result is that, whereas formerly he gathered 65 eggs in one day, he now collects 115.

It must be carefully noted that Mr Habig's musical hens so far have only been reared on Jazz music; yes nothing but pure Jazz. They like it best, to the exclusion of all other "highbrow" or classic music.

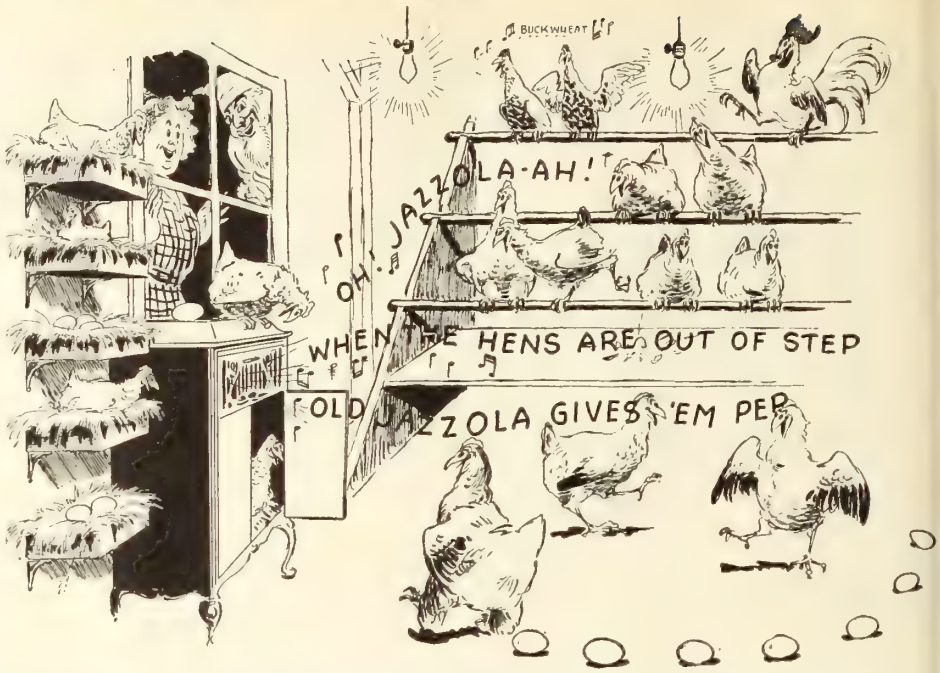
Do musically produced eggs—with Jazz—give us omelets that shimmy?

Imagine eggs influenced by the strains of the Marseillaise? Gosh, but won't this make *fiery* ham and eggs! No need to even fry them—no doubt they are fiery enough!

On the other hand, ponder about the effect syncopated and futurist music must have on the poor hen. Surely you couldn't blame her if she were to lay scrambled eggs!

But this is far from the worst. Suppose we *hatch out* such musically produced eggs! Will the new chicks shimmy, dance, waltz or fox-trot, all depending upon the records their mothers were listening to?

But the end of atrocities is not yet. Soon every egg will be branded with its particular brand of music, under which it was produced.



An Indiana Farmer, Habig by Name, Has Found That by Playing "Jazz" Tunes on His Victrola, Placed in the Chicken Coop, That His Chickens Become so Full of Pep That They Lay Eggs Faster Than He Can Gather Them Up,—Almost!! For Guinea Hens, Echoes from Verdi Are Appropriate.

Thus you step up to the egg counter and select your eggs suited to the particular tastes of your family.

For father's breakfast: *"Vamp the lady."*

For Jimmy's breakfast (aged 19): *"Spring Song."*

For Betty's breakfast (age 16): *"Kiss Me Again."*

For Mother-in-law, breakfast, lunch or supper: *"Good-bye Forever,"* or *"Funeral March,"* by Chopin.

For Alice's breakfast (she's a switchboard operator): *"I hear you calling me"* and for supper: *"Ring out, Wild Bells,"* by Gounod.

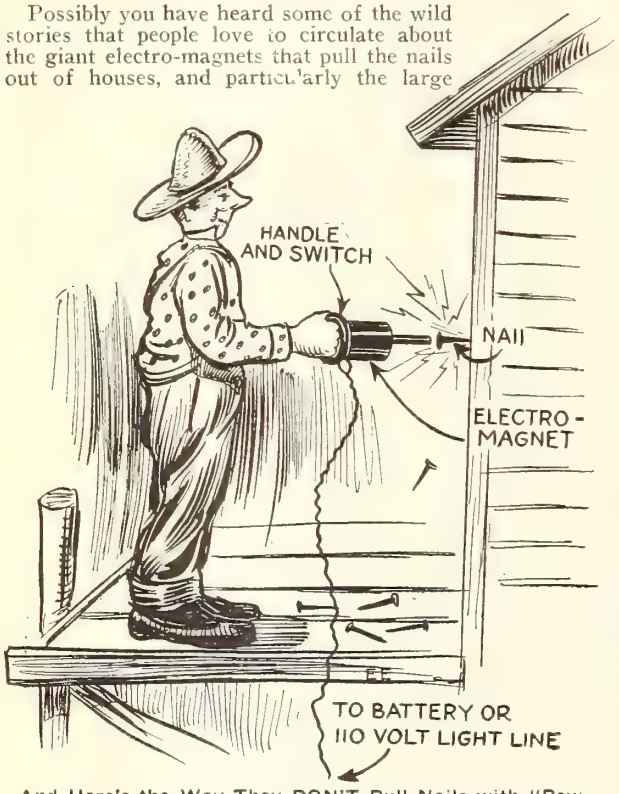
For mother's supper: *"Waiting."*

For grandfather's breakfast: *"I may be old, but I've got young ideas."*

For the Cook: *"Tipperary."*

How Magnets Don't Pull Nails!

Possibly you have heard some of the wild stories that people love to circulate about the giant electro-magnets that pull the nails out of houses, and particularly the large buildings which were erected by the Government at the huge army camps during the war, and many of which buildings are now being demolished. This story has become so persistent, and we have heard it so often, that we had our artist draw the accompanying illustration just to show how cute one of these "nail-pulling" experts would look, with a nifty little electro-magnet in his hand, so as not to split the boards, as some of the people who profess to know about these matters, have told us. Well, here's how he looks, according to what they have told us; but, were we to show you how he would look if he had an electro-magnet sufficiently powerful to pull these nails by their "heads" out of the building structure, the magnet would be bigger than the man almost, and it would take a young steam derrick to cart the magnet around and manipulate it. And then it could only pull out carpet tacks.



And Here's the Way They DON'T Pull Nails with "Powerful" Electro-Magnets at the Government Military Camps Where They Are Demolishing Buildings by the Dozens at Present. If You Think Any Ordinary Magnet Will Pull a Ten-Penny Nail Out of Wood, Just Try It!

If you have ever tried to pull a nail that has been firmly driven in the wood, by means of a nail puller (and they do make good nail pullers nowadays), you will at once realize that it would require some magnet, even to budge an 8 to 10 penny nail, especially when you consider that the lumber used in the camp buildings was quite green and sappy, and this has now dried and contracted, holding the nails tighter than a contract of marriage.

The experts of the Cutler-Hammer concern, specialists and builders of electro-magnets from the smallest to the largest, were asked as to the possibility of this "nail-pulling" magnet fable and, lucky for us, we had a suit of armor on that day or we would have been badly bruised by the tornado of glass ink stands, paper weights, et cetera, which greeted this query. A word to the wise is, and was, sufficient!—and we are satisfied to go home and smoke our pipes in peace and laugh up our sleeves, long and gleefully, at the wonderful magnet nail pullers which are "helping" (?) our Uncle Sam to tear down buildings!

Anyone who has had much to do with electro-magnets, even those as large as five feet in diameter and capable of lifting twenty tons or more of pig-iron, will at once realize that the head of a nail presents but a very small area on which to set up magnetic attraction. It is a scientific fact, as pointed out by the engineers of the aforementioned concern in an article publisht by us some time ago, that if such a five-foot, twenty-ton lifting magnet were placed near a cube of iron, say two inches square, that this cube will not be attracted over a distance exceeding one to two feet, but here we have a relatively large area in which to set up magnetic flux and attraction—four square inches, and also the iron cube is not held in any way, but is perfectly free.

Scientific Humor

FIRST PRIZE $3.00

And a Mastodon Is Done!—TEACHER—"What is a polygon?"

STUDENT—"Oh, a dead parrot of course."—*Henry F. Robbins.*

Not in U. S. A.!—The astronomy pupil was asked—when is the moon full?

When it is all lit up, came the reply.—*E. M. Bacigalupi.*

Indeed Y'ass!—"Could you telephone (tell-a-phone) from a trolley car?"

"I don't think I could."

"Your vision must be terribly defective."—*J. B. Dowden.*

A Ringer.—"Why didn't you send up a man to mend our electric bell?"



"He did go, Madam, but as he rang the door bell twice and got no answer, he concluded that there was no one one at home."—*Richard Schleidt.*

Hur-Ray!—Alice and John were returning from the "movies" where they had seen the well-known player, Chas. Ray, upon the screen. Alice was pensive for a while till finally she lisped:

"John, dear," slipping her arm around him, "is Charlie Ray related to this—er—*Violet* Ray?"—*Geo. T. Conner.*

Requiescat in Pace!—TEACHER (in chemistry)—"Suppose you were called upon to attend a person who had swallowed a heavy dose of oxalic acid, what would you administer?"

PUPIL—"The sacrament!"—*George W. Gish.*

We'll Be Switched!—"I guess Ma has been hunting bargains again."

"Why?"

"Caws Pa just asked her what kind of a switch she bought and she said she got a snap."—*Bunnie Wells.*

Ought to Keep Company With the Cat!—Tuesday morning while sprinkling the clothes of the week's washing, my little girl, who is three years old, came running all excited and dragging my electric iron.



"Oh, Mamma," she said, "let's turn on the juice and see her spit."—*Mrs. Bert Trullinger.*

In the Dark, of Course!—Not long ago a farmer in the swamps of Mississippi had an electric lighting plant installed on his farm. Eventually something went wrong with the outfit and an electrician was called in. He found the dynamo all shot to pieces, but set to work and remained busy till darkness stopped him. Then the farmer came out from supper to see how things were going.

"Mr. Blank," said the mechanic, "I notice a considerable amount of sparking in the fields here."

"Heck yes!" agreed the farmer. "The city chaps allus does their sparkin' round these parts of a evenin'."—*George T. Conner.*

Mr. Burbank, Take Notice!—1ST. AGRICULTURE STUDENT—"My fortune is made."

2D AG.—"How's that?"

1ST AG.—"I'm going to graft a bean plant on a corn stalk and raise ready-made succotash."—*A. H. Flury.*



Illuminating.—At their hotel, Pat and Mike were frequently wakened during the night by bed-bugs. Next day they applied for different rooms. After turning off the light Pat noticed several fire-flies in his room. He quickly arose and called to his partner: "Mike, get up. The bloomin' critters are after us wid flash-lights."—*G. Fisher.*

THIS month, we are pleased to say, our new department shows considerable improvement over the last. Contributions still come in with unabated fury from all parts of the world. "Current jokes" are still as thick as in currant pies and as indigestible—if you eat too much of them. We hope soon to see the last one of them.

Good old pre-historic jokes of antedilwian times are still fluttering in with every mail, some of them having no doubt been copied from hieroglyphs. You see a joke is somewhat like an invention—it is re-discovered periodically by independent inventors. But we have hopes—so on with the dance.

All jokes publishi here are paid for at the rate of $1.00 *each, besides a first prize of* $3.00. *And every time we pay a dollar for an old one—and it happens often—the joke is of course on us! P. S.—We have a good notion to pay ourselves* $1.00 *for the above witty one!*

Help! Will Someone Else Cop 'Er!

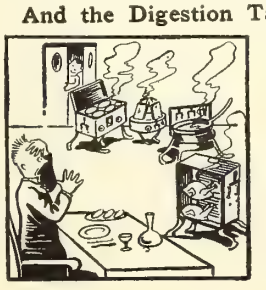
My girl is sure some alchemist,
That's why I'll have to drop her;
For every time I'm out with her
My silver turns to *copper.*
—*J. H. Schalek.*

Watt—Again?—LOGICAL—"I want some good current literature."

"Here are some books on electric lighting."

"Ohm! ah ha! I ampereing at them. Watt I want is light reading for Eddie's sons until they armature."—*Wm. F. Mahony.*

And the Digestion Tablets, Please!—



IRATE DINER—"Send the cook in here."

WAITER—"Certainly, sir. Shall I send in the automatic roaster, the mechanical fryer, or the electrical toaster?"—*C. A. Henderson.*

Extermination?—BOTANY TEACHER—"Johnny, what can you say about germination?"

JOHNNY—"That's easy, we just got done licking the German nation."—*Roy Andersen.*

So That's Why We Get Burnt!—1ST BOY—"Did you know that the human being contains sulphur?"

2ND BOY—"No, really?"

1ST BOY—"Yes, that's why some girls make better matches than others."—*Henry F. Robbins.*

She Must Be a "Magnavox"!—SPARK—"What do you think of this new invention, — the loud-talker?"



COIL — "New invention, nothing. I've had a mother - in - law around the house for the past fifteen years."—*A. H. Flury.*

HE 8 4 2.—He looked as though he needed something to drive dull carraway. "Got any consecrated lye"? "You mean concentrated lye", suggested the druggist. "Maybe I do. It does nutmeg any difference. It's what I camphor, anyhow," said the customer; "what does it sulphur?" "Ten scents a can," said the druggist, furiously sucking at a sour lemon to keep from laughing. "Gimme a can," said the customer rather gingerly, "I never cinnamon as witty as you." "Well," said the druggist, eyeing the customer with a syruptitious glance, "I ammonia novice but I've soda good many puns but I don't care a copperas far as I'm concerned. You don't hear me myrrh-myrrh, do you?"—*J. H. Schalek.*

Maybe a Scientific Blunder!—NEW LABORATORY ASS'T.—"What is a Bachelor of Science after he gets married?"

THE LAB. "WISE CRACKER"—"A student of Domestic Science."—*Adolf E. Dietrich.*

Can a Ford Afford It?—BROWN—"Jones is getting too technical!"



SMITH — "Yeh?"

BROWN — "He told me his Ford had *epilectric* fits!" — *R. F. Twinam.*

Some Machine—"I watched a wonderful machine at our shop work this morning."

"And how does it work?" we asked.

"Well," was the reply, "by means of a pedal attachment, a fulcrumed lever converts a vertical reciprocating motion into a circular movement. The principal part of the machine is a huge disk that revolves in a vertical plane. Power is applied thru the axis of the disk, and work is done on the periphery, and the hardest substance, by mere impact may be reduced to any shape."

"What is this wonderful machine?" we asked.

"A grindstone," was the reply.—*John Glenn.*



THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

THE LIFE OF LIBERTY MOTORS.

(1046) E. O. Bearden, D.F.M., A.F.M., ex-sergeant mechanic, writes the Oracle:

Q. The ELECTRICAL EXPERIMENTER publishes a statement made by Col. H. H. Arnold, U.S.A., that the life of a Liberty Motor 400 H.P. was 100 hours. I beg to differ with that statement, having had charge of a flight of 31 D.H.-IX's in Russia. All of my engines had flown in that nine months over 150 hours and some still more up to the time I left the squadron. And being I have done some of the longest raids of the war behind a Liberty, I say that it is the finest internal combustion engine made, and I have had 12 years' experience in aeronautical engineering work in Germany, France and England. In my nine months' experience with the Liberty I did not have even a broken valve spring out of 31 machines.

A. We are glad to give the following explanation by Col. Arnold, of his statement on the 100 hours' life of a Liberty motor:

"To the Editor, Electrical Experimenter.

"Dear Sir:

"Apparently the statement that I made that the life of the Liberty Motor was 100 hours is not understood by the public at large.

"The TRANSCONTINENTAL RACE, in which there were about forty-five Liberty Engines used, demonstrated that the life of the Liberty 400 H.P. Engine was about 100 hours WHEN USED WITH THE THROTTLE WIDE OPEN. The enclosed letter states that Mr. Bearden had engines which had been flown in 'nine months over 150 hours, and some still more. For this information it is to be noted that during aerial forest patrol in the year 1919 the Air Service had some Liberty Engines which were used more than 400 hours and still in use; but those same engines which had an average of 75 to 100 hours when used in the Transcontinental Race with the throttle wide open went to pieces after 25 or 30 hours' running. It is hoped that this explanation will clear up the statement quoted by me.

"H. H. ARNOLD,
"Colonel, Air Service,
"Department Air Service Officer."

ELECTROLYTIC RECTIFIER.

(1047) Ernest L. Allen, Slater Park, Pawtucket, R. I., writes this department:

Q. 1. As to the proper solution for electrolytic rectifiers.

A. 1. We would state that the solution for an electrolytic rectifier should be preferably of aluminum phosfate; sodium phosfate comes next on the list for obtaining the best practical results. Then, in order, any of the solutions named herewith can be used:

Bicarbonate of soda,
Sodium chlorid,
Acidulated water.

In each case, the salt added to the water causes what we call a saturate solution.

The distance between the plates should preferably be one inch, and the plates will have to be sufficiently large to allow the amperage required by the apparatus to flow thru. Likewise, you will find that some form of resistance will have to be connected into the circuit, and preferably four jars are used with the single phase current.

TESLA TURBINE.

(1048) Eustis H. Thompson, 17 Midship Road, St. Helena, Md., inquires:

Q. 1. How does the Tesla steam turbine operate?

A. 1. We have no exact data on the Tesla turbine. However, we understand that it consists of a number of very smooth polished steel plates, closely joined together and perfectly aligned. These plates are mounted on a shaft connected in such a way that there is an opening running thru the center to the space between the plates. Steam is forced into the center canal, and escaping along the sides of these closely aligned plates, causes a rapid whirling motion. This same device is used as a pump by simply reversing the connections.

For utilizing the excess natural power you mention, we would advise the production of nitric acid or nitrates for fertilizer, the purification of metals, or any electrolytic means of forming elements. You might build huge arc furnaces and use the excess power for smelting, etc.

DOLLARS FOR JOKES

A SCIENTIFIC magazine is supposedly notorious for its dry reading. Still we flatter ourselves that the ELECTRICAL EXPERIMENTER can hold your attention without your yawning too frequently.

Of course you like to laugh—we all do. Sometimes we make you smile while you peruse the EXPERIMENTER. Perhaps sometimes you laugh out loud—at some of our "preposterous ideas" which we print here. And then of course the joke's on us, because we were real serious!

Now it occurred to us that we would like to print a column of real, original jokes every month, but here's the hook: The joke must be a SCIENTIFIC JOKE. No, this is no joke, we mean it!

Anyone can print or re-print jokes, but we want them with a dose of science. So, till further notice we will pay $3.00 as a monthly 1st prize for the best joke, and $1.00 for each other one we print.

So you will know what we mean with a "Scientific Joke," we print one here, which we purloined from the "Baltimore American":

LOGICAL.—"I want some good current literature."
"Here are some books on electric lighting."

Now of course, our readers can do much better than this. So let's wait and see. One reader can submit as many jokes as he pleases. Even if it is old the joke is not necessarily barred or condemned. There is one rule however: The joke must not be too technical; in other words, it must be readily understood by anyone. Not more than 100 words can be used. Use only one side of the paper.

Address
SCIENTIFIC JOKE EDITOR,
Care of this publication.

DEVICE TO CHECK FALLING AIRPLANES.

(1049) M. H. Garland, 5539 Page Ave., St. Louis, Mo., writes us:

Q. 1. Describing a rocket device for checking falling airplanes.

A. 1. Regarding your scheme for attaching several cylinders filled with powder to operate on the order of a sky rocket, so as to permit an airplane to be checked in its downward flight in case the engine should fail, etc., it is very difficult to figure out beforehand, even approximately, just what would happen with such a device as this, as there are so many different factors which may arise in attempting to apply the scheme in practise.

We believe the quickest way in which to ascertain what this device can and would do would be to experiment with a small model airplane rigged up with a series of small fire crackers or special tubes filled with powder, arranged to be ignited in the desired manner.

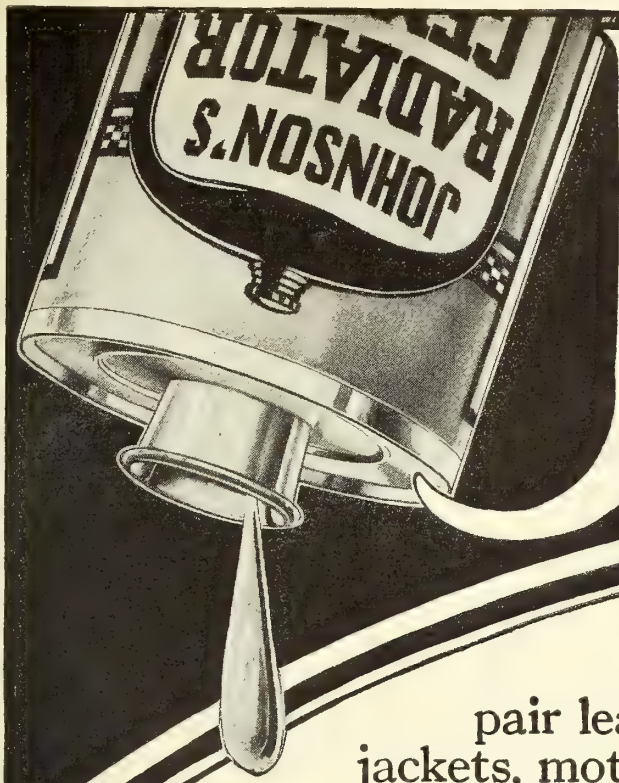
RADIUM FOR CANCER TREATMENT.

(1050) Charles Rinde, 406 W. Oak Street, Lodi, California, states:

Q. 1. Can radium cure cancer of all sorts:

A. 1. In regard to whether or not Radium treatment can cure cancer of all sorts, we would have to know more definitely as to the exact location and the diagnosis the attending physician has made of the disease before we can advise definitely as to whether or not it could be cured by radium.

Cancer consists of various tumors, both benign and malignant. A Rodent Ulcer sometimes takes as long as two years or more before the "Radium treatment" has any effect upon it whatsoever. Cancer of the tongue and Carcinoma of the tongue of a Melanotic nature does not generally give very favorable reactions toward Radium treatment. Then again the effects of the treatment may not be as permanent as one would like it to be. For instance, in Lymphosarcoma the growth disappears extremely rapidly when irradiated, but usually fresh tumors continue to arise in Lymphatic glands in various parts of the body, and hence a more thoro treatment will be necessary. In Glioma of the Orbit, on the other hand, the tumor disappears within a fortnight of the treatment, but sometimes recurs.



JOHNSON'S RADIATOR CEMENT

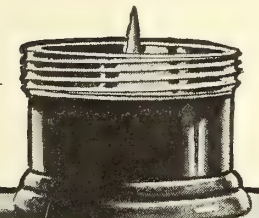
THE easiest and quickest way to repair leaks in radiators, pumps, water jackets, motor head gaskets, hose connections, etc., is with Johnson's Radiator Cement. It will stop leaks in from two to ten minutes without laying up the car. It requires no experience to use Johnson's Radiator Cement—all you have to do is to remove the radiator cap and pour the Radiator Cement into the radiator.

Quick—Efficient—Harmless

Johnson's Radiator Cement will not coat or clog the cooling system. It blends perfectly with the water until it reaches the leaks. As it comes in contact with the air it forms a hard, tough, resisting substance which is insoluble in water and stops the leak. A half-pint is sufficient for a Ford.

Keep Your Car Young with Johnson's Car Savers

Start today to reduce the depreciation of your automobile. An hour or two every month and JOHNSON'S CAR SAVERS will prove their value in dollars and cents when you come to sell or turn in your car.



Johnson's Carbon Remover—prevents 80% of engine trouble.
Johnson's Stop-Squeak Oil—a wonderful spring lubricant.
Johnson's Valve Grinding Compound—gives a velvet seat.
Johnson's Cleaner and Prepared Wax—make body, hood and fenders look like new.
Johnson's Black-Lac—the perfect top dressing.
Johnson's Auto-Lak—a splendid one coat body varnish.
Johnson's Hastee Patch—can be applied in two minutes.

Write for our folder on "Keeping Cars Young" —it's free.

S. C. JOHNSON & SON
Dept. EE.6.
Racine, Wisconsin, U. S. A.

HE MADE THE WORLD BLUSH FOR SHAME

He was Feared and Worshiped, Hated and Loved. Alone He Defied the World. He Died as He Had Lived—In Tragedy. But He Left a Heritage of Literature That Will Live Forever. No One Can Afford to Miss the Lesson It Teaches.

The Wizard of Words

What strong power did Brann, The Iconoclast, exercise over men? What was his mysterious influence that he could craze some people with hatred and hypnotize others with love? Why did one man give his own life that he might take the life of Brann? Why at his death did thousands upon thousands journey to his grave to pay him tribute? Was he so consummate a master of the passions of men that he could inspire both hatred and love? What was the magic power of his wizardry of words?



Brann, the Iconoclast

Brann, The Iconoclast

"Child of the Devil," one man called him. "Journalism's Most Tragic and Pathetic Figure," Elbert said of him. Brann was an iconoclast. He tore down the conventions of life—stripped off the cloak of hypocrisy and laid bare the blinding nakedness of TRUTH! Nothing could stop the fury of his attack. When he wrote or spoke, the artificial barriers of society tottered, the sham draperies of Virtue fell, and the false pretenses of love and marriage stood exposed in their shame. Sins of the World—Mysteries of Heaven and Hell—he dared to assail all with unflinching independence.

They tried to stop him—the press, society, political and financial powers reached out to pull him down. But nothing on earth could daunt him. He said: "I'd rather my babes were born in a canebrake and reared on bark and wild berries, with the blood of independence burning in their veins, than spawned in a palace and brought up by bootlicks and policy-players."

A Few Chapters
- A Pilgrimage to Perdition
- Satan Loosed for a Season
- Some Cheerful Liars
- The Woman Thou Gavest Me
- The Seven Vials of Wrath
- Her Beautiful Eyes
- Fake Journalism
- A Social Swim
- Coining Blood into Boodle
- Hunting for a Husband
- Thou Shalt Not
- Mankind's Mock-Modesty
- Speaking of Gall
- Potiphar's Wife
- From the Gods to the Gutter
- Balaam's Ass

His weapon was—WORDS. Mere words—combinations of letters! But under his magic they burned like acid, seared like flames and cut like a whip. He attacked every fraud and fake in Christendom. With utter frankness he wrote down things as he saw them.



Send No Money

Whatever your creed, your politics, your station in life, you MUST know Brann, the Iconoclast.

Now for the first time the complete works of Brann have been placed in 12 handsome volumes, 3800 pages. Again his flaming spirit will startle the world.

We want you to see and read the complete works of Brann the Iconoclast in your own home, without sending a penny in advance. Printed in clear, readable type on Bangalore wove antique finish paper, gold topped, silk banded, uniformly bound in rich, green Flaenweave cloth, back illuminated in gold stamp. If after reading the volumes in 5 days you are not more pleased than you expected to be, return them and you will not owe one penny. If you decide to keep them, as we feel sure you will, send only $1 after 5 days then $2 a month for a few months.

Mail the coupon now without money. The present price must be increased when the next edition comes off the press. Save money by mailing the coupon NOW.

BRANN PUBLISHERS INC.
Dept. 226, 130 East 25th St., New York City

— — — FREE EXAMINATION COUPON — — —

THE BRANN PUBLISHERS Inc.,
Dept. 226, 130 East 25th St., New York City.

Gentlemen:—Send me the 12 volumes of Brann (complete) prepaid. I will either return the books in 5 days after I receive them or will send you the first payment of $1, and then $2 a month until the special introductory price of $27 is paid. 5% discount if cash is paid in full after 5 days' examination.

Name .....

Address .....

City ..... State .....

Occupation .....



BOOK REVIEW

THE CONDENSED CHEMICAL DICTIONARY. 525 pages, cloth covers, size 6¼x9¼ inches. Publisht by the Chemical Catalog Co., New York, 1919.

Undoubtedly, this book is one of the finest and most complete of the chemical catalogs yet publisht, being absolutely reliable and explicit in its details. It is a catalog intended for the chemically educated reader, or the layman in contact with various industries whether he be exporter, importer, broker, jobber, purchasing agent, and in fact wherever the individual having frequent need for detailed information in regard to chemicals and the chemical profession.

We do not believe that there is any other publication having incorporated in one single volume all the matters which this book contains. A novel feature and a great convenience is the fact that a generous space is left between all items giving room for a line or so for text data and a wide margin at the bottom of each page, leaving more room for additional more extended notes.

The book is not crowded and the type is very clear, the arrangement itself being in definite logical order. It is profusely cross-indexed and modern spelling, that is, A. C. S. spelling is used, except where departures from the former spelling are very great, in which case both old and new terms are given. The derivation, properties, a method of purification, grades, containers to be used, the uses, fire hazards, shipping regulations, proprietary uses, and whether made in America or not, are found in logical order, readily understood.

An individual asset is the table appendix in the back of the book, giving atomic weights, tables of weights and measures, metric equivalents, conversion of Fahrenheit and Centigrade scales, specific gravities, definition of units and regulations regarding the transportation of chemicals, which renders this book an extremely desirable reference for every chemist whether amateur, professional or expert.

THE FORD STANDARD EQUIPMENT. Profusely illustrated. 139 pages, size 5¼x 8 inches. Flexible cover. Publisht by the American Bureau of Engineering, Chicago, Illinois.

This is a book originally designed for repair men in any branch of Ford repair work whether it is generator, starter, ignition or motor repair. The manner in which to locate trouble, how to install lighting, or starting systems, of Ford type and many other types, are all included. Obviously, it is not a book for any kind of Ford installation, but it is the book required to thoroly understand the Ford starting and lighting system now being placed in cars made by the Ford Company.

A greater part of the book is devoted to the starting and lighting system, but the ignition system is also completely dealt with, as are troubles other than electric. It is a book for every Ford owner, garage man and repair man.

INVENTIONS: THEIR PURCHASE AND SALE. By Wm. E. Baff. Cloth bound stiff covers, 230 pages, including index. Size 5x8 inches. Publisht by D Van Nostrand Company, New York.

An ideal book for the inventor, patent attorney, manufacturer, or buyer of patents; describing explicitly the salability of the invention, what do and do not constitute well-founded claims; how to make claims; marketing; together with the cost and retail prices of articles.

It is so profuse in its knowledge, which it imparts to every conscientious reader, that no inventor whether he is a new man in the field or an old timer, should fail to read it.

The book is written by a patent attorney of good standing and explains with remarkable precision how everything regarding patents is done, from the time the inventor gets a "bug idea" until the very end, viz., the final exploitation of the patent.

We would advise every inventor presently engaged in patent work of any nature, or who intends or has had patentable ideas, to secure this most excellent treatise.

ABOVE THE FRENCH LINES. Letters of Stuart Walcott, American Aviator. Cloth covers, 94 pages, illustrated. Size of book 5½x8 inches. Published by Princeton University Press, Princeton, N. J.

A very interesting and out of the ordinary volume which everyone will enjoy reading, picturing as it does the great charm of a strong personality which shows itself thru the various letters here reproduced. The author was one of those sterling aviators who introduced the courage and intrepidity of the American soldier to the French army, and many a pleasant half hour can be spent with this little volume which will appeal to everyone interested in the history of the fliers on the Western battle front. It is in line with that unbeatable little gem of spontaneous mirth, "Dere Mabel." These letters combine the tales of the strenuous days of the aviator and his flying machine in the thick of war, and also little glimpses and side-lights on the *vin rouge* days behind the French lines.

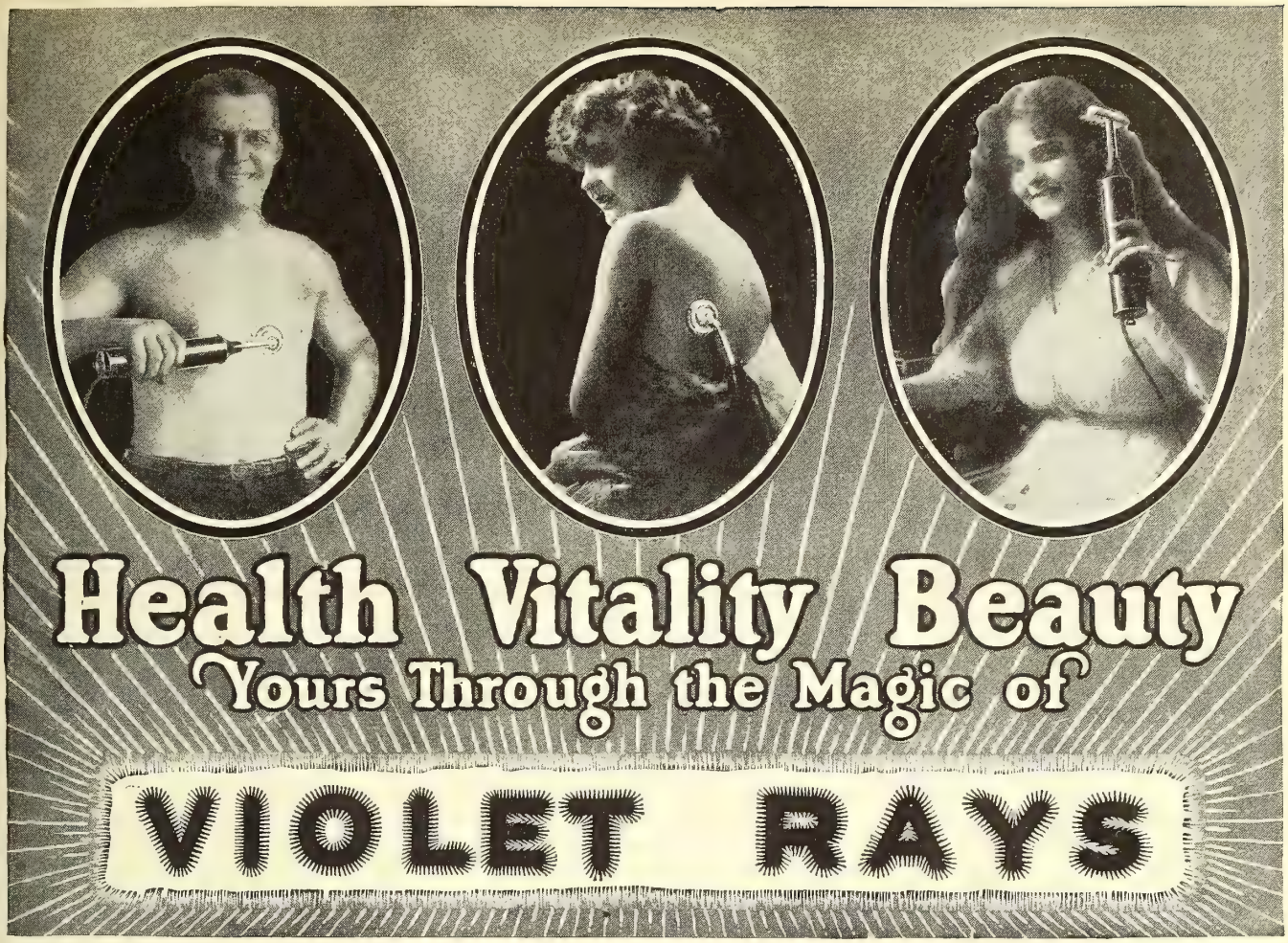
EXAMPLES IN MAGNETISM. By Professor F. E. Austin, B.S., E.E. Flexible covers, 90 pages, 27 illustrations. Size 5x 7½ inches. Publisht by the Author, Hanover, New Hampshire.

This manual of examples in magnetism will prove useful to students of electrical and radio subjects and particularly those interested in the arithmetical and higher mathematical aspects of the subject. The work covers the elementary and further advanced mathematical relations dealing with magnetism and magnetic fields, and some very interesting and well illustrated problems are worked out, so that the student can fully grasp the explanations given. There are sections dealing with the calculation of magnetic moments; pole strengths; the earth's magnetic field and its components; turning moments of magnets; results and forces due to magnetic poles; comparison of intensity of magnetic fields; mapping of magnetic fields, etc. In the appendix at the end of the book are a number of extremely useful tables. One of these gives the three variable magnetic elements, that is, magnetic declination, inclination, and horizontal intensity in gausses for various states and cities thruout the United States, etc. Another table gives sines, cosines, tangents, etc. The index is quite profuse and there is also provided an index of the various examples, problems, illustrations and lessons.

EXAMPLES IN ALTERNATING CURRENTS. Vol. 1, 3d edition (with additions). By Professor F. E. Austin, B.S., E.E. Flexible covers, 224 pages, illustrations. Size 5x7½ inches. Publisht by the Author, Hanover, New Hampshire.

Every student of alternating currents, especially those interested in radio work, will find this volume by Prof. Austin very practical and useful. This book covers problems in alternating currents and the general theory of alternating current circuits in a clear manner, which anyone can understand if they are familiar with the simplest rules of algebra. The calculation and relation of electro-motive force, current and resist-

(Continued on page 192)



Try This Wonderful Machine 10 Days Free

YOU can now enjoy the wonderful, energizing, health-giving power of Violet Rays in your own home! This famous treatment, formerly obtainable only from eminent physicians and beauty specialists at high fees, is now brought to you for your personal use, and at a trifling cost, through new Vi-Rex Violet Ray Machine. This new invention, so simple that a child can operate it, applies to your body all the remarkable, vitalizing effects of Violet Rays.

Rid yourself of headaches, catarrh, constipation, lumbago, insomnia, nervousness, neuritis. Relieve your pain from rheumatism, neuralgia, indigestion. Give yourself beauty treatments—remove eczema, pimples, blackheads, obesity. You can make your body alive with vitality, your skin smooth and fine of texture, free from blemishes and sallowness. Soothe your nerves, build up your strength, feel the thrill of real vigor and "pep," and have a clear, unblemished complexion. All this you can have by the use of Violet Rays.

Not a Vibrator

This instrument is not a vibrator. It does not contract the muscles or shock the nerves. Its magic rays pass through every cell and tissue, creating "cellular massage"—the most beneficial electrical treatment known. It leaves no soreness after use, only a delightful sensation of agreeable relief. Its great value is based on proven scientific facts now well established by experience. Violet Rays are used in nearly every modern sanitarium, hospital and health resort. Physicians and osteopaths and chiropractors everywhere use and endorse them. Like thousands of others, you will be amazed at the quick, gratifying results from Violet Ray treatments.

What Users and Physicians Say

Trixie Friganza, well known actress, says, "Cheerfully will I add my praise for your Violet Ray machine. It's the best 'pain chaser' and 'soother' I've had the good fortune to find. It's WONDERFUL. It cured my brother of neuritis. As for myself I use it for facial treatments and general massage. I cannot say too much for it."

Dr. Bert H. Rice, of Vinton, Iowa, says: "I have good results with the Instrument in all cases of neuralgia. Almost instant relief in Facial Neuralgia."

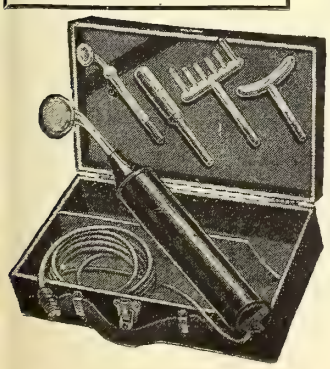
Dr. Daniels, Lisbon, North Dakota, says: "Have used it in such cases as Goitre, Bronchitis, Pleurisy, Neuritis, Neuralgia, and Lumbago, and find it very beneficial. In fact, I would not be without it in my office."

Try Violet Rays For

Asthma	Headache
Barbers' Itch	Goitre
Boils	Insomnia
Blackheads	Lumbago
Catarrh	Nervousness
Chilblains	Neuralgia
Colds	Neuritis
Constipation	Pains
Dandruff	Paralysis
Deafness	Pimples
Earache	Rheumatism
Eczema	Skin Diseases
Eye Disease	Sore Throat
Falling Hair	Sprains
Hay Fever	Tonsilitis

Whooping Cough

Mail Coupon for Free Book



Through our special, liberal offer, you can try Violet Ray treatments without risking a penny. Use this wonderful machine for ten days. If you do not find quick relief, if you do not feel better, sleep better, eat better, *look* better, send it back and you will not be out one penny. Prove it to yourself that Violet Rays bring you the magic of electricity in its most wonderful curative form.

We want you to know in detail about the magic action of Violet Rays. We want you to see for yourself how it has helped thousands of others. Learn how you can have superb health and radiant beauty. All this you will find in this great health and beauty book which will be sent you free. Simply mail the coupon or write a postal or letter. Do this now, before our special free trial offer is withdrawn.

VI-REX ELECTRIC CO.

Dept 46 **326 West Madison Street, Chicago**

Vi-Rex Electric Co., Dept. 46,
326 West Madison Street, Chicago.

Please send me without any cost or obligation, your free book describing your Violet Ray Machine and details of your free trial offer.

Name .....

Address .....

City .....

State .....

—ATTENTION—

MOTORISTS and DEALERS!!!

TIRES, TIRES, TIRES Galore

at exceptionally low prices, considering the very high quality of our merchandise. Are you skeptical, just try us ONCE.

Slightly Used and Factory Repaired Tires

	Used Tires	NEW TUBES
30x3	$4.50	$1.95
30x3½	5.50	2.30
31x3½	5.95	2.40
32x3½	6.25	2.40
34x3½	6.95	2.60
31x4	7.20	2.70
32x4	7.95	2.80
33x4	8.85	2.90
34x4	9.00	2.90
36x4	10.00	3.00
34x4½	9.30	3.15
35x4½	9.60	3.25
36x4½	9.95	3.40
37x4½	12.25	3.50
35x5	11.00	3.75
36x5	11.50	3.85
37x5	12.00	3.95

Of course, owing to the low prices quoted, these tires are not guaranteed for any definite number of miles, but should it happen that you do not receive service in proportion to the price paid, we will make reasonable adjustments if tires are returned to us prepaid. Is this not fair enough?

Send $1.00 deposit for each tire ordered. Tires will be sent promptly C. O. D. with privilege of examination.

LINCOLN TIRE & SUPPLY CO.
1429 S. Michigan Ave.
Dept. 64 CHICAGO, ILL.

BE AN EXPERT



Auto and Tractor Mechanic
Earn $100 to $400 a Month

Young man, are you mechanically inclined? Come to the Sweeney School. Learn to be an expert. I teach with tools not books. Do the work yourself, that's the secret of the

SWEENEY SYSTEM

of practical training by which 5,000 soldiers were trained for U. S. Government and over 20,000 expert mechanics. Learn in a few weeks; no previous experience necessary.

FREE Write today for illustrated free catalog showing hundreds of pictures men working in new Million Dollar Trade School.

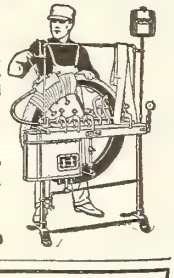
LEARN A TRADE
Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
66 SWEENEY BLDG. KANSAS CITY, MO.

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2205 Fourth St. Waupun, Wisconsin

You Can Save $50.00



$8.46 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

Book Review

(*Continued from page* 190)

ance are dwelled upon at length in various forms of complex circuits, including those with resistance, inductance and capacity, conected both in series and in parallel. The fore part of the work covers alternating current wave formations; the production of electro-motive forces; A. C. pressures; value of sine curve; rate of change of sine curve alternating quantities; how to plot "curve of squares" for a circle; method of finding the areas of curves; equivalent sine curve; effective or R. M. S. values of non-sine pressures; calculation of the inductance of a coil, and numerous problems on this and allied subjects.

All of the mathematical subjects are clearly explained, making the work a very valuable one indeed to the student. An appendix of useful tables is provided giving the values all worked out for 2π and $\frac{1}{2\pi f}$ and $\frac{1}{(2\pi f)^2}$ for various frequencies f, in cycles per second, from one up to 150, and also 1000, 2,000 and 150,000 cycles per second. Valuable tables are also given of the numeric values of the capacity necessary to neutralize the inductance L in henrys, to produce resonance in an alternating current circuit.

How to Keep up a Car

By HAROLD HOLLINGSHEAD

(*Continued from page* 156)

applied to valve of inner tube before air is applied will prevent any air from escaping from tire.

THE CARE OF BODY.

Now how to keep the isinglass and Pantasote tops in good condition is quite a question to most people. If the top is in a very bad condition, first clear thoroly with kerosene and let dry. Then apply a heavy coat of 3-in-1 oil with cheese-cloth. This is the finest oil of its kind for such purposes, and your neighbors will think you have bought a brand new top. Next, the isinglass is not cleaned with gasolene, kerosene or benzine, but by using a clean soft chamois dampened in clear water, using a little elbow grease, on both sides of the isinglass, together with cleaning and dampening the chamois as you go along. You will find the rust and grit coming off on your chamois, and your glass becoming clear. Be sure and keep cleaning chamois well in clear water, and use no soap.

A rag partially dampened in kerosene and 3-in-1 oil is an excellent remedy to remove all sand and grit from body. To keep from scratching paint on body, great care should be taken to thoroly shake out cloth as you go along, as this cloth will accumulate much grit, which is very injurious to paint. After this is done, a clean piece of silk cloth, from an old shirt-waist, will wonderfully brighten up the paint. If these rules are carried out by automobile owners and drivers they will find their gasolene and repair bills much lower.

A FEW POINTS IN DRIVING.

In driving a car, do not advance spark on starting, or on a hill or heavy pull. You have no doubt remembered your motor knocking on a hill, thru your spark throttle being fully advanced. Restart your spark and you may not get the speed, but you will eliminate the knock, and make your motor last twice as long and save your repair bill. In running your motor idle, slow down motor to slowest possible speed. This will keep motor from heating up and eliminate the collection of carbon, and will also save gas bill. In starting and stopping at all times shift to low or intermediate gears, which will save the strain which would come on motor by pulling in high gear.

AIR FLEET FOR SOUTH POLE.

A fleet of twelve to fourteen airplanes will be taken along on the Terra Nova, the ship which John L. Cope will fit out at London, for his expedition to the South Pole.

"It is not without realization of the limitations of the use of airplanes that we have included them in the equipment," said Captain Wilkins, who commands the air wing. "There will be two pilots to each machine, except on the single-seater scouts. The fuselages will be so constructed that they can be used as sledges.

"There is a general impression abroad that a spectacular dash to the South Pole will be made by air, but this is not so. The principal use of airplanes will be for photographic flights."

Advertising Talks NUMBER 8

I want to ask the readers of ELECTRICAL EXPERIMENTER a very frank question. "Why is it that none of you seem to be interested in becoming Travelling Salesmen or in learning to be an expert Automobile Repairman."

The circulation of the EXPERIMENTER is over 150,000 each month. According to the figures which you all gave me a little while ago there are over four readers to every copy. This means over 600,000 readers of our magazine.

It seems as though among such a vast number of progressive men as this (just think of it, over half a million) there must be a great many who would want to become either Star Salesmen or to learn auto mechanics—the heart of the great automobile industry. This latter industry has already become one of the greatest in the United States—no other country comes anywhere near equaling us in our production of automobiles, trucks, tractors or accessories. And the industry is growing every day. It bids fair to become our second greatest industry, next only to the steel business.

High grade travelling salesmen as well as expert auto mechanics are making big money these days. Many young men all over the country are studying for one or the other position. Why not the readers of ELECTRICAL EXPERIMENTER?

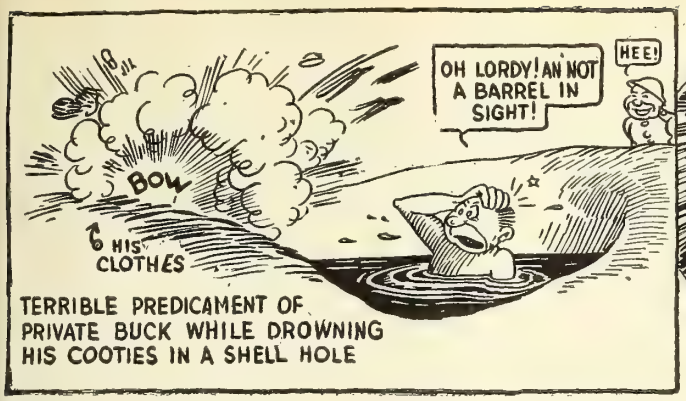
During the past year a number of advertisers have run attractive ads. in our magazine announcing what looked to me like mighty good offers covering instruction in salesmanship and automobile mechanics. When the ads. appeared I thought "Surely, these are going to strike a very responsive chord among our readers." I looked for the ads. to pull heavily. But they did not. For some reason or other very few readers paid any attention to them and in each case the advertiser reported failure.

If our readers are really not interested in such subjects, I don't want to urge these advertisers to try again. But if you are I do. Won't some of you write me personally and tell me whether or not you are interested and if not, just why you aren't—or if there was anything in the ads. that didn't appeal to you, tell me just what it was. I'll certainly appreciate every letter you send me, and you will be helping your magazine and indirectly yourself.

The E. E. is your magazine. The more you patronize your advertisers the more space they will use in ELECTRICAL EXPERIMENTER. The more advertising we carry, the more pages of solid text in that issue. For each additional two pages of advertising we get we add three solid pages of reading matter. So by helping the advertising you help yourself.

Please let me hear from you—just as many as can write me to-day.

R. W. de Mott
Advertising Manager.





The Laughter and Tears of America's Greatest Army

The One Priceless Souvenir of the Great War That You Will Enjoy and Treasure Above All Others — A Complete File of 71 Overseas Issues of the Famous Stars and Stripes Bound Into One De-Luxe Volume.

HERE is the most remarkable human document that has come out of the great world war. Here is a living, breathing record of the lives of two million men in war—written by the men themselves as they fought on the bleeding soil of France. It is our soldiers' own wonderful story of those days over there—a story that will live forever as the most unique historical document ever written.

Here is their own true story—the sort that grips the heart and stirs the emotions for it rings with the sincerity of men who suffered the Hell of war and came back smiling. From cover to cover this wonderful volume breathes of the romance, the pathos and humor of the struggles and adventures of America's greatest army.

Nothing can give you so vivid, realistic and gripping a picture of what our soldiers experienced in France as their own remarkable newspaper, the Stars and Stripes, written by the soldiers, for the soldiers, over there on the battlefields in the thick of the fight. It is an amazing story this famous newspaper tells—a day-by-day, intimate, heart-stirring story of war and of the irrepressible spirit of fun that made the American doughboy the wonder of the world.

All the Overseas Issues of The Stars and Stripes in One Complete Bound Volume

Behind The Scenes With The American Doughboys

To read the Overseas issues of the Stars and Stripes is to live over, in startling reality, those days with our soldiers in France. It will bring you face to face with actual conditions as they knew them—their novel life in the French villages, their droll experiences with foreign customs, their marches over the long white dusty roads, their nerve-torturing baptism of fire, their glorious gallantry at Chateau Thierry, Saint Mihiel, and their magnificent drive through the Argonne.

The Stars and Stripes is the only publication of its kind in the History of the United States. It was originally intended only for distribution among the men of the A. E. F. in France but its fame grew and spread and many copies found their way back to the States. These are highly treasured and jealously held by their fortunate owners. Fabulous prices have been paid for single issues. Articles from the columns of this remarkable newspaper were reprinted everywhere and finally there sprang up an insistent demand from parents of soldiers, Universities, Statesmen and patriots throughout the country for complete files of this unique, historical publication.

To satisfy this demand all the overseas issues have now been bound into one De Luxe Volume—with sturdy khaki-colored covers—richly embossed—a beautiful lasting edition that you will treasure now and hand down to your children. The first issue of the Stars and Stripes was published February 8, 1918—the last June 13, 1919. There were 71 issues, each paper consisting of 8 pages, 18½ x 24½ inches in size and every number appears in this beautiful bound volume. Each issue of the original newspaper has been reproduced, line for line, exactly as it was printed in France.

Limited Edition—Reserve Your Copy Now

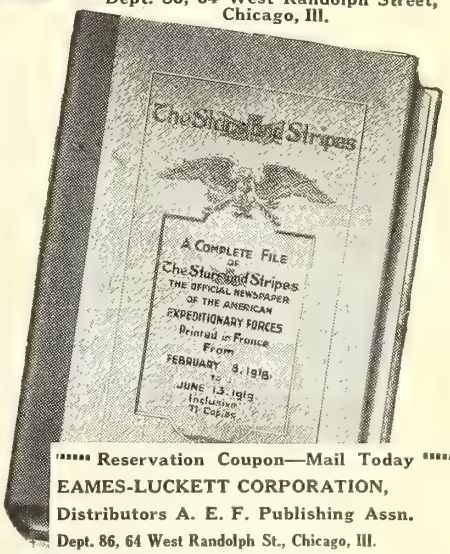
Think of having a complete file of this historic newspaper—the most unique souvenir of the war! You will find endless fascination in the many great features that an army eagerly read—Walgren's famous cartoons, Balbridge's drawings, the Poet's Column, the Letters of Henry's Pal to Henry, the Liars' Column, Captain Hansen's official accounts of the battles, skirmishes and marches, the histories of the Divisions and Divisional insignia.

This edition of the complete file of the overseas Stars and Stripes—this unique, intimate and human record of the great war—is limited. Hundreds of reservation orders have already been placed and more are pouring in each day. It is not at all unlikely that the entire edition will be quickly subscribed. Place your order to-day to avoid disappointment.

Send No Money

Clip and mail the coupon quick! We will reserve a copy of this limited edition for you and ship it to you by express as soon as it comes from the binders. When it reaches your express office you can examine it thoroughly. If you decide to keep it, pay your express agent, the Special Low Price of $12. If you are not satisfied that you want to keep this great souvenir of the war, return it and you will not be out one penny. This may be your only opportunity to secure a complete file of this historic newspaper. Certainly it will never again be offered at this low price. Therefore we urge you to act quickly. Mailing the coupon puts you under no obligation. It merely signifies your desire to see this great volume—you send not a penny of money—just the coupon. Address:

Eames-Luckett Corporation
Distributors A. E. F. Pub. Assn.
Dept. 86, 64 West Randolph Street, Chicago, Ill.



Reservation Coupon—Mail Today

EAMES-LUCKETT CORPORATION,
Distributors A. E. F. Publishing Assn.
Dept. 86, 64 West Randolph St., Chicago, Ill.

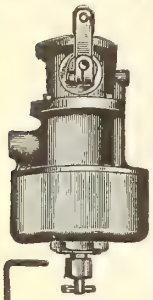
Please reserve for me one complete bound file of all the 71 issues of the overseas Stars and Stripes, to be shipped to me as soon as it is ready. When it arrives I shall examine it thoroughly and if satisfied I shall pay the express company $12.00. Otherwise I will return it to you at your expense.

Name .....

Address .....

City ..... State .....

SAVE 1/2



Your "GAS" and ALL Your Trouble

15-DAY FREE TRIAL
Money-back Guarantee

Entirely NEW principle—not a moving part—Simple. Has the Pep and Power.

U. & J. Carburetor

Doubles Mileage—Guaranteed to start car in zero weather—No Priming. 50,000 delighted users. Now ready for Ford, Dodge, Maxwell and Overland.

DEALERS—Service Stations, Salesmen: The "U. & J." sells on demonstration—installed in thirty minutes—some good open territory.

We also manufacture the U. & J. FORD TIMER. Will last as long as the car. PRICE $2.50

U. & J. CARBURETOR CO.
Dept. 275—507 W. Jackson Blvd., CHICAGO



SLIGHTLY USED STANDARD MAKE TIRES

Size	Price	Size	Price
30x3	$5.00	33x4½ (Cords)	$16.00
30x3½	6.50	34x4½	12.75
32x3½	8.00	35x4½	13.75
31x4	8.75	36x4½	14.50
32x4	9.50	37x4½ (Cords)	25.00
33x4	10.50	35x5	14.75
34x4	11.75	36x5	15.00
32x4½ (Cords)	15.00	37x5	15.50

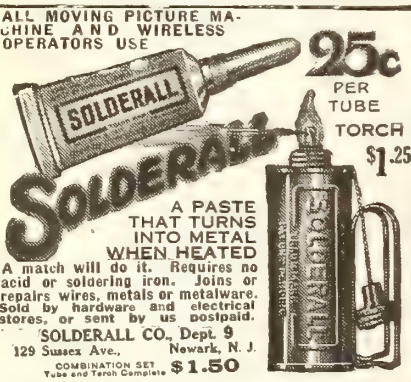
Special Brand New Tubes, Guaranteed. Three sizes only.

Size	Price
30x3	$1.75
30x3½	2.00
31x4	2.35

Order now. Shipment made the same day. $1 deposit required with each tire ordered. Balance C. O. D., subject to your examination. Specify whether you desire to have clincher or straight side tire. Special cash discount of 5 per cent. if full amount accompanies order.

G. & H. TIRE & VULCANIZING CO.
2559 S. State St., Chicago, Ill.

ALL MOVING PICTURE MACHINE AND WIRELESS OPERATORS USE



25c PER TUBE

TORCH $1.25

A PASTE THAT TURNS INTO METAL WHEN HEATED

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. 9
129 Sussex Ave., Newark, N. J.

COMBINATION SET Tube and Torch Complete $1.50

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR

LASTING

THAT'S THE ECONOMY of owning this new handy, compact Utility Chest. Built with a solid oak frame, and joints that are not dovetailed, but lock-cornered for extra strength, this chest is a sturdy keeper of tools; bang-proof, knock-proof, and weather-proof. The auto mechanic, electrician, plumber, lineman will find the right house for his tools in this UNION Utility Chest. Note tray that lifts with cover, yet fits snugly when cover is closed.



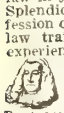
Write for Catlog prices and dealer's name

UNION TOOL CHEST COMPANY, Inc.
36 Mill Street Rochester, N. Y.

UNION TOOL CHESTS

Free Book—LAW

Send for this Free 118 Page Book. It tells how you can gain a thorough knowledge of law in your spare time, as 40,000 others are doing. Splendid opportunities in the profession of law. Business today needs law trained men. Free book gives experiences of successful law trained men, and tells how you can read law under guidance of Ex-President Taft and 80 other eminent authorities.





BLACKSTONE INSTITUTE
Dept. 140-A 608 S. Dearborn St., Chicago

U. S. LEADS IN RADIO, SAYS MARCONI.

The Italian newspapers recently publisht an article by Guglielmo Marconi, the inventor of wireless telegraphy, which says that the United States heads the list of all countries in wireless inventions, her inventors having surpast all others in producing practical apparatus for transmission of the human voice thru electric waves.

"Within this year," said Signor Marconi, "wireless telephones will substitute the present clumsy system with great economic advantage, suppressing the cost of the telephone lines and their upkeep. They will also do away with the interruptions due to atmospheric causes."

Popular Astronomy
The Earth as a Magnet

By ISABEL M. LEWIS, M.A.

(*Continued from page* 161)

118 days—a record time. She has traversed all oceans from 80° North to the parallel of 60° South and has crost and recrost her own path and the path of her predecessor the *Galilee* many times, thus making it possible to determine for the points of intersection the secular changes in the magnetic elements.

After a thoro overhauling in 1919 and the installation of a four-cylinder gasoline engine, *made of bronze thruout,* to take the place of the producer-gas engine used on earlier cruises, the *Carnegie* started on her sixth cruise with a crew of twenty-three officers and men on October 9, 1919. A cruise of 61,500 miles has been planned in the South Atlantic, Indian and Pacific Oceans to last approximately two years. Unsurveyed regions in the South Atlantic and Indian Ocean will be covered and the route is planned so as to obtain a large number of observations of the progressive changes that have taken place in the magnetic elements. This is accomplisht as stated above by intersecting former routes and obtaining new values of the elements at the points of intersection.

In addition to its ocean magnetic surveys the *Bureau of Terrestrial Magnetism* also carries on extensive land surveys in all parts of the globe. In 1919 special expeditions were sent out by the Department to observe the total solar eclipse of May 29th at stations distributed over the entire zone of visibility of the eclipse and immediately outside. At Dr. Bauer's station in Liberia the total phase was visible in a cloudless sky for more than six minutes, which is very close to the maximum length of phase that can possibly be observed. Unmistakable evidence was gathered at all stations of an appreciable variation in the earth's magnetic field during a solar eclipse, which variation is the reverse of that causing the daylight portion of the solar diurnal variation of the needle.

In addition to the magnetic survey work on land and sea which is the chief work of the *Bureau of Terrestrial Magnetism,* atmospheric-electric observations are carried on continually on land and sea and experiments have been carried on at Langley Field, Va., lately in the development of methods and instruments for determining the geographic position of airplanes by astronomical observations. There has also been recently formed under this department a *Section of Terrestrial Electricity.*

The cause of the earth's magnetic field is still one of the greatest unsolved problems of astro-physics. The theory that has been advanced by Schuster that all large rotating masses are magnets *as a result of their rotation* has received considerable attention from astrophysicists, and attempts have been made to prove this experimentally. It has been found that iron globes spun

(*Continued on page* 196)

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

Write Today for Our Free Blue Print Offer

Agents wanted for our ready built phonographs

Choraleon Phonograph Co.
607 Choraleon Bldg., Elkhart, Ind.



SAVE OVER HALF

FREE



$20

TENOR BANJO Ukulele, Hawaiian Guitar, Violin, Mandolin, Guitar, Cornet or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiian Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.

SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 41 CHICAGO, ILL.



SAVE 25% to 60%

on slightly used
GRAFLEX-KODAKS

Cameras and Lenses of every description. Equal to new. Save money. Write now for Free Bargain Book and Catalog listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 10 days' Free Trial. Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.

CENTRAL CAMERA CO., Dept. 116 124 S. Wabash, Chicago

"MAC" Pocket Ammeter

Necessary to every user of Dry Cells. The ammeter is the only means of indicating the condition of a dry cell.

Accurate—Durable—Dependable—Guaranteed. At leading dealers or send $1.25 with dealer's name to

INTER-STATE AUTO PARTS CO., Inc.
1778 Broadway, New York City, N. Y.
No ammeter at the price is as good.
No ammeter at any price is better.

Learn the Sign-Show Card Business



Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.

EARN $25. TO $75. WEEKLY

You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.

DETROIT SCHOOL OF LETTERING, 686 D. S. L. Bldg. Detroit, Mich.

You DRUGLESS Can be a PHYSICIAN

A well-paid profession is open to you. The field beckons to both men and women. Combined home study and college course. Heal without drugs. Free catalog. International College of Drugless Physicians, Dept. E.E. 6 4200 Grand Blvd., Chicago.

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only 85 cents Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah

Fun, Magic and Mystery!

56 Feats in Magic, 250 New Jokes, 21 Puzzles, 1 Fortune Telling Tablet, 52 Money-Making Secrets, 15 Card Tricks, 71 Toasts, 58 Verses in Comic Poetry, 10 Funny Readings, 41 Epitaphs, and 11 Parlor Pastimes. You get all the above-mentioned and our big illustrated Catalog of 125 Magic Tricks for only 10 cents. Write today.

DETROIT TRICK & NOVELTY CO.
454-456 Dix Avenue Detroit, Mich.

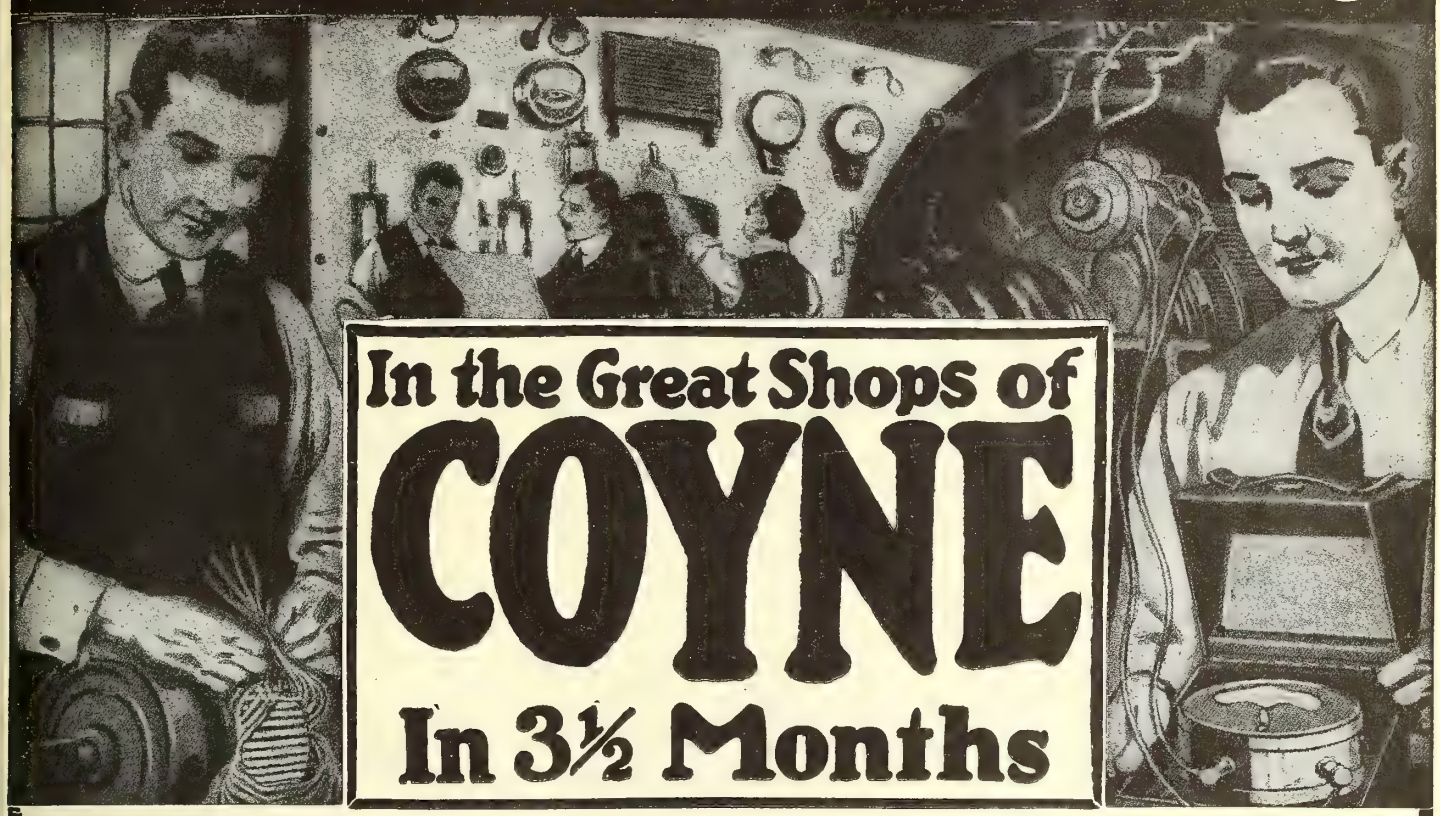
I TEACH
Penmanship
BY MAIL



I won World's First Prize for best course in Penmanship. Under my guidance you can become an expert penman. Am placing many of my students as instructors in commercial colleges at high salaries. If you wish to become a better penman, write me. I will send you FREE one of my Favorite Pens and a copy of the Ransomerian Journal. Write today.

C. W. Ransom, 511 Essex Bldg., Kansas City, Mo.

Learn Electricity



In the Great Shops of COYNE In 3½ Months

THOUSANDS of men have done it. Hundreds are doing it every day. *You* can do it too. Electricity is the greatest force in the world and the whole world is crying for more men to handle it. Practical men who know what's what were never more in demand than they are right now. Come to Chicago and let the great Coyne Shops train you. There is hardly *any limit to what Coyne trained men earn.* In less than four months you can become an electrical expert and hold down a big-paying job. Our sure-fire practical way of teaching and a twenty year record of success proves it.

Be an Expert in 3½ Months.

You don't have to spend from one to four years to become an electrical expert. Thousands of our 3½ months' graduates prove it. You learn here by doing the actual work, not with books and theory. The Coyne method comes right down to brass tacks and eliminates all unnecessary frills and fancy stuff. You get just what you need to cash in with on pay-day. We don't waste your time and money teaching you something you can't use.

Earn While You Learn—

Day or Evening Courses

Many of our students work in their spare time and earn part of their expenses. Others work during the day and take the evening courses, thereby earning all their expenses. Our employment department will help you find the right kind of employment if you want to do the same. Don't worry about money though. Anyone with a little gumption can learn here. The cost of tuition is low and small easy payments are arranged if desired. *All tools and equipment are furnished free.*

$40 to $100 A Week

That's what practical electrically trained men earn. That's what you can earn too after you spend 3½ months in these great $100,000.00 shops. You learn here by working on the actual apparatus. Our shops are equipped with everything from the simple electric bell to the mighty motors, dynamos, generators and electric locomotives—the huge switchboards and power plants. Thousands of successful graduates have found joy in working on this complete equipment and are holding down big jobs today.

Big Jobs Open Now

Hundreds of **big** jobs are open now to men who can fill them—such as Electrical Engineer, Contractor, Power Plant Supt., Sub-station Operator, Auto Elec. Repairman, etc., etc. We will assist you to secure one of these jobs when your training is finished.

Easiest Way Known

Previous experience unnecessary—you don't have to know anything about electricity to learn the Coyne way. Coyne experts know just what every man needs and they see that he gets it. They start you right at the beginning of things and the whole fascinating field of electricity is laid open before your eyes. Under the experts' help and supervision you actually do the work. That's the only way to learn. Nothing can stump a Coyne trained man after he gets his diploma as *Master Electrician.*

Send for Big FREE Book.

Check this coupon and mail it to me personally. *NOW.* Get the big book that tells what Coyne Graduates have done—and what you can do too. Check the trade you are most interested in and mail it *NOW.*

BENNETT W. COOKE, President
COYNE TRADE AND ENGINEERING SCHOOLS
Dept. 26, 39-51 East Illinois Street, Chicago

Learn Drafting

Practical instruction with some of the best experts in the world to guide you. Learn Mechanical or Architectural Drafting, Machine Design and Automobile Design. We place graduates in good positions.

Moving Picture Operating

We train men to hold the position of Chief Operator, paying $50 a week or more. Real practical instruction, with up-to-date machines and apparatus. Learn quickly at small cost.

Mail Coupon For FREE BOOK Now

B. W. COOKE, President, Coyne Trade and Engineering Schools
Dept. 26, 39-51 E. Illinois St., CHICAGO

Please send at once your big Free Book of Opportunity. I am interested in

[ ] Electricity [ ] Drafting [ ] Motion Picture Operating

Name .....

Address .....

Town .....

State .....



Your Psychic Powers — How to Develop Them

This Man Tells You

THIS wonderful book, just published after months of preparation, is by America's foremost investigator of psychical phenomena, Hereward Carrington, Ph. D. For more than twenty years he has been making elaborate researches in this field, exposing the "fakes" and encouraging the genuine psychic workers. No man is better fitted than he to explain all the mysteries of this wonderful subject and to show how anyone, YOU as well as anyone else, can develop those wonderful psychic powers that lie dormant within all of us.

Here are just a very few of the chapters: How to Develop; Harmonious Conditions; The Spirit World; Telepathy; Clairvoyance; Automatic Writing; Crystal Gazing; Self Projection; Haunted Houses; Hypnotism and Mesmerism; Spirit and Thought Photography; Reincarnation and Eastern Philosophy; Snares and Pitfalls to Avoid. Scores of other matters are taken up as well.

SEND NO MONEY. We feel so sure if you examine this book you will never part with it that we offer to send it entirely without charge. If, after examining it, it is not entirely satisfactory, return it to us without hesitation. If you think it is worth the price we ask for it, $3.00, remit us that amount within five days of its receipt. Just fill out this coupon or write us a letter mentioning the Electrical Experimenter. This offer has not been made elsewhere.

MAIL THIS TODAY—NO MONEY REQUIRED

Dodd, Mead & Company, Inc.,
445 Fourth Avenue, New York, N. Y.

Send me Dr. Carrington's book, "Your Psychic Powers; and How to Develop Them." I will either remail the book within five days after receipt and owe you nothing, or will send $3 in full payment.

Name .....
Address .....
City ..... State .....
Elec. Ex.—6-20.

DODD, MEAD & COMPANY
Publishers for Eighty Years
445 Fourth Avenue, New York

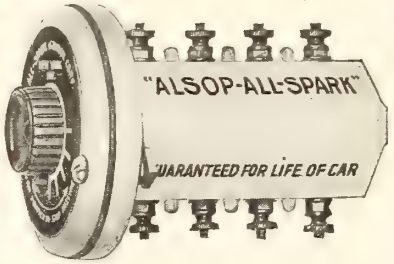
POWER!

O! Boy! but my car runs fine with the ALSOP ALL-SPARK. I have no more spark-plug troubles



INSTALL THE "ALSOP-ALL-SPARK"

on your car and get the increased power that results from a big, hot, fat spark.
It eliminates the cost of new plugs, by causing old, cracked, carbonized and oil soaked plugs to give powerful sparks, which retards carbon, saves gas, develops greater power, and insures continued driving without misfires.
The "Alsop-All-Spark" is simple—merely attach the handsome control dial to your dashboard and attach the wires to the spark plugs. The "Alsop-All-Spark" is safe—it has no dangerous, exposed spark gaps to set your car afire. The "Alsop-All-Spark" is sure—it will not make your car hard to start; and assures continuous running without misfires.



Send $7.50 for 4-cylinder type device—money-back guarantee.

Live Dealers, Agents, Salesmen Wanted

ALL-SPARK IGNITION CO., Inc., 13-X Water Street, New York City

Uttmark's Nautical Academy Radio School

8 State St. New York, N. Y.
Phone Bowling Green 8079
Complete instruction in radio operating in all branches, for Merchant Marine, Ocean Steamships, Telegram Service, Aerial Mail Service, etc. Preparing for Government Examinations.
Elementary and Advanced Classes
Day and Evening Sessions
Write for Circular.

Popular Astronomy
The Earth as a Magnet

(*Continued from page* 194)

at high velocities in the laboratory do *not* exhibit magnetic properties. This may mean simply that the magnetic field is too weak to be detected in the case of a comparatively small iron sphere spun for a limited period under laboratory conditions. It must be remembered that the earth has been rotating rapidly on its axis for millions of years and is, compared to terrestrial objects, an extremely large mass. Yet it has been shown that as a whole our earth is an extremely weak magnet, and that if it were made entirely of steel and magnetized as highly as an ordinary steel-bar magnet, the magnetic forces at its surface would be a thousand times greater than they actually are.

If it is true that all rotating bodies are magnets, then all the heavenly bodies, planets, suns and nebulæ are surrounded by magnetic fields. We know nothing to the contrary. In fact, we know this to be true for the earth and sun, and strongly suspect that it is so in the case of the planets *Jupiter* and *Saturn*.

When we understand more about the properties of matter, the nature of magnetism, as well as of gravity may be revealed to us.

Popular Astronomy
Questions and Answers

[By ISABEL M. LEWIS

The following questions have been asked by A. K. L.:

1. Maps of the solar system show all of the planetary orbits on a plane. Are they actually so?

Answer 1. It is customary to represent the orbits of the planets as complete circles, all lying in the same plane, that of the earth's orbit, or ecliptic. As a matter of fact, the planetary orbits are ellipses of very small eccentricity, not circles, and they do not lie in the same plane, but since the inclination of the planetary orbits to the plane of the ecliptic is so small (amounting to only 7° in the case of Mercury, the most inclined, and averaging about 2° for the others), it is more convenient, tho not strictly accurate, to represent them all lying in one plane. In form the orbits of the planets are so nearly circular that, again with the exception of Mercury, their ellipticity could not be detected on a drawing eight or ten inches in diameter.

2. Was there ever any attention given in astronomical circles to Vail's theory of the annular world, in which he tried to prove that the earth once had Saturn-like rings which produced queer effects upon the religion and mind of primitive man?

Answer 2. I have never heard this theory discussed astronomically.

If the earth had been originally surrounded by Saturn-like rings it is very doubtful whether they could have existed up to the age of primitive man, as the theory you mention states, and yet have disappeared so completely in the comparatively short interval of time, astronomically speaking, that has elapsed since the age of primitive man.

There are astronomers who are inclined to the belief that other planets besides Saturn were originally surrounded by rings of meteoric particles, and, according to a cer-

tain lunar theory, the moon was formed by the breaking up of such a ring, many millions of years ago, and its lunar craters were formed by a bombardment from meteoric masses within the ring. It must be remembered in this connection, however, that many lunar craters are fully fifty or more miles in diameter, while recent observations of Saturn's rings set three miles as an upper limit for the size of the individual moonlets.

3. How powerful would a telescope have to be to ascertain whether the "canals" on Mars are natural or artificial, and what would this power be in ratio with the most powerful existing telescope?

Answer 3. The visibility of the "canals" of Mars is not dependent alone upon the size of the telescope used. We have here a problem in which the atmosphere plays a very important part. Observers of the Martian canals insist that their visibility depends quite as much upon having excellent "seeing" conditions as upon the telescope itself.

It must be remembered that when high magnifying powers are used the imperfections of the atmosphere are also magnified. It is well known that the moon under high magnifying powers appears more as it would viewed thru water instead of thru air.

If it were possible to establish an observatory at an elevation of three and one-half miles, thus leaving behind one-half of the earth's atmosphere, we would come closer to solving the mysteries of the "canals" of Mars than by increasing the size of our telescopes.

I do not know what results have been obtained with the 100-inch Mt. Wilson reflector in observing Mars, or whether this great instrument has yet been turned on Mars, tho it has been stated that it shows a wonderful amount of intricate detail on the moon; but it is well known that the 60-inch reflector of the Mt. Wilson Observatory has not yet revealed the canals of Mars, and neither has the 36-inch Lick reflector. Yet there are now too many independent observers of the canals of Mars who have all seen the same canals with comparatively small telescopes to make their actual existence any longer a matter for doubt.

It is generally considered that high magnifying powers are not suitable for the observation of planetary detail, owing to the imperfections of our own atmosphere. High magnifications only magnify the "boiling" and unsteadiness of the air that are so fatal to the observation of all finer detail on the planets and moon.

If the canals of Mars are actually artificial waterways made by intelligent beings it is, of course, not the actual waterway itself that is visible, but the strip of vegetation lining its banks. No telescope that man has built or could build would show lines on Mars only a few hundred feet wide, and no artificial waterway would be made so wide.

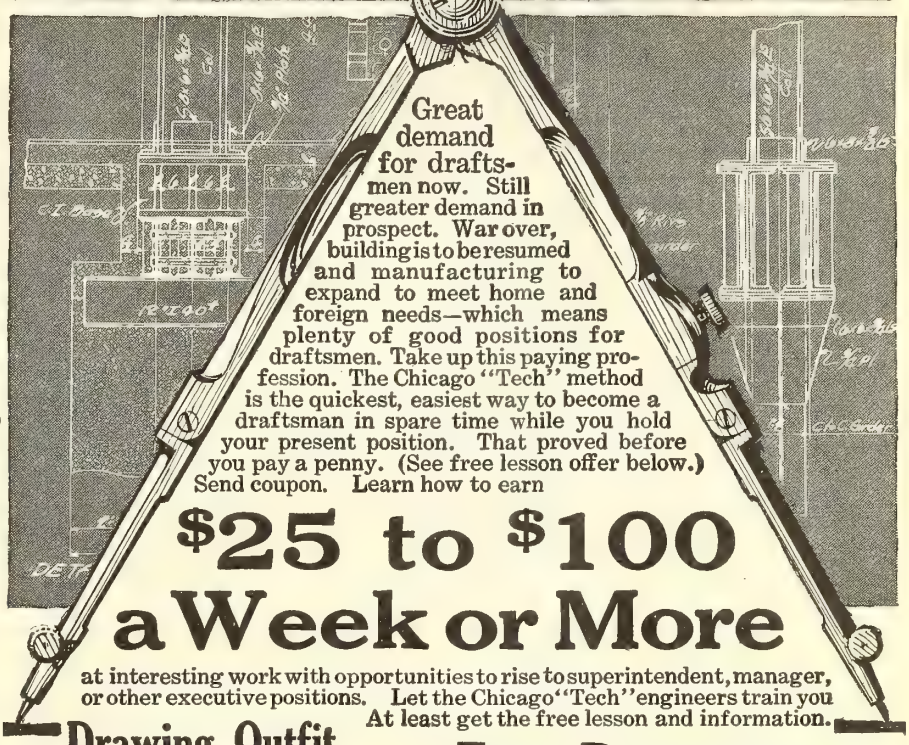
Practical Chemical Experiments

By PROF. F. L. DARROW

(*Continued from page* 167)

appears in the tube. For purposes of comparison test at the same time an equal quantity of distilled water and compare the number of drops of soap necessary to

Make a Bigger Income
Learn Draftsmanship



Great demand for draftsmen now. Still greater demand in prospect. War over, building is to be resumed and manufacturing to expand to meet home and foreign needs—which means plenty of good positions for draftsmen. Take up this paying profession. The Chicago "Tech" method is the quickest, easiest way to become a draftsman in spare time while you hold your present position. That proved before you pay a penny. (See free lesson offer below.) Send coupon. Learn how to earn

$25 to $100 a Week or More

at interesting work with opportunities to rise to superintendent, manager, or other executive positions. Let the Chicago "Tech" engineers train you At least get the free lesson and information.

Drawing Outfit



(*No Extra Charge*)

Every student of the Chicago "Tech" Home Study Course in Draftsmanship receives this drawing outfit—set of instruments in case, drawing board, T square, triangles, scale, curve, drawing paper, pencils, etc., or a cash credit in case he already has an outfit. You use them while learning—then take them right into your practical work.

NOTE: Enrolled with Chicago "Tech" you have the personal direction of practical engineers, builders and architects who teach you the methods they use in their own work. No useless theories, no time wasted. You are prepared to stand beside old, experienced men. Big advantage to learn from a staff like this—every man a specialist.

Come To the College or TRAIN at HOME

Wherever you are you can have this Chicago "Tech" training. Complete instruction by mail. Exercises, lessons, personal direction of our experts right in your own home if you cannot come to the college for a resident course. Send the coupon and get the facts.

Auto and Gas Engine Course

All about automobile mechanism—its construction, operation and REPAIR—taught by mail. You train directly under the Chicago "Tech" automobile experts. Splendid opportunities open now.

Learn All This in Spare Time

All about the Principles of the Automobile.
All about Gasoline Engines.
All about Power Plants and Transmissions.
All about Carburetors and Fuel Supply Systems.
All about Lubrication and Cooling.
All about Batteries.
All about Magneto Ignition.
All about Starting and Lighting Systems.

Know How To Fix Troubles

Most complete instruction in auto repair work. Equips you for high pay or to start a business. Big demand for trained repair men.

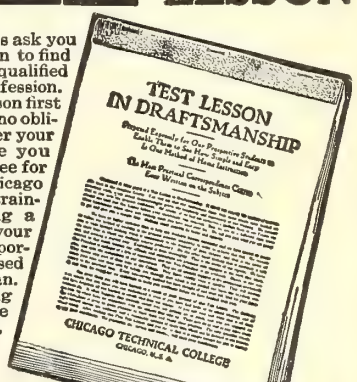
Write Send the coupon and get catalog and all information now.

Easy Payments

The fees for Chicago "Tech" courses are very moderate—and you can pay on easy terms. And also—you can obtain in a few months what it would take several years to acquire by ordinary methods. You can get an early start. You are soon ready to take a paying position and to quickly get back the cost of your course.

FREE TEST LESSON

Other institutions ask you to pay first—and then to find out later how well qualified you are for this profession. We send the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything. And see for yourself just what Chicago "Tech" offers you in training which will bring a ready market for your services and open opportunities which are closed to the untrained man. The coupon will bring all the facts about the course, the small fee, and the easy terms.



Mark with X the branch you are interested in—or if in doubt about which course to take, write a letter stating facts about yourself and asking our advice which will be freely given. Mail either the coupon or the letter today.

CHICAGO TECHNICAL COLLEGE
645 Chicago, "Tech" Bldg., Chicago, Ill.

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below:

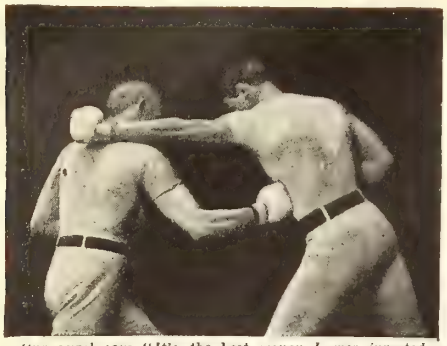
[ ] Draftsmanship	[ ] Plan Reading—Buildings
[ ] Automobiles	[ ] Plan Reading—Machinery
[ ] Gas Engines	[ ] Estimating—Buildings
[ ] Aeroplanes	[ ] Surveying
[ ] Designing	[ ] Plumbing—Estimating, etc.
[ ] Contracting—Buildings	[ ] Steam Engineering

Name .....

Address .....

Post Office..... State.....

Free Trial lesson included when inquiry is for Draftsmanship or Plan Reading.



One pupil says "It's the best money I ever invested. The lessons would be cheap at double the price."

Who wants to learn boxing at home?

Would you like to know how to protect yourself against a bully? To be able to outbox someone bigger than you? To know the eight most effective blows to use, and the best guards against attack, not only against blows, but kicks and wrestling holds? Do you know that you can learn these things easily and quickly by the new system of boxing instruction, the Marshall Stillman Method, making your daily exercise interesting as well as beneficial?

Marshall Stillman teaches boxing by science. By this new method he has taught a novice in 15 minutes the difficult scientific left hand lead. It often takes 20 lessons to learn it by the old method. In 40 minutes Marshall Stillman taught 46 new members of the New York State Guard the principles of the hit, guard, and duck. Boxing professors in the Army say that it took them weeks to teach those fundamentals by the old method.

This system is so simple that it is taught by mail. You learn the fundamentals right in front of your own mirror. When you face your first opponent, you know how to hit him, what to expect in return, and how to guard against it. Two weeks after receiving it pupils have been able to outbox bigger and stronger opponents. Even boys of 15 have learned to protect themselves. Men of 50 have taken it, not only to learn boxing, but for the beneficial daily exercise.

The new complete Home Study Edition is only $5—less than you would pay for a few lessons by the old method. Besides the 5 lessons on the hit, guard, duck, feinting and clinching and footwork with 25 illustrations, it includes one lesson on daily exercise, 8 illustrations; 3 rounds of shadow boxing, 8 bone-breaking holds and releases (Jiu Jitsu) and 8 holds in standing wrestling, with 69 illustrations; and a copy of Mike Donovan's famous book "The Science of Boxing," including 70 illustrations.

Send no money

Frankly, you don't believe boxing can be taught by mail, do you? All right, we'll take you on your own ground—we will mail the complete course to you on 10-day approval. Send the coupon below to the Marshall Stillman Association, Suite E-6, No. 461 Fourth Ave., New York.

Marshall Stillman Association, Suite E-6, No. 461 Fourth Ave., New York.

You may send me on free 10-day approval your new complete Home Study Course in Self Defense, including 5 Lessons in Boxing, one lesson for daily exercise, 3 rounds of shadow boxing, 8 bone-breaking holds and releases, 8 holds in standing wrestling, and a free copy of Mike Donovan's Book, "The Science of Boxing." I will either return the course or remit $5 (Canada $6, foreign countries $7) in full payment within 10 days after its arrival.

Name .....

Address .....

.....

You Can Have Strong Arms



POWERFUL BACK, CHEST, MILITARY SHOULDERS, SHAPELY LEGS, and a HEALTHY STOMACH.

All of the above can be obtained by following the instructions in my book, Strong Arms, which contains a complete course in physical culture that will develop all parts of your body to perfect proportion. The exercises are illustrated with 20 full page half tone cuts and require no apparatus. Send 25c in coin.

300,000 COPIES SOLD

Send your order today before you forget.

Prof. ANTHONY BARKER, D. C.
Studio 561
127 West 42d Street, New York City

give permanent suds in the two cases. This will give an idea of the degree of hardness.

To determine whether the hardness is temporary or permanent boil a 50 cc. sample of the water and test as before. If less soap is required than before but still more than perfectly soft water, the hardness is partly temporary and partly permanent. If there seems to be no difference in the amount of soap required, the hardness is all permanent. If the water seems entirely softened, the hardness is all temporary.

DETERMINING THE IMPORTANT MINERAL CONSTITUENTS.

First evaporate a half liter of the water to one quarter its original volume. Filter and save both precipitate and filtrate.

Dissolve the precipitate by pouring thru the filter the least possible amount of dilute hydrochloric acid, and collect the solution in a clean test tube. In doing this note whether there is any effervescence. If there is, *carbonates* are present.

Iron: To a little of the above solution add a few drops of potassium sulfocyanat solution. If a red coloration results, iron is present.

Calcium and Magnesium: To another small portion of the solution from the precipitate add a little ammonia water and ammonium oxalat solution. If a white precipitate forms calcium is present. Warm and filter. To the filtrate add ammonium chlorid solution and a little of a solution of di-sodium hydrogen phosfate. If upon shaking and rubbing the inside of the test tube with a glass rod, a white crystalline precipitate forms magnesium is present.

Sulfates: For sulfates, test both the solution from the precipitate and the filtrate obtained from evaporating the half liter of water. To a small quantity of each add a little barium chlorid solution and dilute hydrochloric acid. If a white precipitate insoluble in the acid results, sulfates are present.

Phosfates: Evaporate to dryness the remainder of the solution from the precipitate, moisten with nitric acid and add an equal volume of ammonium molybdate solution, prepared as described in the previous article on the sanitary examination of water. Let it stand over night. If a yellow precipitate forms, phosfates are present.

Chlorides: To 10 cc. of the above filtrate add a little silver nitrat solution and dilute nitric acid. A white precipitate shows the presence of chlorides.

Calcium and *magnesium* may also be present in the filtrate and therefore the same tests as before should be made with the filtrate too.

Lead: Evaporate 50 cc. of the filtrate to 10 cc. and add a little of a solution of potassium bichromat. If a yellow precipitate forms lead is present.

A confirmatory test may be made by passing hydrogen sulfid gas thru some of the concentrated filtrate for a few minutes. If lead is present a black precipitate will appear.

Sodium and Potassium: To test for these metals evaporate some of the filtrate, obtained from the evaporation of the half liter of water, to small volume. Into this dip a clean platinum wire and hold it in the oxidizing portion of a Bunsen flame. If the flame is colored yellow, sodium is present. See Fig. 5. Repeat the operation, but this time look at the flame thru three thicknesses of cobalt blue glass. A violet color seen thru the glass proves the presence of potassium.

The course of procedure outlined in this article covers all the important tests made in the ordinary chemical examination of water for industrial purposes. It comprises work of great interest and of high commercial importance.

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures but 4¼ Inches Long. Takes Regular .22 Caliber Cartridges



The new Baby Double Action Hammerless Revolver has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of Efficiency and Practicability. It is small in size, yet is just as effective and serving able as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety that guards against accidental discharge, making it quite safe for you and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be appreciated. The ammunition used is the standard .22 caliber cartridge, obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable, six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. The price of the Baby Revolver is only $6.50 sent by mail, p.p.d. to any address.

$6.50

AGENTS WANTED

Cut Your Own Hair WITH THIS

ONLY 35c



SAFETY HAIR CUTTER Can cut your own hair with this marvelous invention. Cuts the hair any desired length short or long. Does the job as nicely before your own mirror. You can cut the children's hair at home in a jiffy. Can be used as an ordinary razor to shave the face or finish around temple or neck. Sharpened like any razor. Lasts a lifetime. Saves $5 cost first year used. PRICE ONLY 35c, postpaid. Extra Blades 5c.

JOHNSON SMITH & CO., Dept. E10 3224 N. Halsted Street, CHICAGO

THE U.S. BABY TANK It goes with real Yankee Pep—by its own power



Most remarkable Toy ever invented. By drawing the Tank backward, either with the hand or over the floor or table and then placing it down, it will crawl along, overcoming all obstacles, in the same lifelike manner as the larger Tank that proved so deadly in the great war. What makes it go is somewhat of a mystery, for there is no mechanism to wind up as is usually understood with mechanical toys, yet this tank will keep plodding along ten times longer than the ordinary run of toys. It will perform dozens of the most wonderful stunts; it will go backward or forward at will, and altogether will give you more fun and amusement than any other toy yet brought out. 2¼ inches long. Each packed in colored box. **Price only 35 cents prepaid, three for One Dollar, or $3.00 by the dozen, postpaid to any address in the world.** Johnson Smith & Co.

MAGIC FLUTE

Wonderfully Sweet Toned and Musical



The Magic Flute, or Harmonicone is a simple and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it, which when once acquired after a little practice, enables you to produce very sweet music that somewhat resembles a flute. There is no fingering, and when you have mastered it you can play all kinds of music with facility and ear. When played as an accompaniment to a piano or any other musical instrument, the effect is as charming as it is unique. **25c ppd.**

Post Paid **25c**

JOHNSON SMITH & CO., Dept. E10 3224 North Halsted Street, CHICAGO

Good Luck Ring



Quaint and Novel Design

A VERY striking and uncommon ring. Silver finish, skull and crossbone design, with two diamonds, flashing forth sparkling out of the eyes. Said by many to bring Good Luck to the wearer hence its name, Good Luck Ring. A unique ring that you will take a pride in wearing. **ONLY 25 CENTS.**

JOHNSON SMITH & CO., Dept. E10 3224 North Halsted Street, CHICAGO

LUMINOUS PAINT



Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific field, hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, emits rays of white light, rendering it perfectly visible in the dark. **THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use. Anyone can do it. A little applied to the hands of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles with your own Luminous Coating. Luminous Rosaries, etc. Small bottle, price 25c. Larger sizes, 50c and $1 postpaid.

Mystic Skeleton

A jointed figure of a skeleton 14 in. in height, will dance to music and perform various gyrations and movements while the operator may be some distance from it.



10c pd

JOHNSON SMITH & CO., Dept. E10 3224 North Halsted Street, CHICAGO

Serpent's Eggs

Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which writhes, curls and twists about in a most life like manner. Price per box, 10c ppd.



All the Latest Surprising and Joke Novelties

Pharo's Serpents Eggs, box	10c	Mesmerized Penny-riddles the law of gravitation	20c
Miniature Water Pistol	10c	Mysterious Tumbler and Vanishing Coin Trick	25c
Cleopatra's Snake (very lifelike)	15c	Magic Plate Lifter	25c
False Mustache (fool your friends)	6c	Great Burglar Puzzle	10c
Automobile Puzzle (Latest)	20c	Wire Puzzles, 12c. $2 different	$1.00
Mysterious Ghost, shines at night	10c	"Bloc-Trick" Push Button	10c
Rubber Dagger (sensational)	20c	Imitation Bed Bugs	10c
Lookbackoscope (see behind you)	15c	Squirt Ring	25c
Great Mind Reading Mystery Cds.	10c	Glass Watch	25c
3 Illustrated Detective Trick Cds	10c	Mud-Spring Billiard Ball Trick	25c
X Ray Novelty	10c	Inkless Pen (writes with water)	10c
Trick Pencil	15c		
Rubber Tacks (a good joke)	10c		

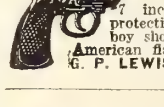
JOHNSON SMITH & CO., Dept. E10 3224 North Halsted Street, CHICAGO

PROSPECTIVE STUDENTS

B. C. N. will give you your N.D. degree in two years, day and night classes. This institution teaches Electrical Therapeutics, Static, High Frequency, Violet Ray, Galvanic Current, X-Ray, Osteopathy, Orthopaedics, Chiropractic, Psychology, as embodied under the Triplicity of Sciences known as **Natureopathy.** The field is unlimited right now for Natureopathic Physicians. Our experienced faculty of fourteen practical physicians will guide you surely and carefully to attain success. Earn while you learn if you so desire. Graduates of single branch schools who are here now say that the Blumer System is the most wonderful drugless healing system in existence. Write today for our catalogue. Start right. Address Executive Secretary,

BLUMER COLLEGE of NATUREOPATHY
97 Ann St., Dept. H., Hartford, Conn.

15 cents postage will bring to you "The Scientific Natureopath." Address Publicity Dept. of the above college.



BLANK CARTRIDGE PISTOL Sent Prepaid **ONLY $1**

7 inches long, **real revolver style.** For protection and sport, every man, woman and boy should have one. Order at once. Get an American flag **FREE.** Money refunded if desired. **G. P. LEWIS CO., 1402 Broadway, New York City**



158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. Only 10
Finest Approval Sheets 50% to 60%. AGENTS WANTED. Big 72-p. Lists *Free*. We Buy Stamps. Established 25 yrs.
Hussman Stamp Co., Dept. 67, St. Louis, Mo.

Radium—the Bad Boy of Science

By HAROLD F. RICHARDS, M.A.

(*Continued from page* 171)

a *skyscraper*, or it could be included in the circuit of the electric chimes in a church steeple, so that the successive alpha particles could *play chimes* for the amusement of the town. In order to emphasize the enormous magnification represented by these actions, I may be permitted to repeat what I said in a previous article—"that the electrical charge carried by an alpha particle is so small, that as many of them would be required to light an ordinary incandescent lamp, as there are drops of water in the modern swimming tank."

2. A "SPEEDOMETER" FOR GASEOUS IONS.

The nature of the *ions* produced in gases by the action of radium rays, ultra-violet light and X-rays is best investigated by determining *the velocity with which the ions move.* The variation of this velocity with the nature, pressure and temperature of the gas sheds much light upon the characteristics of the ion. Before describing the experiment I may as well state that the results of many experiments have shown that, in all probability, *the process of ionization consists in the expulsion of an electron from a molecule of gas.* The electrical charge on the electron then attracts other molecules to it, *so that the ion is really a cluster of molecules, bearing a single electronic charge.* This molecular aggregate moves under the action of an electric field, but suffers many collisions with other molecules. The experiment to be described permits us to measure the *velocity* with which the positive and negative ions move. The apparatus *automatically* starts and stops the action in the space of *seven-thousandths* of a second, and registers how fast the ions traveled *in the meantime.*

Figure 2 illustrates the apparatus used. It involves what is called a *gravity* or *drop chronometer,* which is really nothing more than a clock capable of measuring intervals of time down to *one thousandth of a second.* As is well known, the action of gravity upon a body is always *uniform,* and we can determine at once, by a simple calculation, how long it will take a falling body to cover the distance between two given points, if we know how far it has already fallen. In the apparatus as illustrated, the *projectile* is a steel cylinder held in place by an electro-magnet. If the circuit in the magnet is broken, the projectile falls, and in so doing releases *in succession* two light mechanical *trips* of iron, which have been held in place by very weak magnets. When the trips are thrown by the falling weight, *electrical connections* are broken, and the time elapsing between the breaking of these two connections is readily found, when we know how far the two trips are apart and how far the weight has fallen before striking the first one. When the first trip is thrown, the primary circuit of a large *induction coil* is broken, and this causes a *single instantaneous* flash of X-rays to pass thru a narrow slit into the ionization chamber. In order to avoid a spark when the connection is broken, so that the break will be instantaneous, a capacity of a few tenths of a microfarad is connected around the break. This is not shown in the diagram. The X-rays are so directed that they produce a thin layer of ions at the surface of the first plate in the ionization vessel, which is simply a brass box. This plate is originally connected to the negative pole of a battery of storage cells, and the *electric*

Who Wants Perfect Health?

EVERYONE. Yet how few really attain it! Not so much because of lack of time and attention given to the subject, but because of inefficient methods of instruction. Too many men waste time in the kindergarden of exercise.

If a man wants to improve his education or develop his mental talents, does he go to kindergarden to do so?

I'll say not! And there is no reason why any adult should bother with the kindergarden of exercise.

In training the mind, the power to think is developed by making the task or problem increasingly difficult as the ability to concentrate becomes greater. To send a high school graduate to kindergarden would be the height of folly. To send a full grown man to the kindergarden of exercise is equally ridiculous.



ARCHIE GILLESPIE

(Reproduced from *Strength*)

Graded Weight Exercises

Physical education should be carried out with the same general idea used in developing the mind. Any adult or growing boy has passed through the kindergarden stage of exercise during the days of early childhood. Why bother now with exercises which would be beneficial only to a child?

Begin exercising with a system suited to your individual needs and graded to suit your physical condition. Perfect health is within the reach of every normal man and boy. *You* can equal the health and strength of the athlete shown in this picture. He is but one of the many perfect specimens developed by the Milo system during the past eighteen years. We can do the same for you.

We guarantee results, and will not accept your case if we do not think we can benefit you.

Our adjustable bar bells are the finest obtainable and our courses of instructions are second to none. Let us start you on the royal road to health. You will have the benefit of our years of experience in this work, and will be entitled to the advice of our expert instructors at all times. Don't put it off. SEND FOR

Illustrated Catalog and Folder No. 18 describing our system of exercising. BOTH FREE.

THE MILO BAR BELL CO.

Physical culture specialists and largest manufacturers and distributors of bar bells, dumbbells and kettle bells in the world.

Diamond and Third Streets

Dept. 6 **Philadelphia, Pa.**

STRENGTH

Are you interested in good health and the best methods for obtaining it? Read STRENGTH! It contains many articles of value and interest to all seekers after good health, and is superbly illustrated with pictures of the best developed men in the country. An inspiration which will enable you to attain perfect health and the bodily strength and vigor desired by all men.

The principles advocated by "Strength" are not mere fads, but have been proven by years of practice. Don't envy the man who is well developed. *You* can develop a strong body and compel the admiration and respect of your friends. There is no reason why any man should be weak or sickly. *Prepare to live.* Send in your subscription to-day.

SUBSCRIPTION BLANK

Date.....

MILO BAR BELL CO.
Diamond & Third Sts..
Dept. 6, Philadelphia, Pa

I herewith enclose one dollar ($1.00) in payment for one year's subscription to "STRENGTH." ($1.25 Canada and foreign countries.)

Name.....

Street Address.....

City or Town..... State.....

Do You Know?

THAT

THE EXPERIMENTER'S CYCLOPEDIA TELLS:

How to make any telephone send and receive wireless messages.

How to make a camera for 10c photographs clear and sharp.

How to make transformers for 10c for A.C. and D.C. currents.

How to make flashlight batteries burn three times as long.

How to make a good two volt storage battery for 50c.

How to make a telephone with bell system for ten cents.

How to make duplicates of old postage stamps at 2c a dozen.

How to make a small simple motion picture camera

How to make a vest pocket wireless telegraph.

How to make any clock run two years with one winding.

How to make an automatic recorder for telephone calls.

How to make an electric experiment battery for five cents.

How to make or buy moving picture films for a ½c a foot.

How to make the midget battery switch for five cents a dozen.

How to make pictures in daylight without a dark room.

How to make ink appear—dissappear any moment wanted.

TRY THIS TRICK

Ask the druggist for some Sulphate of Quinine acidulated with sulphuric acid this looks exactly like water. Now tell one of your friends who is a picture enthusiast that it is impossible for him to get a picture of you. He will offer to make one, but warn him that he is simply wasting his material. When he is ready to take your picture streak a little of the solution across your face, it is perfectly harmless and is invisible then when the picture is developed your friend will be amazed to find a big black smudge across the picture. This seems to be impossible but seeing is believing.

THAT—When you send your order for the **Experimenter's Cyclopedia** you receive by return mail a volume that is incomparable. No work in all this world will give you so much valuable trade secrets and plans for making **wireless, electrical** and **chemistry** apparatus, supplies, etc., as this volume will and at so little cost even if you don't start a business of your own it will at least save you many dollars. Among the contents:

IT TELLS HOW TO MAKE

Print-O-Graph for 50c prints circulars, letterheads, signs, etc. in one or more colors. Print labels and stickers at 10c a thousand. **Print-O-Graph is not a** gelatine duplicator.

Wireless Telephone without aerials, easy to make when you know how. Materials required are receiver, transmitter, battery and wire. Transmits clearly at any distance.

Burglar Alarm, closed circuit for $1.00. Can be installed anywhere, bell rings automatically when wire or tin-foil is broken. No relays, electro-magnets, buttons, springs, etc., required.

New Electric Battery for 50c. Make and charge it at home. No electricity, wet or dry batteries required. This battery produces 30 volts.

Wireless Set for $1.00. No! Will not send and receive a thousand miles but is an efficient wireless apparatus that will operate anywhere if instruments are carefully made.

Aeroplane Photography—photograph your town and you can make the picture look as if photographed from an aeroplane; tell them you were up and made a snapshot.

Liquid Pocket Flashlight for 25c gives light for 6 weeks with one charge, no matches, oil wicks or batteries required, handy and safe as a flashlight.

Hypnotism made easy with this chemical method anyone can be easily hypnotized, results guaranteed. No high brow language but plain simple instructions.

Telegraph electricity free. You can get 7 volts of earth electricity free, anywhere, anytime, never runs down, operates telegraph lines up to 2½ miles.

Old coins made visible. Unreadable impressions on old coins can be made readable again without cost. This secret is indeed valuable.

Midget Ice plant for 50c. Freezes a daily supply of pure cold ice for a few cents in any season and in any part of the world.

Self Lighting Gas, an inexpensive chemical. Once applied to any gas mantle or burner. Lights the gas instantly, when turned on.

Phone in Privacy without telephone booth. Simple home made device placed inside any telephone mouthpiece enables you to phone without being overheard.

Mysterious Ball, easily made. You can pitch the most peculiar curves such as no ball player can catch. **Make real** sensative photo post cards at 10c a dozen.

How to make telegraph sets for 10c with magnet sounder, telegraph key, etc. 8 ins. x 11 ins. photo enlargements for 10c. **Magnetless buzzers for 25c—Red** and **White Rubber Bands,** all sizes for 50c a thousand—**Electric Walking Stick** for 25c—6 inch **Rubber Printing Stamps,** any wording for 5c—**Genuine Stamp Photos** at 1c a dozen—**Rheostats** at 5c each—**Nickel Plating Outfits** for 50c—How to make **Chemical Outfits—Code Practice Sets—Lighting Outfits—Microphones—Buzzers—Voltage Increasers—Barometers—Flexible Mirrors—X-Rays—Dectors—Batteries** and hundreds of other electrical and wireless apparatus, supplies, etc., etc.

The above is but a sample explaining the general type of the work and the low prices for which you can make them and many others at home. The Cyclopedia is full of unique ideas which will keep you awake nights. No man can read it without feeling the impulse upon him to start something.

PRICES AND CONDITIONS

The price of the **Experimenter's Cyclopedia is $2.00 postpaid** to any address. Printed on large 8"x11" pages, bound in heavy loose-leaf covers. For your convenience in attaching additional pages as may be sent you from week to week. This additional service is free for one year and is of great value to Experimenters interested in electricity, wireless, etc. This is just the book for all Electrical Experimenter readers, and you shall be the judge. **Send a deposit of 50c** and the complete Cyclopedia will be sent you by return mail. Upon receiving it take **THREE DAYS TO EXAMINE IT;** if you find any thing misrepresented, mail the book back to me and your 50c will come back—otherwise remit the balance. **Don't trust a bad memory—SEND THAT 50c TODAY.**

IRVING B. ADAMS, 1305 South Peoria St., Chicago, U. S. A.

All Parts and Material which you cannot make yourself, I will supply them for a few cents.

HELLO, BOYS!

Put up your own TELEPHONE — anywhere — in the house—in camp—on the farm and numerous other places.

TRADE-MARK

MECANEL TELEPHONES are REAL ELECTRIC TELEPHONES that operate on a couple of dry batteries with the same wiring connections as that of the ordinary door-bell. Heaps of fun in calling your chum, upstairs, across the way, from house to garage, barn or shed, tent to tent, etc.

BOY SCOUTS just think. . . . a real TELEPHONE, similar to those used in the trenches during the recent war.

ARMISET as illustrated comes complete with 2 receivers, 2 transmitters, connecting cord and diagrams, fully guaranteed to work perfectly. Price **$1.50**

Ask your dealer for a MECANEL telephone, if he has not got it, send us $1.50 and we shall mail you a set POSTPAID.

INLAND-SPECIALTY CO., 1562 N. Robey St., CHICAGO

READ THE CLASSIFIED ADVERTISEMENTS ON PAGES 236 TO 239. YOU'LL FIND MANY GOOD THINGS THERE

field causes the *negative* ions to be driven across to the other plate, while the *positive* ions are immediately absorbed in the first plate. The charge communicated to the second plate is measured later with an electrometer. Now comes the most important feature of the experiment. When the falling weight strikes the first trip and thus causes ions to be produced at the surface of the first plate, that plate is at a *negative* voltage; but when the weight strikes the second trip the plate is brought into connection with the *positive* end of the battery, the electric field in the ionization chamber is *reversed,* and the ions which were moving towards the second plate are turned back to the first plate. The time elapsing between the production of the ions and the reversal of the field can be easily regulated to such a value that the negative ions just fail to reach the second plate, before they are forced to turn around and return to the first plate. The *drop chronometer* tells us this time, and since we know the distance between the plates, we can at once tell how fast the ions traveled.

In order to ascertain when the ions have just reached the second plate, the time allowed for the ions to travel towards it is gradually increased until the electrometer shows the first indication of a charge. The electrometer consists of a flat circular brass disc cut into four segments. Two of these segments are connected to earth, and two to the plate whose potential is to be measured. A very thin needle of paper, covered with aluminium foil, is suspended by a fine quartz fiber above the crack between the segments. The needle is charged to 80 or 100 volts. When any electrical charge reaches the brass disc, the needle is deflected, and the amount of twist is measured by the motion of a spot of light reflected from a very small mirror attached to the fiber that carries the needle. The method by which the reversal of the electric field is effected is very simple. A battery of storage cells is earthed in the middle, so that its two poles are at potentials of 50 volts *negative* and 50 volts *positive,* respectively. These two poles are *short-circuited* thru a *high* resistance of 50,000 ohms, furnished by a test tube filled with water. Before the lower trip is struck, the plate of the ionization chamber is connected to the *negative* end of this circuit, but when the trip is thrown, the circuit is broken, and the plate is left connected to the *positive* pole to the battery. This reversal of potential occurs virtually instantaneously, because the water resistance is practically *non-inductive.*

In an actual experiment, the weight was allowed to fall one foot before striking the trip that starts the experiment. The distance between the two trips necessary to allow the ions just to reach the second plate was found to be 0.75 inch. Therefore the time elapsing between the starting and stopping of the experiment was 0.007 second. In this time the ions moved 0.25 inch, which was the distance between the plates. Dividing 0.25 by 0.007, we find that the velocity of the ions was 36 inches per second, or about 2 miles per hour. This was in air at atmospheric pressure.

In the course of many experiments, performed under different conditions, it was found that the velocity of the negative ion in air varied from 20 *to* 140 *inches per second,* for a field of 50 volts per inch. The apparatus is sufficiently sensitive to reveal the difference between the velocities of the positive and negative ions. The latter always move somewhat faster than the positive ions, which shows that the positive ions are *heavier* than the negative ones. From these figures it is evident that the ions are very slow compared to the *alpha* or *beta* rays of radium, for these rays travel at speeds varying from 15,000 to 150,000 *miles per second!*

"A" FOR ADAM, AND "E" FOR EVE.

A telephone clerk in the San Francisco, Cal., office of the Postal Telegraph-Cable Company, had finished copying a telegram from a patron, and then began repeating the contents of the message according to instructions, relates *Telegraph and Telephone Age*. The first word of the message was "Ship," and the clerk quite properly started in: "S, for Samuel, H, for Henry, I, for Isaac, P, for Philip," and about this stage she realized that the patron was making signs, or yelling for help. When he succeeded in "breaking," the clerk was advised that the sender of the message did not care a Chinaman's back-tooth about her friends, Sam, Henry and Ike. What he wanted was to have the message read back to him. What could the poor girl do?

How "Cartoon Movies" are Made

By JOSEPH H. KRAUS

(*Continued from page* 132)

Thus it might take 20 to 30 pictures to show a person talking, his mouth opening and closing. In photographing for this result, very peculiar skill is needed. Thus there may be two exposures, of one picture; one of another, perhaps three of the third, et cetra to give the desired effect. In the "breath space" mentioned, after the Kaiser and Prince have knocked at the door of the inter-allied peace council, the words slowly formulate "Looks like ve're not vanted."

415 SEPARATE DRAWINGS IN 1 "MOVIE" CARTOON.

In animations of chasers, (where people race down the street one after the other, et cetra, in one cartoon made by Mr. Bert Green, who has drawn the cartoons here shown, was shown a street at night and as you look down the block you would see a man coming around the corner, rush to a saloon on which was the sign "closed". He then stumbled across the street, only to find another hope shattered—"Closed" on the next saloon. He did this all the way down the street, pausing, leaping, running, jumping, before one-half dozen saloons, until he got to the foot of the street (or the foot of the screen, rather). In this latter act, lasting a few seconds only, Mr. Green figured 160 drawings would be necessary, but by the time he had his created friend "down front," 415 drawings had been made.

Drawings of this nature are held until ready for the camera man, whence they are taken to the photographic room, where they are placed in the frame, one after another in their proper relation and photographed by the pressing of the button, which in turn releases the shutter. The camera itself is electrically driven with a cam-like device which allows for the snapping of one picture at a time. Sometimes the button is prest three or four times in succession in order to obtain that many stills of that particular position. The film, is then in order, to be run off and corrections, changes, and cuttings, are made in the trial room. Two lamps, one on each side, of the mercury vapor type are used to illuminate the board.

EDUCATIONAL VALUE.

So far we have spoken of "cartoon movies" in respect to comedy and animated functions, but they have a purpose which serves far better ends than these. Take, for instance, the drawings showing in animated form, the cross-section of a gasoline engine in action, the gas coming down, bubbling over, vaporizing, filling the chamber, the revolutions of the shaft taking place, the piston being pulled down, the valves closing, the piston rising upward, and at the height of compression, a spark occurs, the explosion forcing the piston around again,

LEARN WIRING!

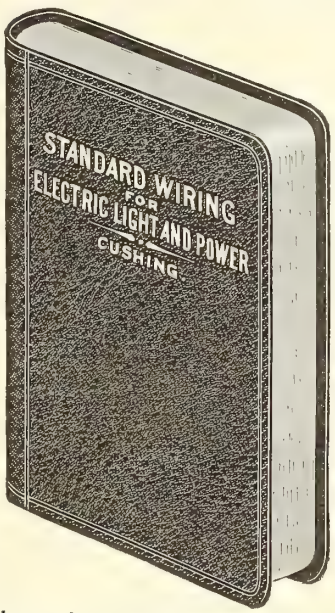
EARN $75 A WEEK

THE NEW EDITION **1920** COMPLETELY REVISED

"STANDARD WIRING"

Will Make You An Expert Wireman

"THE NATIONAL AUTHORITY FOR TWENTY-SIX YEARS"



This Year's Edition Contains Over Twice the Useful Information Ever Published in Any Previous Edition

— CONTENTS —

GENERATORS AND MOTORS—All about them. How to install, operate, protect and care for them. How to wire to and from them for any voltage or horsepower for both D.C. and A.C. single, two and three-phase. How to operate and wire for two-wire and three-wire systems with diagrams. All about their troubles and how to cure and avoid them.

INSIDE WIRING—When and where to use rubber covered, slow burning and weather-proof wire. How to find the proper size of wire to use for lamps, motors or heating devices for any current, voltage and drop, either by formula or by the many tables that are given in this section of the book. How to wire for two-wire or three-wire systems. Direct current, two-phase and three-phase with formulae and tables, with examples worked out for each system and in a simple manner that anyone can understand and use. How to run wires on walls, ceilings, floors, through partitions and walls and in concealed places, damp places and where dangerous surroundings exist. When and where to install Switches, Cut-outs and Circuit Breakers and just how to do it. How to wire for high and low voltage systems and the precautions to be taken. The proper way to install Knife and Snap Switches, Cabinets and Cut-out Boxes, Outlet, Junction and Switch Boxes, Panel Boards, Wooden and Metal Raceways. How to install complete interior conduit jobs either for rigid metal, flexible metal or flexible non-metallic conduit. Concealed knob and tube work or armored cable. How and where to install and wire electric and combination lighting fixtures. How and where to use flexible cord and where not to use it. How to install arc lamps and gas filled lamps and the fixtures and rules required.

OUTSIDE WIRING—Pole line construction, line wires, service wires, roof structures, poles and their dimensions and weights, and how to erect and protect them and wires they carry. Insulators, guard arms, guy anchors. Tree wiring, splicing, service and entrance wiring. How to install Lightning arresters. Transformers with diagrams and instructions.

LIGHT AND ILLUMINATION—What is meant by proper and efficient illumination, the latest data on Mazda lamps of every candle power and wattage. Direct, indirect and semi-indirect illumination and where each should be used. Illumination required for various classes of service from show window lighting to public halls and from factories to small residences.

SPECIAL SECTIONS—House and residence wiring with diagrams; how to wire garages; how to wire theatres and moving picture houses; electric organs; electric signs; marine wiring for ships and vessels; how to install and care for watt-hour meters; electric ranges, etc.

STORAGE BATTERIES—Both lead and Edison types and how to install, charge, discharge and care for them to get the best results.

250 ELECTRICAL AND MECHANICAL TERMS AND UNITS—Giving their definitions, values and what they mean in your work together with the complete metric system of weights and measures.

TABLES—Fifty-two tables giving every dimension, carrying capacity, resistance, weight and strength of every size of wire and cable of copper, steel or iron. All the necessary dimensions, capacities, weights, and other data on conduits, fuses, insulators, lamp sockets, motor efficiencies, current per horse power of motors. Proper size of wire for all classes of power, light and heating installations. The proper symbols to use to indicate on plans just what is wanted from a motor to a small snap switch with all necessary diagrams.

The most complete and only accurate book on Electric Light and Power Wiring and Construction published.

440 Pages—Leather Cover—Gilt Edges—Pocket Size—$3.00
Sent Postpaid to any address on receipt of price by

H. C. CUSHING Jr., 10 West 40th St., New York, N.Y.

EVERY ELECTRICAL INSPECTOR IN THE UNITED STATES WILL APPROVE YOUR WORK IF DONE IN ACCORDANCE WITH THE SIMPLE RULE CONTAINED IN "STANDARD WIRING"

Save on SOX

Buy NOW Direct!

Offer good this month only. Last lot sold out fast. Everybody delighted. Never again a bargain like this.

Lisle Finish SOX

Extra fine quality—medium weight. Positively not seconds. Cost you 50c to 75c pair elsewhere. Our price only Pair $3.75. A clear saving of from $2.25 to $5.25 per dozen pair for you. Colors—white, natural, tan—very popular now, and black. Won't fade. Sold only in dozens—colors and sizes mixed if desired. Rate, per pair..... **Only 31c**

Extra Strong Heel and Toe

One Dozen

SILK SOX Best Pure Thread Silk

Guaranteed finest quality and perfect. NOW for only $2.95. Best for dress wear. Silk hose indicates the man with money. Get this wonderful bargain now. Better than many that sell for $1.75 a pair. Colors—black, white, champagne, brown, navy, green, purple and gray; assorted if desired. 3 pair $2.95. Rate per pair **Only 98c**

3 Pair

Free Examination

Look at these sox. Examine them carefully before you keep them. Remember, the risk is all ours.

Order Now! Send No Money

Send your name and address. A postal will do! Sox mailed prepaid. You pay postman cost of sox on delivery. No extra charge of any kind. Guaranteed to please or money refunded. Order now. Mention size and color wanted. When ordering state Dept. 226

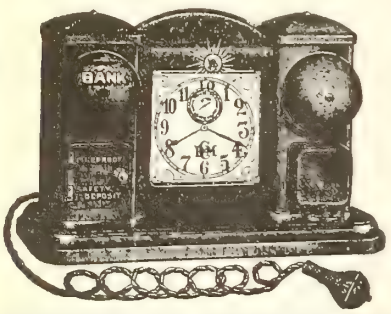
BACH BROS. 20 Years Satisfying Customers Our Record References: Dun or Bradstreet.
115th St. & Michigan Ave., Dept. 226 Chicago

Electric Alarm Clock and Bank

SERVES FIVE DISTINCT USES

Electric Alarm, Electric Call Bell, Electric Lamp, Savings Bank, and Safety Deposit

Guaranteed Accurate Timekeeper. Alarm Rings Until You Get Up and Stop It.



It lights up the Dial of the Clock at any time of the night. Alarm is Continuous—rings until you get up and stop it. Simply press the button at end of cord and it instantly illuminates, not only the clock, but the entire room. By changing the switch you can use lamp or call bell as desired. As a call bell in sick room, office, shop or home, it is always ready and at hand. Not the least useful parts about this Clock are the Savings Bank and Safety Deposit. The Safe Deposit opens by Secret Combination Lock. The Clock is an Excellent Timekeeper, made of steel, fully nickel-plated. It is operated by an ordinary No. 6 Dry Battery, which lasts a couple of years and can be replaced at slight expense. Batteries are obtainable everywhere.

Price $10 Only Shipped by Express, charges collect, or by parcel post, prepaid, if you add $1.00 more Weight, 9 lbs.

JOHNSON SMITH & CO., Dept. E10, 3224 North Halsted Street, CHICAGO

DENINGER WILL SAVE YOU $40

BIG MONEY SAVINGS FOR YOU



Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog

Deninger Cycle Co., Rochester, N.Y.

YOU 25 TO 50 DOLLARS



STUDENTS **ART** MAGAZINE

Publishes cash art assignments, lessons and articles on Cartooning, Designing, Illustrating, Lettering and Chalk-Talking. Criticises amateurs' work. Full of information for artists and art students.

Satisfactory or money refunded. 20c a copy, $1 for 6. *Send $1 NOW. Thrift Stamps Taken*

G. H. Lockwood, Editor, Dept. 594, Kalamazoo, Mich.

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
DEPT. 774A. 431 So. Dearborn St., CHICAGO

—all shown in animated form so beautifully, that one can never forget the internal operation of a gasoline engine, when once it has been seen.

Again in this gasoline engine movie, the stationary parts are placed on celluloid and moving parts on paper, both the celluloid and paper being photographed together, like mat work in regular photography,—sixty-four drawings, each separate and distinct, were necessary for the moving piston alone, in order to eliminate the jerk, so common in most cartoons of this type.

Even cut or sectional models cannot explain or instruct in detail to the same extent that these animated pictures do, and for this reason we see a great future for animated cartoons of this nature. Not alone in the field, of the cartoon itself but in the educational field, namely showing people how to do things and demonstrating to laborers who may not know the language, exactly what they must do in order to carry on to successful completion, some necessary operations.

Mr. Bert Green and Miss Kelly, his assistant, have often sat up nights for weeks at a time photographing and drawing pictures for animated cartoons of this type.

"In order to have a smooth running cartoon", says Mr. Green, "it is necessary that a good deal of patience and time be expended. It is actual labor and by no means happens as quickly as you'd think."

The Amateur Magician

By JOSEPH H. KRAUS

(*Continued from page* 163)

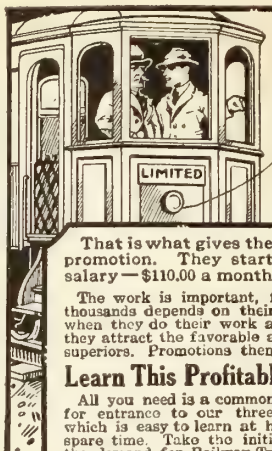
Our puzzled faces grew even more perplext when the Professor burst out in an uproarious laugh, "Simple; why, it's so simple," he ejaculated. Taking the wheel itself from its suspended pin, he stated: "Now this wheel is 12 inches in diameter, perfectly balanced, having a jewel bearing or a cup shape bearing in one end which rests upon this pointed steel rod. There are no wires leading to the wheel itself, but under the arrow at this end is a curved flat piece of soft iron. This is balanced by a piece of copper at the opposite end similarly placed. The entire bottom is then covered over with a thin piece of black paper and varnished so that the iron and copper embodied in the wood base will not be seen in the event that the wheel be removed.

"The disc upon which it rotates is numbered as you see from 1 to 10, and in the false bottom of the table is the mechanism which controls the wheel. This mechanism chiefly consists of ten electric bell magnets taken from ordinary electric bells, and so mounted that they will act directly upon the iron base inserted into the wheel. Thus when an electric circuit is made thru any of the magnets, the wheel naturally stops at that point, being first slowly retarded and then held in place (due to the relatively long iron armature). In order, however, that the action be invisible to the spectators, the wheel is allowed to slow down considerably so that it barely moves along.

"In the false bottom of the table likewise, is the required battery. Here, three ordinary dry cells are employed, altho more compact units could be used. As to the wiring, I shall show you this presently."

Releasing the catch on the side of the table, he lifted the cover off, much the same as one opens a phonograph box. The wiring there was clearly apparent. "You have noted by this time," he added, "that the table is made up of small brass squares, fastened to the wood seemingly for an artistic effect, but mainly for concealing the method of making contact to the magnets,

(*Continued on page* 205)



RAILWAY TRAFFIC INSPECTORS ASSOCIATE WITH BIG MEN

That is what gives them chances for promotion. They start in at a good salary—$110.00 a month and expenses.

The work is important, for the safety of thousands depends on their vigilance. And when they do their work as we teach them they attract the favorable attention of their superiors. Promotions then are rapid.

Learn This Profitable Profession

All you need is a common school education for entrance to our three-month's course, which is easy to learn at home during your spare time. Take the initiative now, while the demand for Railway Traffic Inspectors is so good. THERE IS A BIG DEMAND IN THIS FIELD.

We know of fine openings for our graduates. Many who started our course a few months ago now hold positions.

OUR BOOKLET tells of this ideal vocation—out in the big out-doors—how you associate with big men—how you can earn an excellent salary from the start—how you can climb to the very top. The opportunity COUPON (below) is your key to a better salary now and a much bigger future. Why not send it today? Remember you start at $110 a month and WE SECURE YOUR POSITION.

WE ARRANGE FOR A POSITION

Standard Business Training Institute, BUFFALO, N. Y.

Please send without obligation to me, your Booklet D119, explaining your Railway Traffic Inspector's Course.

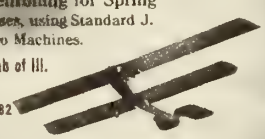
Name.....

Address.....

LEARN TO FLY

in Chicago, in the Foremost Flying School of the Middle West

Students now enrolling for Spring and Summer classes, using Standard J. Canucks and Avro Machines.



Aerodrome Aero Club of Ill. Field, Ashburn, Ill.

Phones: Randolph 2182 / Prospect 151

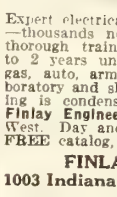
Send for Descriptive Literature and Details

THE RALPH C. DIGGINS CO.
502 Cunard Building CHICAGO, ILL.

LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries—thousands needed today. We give you personal and thorough training—practical, technical courses 3 months to 2 years under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. **Not a trade school.** Training is condensed—if your time is limited, come to the **Finlay Engineering College**—only one of its kind in the West. Day and night sessions—enroll anytime. Write for **FREE** catalog, a post card will do.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.



"Lighting Fixtures"

Ready to Hang

(Direct from Manufacturers)

Completely wired, including glassware. New designs.

Send for catalogue No. 18

ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

YOUR FUTURE

depends upon the use you make of present opportunities. Write now for literature explaining our day and evening courses in Chiropractic, the greatest science of the age. Hurry for prices advance soon. New classes forming now.

The New York College of Chiropractic
1416 Broadway, New York City

75 CENTS (no stamps) **For All the Parts and Plans of this Plane.**



Great fun to make it in less than 2 hrs. then see it fly 75 feet. 7 other models, all cloth wings. Airplane Circulet 4 cents stamps. Mention your favorite color wings.

HERE BOYS

NIFTY NOVELTY & TOY CO. Mail Dept., Newark, N. J.

A Wartime Radio Detective—Part II

By PIERRE H. BOUCHERON

(*Continued from page* 177)

I swept the Hudson River with my glasses and I was sure I saw a rather uncertain answering "blinker" on one of the ships lying at anchor!

Following previous instructions our next step, now that we were sure of the existence of the flashes, was to immediately dash to the top of the Singer tower in order to catch the signalers "with the goods." After considerable argument, necessitating much explaining and proof of authority, a night watchman took us to the tower, where for the space of half-an-hour we searched diligently for the concealed signaling system, but without results. The watchman finally decided to leave us and went back to the elevator with which we had come up, after having promised to return in a short time. As for my companion and I, we decided to remain in the now completely darkened tower and endeavor to hear or see anything connected with the mysterious flashes as we were both certain they had originated in this very spot.

The elevator had no sooner started on its downward trip when the corner where we had crawled at the top of the tower was suddenly illuminated by several vivid flashes of a most weird bluish kind. At the same time we heard the sharp metallic click of an electric circuit-closing device. We were both transfixt with astonishment and fright. My detective friend made for his hip pocket while I, if I remember rightly, literally sweated blood—as I frantically tried to regain my wits and decide on the next move. The flashes stopt for a short period when they suddenly reappeared again. This time we both looked in the direction from which they came, which we noticed to be at the top of the elevator shaft. Thru the blinding light of the flashes I saw the exact spot from which they were emanating. Finally the awful truth dawned upon me—the "mysterious" light signals were being caused by the *elevator starting and stopping switching device!* That is, the circuit-breaking system which controlled the electrically operated elevators, and which in this particular case were installed at the very top of the shaft, were directly responsible, for every time the elevator started and stopt the resulting make-and-break of the circuit breaker would cause a rather large arcing at the points of contact and this vivid arcing could plainly be seen to distant observers thru the tower windows. It will thus be evident that if the elevator stopt at several floors on its way up or down, a considerable number of flashes would result and these had naturally enough aroused suspicion. Needless to say our written report on this case was a short and snappy one. No, thoughtful reader, in our hurried exit from the building we did not stop to explain things to the night watchman. Thus ended an otherwise perfect tho at first mysterious night.

THE PARADOXICAL PHANTOPLEX CIRCUIT.

For many moons there had been literally heaped upon our heads all manner of complaints and reports from telephone subscribers all the way from Yonkers to Albany, N. Y. These reports were to the effect that signals closely resembling the dots and dashes of Radio-telegraphy were being heard on telephone lines, and in some cases these signals were so strong as to seriously interfere with speech. At first this was assumed to be *induction* of some sort which could easily be traced by telephone engi-

LEARN WIRELESS AT HOME

The Demand for Wireless Operators Far Exceeds the Supply

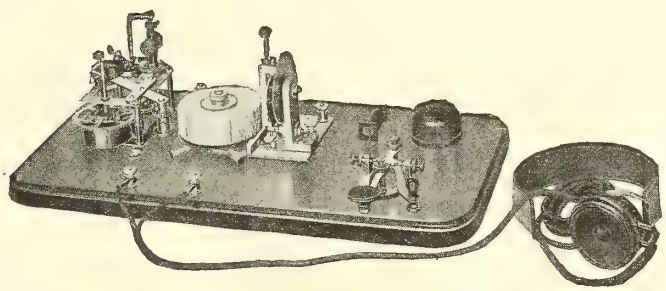
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, Chief Radio Inspector, Bureau of Navigation, N. Y. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way, will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free,* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do,* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* **This set is not loaned, but *given* to all students completing the Course.**

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph,* place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—*but do it today.*

NEW YORK WIRELESS INSTITUTE
Dept. 12, 258 Broadway
New York City

New York Wireless Institute
Dept. 12, 258 B'way, N. Y. City

Send me free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your *Free Instrument Offer.*

Name .....

Address .....

City or Town ..... State .....



$100 FOR ONE DRAWING

Illustraters, Cartoonists, Commercial Artists make big money. You can earn $25 to $100 a week and more. Learn at home in spare time under personal direction of Will H. Chandlee, famous newspaper, magazine, advertising artist of 30 years' successful experience.

Be An ARTIST

FREE COUPON
WASHINGTON SCHOOL OF ART, Inc.
1504 H Street, N. W. Washington, D. C.

Send me particulars of FREE ARTIST'S OUTFIT Offer and free book, "How to Become an Artist."

Name .....
Address .....
City.....State.....

Delightful, fascinating profession. Wonderful new home-study method makes drawing easy! Send coupon or postal today for amazing offer — complete Artist's Outfit given.

FREE! to new students. Write for handsome book, "How to Become an Artist." Don't delay—write, or send coupon at once. Address

Washington School of Art, Inc.
1504 H St. N.W.
Washington, D. C.



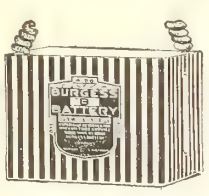
HANDY VEST POCKET BLOW TORCH $1

Clean, Compact, Neat, Efficient. Gives Instant Intensive Heat and Sootless Flame. Inexpensive to operate. Anyone can operate it. Useful for ELECTRICIANS, MECHANICS, AUTOMOBILISTS, HOME TINKERING. Add 25c and we will include bar of guaranteed ALUMINUM SOLDER for mending aluminum ware at home yourself.

Torch .....$1.00 Postpaid
Torch and Solder.... 1.25 Postpaid

REO SPECIALTY CO.
6381 Woodbine Avenue
Philadelphia, Pa.

BURGESS "B" BATTERIES



These batteries proved so successful in Government Apparatus that they are being used by progressive amateurs. Made in three sizes and now available for general use. For full information write to

BURGESS BATTERY COMPANY
Harris Trust Bldg. -:- Chicago



Cleartone Phonographs
$4.00 to $200.00 Retail

Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B East 12th Street, N. Y.

Learn to Dance!



You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful Peak System of Mail Instruction.

New Diagram Method. Easily learned; no music needed; thousands taught successfully.

Write for Special Terms. Send *today* for FREE information and surprisingly low offer.

WILLIAM CHANDLER PEAK, M. B.
Room 233, 621 Crescent Place — Chicago, Ill.

neers. However, the number of cases assumed such large proportions, and some of them seemed to be so logical in their wording, that it was finally decided to investigate them. In fact, the deciding factor was brought about by a report prepared by an expert radio man who was willing to back his professional reputation that the signals were man-made, and furthermore sounded very much like radio.

Ordinarily, such a condition might have been explained by ascribing it to the bona fide transmission of nearby naval stations, where oscillations were induced in a telephone wire acting as an antenna, and where the telephone transmitter rectified the signals so as to be heard in the receiver. However, in this case the signals were said to be *unreadable;* that is to say the characters themselves were foreign to either the Morse or Continental Codes, and even an expert operator was unable to make sense of any individual character; moreover, had they been regular radio signals, code or cipher words could have been copied. Accordingly, several expert radio men were instructed to investigate the origin of these strange signals, starting from the outskirts of New York City, and slowly working up as far as Albany, N. Y. With the assistance of telephone exchange officials, a series of tests were conducted and the strange signals heard at various times on many telephone circuits leading to the Capitol.

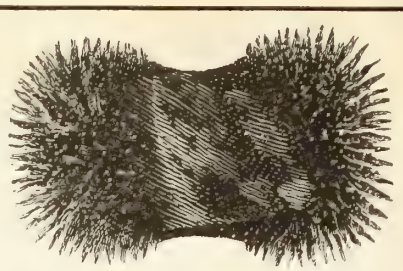
We had with us an expert telegraph and radio operator whose boast was that he could copy two messages being sent at the same time, one in Continental and the other in Morse Code, writing with both hands. Not only this, but he claimed he could read messages *backwards* as well; so that with such talent in our party we were prepared to copy anything in the dot and dash category, including static and Martian! After a great deal of head shaking and cursing, our expert friend admitted having met his Waterloo, as altho the signals were composed of dots, dashes and spaces, *no combination of them could be interpreted to assume the outline of even one letter!* Had we been able to make sense of the signals their source of origin could have been traced without much trouble, but under such circumstances there was only one conclusion to be formed, which was that here was secret information of some sort being transmitted between certain points without the cognizance of government, telegraph or telephone engineers and officials. So the case began to take on a more serious aspect, particularly when it was brought to the attention of officers charged with the welfare of the nation.

Our expert operator, however, had not given up hope, and each time the signals were heard saw him making wild pencil and paper movements in an endeavor to catch some of the elusive dots and dashes.

Finally the denouement came with the unexpectedness of an exploding bomb, when one day our expert telegrapher dasht into our midst, shouting "I've got it, I've got it." In his hand he held a piece of paper which he proceeded to explain to us. The accompanying illustration, Fig. 1, is a copy of his sketch as nearly as I can remember it.

It seems that he had managed to copy on paper a series of dots and dashes exactly as he had heard them, even tho they had been sent at a considerable rate of speed; after which he had carefully studied the characteristic of each dot, dash and space. As will be seen in the illustration the upper line of dots and dashes are those which he had heard, while in the lower line is to be seen the *exact opposite* of the above. That is to say, where a *space* had occurred in the series of "heard signals," a *dash* had been marked below; where a dot had occurred a slight space had been marked below, and

(*Continued on page* 220)



The Wonderful Lode Stone

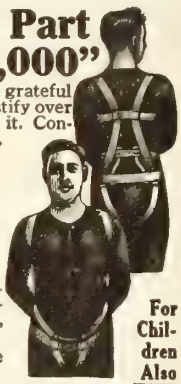
Have you a cabinet of minerals? Are you interested in scientific or wireless experiments? In aviation—in the magneto, and its magnets? Would you like to solve the unsolved problem of perpetual motion? Would you like to make a Viking compass out of a Lode stone? Do you think you can find an insulation for its magnetism? (so far unfound).

Get a Lodestone!

The writer has a few very powerful imported stones for sale—prices ranging from $1 to $5 according to size, shape, beauty and power. Write today.

Eugene S. Todd
113 FULTON STREET NEW YORK

"I Would Not Part with it for $10,000"



So writes an enthusiastic, grateful customer. In like manner testify over 100,000 people who have worn it. Conserve your body and life *first.*

The Natural Body Brace

Overcomes WEAKNESS and ORGANIC AILMENTS of WOMEN AND MEN. Develops erect, graceful figure.

Brings restful relief, comfort, ability to do things, health and strength.

Wear It 30 Days Free at Our Expense

For Children Also

Does away with the strain and pain of standing and walking; replaces and supports misplaced internal organs; reduces enlarged abdomen; straightens and strengthens the back; corrects stooping shoulders; develops lungs, chest and bust; relieves backache, curvatures, nervousness, ruptures, constipation. Comfortable and easy to wear.

Keep Yourself Fit

Write today for illustrated booklet, measurement blank, etc., and read our very liberal proposition.

HOWARD C. RASH, Pres. Natural Body Brace Co.
286 Rash Building SALINA, KANSAS

Telegraph Pictures
BY ELECTRICITY



Complete sets of two machines of this marvelous equipment at ridiculously low prices. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Will transmit pictures, maps, drawings and hand writing. Picture telegraphing is the coming science. Write today.

J. LEISHMAN CO., Dept.T Ogden, Utah

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S., 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER OVERLAND, MO.

The How and Why of
RADIO APPARATUS
By H. W. SECOR

Explains fully in a simple, interesting way everything the wireless amateur should know.

Just off the press. Cloth bound in Vellum de Luxe. Gold stamped and hand sewed—160 pages. Size 6 by 9 inches. No wireless enthusiast can afford to be without "The How and Why of Radio Apparatus". Postpaid $1.75.

Experimenter Publishing Co.
233 Fulton Street, New York City

The Amateur Magician

(*Continued from page 202*)

which are between two adjacent brass squares. These are all placed on the diagonal, as shown in this little sketch. It is very simple now for me to place my hand over the required square and when the wheel slows down sufficiently to allow the ring on my finger to make contact between the two squares, which excites the respective magnet. This accounts for the wheel stopping at the place I desire. Incidently, if I should energize the magnet following the one where the wheel has stopt by placing my finger across those contacts, the wheel will move forward due to the action of the magnets making a sort of an electric motor from the device."

Closing the cabinet he showed how, by placing his ring between two adjacent points, and running his hand across the table in a careless sort of manner, he could cause the roulette wheel to rotate with increasing speed every time he repeated this procedure. "It can readily be stopt incidently by just going backward, like this," and demonstrated that by passing his hand along adjacent squares in an opposite direction, bringing the wheel to practically an immediate stop. "Neither of these systems are generally used because of their very perceptible fraudulent trait. For that reason, the wheel is always allowed to slow down sufficiently before the current is permitted to flow thru it."

The visitors eventually left, and before I went I said: "Can you give me a diagram of the hook-up of that outfit, Professor?" "With the utmost of pleasure," he answered, and scribbled down the diagrams which we are able to reproduce here.

"By the way, Old Timer, I've received quite a number of letters from individuals who think that I am revealing the secrets of the magic profession, but I would like to state here that all my experiments have been *original with me,* and in all my years in the Magic field I have never come across any similar ones. It may be that since I have retired some devices apparently similar to mine have come out, but I wish to state here that I will attempt to keep my devices strictly within new and unknown fields, and in no way will I attempt to present to the public sleight of hands or 'Black Art' tricks, which are so old that they have whiskers sprouting out all over them. Some of them would do good to get shaved at least once every hundred years." I've noticed that also, I added, but every knock is a boost, you know. Then thanking him for the pleasant evening I had enjoyed, I departed. More anon.

A Sea-Going Ferris Wheel

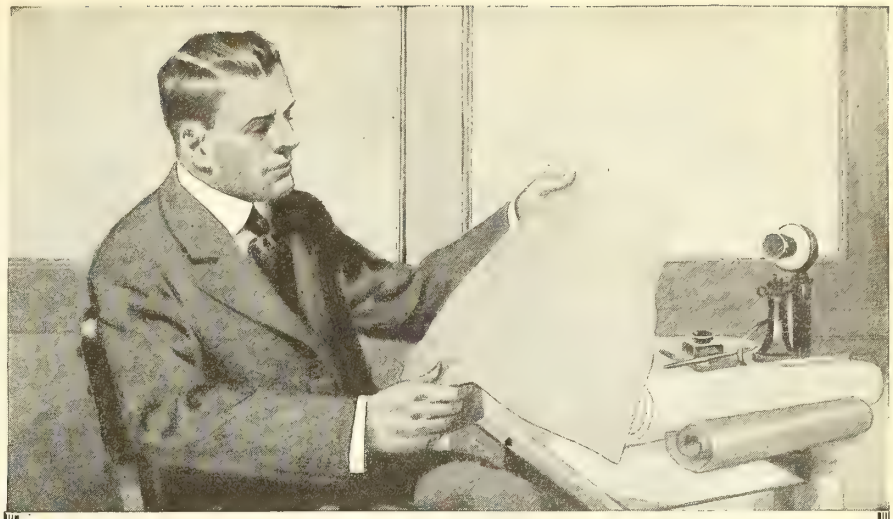
By H. GERNSBACK

(*Continued from page 143*)

this were not so, the waves could overturn or spin the car around on its axis, with destructive effects on the passengers.

As will also be noted, the track should be so designed that the wheel only dips into the water up to its hubs. In other words, three cars will always be submerged, while three will be out of water and vice versa.

As to danger, there is much less danger to such a device as this than will be found in our roller coasters, which kill scores of people yearly. The experience we have gained from submarines during the war enables us to build the cars water-tight and practically free from all danger. Even if



Mechanical Engineering

Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered those with special training.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you.* Choose the work you like best in the coupon, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. The most important thing you have to do is to mark and mail this coupon *now.*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6234, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Car Running	☐ Outdoor Sign Painter
☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ BOOKKEEPER
☐ Mechanical Draftsman	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Ship Draftsman	☐ Traffic Management
☐ Machine Shop Practice	☐ Commercial Law
☐ Gas Engineer	☐ GOOD ENGLISH
☐ CIVIL ENGINEER	☐ Common School Subjects
☐ Surveying and Mapping	☐ CIVIL SERVICE
☐ MINE FOREM'N OR ENG'R	☐ Railway Mail Clerk
☐ ARCHITECT	☐ STATIONARY ENGINEER
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.

Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. **Guaranteed by the maker.** Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness. Sent by mail or express, safely packed, prepaid, for only **99 cents.** Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send **99 cents today. To dealers 6 for Four Dollars.**

EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.

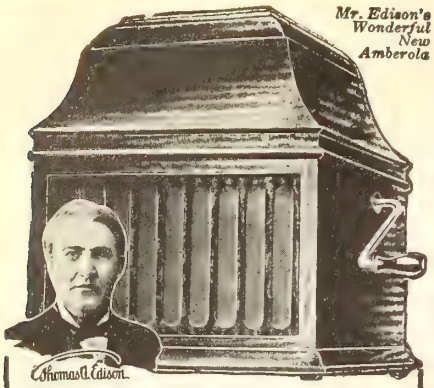
MODEL AIRPLANE SUPPLIES

Build and fly Model Airplanes



Send 5¢ for catalog of complete and knocked-down scale models of new machines, parts, fittings, and supplies.

Wading River Mfg. Co. 672 Broadway, Brooklyn, N.Y.



Only $1.00 Down

Keep the New Edison Amberola—Edison's great phonograph with the diamond stylus—and your choice of records, for only $1.00. Pay balance at rate of only a few cents a day. Hear it in your own home before you decide. Only $1.00 down. **Write today** *for our New Edison Book* and pictures, *free.*

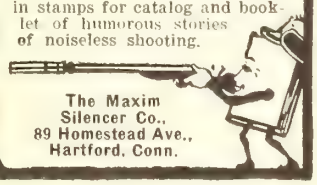
F. K. BABSON, Edison Phonograph Dist. A515 Edison Blk., Chicago

Shoot Without Noise

Do away with that old fashioned report, and the disturbance. Avoid flinching, improve your accuracy and enjoy precision shooting anywhere at any time with a

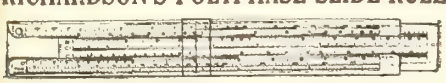
MAXIM SILENCER

Price, .22 cal., $6.00. Send 6c in stamps for catalog and booklet of humorous stories of noiseless shooting.



The Maxim Silencer Co., 89 Homestead Ave., Hartford, Conn.

RICHARDSON'S POLYPHASE SLIDE RULE



has the regular A, B, C, and D Scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case with 100 page Instruction Book $2.00.

An ideal Slide Rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10. each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO. NILES, MICH.

DRIVER AGENTS WANTED

116-inch Wheel Base



158-inch Spring Suspension

5-Pass. Touring

To drive and demonstrate 1920, 4-cyl., 37 H. P. BUSH Car—Timken Bearings—Willard Batteries—2-Unit Strs. & Ltg.—Full Floating Axel. Write at once for the best Automobile Offer in existence—don't wait—prompt shipments. Money-back guarantee.

BUSH Address J. H. Bush, President, Dept. F19 MOTOR CO., Bush Temple, Chicago, Illinois

Learn Autos and Tractors



Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O

one of the cables should break, which of course is a possibility, there still would be another cable to haul the car back to safety, the walled track preventing the wheel from leaving the track in so doing. And while one cable may break, it is perhaps needless to state that both of them would not break simultaneously, the chances not being one in a million. These steel cables do not have to be very heavy either. About ½ inch to ¾ of an inch in diameter will carry the load without much trouble. Remember the cables are not used for lifting the wheel. They are only used for pulling purposes, and this amounts to only a few tons, notwithstanding the fact that the wheel with its cabs weight several hundred tons.

A progressive sea-shore amusement Company has already announced its intention to build this wheel at Coney Island next year.

The Latest Pleasure Tortures

(*Continued from page* 140)

THE "SOFT SPOT."

The Pleasure Seekers now travel to the "Soft Spot." This is a large balloon filled with comprest air, the electrically driven compressor being stationed below. Sloping sides cause considerable difficulty in attempting to get out. A pretty little slide is the entrance and as Mr. and Miss Pleasure Seeker shoot thru space, they suddenly land on the balloon, just as soft a spot as a feather bed, but the instant that they hit the balloon with a thud the displacement of the air in it causes surrounding individuals to fall down, creating a general mix-up. The attempts to get out of the bowl, however, are not so funny to the Pleasure Seekers as they are to the crowd surrounding the pit.

By the aid of four or five assistants, they eventually manage to revive sufficiently to enable them to get out and off they go to the "Humpty Dumpty Wheel." This latest device is the subject of a recent patent issued to Messrs. Henry and Charles Brennig.

THE "HUMPTY DUMPTY WHEEL."

The couple enter one of the cars and make themselves comfortable. This car rests on a circular track amply reinforced, which track has several "bumps" in it. Both of these vertically positioned wheels, are connected to a shaft which is directly coupled with a motor thru a bevel gear. The shaft causes the two wheels to swing around in a horizontal position. At the same time, the bevel gears give a vertical motion to the wheels upon which the tracks are mounted so that two simultaneous movements are at the same time noted by the couple. In addition to the dizzy feeling created by these movements, an occasional bump in the track adds to the confusion and the car itself oscillates back and forth, attempting to remain at the bottom by gravitational influence but acting very erratically, because of the track movement under it. This causes either unconfined joy or a hypnotic effect upon the individuals. After leaving this combined carousel, roller coaster and Ferris wheel, Mr. and Miss Pleasure Seeker wander to the coal mine, switchbacks, witching waves and other popular amusements, not forgetting a *balloon ascent* taking them to giddy heights and finally home, ill at ease temporarily, perhaps, but "happy!"

Build and Fly Model Aeroplanes



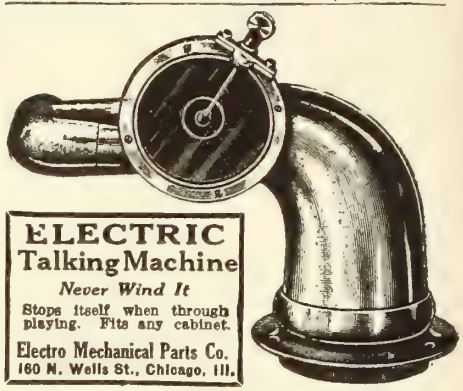
Learn about Aeroplanes and how they fly. Build a Model Aeroplane that will fly like a real one. With IDEAL Scale Drawings and Building and Flying Instructions you can build exact 3 ft. duplicates of famous 'planes. Send now for Drawings and Instructions for the one you want to build.

N C-4 (4½ ft.) Naval-Curtiss Seaplane
DeHAVILLAND Battle Plane
Curtiss JN 4 D-2 Training Plane
Curtiss Military Tractor
Bleriot Monoplane
Nieuport Monoplane
Taube Monoplane

35c Each Postpaid

Catalogue of IDEAL Model Aeroplanes and supplies, 5c if you write at once. Regular price 10c. None Free.

IDEAL AIRPLANE & SUPPLY COMPANY
Making Model Aeroplanes Since 1911.
159-161 Wooster Street, Cor. West Houston, New York



ELECTRIC Talking Machine

Never Wind It

Stops itself when through playing. Fits any cabinet.

Electro Mechanical Parts Co.
160 N. Wells St., Chicago, Ill.

FREE TO PHOTOPLAY WRITERS

A wonderful book, illustrated with 100 potographs, of stars, directors, producers, scenes in the filming, studio interiors and exteriors. Literally takes you on tour of the great Motion Picture Studios.

It tells how Adrian Johnson, author of 300 produced photoplays by formulating a simple, practical, followable system of screen writing, has brought this fascinating profitable profession to your very door.

It is a system for persons of average intelligence. You need not be a "genius" to master it.

Send no money. Get this beautiful souvenir book today, for the asking.

The Adrian Johnson Photoplay System
111 American Theatre Building, New York, N. Y.

CONVERT YOUR BICYCLE INTO A MOTOR CYCLE



by using a STEFFEY MOTOR. PRACTICAL — RELIABLE. In use over 20 years. Fits any bicycle. Send stamp for circulars.

STEFFEY MFG. CO.
Dept. E, 5025 Brown Street Phila., Pa.

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. **Guarantee Bond for 8000 Miles.** (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.
901 Oak St. Kansas City, Mo.

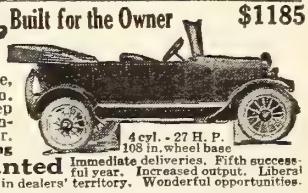
Small Steam Engines and Boilers



Gas and Gasoline Engines, ⅛ H. P. up; Tanks, Pumps, Gears, Model Maker's Supplies. Get our Big Catalogue sent postpaid for 15c (coin preferred) or stamps. Refunded first order. 192 Pages—over 200 Illustrations.

MODERN ENGINE & SUPPLY CO. 346 Monadnock Block, CHICAGO.

The Seneca MOTOR CAR **Built for the Owner** **$1185**



Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. Comfortable E-Z riding

4 cyl. - 27 H. P. 108 in. wheel base

Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. Write or Wire NOW.

THE SENECA MOTORCAR CO., 46 Seneca Factory, FOSTORIA, OHIO

"Newsophone" to Supplant Newspapers

(*Continued from page* 147)

the best electrical talent available. One of the problems which has to be solved in this direction, is the production of a large amount of electrical energy or else its control by the single phonograph reproducer, so as to supply any number of subscribers, from one to one hundred or more, who might call up simultaneously. It must be remembered of course, that to actuate the electrical circuit and telephone receiver at the other end of each line, requires a certain amount of energy, say five watts. Thus, if a hundred subscribers should all be put on the line, it takes 500 watts or one-half kilowatt!

A few years ago, it would have been almost impossible, as simple as the problem might seem electrically, to have done this, even with the most elaborate apparatus and telephone amplifiers,—but now, thanks to the wonderful properties of the versatile de Forest *audion,* such as used for telephony and radio amplifiers today, it is a relatively simple matter when properly worked out, to cause the phonograph reproducer of the Newsophone to control several or even several hundred horsepower of electrical energy, if necessary.

In the Newsophone, as shown in one of the accompanying drawings, Mr. Yeager shows an arrangement which he has tried out very successfully in some of his experimental work, whereby a carbon grain microphone (or sound-sensitive electrical regulating apparatus) is acoustically and mechanically joined to the mica diafram of the phonographic reproducer, carrying the unusual saffire stylus which runs in the groove corresponding to the voice record on the cylinder.

Some time ago, when Secretary Daniels of the United States Navy spoke from America to the President's ship, the *George Washington* lying in Brest Harbor, France, a microphone the same as in your regular telephone into which he spoke, regulated or controlled energy nearly 100 horse-power in strength, at the powerful Arlington radio station and with this gigantic power, the radio waves corresponding to his voice, vibrated thru the ether across the Atlantic, over 3000 miles.

NEWSOPHONE GREAT AID TO THE BLIND.

One of the great possibilities for the newsophone,—a field in which it seems to have practically everything to itself it would seem, is in its aid to the blind! Mr. Yeager early in his plans for the possibilities of the Newsophone, thought of this great boon to humanity especially because of the many blinded war veterans, and has proposed this matter to several leading people in charge of the welfare of blinded soldiers and sailors in various countries, and received favorable comments on it from such prominent men as Mr. Arthur Pearson, Chairman of the Blinded Soldiers and Sailors Care Committee, of England, and several other people of note.

DETAILS OF THE NEWSOPHONE INSTRUMENT.

The *Newsophone switch board* for distributing the news to the various subscribers resembles the regular telephone switchboard, with which most of us are familiar, with the exception that on the front panel of the switch-board, there is mounted in rows, the various phonograph units. Each phonograph unit comprises a record shaver, a recording phonograph and reproducing phonograph. The recording is done by one of the attendants speaking thru the flexible



"I should worry about Punctures or Blowouts"

with NN'ER ARMOR TIRES

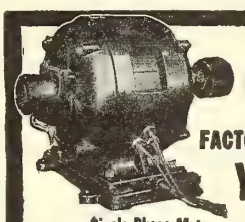
A written guarantee bond of 5,000 miles of satisfactory service is furnished with every order. We have perfected a simple way to manufacture these **NN'ER ARMOR TIRES.** Everybody knows that FULL VALUE that goes into any article manufactured is put in where THEY ARE MADE. When a tire passes from the factory to the jobber, and then through the dealer and there is a large overhead expense added for national advertising, the price is double or more than the actual value of the tire. The middlemen do not add one red cent's worth of value to any tire. All they add is profits and expense.

NN'ER ARMOR TIRES are Puncture Proof, prevent blowouts and are powerfully built for rough usage; and best of all, they are sold direct to you—not through dealers. **NN'ER ARMOR TIRES** give you your money's worth in the largest sense of the word. You cannot find another tire that possesses all these features at the prices listed below. Don't deprive yourself of the economy and safety gained by the use of **NN'ER ARMOR TIRES.** Over a hundred thousand satisfied users. Order a complete set today.

Size	Armor Tire	Heavy Tube	Size	Armor Tire	Heavy Tube	Size	Armor Tire	Heavy Tube
28x3	$3.75	$1.50	33x4	$6.25	$1.90	35x4½	$8.75	$2.65
30x3	4.00	1.50	34x4	6.50	1.95	36x4½	9.00	2.70
30x3½	4.50	1.55	35x4	6.75	2.00	37x4½	9.25	2.75
32x3½	4.75	1.60	36x4	7.00	2.10	34x5	10.25	3.10
31x4	5.75	1.80	33x4½	8.25	2 55	35x5	10.50	3.15
32x4	6.00	1.85	34x4½	8.50	2.60	37x5	10.50	3.25

We pay all express charges when complete remittance accompanies order. We recommend that you remit in full, thereby saving the express charges and the C. O. D. return charges. With your order for **NN'ER ARMOR TIRES** we will furnish our exclusive agency proposition, which will give you an opportunity of establishing a profitable business in your territory.

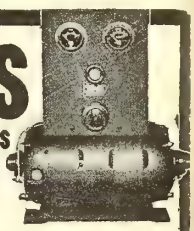
Auto Owners' Tire Factory, Michigan Ave., Dept. 85 Chicago



NEW MOTORS

FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.



Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4	H. P., 110 volts, Induction, full load start	$28.50
1/2	H. P., 110-220 volts, Induction, full load start	$38.50
1/2	H. P., 110-220 volts, repulsion, for compressor	$52.50
1	H. P., 110-220 volts, repulsion, with sliding base	$76.50
2	H. P., 110-220 volts, repulsion, sliding base	$116.50
3	H. P., 110-220 volts, repulsion, sliding base	$142.50
5	H. P., 110-220 volts, repulsion, sliding base	$184.50

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements

8 volts, 10 amp.	$19.50
15 volts, 10 amp.	$24.50
40 volts, 8 amp.	$31.50
110 v, 2½ amp.	$31.50
110 volts, 5 amp.	$46.50
40 volts, 30 amp.	$78.50
110 volts, 10 amp.	$106.50
110 volts, 26 amp.	$146.50
Moving Picture Arc Generator 60 v., 35 a.	$106.50

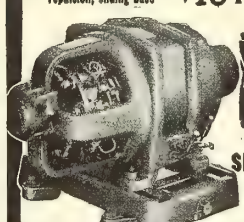
Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., complete with base and pulley.

½ H. P.	$46.50
1 H. P.	$64.00
2 H. P.	$81.00
3 H. P.	$96.00
5 H. P.	$112.00
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only	$36.50

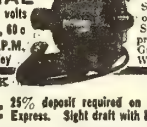
Battery Charging Outfits
To operate on A. C., 60 cycle, single phase. Voltage as specified.

110-220 v., A.C., 150 watts, 15 v., with switchboard	$68.50
110-220 v., A.C., 150 watts, 30 v., with switchboard	$68.50
110-220 v., A.C., 175 watts, 24 volts, with switchboard	$68.50
110-220 v., A.C., 250 watts, 36 volts, with switchboard	$88.50
220 volts, 2 phase, 600 watts, 24 v., without switchboard	$75.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

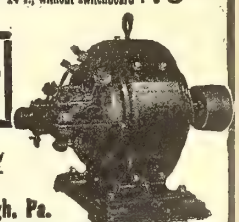


SPECIAL 1/4 H.P. 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley



WASHING MACHINE MOTORS Suitable for operating ½ Small Compressors, Coffee Grinders, Bottle Washers, Etc. $22.75 Each Reg. Val. $32.50

MONEY BACK GUARANTEE



SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 12, West End, Pittsburgh, Pa.

CHARGE YOUR OWN BATTERY AT HOME FOR 10c.

F-F Battery Boosters have been in service for over 5 years and their growing popularity is a reliable measure of their ability to perform the service for which they are intended.

Our increased factory space is buzzing steadily so we can take care of your requirements.



F-F BATTERY BOOSTER or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current

Bantam type 6-6 amp. 6 v. battery	$15	**Bantam** type 12-5 amp. 12 v. battery	$20
Type 16-8 amp. 6 v. battery	24	Type 112-6 amp. 12 v. battery	24
Type 166-12 amp. 6 v. battery	32	Type 1612-7 amp. 12 v. battery	32
Type 1626-12 or 7 amperes in combination for both 6 and 12 volt batteries			48

Shipping weight complete with Ammeter and Battery Clips. 11 to 15 pounds.

All outfits do the same work except as to time to complete a charge.

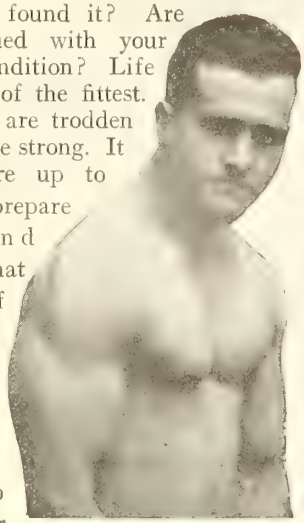
Include postage and insurance with remittance for parcel post shipment.

Ask for bulletin **No. 12** describing these and other F-F charging apparatus of larger capacities and of other voltages and cycles; also Boosters that operate on Farm Lighting Plants and Direct Current.

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

The Road to Strength

Have you found it? Are you satisfied with your present condition? Life is a fight of the fittest. The weak are trodden down by the strong. It is therefore up to you to prepare yourself and build up that body of yours for the fight. Enter the conflict and be a success. No one cares for the failure.



EARLE LIEDERMAN
The Acme of Physical Perfection

Be a Man of Strength and Power

What I have already done for thousands of others I can do for you. I will broaden your shoulders, deepen your chest (increasing your lung power), enlarge your arms and strengthen every muscle of your body. I will fill you with vim and pep so that you will be admired for your perfect physique and dominance of strength.

Send for MY NEW BOOK

"Muscular Development"

It tells the secret. Handsomely illustrated with 25 full page photographs of myself and some of the world's best athletes whom I have trained. This valuable book and my special offer will be sent on receipt of 10c, stamps or coin, to cover cost of wrapping and mailing. Don't delay! Send for it now, while it is on your mind.

EARLE E. LIEDERMAN

Dept. 216 203 Broadway New York

Don't Be Satisfied With a Little Job —

Get into the interesting, growing, Motion Picture field. High Salaries and Good Opportunities await the trained Electrician. The Secrets of successful illumination used by the leading theaters, clearly explained in

Motion Picture Electricity

By J. H. Hallberg

280 pages, handsomely bound, profusely illustrated. A remarkable book by a practical electrical expert. Explains all electrical terms, formulae and principles, resistance and resistance devices, electric service, wiring, lighting, etc. Also contains practical suggestions and all necessary reference tables on wire sizes and capacity, weights and measures, heat units, etc., etc. Explains the principles of correct illumination, both inside and for advertising purposes. Instructs in the correct projection of pictures. Gives prices of equipment and cost of operation.

Price $2.50 Postpaid

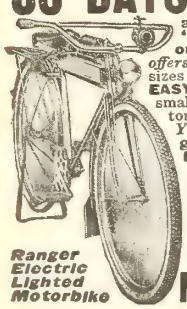
This book will help you to advance rapidly in this well-paying profession.

Decide now, to fit yourself for a bigger job. Order your copy today.

CHALMERS PUBLISHING CO.

Room 604, 516 Fifth Ave., New York City

30 DAYS FREE TRIAL



Ranger Electric Lighted Motorbike

and *freight prepaid* on any "RANGER" bicycle. **Write at once** for our *big catalog* and *special offers.* Select from 44 styles, colors and sizes in the "RANGER" line.

EASY PAYMENTS if desired, at a small advance over our Special Factory-to-Rider cash prices.

You cannot afford to buy without getting our *latest propositions* and **Factory-to-Rider** prices.

Boys, be a **"Rider Agent"** and make big money taking orders for bicycles and supplies. Get our *liberal terms* on a sample to introduce the new **"RANGER".**

Tires, equipment, sundries and everything in the bicycle line at *half usual prices. Write today.*

MEAD CYCLE COMPANY Dept. T-107 Chicago

tube, the same as on a business type *Dictaphone.* Each day or at each change of the news period, the same as when new editions of the newspaper come out, the message records are removed from the reproducing machine and new ones inserted. The old ones are then shaved at any convenient time which makes them ready for the next *news recording.* The phonographs, are of course, all driven by electric motors and started and stopt by the press of a button controlling electro-magnets actuating on the necessary clutches and brakes. The various sections of the switch-board panels assigned to the respective news topics, would be labelled,— Social news, Sports, Stock Markets, Marriages, etc., and the incoming calls from subscribers for these different classes of news could thus be instantly switched to the respective switch-board section, and the operator having jurisdiction over this particular news.

For smaller localities, the inventor has several other ideas which could be worked out for a lower priced equipment, with a small switch-board. For these small districts it would not be necessary to have a complete phonograph record for *each* news item, and one record could then take care of several items such as Financial, Social and Sport news. The machine would of course be calibrated so that the operator would know on what part of the record each news item was recorded in the same manner as the regular business Dictaphone is calibrated, so that you can tell on what part a certain letter is recorded by knowing between what scale numbers along the record, the letter was recorded.

LATEST NEWS VIA POCKET RADIOPHONE.

Thus far we have seen that the Newsophone presents itself in a very practical manner and one that can be adapted to the requirements of practical inter-communication at a reasonable cost, when used in connection with the regular telephone service. However, there is another aspect of the Newsophone, and that is to use it in conjunction with *wireless telephony.*

As Mr. Yeager has pointed out, and has been suggested many times in the past few years by some of our leading radio experts, including Signor Marconi himself, it will probably be only a very short time before it will be possible for anyone to intercept wireless telephone messages from a considerable distance, thanks to a pocket wireless receiving set which can be carried in the ordinary coat pocket. In fact some of these sets have been built so small that they will easily go in the vest pocket, exclusive of the watch-case receiver which is held to the ear. A great dream of the future, which we would like to mention here so that it goes on record, and which most probably the readers of this article will live to see before a great while, is the radio distribution of news by central news agencies in the larger cities, to thousands of radio stations in all parts of the world. Then any one can simply "listen in" on their pocket wireless set, connected to the nearest metal body such as a radiator, iron bed or umbrella, and receive the "Latest News."

X-RAYING OLD MASTERS.

The examination of old masters is the latest use to which the X-rays have been put. The results, as Major G. W. C. Kaye demonstrated at the Royal Institution, are important. He showed two pictures by Dutch masters, one representing the Madonna and another the Crucifixion. In the former the Madonna appeared to be looking at something which was non-existent on the canvas, but a radiograph examination proved that the missing something was a child.

In the second picture a woman in an attitude of prayer was discovered to have been painted over what was in the original the figure of a man in monkish garb.

ELECTRICAL—FIRES

are feared by all fire fighters. Water or ordinary chemicals are dangerous to use and have no effect on fire. A



Nu-Ex FIRE-KILLER

breaks electrical arcs and extinguishes the fire instantly. It can be directed into electrical machinery without damage to apparatus or injury to operator.

Write for Our Agency or Distributors Plan

THE NU-EX FIRE APPLIANCE CO.
COLUMBUS, OHIO



NUXATED IRON

Nuxated Iron by enriching the blood and creating new red blood cells, strengthens the nerves, rebuilds the weakened tissues and helps to instill renewed force and energy into the whole system. Three million people use it annually. Ask your doctor or druggist.



SAVE! DOCTOR BILLS

With this Book of Over 1000 Pages

Description of Diseases, treatment and prevention. One remedy worth cost. Saves hundreds of dollars a year. Board binding. **$1.00 POSTPAID**

THE F. ADAMIK CO.
Dept. 6, 2040 Carver Street Chicago, Ill.



WHAT EVERY GIRL SHOULD KNOW

SENT PREPAID FOR ONLY 50c

This book is written by Margaret Sanger, the great birth control advocate and contains information never before published. Anyone reading this book cannot help but be benefited. It is highly endorsed by eminent physicians. Send us your order at once. Don't delay.

Truth Pub. Co., Dept. B. T., 1402 B'way, N. Y.

Interplanetary Communication

By ALBERT V. T. DAY

(*Continued from page* 135)

might be discovered in the rays from the sun and many stars, and if the photo-electric detector could be made sufficiently rapid in function, it might disclose such fluctuations occurring at very high frequencies, for instance on the order of radio waves.

It seems not unlikely that explosions within the solar atmosphere would produce sound waves affecting in some manner the radiated light intensity with a modulation of corresponding periodicity. *The plunging of meteors into the sun might be HEARD in this way.* The rushing meteor streams of Saturn's rings might also be heard by their irregular light reflection as they pass thru the field of the telescope. It is not inconceivable that one might even listen to the scintillating waves and dashing sunlit streams of another planet's waters. These speculative prospects of course depend on the assumption that any fluctuations inherent in the sun's light would be insufficient to drown the effects of fluctuations in its reflected light caused by the planet or other reflecting object under investigation. In any event it seems likely that many clues to celestial phenomena might be discovered through light fluctuations not sensible to the eye.

For many of the foregoing purposes, the optical accuracy of a telescope would be unnecessary, and a relatively enormous light-collecting reflector surface could be employed. The photo-electric detector could be located on a mountain eminence to receive the concentrated superposed light beams from a large number of individual reflectors mounted on lower ground, or on an opposing slope. If it were in any way worth while and expense it would be practicable to thus cover an acre or even a square mile, with reflectors thus disposed to coact upon a common detector. This system would be efficient in requiring only a single reflection of the received light. A very simple mechanical scheme has already been devised for composing the angular motion components of the reflectors essential to render their reflected beams stationary and convergent upon their common detector. Substitution of a source of signaling light in the place of the detector will project the artificial light for outgoing signals, under control of a modulating circuit affecting a synchronous tilting of all the reflectors.

A slight addition to this reflector—directing mechanism will enable the reflectors to continually project a beam of reflected sunlight from one planet to another, under control of the modulating circuit. In this instance there will be no limit to the reflecting area, within the bounds of permissible expense. This scheme might be employed for exchanging signals between Mars and the Earth, while the Earth is observed from the night side of Mars near the horizon. Each planet could then send its reflected sunlight signal from its daylight side, and detect its reply signal on its night side, if this were necessary in order to avoid interference of local sunlight with the received signal. Obviously the communication could be rendered continuous by establishment of stations encircling the planets at suitable intervals of longitude.

Not only could light fluctuations be detected in the foregoing manner, but the apparatus could also be adapted to detect and measure constant lights of minute intensity, by employing a periodic rotary shutter, for instance in the focal plane, to cause fluctuations in the light received by the detector. In this instance the frequency of the light fluctuations could be chosen for maximum efficiency.

The foreman says

"I suppose it's because I used them myself when I was at the bench, but it does seem as though the best men in the shop have a preference for Starrett Tools.

"Of course, most of them sort of got into the habit of relying on Starrett for fine work when they were apprentices and journeymen.

"Speaking of apprentices — that little red book there, 'The Starrett Book for Machinists' Apprentices,' has saved me more time and helped more young fellows to learn how to do things right than anything else in the shop.

"When a young lad asks me how to do this or that, I usually tell him or show him, and then ask him if he has one of those books. I've noticed that as soon as he gets one of them he doesn't have half so many questions to ask.

"Starrett gets out another book, 'The Machinists' Data Book,' that's just about as big a help to the experienced machinist. It's got all the tables and formulas and so on that he ever needs, and it isn't cluttered up with a lot of engineers' stuff that he doesn't use.

"Yes, I bought one of each of the books down at the hardware store, as soon as they came out. They cost me seventy-five cents each, but they're worth it."



Starrett Tools

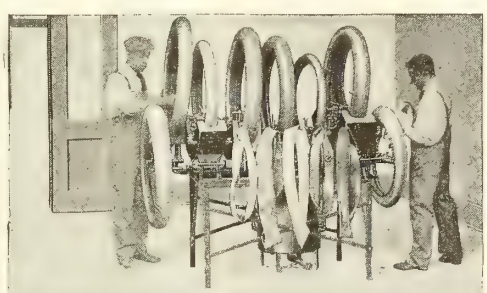


The L. S. STARRETT COMPANY
THE WORLD'S GREATEST TOOLMAKERS
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

Machinists the world over have put their faith in the accuracy of Starrett Tools for thirty-nine years. Write for illustrated Catalog No. 21 "LE"

42-989

HOORAY FOR THE VANDERPOOL



Is What Vanderpool users say. The Vanderpool is compact, takes little space, scientifically arranged that you can turn out a great amount of work in a short time. Ask any Vanderpool user.

VANDERPOOL MEN MAKE BIG MONEY

You will, too, after you are started. Our most successful men began without any knowledge of Tire-Rebuilding, but with the Vanderpool method of free Home-study, they became proficient in a short time. You can learn in a few weeks of your spare time. Vanderpool equipment will fit you out for first-class work.

INDEPENDENCE AND A BUSINESS OF YOUR OWN

is within your reach at this very moment. Send a Post Card for our books, and get started at once.

THE VANDERPOOL VULCANIZING CO. Dept. 9F, Springfield, Ohio

AMAZING OPPORTUNITIES in the Airplane Industry

Right now is your opportunity to get into the greatest industry the World has ever known. Thousands of new positions opening up everywhere in this attractive new field. Never before have ambitious men had such a glorious chance. Send Coupon at once—find out how our wonderful Course in Practical Aeronautics will give you the knowledge to enter this new field. Learn at home by mail during your spare time.

Prepare NOW for these positions
Aeronautical Engineer
Aeronautical Instructor
Aeronautical Contractor
Aeroplane Repairman
Aeroplane Mechanic
Aeroplane Inspector
Aeroplane Salesman
Aeroplane Assembler
Aeroplane Builder

Enormous Demand for Men—Big Pay

If you know Practical Aeronautics, some big Airplane Corporation will want you. Unheard of Salaries are being paid trained men. Act at once The pioneers are going to reap the big rewards. Automobile history, railroad history, movie history will repeat itself in Aviation

Special Offer NOW—Send Coupon

Send the Coupon at once for full particulars of our remarkable offer open to you now. We will also send you our big new book "Opportunities in the Airplane Industry." No obligation. Be sure to tear off and mail coupon today.

AMERICAN SCHOOL OF AVIATION
431 S. Dearborn St. Dept. 775 A Chicago

FREE BOOK COUPON

American School of Aviation
431 S. Dearborn St., Chicago
Dept. 775 A

Gentlemen: Please send me full particulars of your remarkable offer, also your new big book "Opportunities in the Airplane Industry." I assume no obligation.

Name.....

Address.....

RADIO AMATEUR NEWS

REG. U.S. PAT. OFF.

"The 100% Wireless Magazine"

20 Cents
JUNE
1920
Over 100 Illustrations
Edited by
H. GERNSBACK



FOR SALE AT ALL NEWS STANDS

ARTISTIC TWO COLOR COVER

"THE 100% WIRELESS MAGAZINE"

What "Radio Amateur News" Is:

RADIO AMATEUR NEWS holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO AMATEUR NEWS now leads all other wireless magazines. Take for instance the April issue with its 72 pages; there are seventy-four separate purely radio articles and 107 illustrations. *Over thirty-eight thousand copies were printed and circulated.*

Each issue of the RADIO AMATEUR NEWS now contains 72 pages (or more) and an artistic cover in two colors. The illustrations average 120 every month and there are from 60 to 80 up-to-date articles, some by our greatest radio scientists, in every issue.

RADIO AMATEUR NEWS is the greatest and biggest radio magazine in print today.

RADIO AMATEUR NEWS is the only INDEPENDENT monthly wireless magazine in existence. It caters to no commercial interests—it has no boss save its readers. It is "different"—it has the latest radio news. It is a scientific magazine but it caters largely to the RADIO AMATEUR—it is by and for the Amateur. It is published by the publishers of the ELECTRICAL EXPERIMENTER (Science and Invention), but there is no duplication of articles in the two magazines. Both are entirely different—but both together will give you ALL the radio news of all the world. Whether you are a professor or an Amateur, get a sample copy or order it from your Newsdealer today.

Partial CONTENTS OF JUNE ISSUE:

Development in Radio Receivers
By R. H. G. Mathews.

An Experimental Wave-Tester for Receiving
By Raymond Evans.

A One Hundred Mile Radiophone and Telegraph Set
By W. I. Winner.

German Radio Instruments
By Von R. Wilhelmi.

A New Inductance
By Pierre H. Boucheron.

Music By Radio Spark Tones
By Reverend Georges Desilets.

French Application of the Momentous Vacuum Tubes, Part II.
By Capitaine Metz.

THIRD $100.00 RADIO PRIZE CONTEST

A new radio contest. The third one offering $100.00 in prizes began in our May issue. Now that the summer is with us, most of our radio enthusiasts wish to take along with them a portable radio receiving set. The new prize contest was inaugurated for this very purpose, i. e., to bring out new ideas not only on portable radio outfits, but the best prize will be given to the one who constructs the *smallest and most efficient* radio portable outfit. This prize contest will bring forth many new ideas, and here is your chance to get in on some easy money.

For full particulars, see June issue of RADIO AMATEUR NEWS.

20c The Copy
$2.00 A Year
Canada and Foreign $2.50 A Year

SEND 20c FOR SAMPLE COPY TODAY

72 PAGES
120 ILLUSTRATIONS

SPECIAL OFFER

Gentlemen:
Please enter my subscription for RADIO AMATEUR NEWS for the term of one year for which I enclose herewith $2.00. As a special offer you will also send me for 25c extra your great Wireless Course containing 160 pages, 350 illustrations, size 6¾ x 10" with fine flexible cloth cover. I have written my name and address in margin below.

EXPERIMENTER PUB. CO., 231 Fulton St., New York City



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

SPECIAL NOTICE!

Of late we have received so many letters from our correspondents regarding patent advice, that it has been quite impossible to publish all of them.

Altho printed in the smallest type possible, we cannot accommodate more than ten or twelve answers a month. At the present time we are about four months behind. Of course, if our correspondents have time, no harm is done! We would however, advise that if a quicker answer is wanted, correspondents should avail themselves of our special service, as per the notice printed at the head of this column.

All letters are answered in turn as they come into this office, and for this reason it will be understood why it takes so long for an answer to be publisht. Will correspondents please bear this in mind?—EDITOR.

Automatic Steam Valve

(385) Mr. John Burbank of Brunswick, Maine, sends in a drawing of a thermoradiator valve which allows for the escape of air until its temperature reaches about 80 degrees, at which time the mercury in a tube is caused to expand, the expansive force closing the valve successfully.

A plunger action in the valve seat itself allows or much higher temperature without damage in any way.

A. This device is probably one of the cleverest which has yet come to our attention, and we believe that it will be extremely practical, because it can be cheaply made, is fool-proof, and seems to possess all those features which are so necessary and are not embodied in the present radiator valves.

We would advise, therefore, that you get in touch with a reliable patent attorney and have a search made.

Transmitter Diafram

(386) Mr. A. G. Buckner of Portland, Oregon, submits a drawing of a telephone transmitter to the diafram of which is attached a coil of wire. This coil is surrounded by another stationary coil, the claims being that a solenoidal action will take place between the two coils, allowing for an inductive effect from one coil to the other. It is claimed that inasmuch as the diafram vibrates, the device should work.

A. You are quite right in assuming that when the diafram of a receiver vibrates, particularly if made in the manner you describe, that a current will be induced in another coil which could be used for transmitting purposes. But in order to receive an audible signal at the other end of this line, the initial energy would have to be amplified about 16,000 times thru audion amplifiers.

You must remember that the diafram of a transmitter vibrates about .005 of an inch maximum. This does not allow for a great cutting of the magnetic lines of force in the primary coil. The additional weight applied to the diafram would also tend to cause a sluggish action on its part and altho the plan you have suggested is feasible, we do not believe that it would be a commercial success, similar ones having already been patented and forgotten; one in particular, where the diafram had a very thin perfectly flat coil of wire attached to it, this being in juxtaposition with the stationary coil, also of the pancake type. In this way, a much greater effect was noticed but not sufficient to produce audible transmission, without amplification. We, therefore, would not advise a patent on this scheme.

Collapsible Automobile Table.

(387) Mr. Wm. Kossen, of Brooklyn, N. Y., submits a design for a table to be attached to the back of the front seat in touring cars, said table being collapsible. Stating that when persons desire to camp out, they would have good use for the same.

A. We do not believe that the application of a table to the rear of the seat of an automobile, as you have designed, would be of any great value, as when persons desire to camp out, they do not generally like to remain in the car in order to eat their lunch; an added inconvenience being that crumbs, etc., will fall into the car.

Secondly, large cars invariably have some mode of access into the rear of the forward seat in which commodities, etc., are kept. This would prevent the application of the table.

Thirdly, the changes necessitated in the car itself and the various size tables would make such method of procedure a great inconvenience, and quite costly. It would, therefore, be much better to use the small collapsible tables now on the market for purposes of this nature, hence, we do not believe that even tho a patent could be obtained on the device, it would prove of commercial value.

Electric Piano.

(388) Mr. B. M. Gritz of Adams, Massachusetts, submits a device which he claims is entirely original in the form of an electric piano. Each key will make contact closing a circuit to magnets which in turn are to attract the hammers.

A. We regret to inform you that your idea is not original. This is contrary to the belief which you have entertained. A quite similar electric piano, yet simpler than yours, was described in the ELECTRICAL EXPERIMENTER fully 2½ years ago.

This latter was even so arranged that it could be played by means of the ordinary "roll" and hence we do not believe you could obtain a patent on the same.

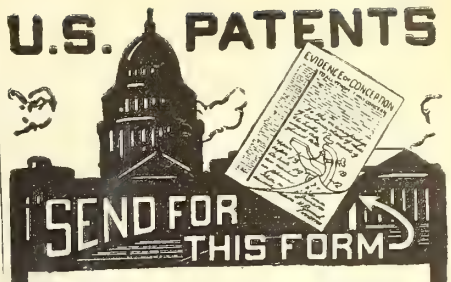
Loading Coil.

(389) Mr. Duane Ingraham, of Herminie, Pa., sends us a drawing of a loading coil made up in three parts, one perpendicular and two horizontally arranged along the same line, saying "Could I obtain a patent on this combination amateur and commercial loading coil which I invented? It consists of two coils of wire and four switch levers for control. The horizontal coils are arranged so that they form one coil, the vertical one extending upward from the center. The latter is for short wave lengths and has taps at every inch, the former for long wave lengths. Dead-end switches are included. The entire device is 26 inches long and 12 inches high."

A. We could not advise a patent on the loading coil which you have shown in your diagram for several reasons; first, it is too cumbersome, occupying too much room. Secondly, the bank-wound or honeycomb coils could be built much cheaper, serving the same purpose.

Thirdly, it would be very simple for anyone to obtain three loading coils and place them in the position they occupy in your diagram, or in fact, in any other position which would answer the purpose just as well, and it would be impossible for you to obtain a patent on the switches and method of placing the switches which you illustrate; hence, we do not advise now or any other time, the patenting of simple radio apparatus of this nature.

U.S. PATENTS



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE ON CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St. San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name ..... *Address* .....

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—**"Inventions and Trade Marks, Their Protection and Exploitation"** and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. **A postal will do—it is free.**

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c.



"The Book for Inventors and Manufacturers"

SIXTH EDITION.

By return mail FREE.

Write LACEY & LACEY

Dept K. Washington, D.C.



Get This Book !

Contains first hand, practical advice by an experienced inventor. NOT on how to get your inventions patented, but how to dispose of them after patented with the greatest advantage to you; what kind of agreements protect you; contracts and offers to avoid. Full of valuable pointers; every page one of interest and advice.

$1.50 will bring you a copy of THE INVENTOR'S MANUAL OF VALUABLE INFORMATION

G. E. Perry & Company, Publishers

Dept. 20 1328 Broadway New York

Do you know every move your attorney makes?

INVENTORS

My clients are immediately informed of every step in the prosecution of their applications. Write now—PATENTS—Send sketch.

Office of WARNER I. CUBBERLEY, Patent Atty. 22 National Union Bldg., Wash., D. C.

DICKMAN & CO.

SOLICITORS OF

PATENTS

506-7 BOND BLDG., WASH., D. C.

NO BOOKLETS

PERSONAL ATTENTION TO ALL CASES

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 766 Bogue Bldg., Indianapolis

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

Antenna Switch.

(390) Mr. Dominick Siedlecki, of Schenectady, New York, submits a drawing of an antenna switch constructed on the principle of a balance. Pressing on either side opens the circuit at one end, and closes another. Three contacts are used in one circuit, and two on the opposite swing of this "balance" switch. The correspondent writes: "You can easily see by the illustration that by just one short snappy movement pressing on either knob, opens one circuit automatically; closes another. I have constructed a model which works very well."

A. There is nothing new in the device which you propose. It has been used time and again in radio circuits. In addition, it is good for only small power, falling far below devices presently on the market even for these low-power circuits. Hence, we do not believe that patent is advisable, or would even be allowed by the patent office.

Compound Gasolene Engine.

(391) Mr. Joseph Jakubowski, of Webster, Mass., asks our advice, "Would it be possible to obtain a patent on a gasolene engine made to run on the principle of a cross-compound steam engine? If mixture explodes in No. 1 cylinder, it could pass on to another cylinder."

A. It would be impossible to have a gasolene engine work on the principle of a compound steam engine, the reason being that gasolene when once exploded has not the energy which it would have if a new mixture were allowed to enter.

Of course, the mixture after having exploded, could pass into a cylinder forcing another piston out to a slight extent, but the added efficiency from this other cylinder could not be considered, when the added bulk is taken into consideration, as well as the back pressure caused on the No. 1 cylinder.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of ELECTRICAL EXPERIMENTER, published monthly, at New York, N. Y., for April 1. 1920.

State of New York, } ss.
County of New York, }

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared HUGO GERNSBACK, who, having been duly sworn according to law, deposes and says that he is the Editor of the ELECTRICAL EXPERIMENTER, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912. embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Experimenter Publishing Co., 233 Fulton St., New York City; Editor, Hugo Gernsback, 233 Fulton St., New York City; Managing Editor, Harry Winfield Secor, 233 Fulton St., New York City; Business Manager, R. W. DeMott, 233 Fulton St.. New York City.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

Experimenter Publishing Co., 233 Fulton St., New York City.

Hugo Gernsback, 233 Fulton St., New York City.

Sidney Gernsback, 233 Fulton St., New York City.

Mrs. K. Hymes, 233 Fulton St., New York City.

Harry Winfield Secor, 233 Fulton St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none. so state.)

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest, direct or indirect, in the said stock, bonds, or other securities than as so stated by him.

H. GERNSBACK.

Sworn to and subscribed before me this 5th day of April, 1920.

[SEAL] BEATRICE K. OWEN,
Notary Public, New York County, No. 57. New York Register, No. 1129.
(My commission expires March 30, 1921.)

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?

Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.
1926 Broadway, New York

PATENTS

C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.

MUNN & CO., 622 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 622 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

Patents Promptly Procured

Send sketch or model for actual search of U. S. Patents. Highest references. Personal service. Moderate fees. Write for Free Patent Book.

GEORGE P. KIMMEL, Patent Lawyer
99-G Loan & Trust Bldg. Washington, D. C.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, **HOW TO GET YOUR PATENT.** Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

WILLIAM C. LINTON

Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.

OFFICES

364 University St. Montreal, Canada
919 F St., N. W. Washington, D. C.

Learn Shorthand, 5 Hours

You will be amazed at the ease and quickness with which you learn the wonderful K. I. Shorthand. In a few hours you'll know the whole system and can then gain speed in taking down dictation, conversation, speeches, orders, etc., as fast as a person talks. A free lesson will be mailed by King Institute, EB-300, Station F, New York, N. Y. Just write for this and see how easy you learn. Astonish everybody with your ability, and earn more money.

Learn Watch Repairing

Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates. Ask for our Free Book. It explains our system and terms.



THE DeSELMS WATCH SCHOOL
720 Perry St., ATTICA, IND.

Become a Specialist in

Accountancy

Write today for particulars of the most unusual course of its kind in existence. Learn how you may get a thorough training in this remarkably profitable profession and besides become a specialist in any branch you may elect. C. P. A. instructors of highest standing. **FREE BOOK** tells just what you want to know. Address—

International Accountants Society, Inc.
Dept. 521 2626 S. Michigan Ave. Chicago, Ill.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

EARTHQUAKE BREAKS TWO CABLES IN THE SOUTH PACIFIC OCEAN.

Two earthquakes occurred in the South Pacific Ocean recently, resulting in the breaking of both South American cables, according to information received in Washington.

An examination of the seismographic records at Georgetown University disclosed that both shocks were recorded there, the first, which was of considerable intensity, at 1:50 P.M. and the second at 6:48 P.M. The first continued until 2:25 P.M.

The centers of the disturbances were estimated at 3,800 miles from Washington.

A report on the breaking of the cables, both of which were south of Callao, has been made to the Navy Department by the cable companies.

The Phantom Arm

By CHARLES S. WOLFE

(*Continued from page* 151)

"Fine!" snarled the Chief. "Fine and sarcastic! But it won't work. My men found the spot where the shot was fired from. They found the gun, evidently thrown away in haste after the shot was fired. And more, within a radius of fifty feet they found a handkerchief with Coates' initials stamped on it in indelible ink for laundry purposes. Everything points to Coates. Everything but the fact that Coates couldn't possibly be in two places at once."

"No, hardly," agreed Fenner. "Well," he looked at me humorously. "Looks as if you've got yourself mixed up in another case, Bill, old top. I know you want to be in on it. Look me up in the morning, will you, and we'll see what we can do."

"In—in the morning!" sputtered Davidson.

"Sure," said Fenner, wearily. "With nobody dead, and the suspect already in the toils, you don't expect me to trot out at midnight, do you? Here, Chief, relax! Where's those extra 'phones? Here—back your ear up to this, and lap up a 'phone full of this stuff. It's great!"

But a slammed door, and a muffled curse, told us that the overwrought Davidson had taken himself and his burden of responsibility off to fresh duties.

The next morning Fenner and I made our way to the City Hall. Davidson, burly and heavy-eyed, glowered at us from behind his desk.

"Any rift in the fog this morning?" queried Fenner, cheerfully. "Have you fastened the crime on Coates' astral entity?"

"Fastened it on nothing!" savagely. "What do you want?"

"Just a slant at the weapon," said Fenner. "We'll begin at the beginning."

Without comment, Davidson produced a modern high-powered rifle. It was a wicked thing. Its sight was calibrated for ranges from point blank to fifteen hundred yards. Fenner took it in his hands and turned it over and over.

"Sure this is the weapon used?" he asked.

"Empty cartridge in it when found," replied Davidson, promptly. "Plain evidence of having been recently discharged."

Watching Fenner closely, I saw a swift gleam of interest light in his eyes, and as suddenly fade. He jerked open the magazine. "You took out the rest of the clip, of course?" he asked, carelessly, as he snapt it shut.

(*Continued on page* 215)



Learn Telegraphy

(Wireless or Morse)

The EASIEST, QUICKEST, CHEAPEST WAY

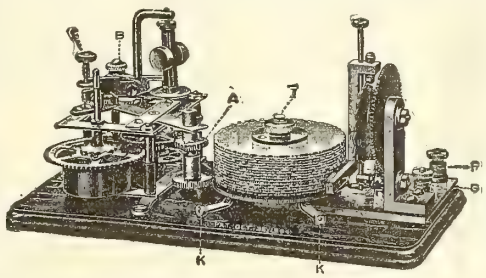
AT HOME

In Half the Usual Time

WITH THE OMNIGRAPH

" Just Listen—The Omnigraph will do the teaching"

The Omnigraph is an **Automatic** Transmitter that teaches you both the Wireless and Morse Codes, at home, without any expense except the cost of the machine itself. Merely connect to battery and your Buzzer, or Buzzer and Head Phones, and the Omnigraph will send unlimited messages by the hour, **at any speed** you desire.



USED BY THE U. S. GOVERNMENT

The Omnigraph is used by the Government in testing all applicants applying for a Radio License. It is also used extensively by the large Universities, Colleges and Telegraph Schools throughout the Country for teaching Wireless and Morse.

Hundreds of the Army's skilled operators who served during the war learned with the Omnigraph.

Let The OMNIGRAPH Teach You Wireless

For a few dollars you can have a complete outfit that will make you an experienced operator in the shortest possible time. No hard, laborious work—just learn by listening. The Omnigraph is adjustable so you can start receiving messages slowly, gradually increasing the speed as you become proficient.

You'll be surprised how quickly you will attain speed. Even if you are already an operator the Omnigraph will help you. It will make you more proficient, more accurate and more confident. Thousands of Omnigraphs are in use to-day and thousands of operators owe their success to them.

Write for Free Catalog

Send for a catalog to-day, showing the 3 different models, $12.00 to $28.00. Every Omnigraph is sold with the absolute guarantee that you must be satisfied or your money back for the asking. Mail the coupon to-day—the catalog will come to you by return mail.

THE OMNIGRAPH MFG. CO.
26 L Cortlandt Street, New York City

The Omnigraph Mfg. Co.
26 L Cortlandt St., New York City

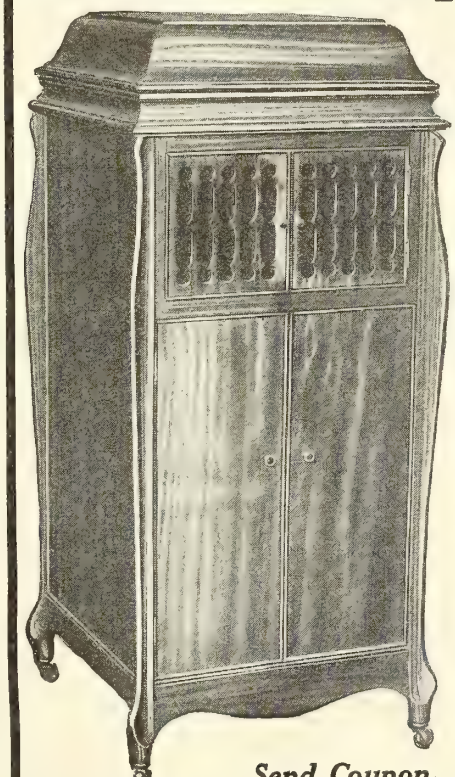
Gentlemen:—
As per your ad in Electrical Experimenter please mail me your free catalog of Omnigraphs.

Name .....

Address .....

City..... State.....

YOU can *Easily* BUILD This PHONOGRAPH



TREMENDOUS SAVING IN COST

You don't need to be a cabinet maker. We have made it an easy and a pleasant job with

Our Simplified Plans We furnish blue prints, diagrams, motor, ready-built horn, cabinet pieces and all metal parts complete. You do the assembling, **6 models to choose from.** A few hours' work, and you will have as fine a type of phonograph as any produced, and at a price away below what you would pay in a store.

KEEP THE SAVINGS IN YOUR POCKET

Machines play all records, have a wonderful tonal quality, excelled by none. No need now for any family to be without a phonograph because of the cost. THE MAKAFONE solves the problem. BUILD IT YOURSELF AT LESS THAN ONE-FOURTH REGULAR COST, but equal to the high priced cabinet machines. Free Records with each outfit. SEND TODAY FOR FREE CATALOG and full particulars of our wonderful offer. *Many a manufacturer got his start in this way. Why not you? Build machines and sell to your friends.*

Agents Attention You can make and sell *these* machines from our plans at a profit of $50 to $75 each. Others are selling two and three a week. Here is your opportunity to make big money and become independent. Pleasant and profitable work.

Send Coupon, Now—To-day

MODERN PHONOGRAPH SUPPLY CO.
278 Springer Bldg., 313 So. Clinton St., Chicago.

Modern Phonograph Supply Co.
278 Springer Bldg.
313 So. Clinton St., Chicago, Ill.

Gentlemen: Please send me full particulars of your Makafone proposition, without obligation to me.

Name .....

Address..... State.....

NAME .....

ADDRESS .....

STATE .....

ELECTRO IMPORTING COMPANY,
231 Fulton St., New York City.

I enclose herewith 6 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 22 containing 80 pages, 200 illustrations and diagrams, including Treatise on Wireless Telegraphy, and 20 coupons for your 160 page Free Wireless Course in 20 lessons.

E.E. 6-20

FILL IN THIS COUPON FOR YOUR COPY OF

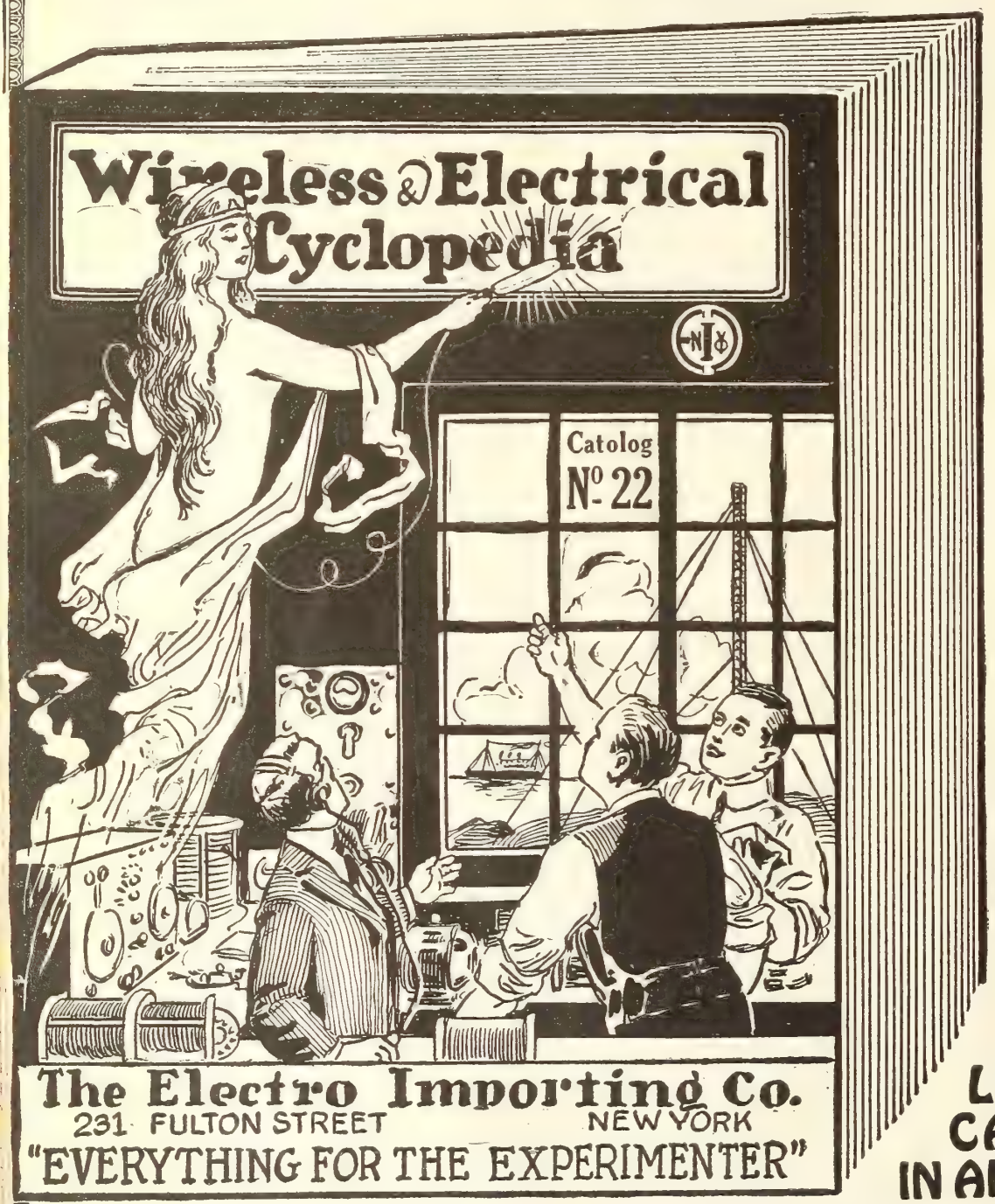
Our New 80 Page Cyclopedia No. 22

IT IS WAITING FOR YOU

Full size fac-simile of our catalog just as it looks when you get it

1-4 INCH THICK **WEIGHT ALMOST 1-2 POUND**

200 Illustrations



A Few Interesting Things from Catalog No. 22

Treatise on Wireless Telegraphy by H. Gernsback, Editor Electrical Experimenter and Radio Amateur News — 11 big pages, 3 illustrations.

The Wireless Law of 1912—all about it, what you can do and what you can't.

How to receive and send Radio messages.

How far you can send messages.

Table of wave lengths, of principal U. S. & foreign Radio high power stations.

How to receive time signals by Radio.

How to construct an amateur aerial.

How to use the test buzzer.

How to join the "Radio League of America" FREE, including application blank.

Experiments with a pony telephone receiver, with 6 illustrations.

Experiments with spark coils.

All about storage batteries, how to test them, recharging, etc.

Tesla experiments, 2 pages.

FREE with this wonderful cyclopedia — 20 coupons for our 160 page Wireless Course in 20 lessons. 350 illustrations, 30 tables. Catalog explains how you can get this Course absolutely free.

"THE LIVEST CATALOG IN AMERICA"

IN this cyclopedia you will find all about radio. One of the greatest catalogs of its kind in print.

You will find in it dozens of wireless instruments of the famous E. I. Co. make. Remember always that this company was the FIRST to make and sell wireless instruments, the first wireless outfit having been placed upon the market by them in 1904. The E. I. Co. *knows how*, because it has the experience. Others imitate but cannot equal E. I. Co. for quality and workmanship.

Other things you will find listed in this catalog: Electrolytic Interrupters, Bulldog Spark Coils, Chemical Outfits, Code Practice Sets, Primary Batteries, Storage Batteries, Hydrometers, Volt and Ammeters, Batterymeters, Electrolytic Rectifiers, Rheostats, Tesla Coils, Microphones, Loud Talkers, Electro-magnets, X-ray tubes, Telephones, Mognetos, Low Tension Transformers, Books, etc., etc.

IN A WORD THE MOST COMPLETE CATALOG IN PRINT

ELECTRO IMPORTING CO.

231 FULTON STREET NEW YORK, N. Y.

"Everything for the Experimenter"

The Phantom Arm

(*Continued from page 213*)

"No," demurred Davidson. "There was only the one cartridge in the chamber."

"Search Coates when you pinched him last night?" quizzed Fenner, still turning the gun over speculatively.

"We did that," acquiesced Davidson. "Why?"

"Find any ammunition for this or any other gun in his clothes?"

"No, but that signifies nothing."

"True," granted Fenner. Suddenly he handed back the rifle. "Whose rifle is it?" He fairly shot the question at the Chief.

"Belongs to a man named Smith," grinned the Chief, evidently pleased that the query had found him prepared.

"And where does Smith come in?" Fenner asked, mildly.

Davidson grinned with huge enjoyment. "He is a friend of Coates," he said, sweetly. "Coates borrowed it from him day before yesterday. Anything else?"

"Yes," said Fenner, cheerfully. "Transportation for two to the scene of the shooting, please."

We boarded a trolley bound for Bloomeville. "Can you let us off at the place where the motorman was shot last night?" Fenner asked the conductor as we handed him our complimentary tickets.

"I can," replied that worthy, grimly. "I can let you off at the ex—act spot. I'll not forget that location for quite some time. I was on the back end when Johnson was shot."

Fenner's glance at me spoke volumes. "Is that so?" he said, interestedly. "How did it happen?"

"I was sitting just inside the rear door, making up my report after we'd past the fare limit and I'd been thru the car," said the conductor, evidently willing to talk. "When I heard something bang against the closed front door, I beat it out on the front platform, and there was Johnson in a heap. I shut off the power and give her the air, and stopt her. Johnson was 'out.' I dragged him into the car, and somebody dug up a half pint, and we got him conscious. I ran the car back, and he rode on the front platform with me, holding a handkerchief to his nose. He was weak and shook up, but game. We both thought Coates did it."

"Did you know Coates?" asked Fenner.

"Sure!" came the reply. "He worked for the company until Johnson threw him off when he was drunk. The 'super' fired him, then."

"Motorman?" queried Fenner.

"No, barnman," said the conductor. "He repaired cars and brought in cripples."

"Didn't you get off and look for him?"

"Not me!" retorted the conductor. "I didn't know how bad Johnson was hurt and I wanted to get him into the hospital fast. Here you are."

And we stept off at the place where Johnson was shot.

The road lay along the river. On the left was the river bank, on the right a gentle slope led up, covered with small trees, thick briar bushes, and crawling vines. Fenner turned his attention to this hill.

We plunged into the underbrush and, following a straight line from the point indicated by the conductor, came to a spot, much trampled, which bore mute evidence of the activities of Davidson's men.

"Sit down, Bill, and make yourself at home on this historic spot," chortled Fenner, "while I take a look around."

Nothing loathe, for the climb thru that tangled underbrush had been strenuous, I sat down to recover.

HEAR CARUSO IN YOUR HOME

Greatest Phonograph Bargain Ever Offered **Send $1 Only**

This is your opportunity to buy direct from the manufacturer

Wonderful $25 Phonograph for $10.98



Plays all Makes of Records Any Size or Cut

Send $1 and Coupon

Extra loud, clear, sweet-toned sound box, silent, powerful spring motor, automatic regulator, starter and stopper. Cabinet finished in Colonial mahogany. The metal parts highly nickeled. Will last a life time and is fully guaranteed in every respect. Phonograph will be shipped upon receipt of $1.00; you pay the balance, $9.98, after you get the phonograph.

Plays Victor, Columbia, Edison and Emerson Records

Send $1.00 today

Columbia Sales Company

53 Academy St., Dept. 690, Newark, N. J.

CUT OUT AND MAIL AT ONCE.

COLUMBIA SALES COMPANY

53 Academy St., Dept. 690, Newark, N. J.

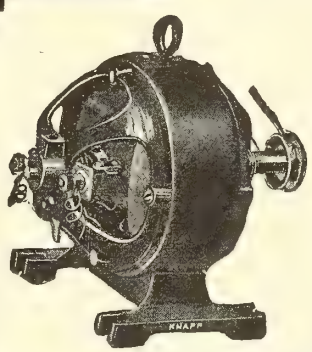
Gentlemen: Enclosed find $1. Ship at once one guaranteed phonograph. If satisfactory, I agree to pay the balance, $9.98, after I receive the machine. If not satisfactory I will return the same, and you will refund my money.

Name .....

Address .....

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

Motors, Electrical Toys and Specialties Are Best



Knapp Goods have stood the test for 29 years. No detail in construction has been spared to make them the best that money can buy. The complete Knapp line includes Toy and Power Motors, Generators and Dynamos. Specialties and Novelties that amuse and instruct. Fans, Rheostats, Compasses, etc. And Knapp prices are always lowest. Always insist on Knapp Goods.

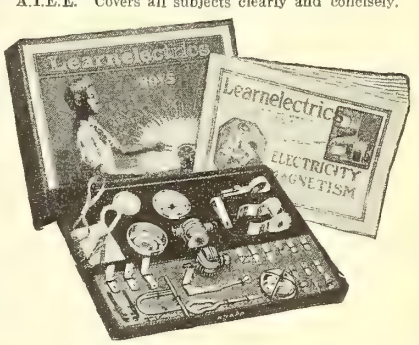
KNAPP DYNAMO MOTOR

Will electroplate, charge storage batteries, run lamps, motors, train of cars, induction coils,—in fact, the number of experiments it can be used for is unlimited. Runs on 4 to 6 Volts or can be connected to run on 110 Volts through a transformer.

Price, Complete, $9.00

KNAPP "LEARNELECTRICS"

A complete Electrical Laboratory, including a very valuable instruction book by H. P. Gorman, A.I.E.E. Covers all subjects clearly and concisely.



Price, Complete, $4.00

Order to-day. Or your dealer can secure them for you. DESCRIPTIVE CIRCULAR and CATALOG of celebrated **KNAPP MOTORS** *and Electrical Specialties from 10c up mailed FREE on request.*

KNAPP ELECTRIC & NOVELTY CO., 523 West 51st Street, New York City

DIAMONDS ON CREDIT

WATCHES ON CREDIT



Diamond Rings Latest Designs

All the popular mountings, plain and fancy engraved, Green, White and Yellow Solid Gold, very special at **$85, $100, $150** and up. Credit terms. See Catalog.



Loftis "Perfection" Diamond Ring and man's "Tooth" Ring

LIBERTY BONDS ACCEPTED

Send for Free Catalog

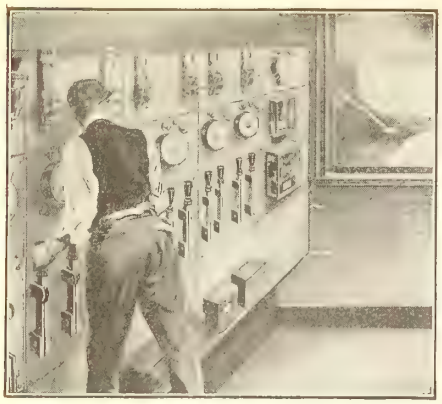
There are 128 pages of Diamonds, Watches, Jewelry, all priced **unusually low.** Whatever you select will be sent prepaid by us. **You see and examine the article right in your own hands.** If satisfied, pay one-fifth of purchase price and keep it, balance divided into eight equal amounts, payable monthly. Send for Catalog today.



Pearl Necklaces, $15 to $500. See Catalog.

LOFTIS BROS. & CO., The National Credit Jewelers

Stores in Leading Cities Dept. A22 108 N. STATE ST., CHICAGO, ILLINOIS



Electricity
Learn at Home

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into good positions and get experience that will give them a real start toward success in life. Good salaries are offered with rapid promotion.

For 28 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6235, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

Handwriting Tells You Secrets

Strengthen your character! Develop your personality! Be successful! Find out what holds you back! Know your faults, your virtues, your strength, your weakness! Know what to cultivate within yourself and what to fight so that you may make the most of yourself. By Graphology we can tell you these, and help you to know yourself.

Know your friends! Know whom to trust and whom not to trust! Is a certain friend—sincere, trustworthy, energetic, kind, generous, or lazy, fickle, deceitful, irritable? Send us sample of their handwriting and find out. Avoid unhappiness by knowing the truth now instead of later!

Send us a dollar and specimen of handwriting for informative analysis. (Critical-Analysis $5.00.) Our expert Graphologists will analyze it carefully so that in business, in love, in everyday friendships, you cannot go wrong. Dollar back if you are not satisfied. Unusual offer for limited time only.

Don't walk in the dark! Don't wait! Send today!

Robert R. Ross, 110 W. 40th St., New York

By the time I was rested Fenner was back at my side, whistling "Till We Meet Again" lustily. "Come on, old timer," he said, gleefully. "Us for the roadbed again."

"Find anything?" I demanded, as I scrambled to my feet and followed him down the hill.

"Now, now," he reproved over his shoulder. "No naughty questions. Don't be like Davidson."

He was evidently in high glee, and I was growing excited. I had seen the mood once before—about a half hour before I was formally introduced to the "Educated Harpoon."

When we reached the roadway, he paused.

"Bill," he said, solemnly, "do I look crazy?"

"No," I said, mystified. "What——"

"Then don't yell for help when you see what I do next," he begged. "I am about to look under a trolley track. It is an undignified proceeding."

"What the——" I began, but he was already prone in the road, his finger moving underneath the rails and between ties.

I glanced up the track. A trolley was approaching, bound cityward. "Look out," I warned. "Here's a car."

"I'm not deaf," he retorted, as he scrambled to his feet. "Stop him."

We rode back to the City Hall.

As we entered, Davidson was about to leave. "Hello, you fellows," he greeted. "I was just going to leave. The mystery is cleared up."

Fenner's face fell. "Who——" he began.

Davidson laughed. "It shows what having a fixed notion of a thing will do to your thinker," he said. "Coates didn't do it, after all. I've turned him loose. We rounded up a guy that I think will confess in a couple of hours."

Fenner was grinning again. "Is that so?" he asked, mockingly. "Well, Chief, that's too bad. Now you'll have to hurry and arrest Coates all over again. For he certainly did do it."

Davidson's jaw dropped. "What the Hell are you talking about?" he demanded. "He couldn't. He was in Lowrey's pool room——"

Fenner broke in earnestly. "Go and round him up again as quickly as you can, Chief. I'll show you."

We sat waiting, Davidson, Fenner and I, in the Chief's private office when two detectives brought in Coates. He was very angry.

"Ain't you done with me yet?" he snarled. "What do you want with me now?"

Davidson turned quizzically to Fenner. Fenner gazed a long minute at Coates. Then he reached for a pad of paper, and took a pencil. "Come here, Coates," he said, "and watch me."

Coates stood by his shoulder, and Fenner sketched rapidly.

As he watched, Coates' face blanched, the sweat stood out on his forehead. Then suddenly he broke out hoarsely, "Yes, you've got me. That's how I pulled it off. I confess, Davidson. It was me. And I'm glad, damned glad, I didn't croak him. With this slick guy after me, it would be me for the chair. Lock me up."

When Coates was gone, Davidson turned to Fenner. "Show me," he demanded, briefly.

Fenner laid the diagram he'd been sketching before us. As I glanced at it, I started. Davidson stared perplexedly. "Looks like Greek to me," he said, dubiously.

"It was clear enough to Coates," exulted Fenner. "Those are electrical symbols, Chief. He's an electrician, you know. I got wise when you showed me the gun this morning. The first thing that struck me

(*Continued on page 218*)

Let Me train YOU in AVIATION



Capt. G. F. Campbell, formerly Third Ace of the Royal Flying Corps.

My advice to you is to start right now to take my **HOME COURSE IN AVIATION** and prepare to fill one of the big jobs later. Wonderful opportunities. **Trained men in big demand.** Prepare now for big future. Lessons are easy to understand. Write TODAY for my FREE BOOK, "The Science of Aviation," and I will send it and write you a personal letter that will interest you. Address:

CAPT. GEO. F. CAMPBELL, Chief Instructor, National Aero Institute, 916 South Michigan Ave., Dept. 7446, CHICAGO

What 15 Cents Will bring You From the Nation's Capital

The little matter of **15 cts.** in stamps or coin will bring you the Pathfinder **13** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for the Nation; a paper that prints all the news of the world and tells the truth and only the truth; now in its **27th** year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, briefly—here it is. Send **15c** to show that you might like such a paper, and we will send the Pathfinder on probation 13 weeks. The 15c does not repay us, but we are glad to invest in new friends.

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, Box 976, Washington, D. C.

LEARN HOW TO BREATHE-RITE FOR HEALTH

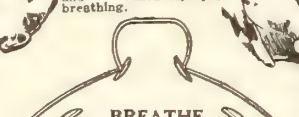


Avoid dangerous mouth breathing which courts deadly infection of lungs and throat thru improper breathing.

"Snorenomore"



Mouth Breathers inhale virulent germs, and are in constant peril.



BREATHE RITE
Endorsed by Physicians

Worn without annoyance. Made of gold wire and aluminum pads

At Best Supply Houses or sent direct for.....$2.00
Booklet Free
BREATHE-RITE CO., Dept. 2, Ann Arbor, Mich.

Electrical Engineering In One Year

men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete



Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops. Free catalog. 28th year opens Sept. 29, 1920

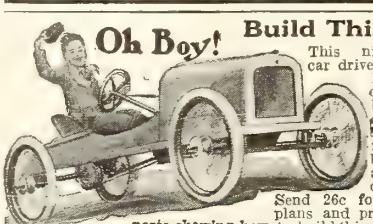
BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

Send To-day for the "Electrical Worker's Friend"

An electrical book of 66 motor drawings with complete instructions for rewinding and reconnecting A.C. motors. **Special at $4.00**
Or write for full particulars of this valuable book

SMITH & SMITH PUBLISHING CO.
Dept. B. 1524 Lowrie St., N. S., Pittsburgh, Pa.

Oh Boy! Build This Car.



This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 26c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO., 156 Sypher Bldg., Toledo, Ohio

STAMMER NO MORE

Kill the *fear* of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Order a copy today. **THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago, Illinois**



THE MOORHEAD
ELECTRON RELAY

PRESENTING TWO
NEW TYPES OF
VACUUM TUBES FOR
EXPERIMENTERS

MOORHEAD LABORATORIES

THE MOORHEAD PERFECT


THE MOORHEAD VT
AMPLIFIER-OSCILLATOR

VACUUM TUBE COMBINATION

—perfected to meet the increasing demand for tubes of superior efficiency, wherein all desirable characteristics are combined without subordinating any essential elements. A combination of two or more *VT tubes* as amplifiers *with* an *Electron Relay* as the initial detector or oscillator is *the ideal receiving combination* for long distance amateur or long wave reception. Both types of tubes are rugged in construction and unqualifiedly guaranteed.

THE MOORHEAD ELECTRON RELAY

The Electron Relay is the original tubular vacuum valve brought out by this company in 1915, now supplied with the standard four prong base for convenience. This tube has the familiar "hissing" point and low B battery potential characteristic of the perfect vacuum detector. Of all vacuum tubes the Moorhead Electron Relay is the *most efficient spark receptor.*

Price — $6 each. Immediate deliveries. Order from your dealer or remit direct to address below.

THE MOORHEAD VT AMPLIFIER-OSCILLATOR

The VT Amplifier-Oscillator is the Navy SE 1444 "hard" tube, and is designed and manufactured expressly for amplification and oscillation purposes. Particular attention is invited to the large amplification constant of this tube. Recent official Navy tests show conclusively that the Moorhead VT tube has a *higher amplification constant* than any other vacuum tube known to the radio art.

Price — $7 each. Immediate deliveries. Order from your dealer or remit direct to address below.

Both tubes licensed under the DeForest Audion and Fleming Patents.

DEALERS—*write for prices and particulars.*

PACIFIC RADIO SUPPLIES CO.
DISTRIBUTORS FOR THE

AMATEURS—*write for descriptive literature.*

MOORHEAD LABORATORIES INC.

638 MISSION ST. :: :: SAN FRANCISCO :: :: CAL.

REFERENCE, THE AMERICAN NATIONAL BANK, SAN FRANCISCO.
Eastern Distributors—Atlantic Radio Supplies Company, 8 Kirk Place, Newark, N. J., Telephone, Market 1575

DON'T FOOL WITH PHYSIC



STRONGFORT
The Perfect Man

Don't try to doctor yourself back to health and strength with so-called "remedies" for constipation, biliousness, or any other chronic ailment or weakness. **It can't be done.** No real MAN was ever made by anything that came out of a bottle—booze or any kind of patented "restorative." Look the facts squarely in the face: **You can't go on indefinitely,** if you feel like a wreck each morning and want a bracer before you go to work; you can't get anywhere in your business or profession if the poison from constipation is infecting your vital organs and beclouding your brain; you can't win out if any chronic ailment or weakness has a grip on you.

God made you and God made Nature — and Nature is the only doctor who can restore your vitality if it is gone; it makes no difference whether it was lost through overwork or worry or illness.

STRONGFORTISM IS NATURE'S WAY

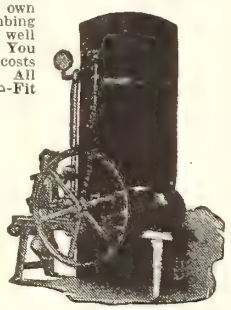
Strongfortism is simply taking advantage of the marvelous power of recuperation implanted by Nature in every human organism; the force that healed frightful wounds in France, when surgeons simply helped Nature to do the work; the power that has made strong, healthy, vigorous men out of thousands of my pupils, who came to me, many of them, broken down human derelicts, hopeless that anything could ever restore their lost virility. Learn about this wonderful force within yourself; you can't afford not to know about it. Send for my FREE BOOK, **"PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY."** It will tell you how Strongfortism will enable you to COME BACK; how to improve yourself 100 per cent. Send three 2c stamps to cover postage and packing and I will mail you a copy at once.

LIONEL STRONGFORT
Physical and Health Specialist
1281 Strongfort Institute NEWARK, N. J.



DO YOUR OWN PLUMBING & HEATING NEW CUT-TO-FIT PLAN

You can install your own complete heating or plumbing system by this method as well as a practical plumber. You save time, high labor costs and unused materials. All parts come to you Cut-to-Fit with plans and information furnished by our Engineers. Our wholesale prices save you ⅓ the first cost.



Make Your Property Worth 50% More

and do the work yourself. Home improvement is your best investment. Our hot-water and steam heating plants, pipeless furnaces, water supply systems and plumbing supplies are the most modern made. They are Guaranteed satisfactory. Send Today for the



Handy Man Book

It illustrates more than 10,000 different plumbing and heating fixtures at our low wholesale prices. It contains information invaluable to the property owner, farmer, carpenter or contractor. You can tell just what your improvements will cost. It explains our plan in detail.

We have spared no effort or expense in preparing this valuable book. To keep from sending it broadcast to uninterested persons we ask a temporary deposit of 25c which will be refunded with your first order. Send for it today.

HARDIN-LAVIN CO.
40 years at 4510-20G. Cottage Grove Avenue, Chicago
$500,000.00 Factories Back Our Guarantee

The Phantom Arm

(*Continued from page 216*)

was the fact that only one shell was in the gun. Now if I was out man hunting with a high-powered rifle, I'd have the whole clip of four or five right in the magazine, so that if I missed the first shot I'd have four more chances. And then—there was the trigger. Did you notice that bright scratch on its dull surface? Well, no human finger leaves a mark like that when it squeezes a trigger. That settled it. Friend Coates went out into that underbrush, carefully estimated distances, took actual sight of the height of Johnson's head above the ground and all those little details, and set up his gun aimed right where Johnson was bound to be at a given instant.

"He erred—about an inch in a matter of four hundred feet. Then"—Fenner fished in his pocket and brought out a little metal contrivance, a cross bar attached to two springs, and continued—"he cocked the gun and placed this bar around the trigger. Behind this he fixed a solenoid—an electromagnet." He paused to let this sink in.

"Then he ran a wire on one side of the circuit down to the track. There is an iron drain pipe crossing the roadway about there and he ran his leads thru that. He picked a tie from which the spikes have loosened slightly, and beneath the rail he arranged a strap switch. See? *When the weight of the car crost the rail at that point it closed the circuit.*

"But the weight of *any* car crossing it would close the circuit, so he had to devise a way to get Johnson, *and Johnson only.* He knew the schedule, and he knew that Johnson must pass there within—say—ten minutes of a given time. He knew that after the car preceding Johnson's had past, nothing could come along the rail except Johnson's car. So he cut another switch into the line up on the hill. This *was a clock switch.* The current was broken in two places. Cars could pass all day and close the strap switch at the rail each time, but the fatal current could not flow until the switch on the hill closed. And this could not happen until the hands of the clock pointed to a predetermined time. In this case the time was eight-twenty-five. I have seen the clock.

"Now when Johnson's car crost the strap switch at eight-thirty, the current from the storage battery made its circuit, the magnet functioned, pulling hard on the bar around the trigger, and the shot was fired. This spring arrangement then disengaged itself automatically, which hurled the bar a goodly distance away from the gun. Coates had tried it out and knew just how it would work."

"Yes," interrupted Davidson, "but why didn't my men find that wire and magnet when they found the gun?"

"Because," chuckled Fenner, "your friend, the clock switch, got busy again at eight-thirty-five and closed an auxiliary circuit, and a cute little electric motor operated from a six-volt storage battery and drum wound up some one hundred feet of thin cable, dragging the magnet along, too. I found the whole outfit where it was hidden. Coates, after you were forced to release him, would have gone back and gathered in the outfit at his leisure.

"You see, you'd have had to release him, for when the shot was fired he was indeed in Lowrey's pool room. *His* fingers were shooting pool. But his trigger finger was engaged in far more deadly work."

Davidson scratched his head. "Well, I'll be damned!" he said, feelingly.

SEND NO MONEY WE TRUST YOU



We are giving away thousands of dollars worth of valuable presents, such as Watches, Sterling Silver Initial Water Sets, Air Rifles, Guns, Moving Picture Machines, Musical Instruments, Cameras, Printing Presses, Typewriters, Telescopes, Books, Puzzles, Games, Tricks, Toys and Novelties, Rubber Stamps, Household Labor Saving Devices, etc. All you have to do is to send your name and we will send you, without any charge, 20 extra large De Luxe colored pictures, to sell at 25c each. When sold, send us the ($5.00) and we will give you goods of your own selection to the value of $4.00 from our wonderful 300 page premium catalog. Remember, you get these goods as a premium for selling the pictures and sending us the money. You do not have to pay one cent for them.

By continuing the sale of our goods you can earn a magnificent bicycle and many other expensive presents. We are a large and responsible concern, having a million customers on our books. Our goods have been extensively advertised in "Popular Mechanics" and all the leading magazines for many years. You can have your choice of $4.00 worth of these goods, and by our method we actually provide you with the means of purchasing these valuable presents. Send in your application at once, and we will immediately send you the first lot, accompanied by our big catalog to select your premiums from.

JOHNSON SMITH & CO.,
Dept. E 10,3224 N. Halsted St., CHICAGO

SELL SANITARY BRUSHES!

You can make big money because the need of our goods is great! A hundred different kinds of brushes for homes, hospitals, public buildings, garages, barber shops, etc. Splendid sales helps and fine sample cases free to salespeople. Unique plan of gaining entrance to homes by invitation. Credit to reliable people. Learn about the best line sold direct to the user -- the big line of everyday, useful home goods!

BIG COMMISSIONS AND PROTECTED TERRITORY

NORTH RIDGE BRUSH CO. Box 32, FREEPORT, ILL.

The ROGERS
Violet Ray, High Frequency Generator
Does not burn out. No sparking—therefore all shocks are eliminated. An ideal outfit, fully guaranteed as to material and workmanship.

PRICE COMPLETE
With One Surface Applicator **$25.00**

Send for free descriptive Booklet

The Rogers Electric Laboratories Co.
Dept. B, 2056 E. 4th St., Cleveland, Ohio



Send for a Complete Catalog of
MASONIC BOOKS
Jewelry and Goods
REDDING & CO.
Publishers and Manufacturers
Dept. 5 200 Fifth Avenue, N. Y.

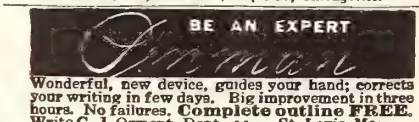
MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE
Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.



GO INTO **MOVING PICTURE BUSINESS**
Small Capital Starts You
Our Catalog FREE. Show you how to earn $25.00 to $50.00 per day
on our easy payment plan. Begin now and get your share. We sell everything. Write today.
Atlas Moving Picture Co.
Dept. 50 538 S. Dearborn St., Chicago



"BOW LEGS and KNOCK-KNEES" UNSIGHTLY
Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.
PERFECT SALES CO.
140 N. Mayfield Ave., Dept. 50, Chicago, Ill.



Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. **Complete outline FREE.** Write C. J. Ozment, Dept. 44, St. Louis, Mo.

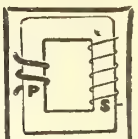
YOU Can Double Your Ability to Earn Money! Hold Friends! Win Love and Happiness! Our System of Personal Efficiency tells you **how!** Success Studygram and Personality Sketch for 10c and birth date. Thomson-Heywood Company. Dept. 350, Chronicle Building, San Francisco.

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

STUDY HUMAN NATURE
MAKE PEOPLE LIKE YOU
get along better, make more money, develop a winning personality, learn to know people as they are. Send 5 cents (stamps) for "Personal Power," a little book that points the way. Address, **Progress League, 312 Union Sq., New York.**



Electricity
taught by a practical man!



The Burgess Service is so universally successful, that we give positive assurance of perfect satisfaction on completing the course or money refunded. There are no strings tied to this—you are the judge.

Hundreds of Burgess-trained men and boys have advanced to better positions by means of the practical electrical knowledge easily learned at home by this method. Give a little of your spare time and you can do the same.

Home Study For Beginners and Electrical Men

This home study course is based on the years of practical experience of Yorke Burgess who gives personal attention to each student. Burgess students are invariably promoted and get better salaries. Beginners get employment in electrical work after taking the course a short while. Burgess students are in demand, over 80 per cent are now engaged in electrical work.

FIFTY-FIFTY EASY TO LEARN—EASY TO PAY FOR

A simple method of learning practical electricity—supplied on easy payments, including apparatus, instruments, materials, etc. Start any time—stop any time. Your payments cease if you are not satisfied. Send for Burgess catalog today. Gives full information without cost or obligation.

YORKE BURGESS, Supt.

BURGESS ELECTRICAL SCHOOL, 745 East 42nd St., Chicago, Ill.

BURGESS BLUE BOOK

a practical and handy reference book for

ELECTRICAL MEN AND STUDENTS

Contains over 200 CALCULATION FORMULAS and WORKED OUT PROBLEMS showing their use. DRAWINGS of ELECTRICAL MACHINERY DEVICES—INSIDE CONNECTIONS—ALTERNATING CURRENT CALCULATIONS and hundreds of every day problems are also covered. Recommended by electrical men all over the country. Purchased by electrical concerns for their employees and customers.

PRICE $1.00

We refund your money if the book does not meet your approval.

BURGESS ENGINEERING CO., 750 East 42nd St., Chicago, Ill

YORKE BURGESS, President

Consulting Electrical Engineering. Power Plants, R. R. Signals, Electric Railroads, Industrial Problems a Specialty. Information furnished on electrical subjects. Inventions perfected.

Electrical Slide Rule

Invaluable to Any Electrical Man

In response to many requests, Mr. Burgess has prepared a set of simple and concise lessons for those who desire to take up the use of this practical instrument.

A HIGH GRADE SLIDE RULE

in a leather case, and a COMPLETE COURSE OF INSTRUCTION will be supplied at a very reasonable

SPECIAL COMBINATION PRICE

We have selected the best rule for the purpose. The simple lessons will enable you to understand its use thoroughly.

Write us for full information

BURGESS ELECTRICAL SCHOOL

750 East 42nd St. Chicago, Ill.

LICENSED BY DE FOREST
AUDIOTRON
The Original Tubular Vacuum Amplifier

The AudioTron Vacuum Tube is now manufactured and sold as a genuine audion licensed under DeForest Patents Nos. 841,387 and 879,532 to be used only for amplification in radio communication and only for experimental and amateur purposes and only in audio frequency circuits.

The AudioTron has a double filament of special thorium tungsten and the operating life is over 2,000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40. Our guarantee insures satisfaction.

PRICE $6.00 EACH

If your local dealer cannot supply you we will ship postpaid when cash accompanies order.

The AudioTron Exclusive Guaranty: Each and every AudioTron is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AudioTron Audio-Frequency Transformer $7.00

Laminated closed core, two coil type.

DEALERS:—Write for our attractive trade Proposition.

AUDIOTRON SALES CO. Lick Bldg. SAN FRANCISCO, CALIF.

$1.00 Postpaid
SHAVES WITH GILLETTE BLADES

equal to any $5.00 safety razor.



Rogers Bros. Safety is as nearly perfect as any safety razor can be made, and no expense is spared to make it the very best ever offered to the user of a high-grade razor at the lowest possible price.

Note the Rogers Bros. exclusive "HEXIGON HANDLE" with a Guarteed Double Silver-Nickel Electroplate throughout. Why pay Five Dollars for an article when you can get one at an advertising price of *One Dollar.* "Unnecessary expense can be cut out through the direct-by-mail selling."

—Mail This Money Saving Coupon—

D. A. R. Sales Company
2521 17th Ave. So.
MINNEAPOLIS, MINN.

Enclosed find one dollar for your special safety razor offer

Name .....

Address .....

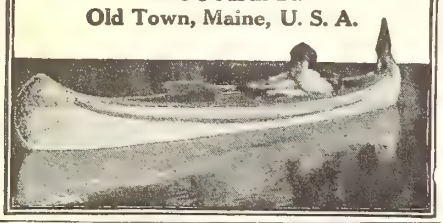
.....

"Old Town Canoes"

You can lazy-paddle an "Old Town" all day long. "Old Towns" are light, buoyant Canoes that answer the slightest pressure of the blade.

They are strong, sturdy canoes built for years of service. The "Sponson Model" is safer than a row boat. Write for catalog. 3000 canoes in stock.

OLD TOWN CANOE CO.
956 Fourth St.
Old Town, Maine, U. S. A.



MONEY for YOU

Spend an hour each day taking subscriptions for the "Experimenter." We'll pay you well and you'll enjoy the work. Write for full particulars. Circulation Dept., ELECTRICAL EXPERIMENTER, 233 Fulton St., N. Y. C.

A Wartime Radio Detective

(*Continued from page* 204)

where a dash had occurred a space of equal length had correspondingly been marked below. The result of this as will be seen was that the lower dots and dashes were *real Morse signals* corresponding in this particular case to NY NY NY AB, meaning that NY (New York) was calling AB (Albany). Other dots and dashes had been copied in a similar manner, and when deciphered were shown to be regular commercal messages of a very ordinary nature and lacking anything like suspicion.

So far, one thing had been solved, which was that the signals were quite authorized ones and were therefore no longer mysterious. As for the reason for their inverted nature which had previously baffled us, this was also very shortly explained to us in the following manner.

A so-called *Phantoplex circuit* had recently been placed in operation by one of the large telegraph companies between New York and Albany, whereby an alternating current was superimposed upon a telephone or telegraph line in such a manner that it was made to operate a complete telegraph system, supposedly without interfering with the normal activity of the line. In other words duplex telegraphy was accomplisht on a *phantom* circuit, and the *back stroke* of the sending operator's key was the one which induced impulses in various external circuits such as telephone and other lines parallel to it; these impulses, of course, corresponding to the frequency of the alternating current used in the "Fan" system. Fig. 2 shows a schematic diagram of a single line Phantoplex terminal station. Thus, in a nut-shell, you have the explanation of a rather simple electrical condition, which puzzled several of the country's leading electrical and radio engineers for many days, and I sometimes wonder how near to a solution we would have arrived, had it not been for the ingenuity of our expert Morse man.

THE ENIGMATIC SHIPMENT OF "MEDICAL" SUPPLIES TO MEXICO.

One day "a friend of the United States" sent in an anonymous letter telling us to watch for a certain case of goods addrest to an individual near Mexico City, Mexico. The case was supposed to leave on the steamer Monterey, sailing on the following Friday. Ordinarily, anonymous letters are usually bad actors and seldom reliable; the contention being that a real citizen is never ashamed to disclose his identity, when the matter has to do with the interest of his country. On the other hand, some of our correspondence school "deteckatives" may come sleuthing back at me with the information that anonymous reports are usually the work of dissatisfied accomplices who have turned traitors by "squealing," and therefore communications of this kind should be treated at face value. Be that as it may, either conclusion may be right, as it all depends upon extenuating circumstances.

This particular anonymous letter was written in a foreign script in exceedingly poor English and explained that we would find the shipment consisting of an interesting array of "supplies" much in demand by the Army and Navy at that time. The case seemed rather unusual and well worthy of investigation, so I and another investigator, specializing in export cases, began a systematic search for the origin of two large packing cases then reposing on one of the East River piers. After many inquiries had

Wireless Telegraph Transformers



With which any amateur can cover great distances. Write today for Bulletin on Wireless.

The Packard Electric Company
Warren, Ohio



The ORIGINAL
AUDIOTRON ADAPTOR

Consists of a standard 4 prong base with appropriately placed brass pillars to accommodate five leads. Practical and convenient.

$1.75 Each, Postpaid

One look convinces you our

Paragon Filament Rheostat

is the best. The 6 ohm non-oxidizing resistance, permits fine adjustment on 4 or 6 volts. Cast in heat-proof Condensite 2¼" dia. for black or front mounting.

$1.75 Each, Postpaid

RADIO EQUIPMENT CO.
630 Washington Street
Boston, Mass.

REBUILT ELECTRIC MOTORS

General Electric
Westinghouse
Crocker-Wheeler
Emerson
Century
Wagner
etc.



All Motors Guaranteed For One Year

Motors bought, exchanged and repaired
ELECTRICAL SUPPLIES
Wholesale Prices
Sockets, wire, tape, loom, fuses, switches, cut outs, etc.
New illustrated catalogue free. Satisfaction guaranteed or money refunded.
HYRE ELECTRIC CO.
631 S. Dearborn St. Chicago, Ill.

SELENIUM CELLS

Made by entirely new process. Highly sensitive and quick-acting. Suitable for all experiments. From $5 up.

Write for Catalog

Selenium Laboratories
Good Ground, Staten Island, N. Y.

Arnold

Loose Couplers
Combination Loose Coupler Parts and accessories.

Send 3c stamp for literature which is sure to interest you.

J. F. ARNOLD
2082 Lexington Av. N.Y.
Established 1910

22½ VOLT B-BATTERY **$2.20** SHIPPED BY EXPRESS ONLY

Guaranteed an Average Life of 8 Months

ORDER ONE TO-DAY

THE H. S. WIRELESS CO.
164 Ross St., Dept. 5G, Brooklyn, N. Y.

LEARN WIRELESS AT HOME

Operators earn $125 to $250 per month; instruments given free; we get you a position.

SOUTHERN WIRELESS INSTITUTE
423 Courtland St. Baltimore, Md.

"The Ellis Music Master Reproducer"

made for all phonographs. Pleases the most exacting music lover. Eliminates twang. Perfect harmony of accompaniments, individuality of artists, voices and instruments reproduced from records in life like reanimation. It sells on its merits. Send 10c for booklets E, "Hints to Music Lovers" and "Music Masters." Agents wanted
J. H. ELLIS, P. O. Box 882, Milwaukee, Wisconsin

Super-Sensitive Microphone ONLY $8.00



This instrument is offered at an extremely low price. It is excellent for building your own amplifier. Can also be used in many experiments where a sensitive microphone is required.

Detectagraph, $18.00

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

Send for One To-day and Convince Yourself



Detectagraph $18.00



THE $18.00 MICROPHO DEAF-PHONE

is a super-sensitive instrument which has been developed to meet the demands for a practical and efficient hearing device at an extremely low price. It is equal to any $35 instrument made and superior to most of them. The outfit consists of One Super-Sensitive Transmitter with cord connector; One Super-Sensitive Ear Piece with small black cord; One Black Single Headband; Black Case and Two Batteries.

Adjusted Model "B" Horn, with No. 20 High Grade Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete.

Write To-day for Free Booklet



G. BOISSONNAULT CO.

26 Cortlandt St. New York

Makers of Super-Sensitive Microphone Apparatus

RADIO OPERATORS

$125.00 per month and upward plus all expenses.

Modern Equipment—
Special Short Course
Individual Instruction
Finest Staff of Teachers Available

Dormitory—Swimming Pool

Call or write for illustrated booklet

Y. M. C. A. Radio School

Dept. R

152 E. 86th Street New York, N. Y.

"BEST RADIO SCHOOL IN THE EAST"

Radio Men

The Mutual Purchasers Association will save you money on all

Wireless Apparatus

Write Dept. E.E. for details.

MUTUAL PURCHASERS ASS'N, 2-4 Stone Street, New York

LEARN WIRELESS

At the **OLDEST, LARGEST** and **BEST EQUIPPED** school of its kind in New England. Positions guaranteed. Thousands of satisfied graduates all over the world. Splendid opportunities now in the Merchant Marine. Day and Evening classes. Start any Monday.

EASTERN RADIO INSTITUTE

899 Boylston St. Boston, Mass.

been made of truckmen, warehousemen and others, we found that the cases had been recently delivered to the truckmen by means of a cart, and the address given on the receipt had been a "blind" one. This in itself began to look suspicious, so that we finally decided to go back to the pier and look the two large cases over a little more carefully.

These consisted of the regular type of packing case surrounded by metal bands to strengthen them. They were addrest to a certain Señor near Mexico City, and in addition bore the legend "Medical Supplies —Handle With Care."

The exigency of this peculiar case, whereby we had been unable to secure any trace of the shippers, coupled with the fact that the ship was due to sail the next day, decided us. One of the cases was carefully opened in such a manner that if found a bona fide shipment, it could easily be repackt and allowed to proceed. Upon prying open one of the covers a great assortment of small medical supplies, such as vaseline, camphor, salts, patent medicines, etc., was found and everything began to point to another false alarm. Inwardly my opinion of anonymous letters dropt about 100%. We had about decided to repack the case when one of our number remarked that since we had gone to all this trouble we might as well empty the contents of the case and make sure. When we reached the center of the case, the cut-rate druggist's "delights" suddenly began to disappear, and in their place there was disclosed to our view a large cardboard box. Upon opening it we found the niftiest set of *radio receiving instruments* that ever graced a trans-Atlantic long distance station. *A loose coupler, evidently designed for long wave reception, loading coils, several sets of head telephones, an array of variable condensers and even tho they were practically unprocurable except to the Army and Navy signal branches, there was included twelve vacuum tubes of a type manufactured at that time by the Western Electric Company, as well as several testing devices.*

This was indeed quite a find, as during this period the shipment of radio instruments was very carefully watched particularly when destined to nearby neutral or unfriendly nations, as it was known that despite close censorship of the regular means of communication, definite information was being exchanged between stations in the United States and Germany. Then to make the disclosure complete, the second case of the shipment in question was found to contain parts necessary for the installation of a 50 kilowatt Telefunken radio transmitter which was not a surprise, considering certain information we had previously received on the activities of numerous high power radio stations lately established in nearby countries.

By the way, it may interest some of our embryo sleuths to know that the particular Herr Professor, who had been engineering these "medical" supplies shipments, was shortly thereafter caught in a downtown warehouse in the very act of "doctoring" a case of "hardware," destined to a point not far from Cartagena, Colombia, where, some of you may recall, was located a "somewhat active" high power radio station, sadly in need of repair parts.

There you are, gentle reader; you know almost as much about the case as I do. In the next installment I will tell you about the clever use made of a lightning rod for sending and receiving; the scientist who had secured permission to erect a long antenna in order to develop a new system of "underground radio," after which we shall take a ramble into the very heart of the Catskills, where a German millionaire had erected a secret windmill tower radio station.

Learn to Talk Convincingly

and the World is at Your Feet

WHY can one man sell where another fails? Why can one man literally carry an audience off its feet, while another makes little or no impression? Why can one man get the sought-after job when another better qualified is turned down. The thing that counts is not only *what* you say, but *how* you says it.

The world is full of "order takers" who should be salesmen—good men earning much less than they're worth; all because so few know how to use that God-given faculty of speech.



Let me Teach You

I can teach you how to make what you say have the effect you want it to—how to overcome timidity—give you confidence in yourself, develop your personality—how, instead of antagonizing people when they disagree with you, you may swing them around to your way of thinking.

Results in One Evening

The remarkable thing about my method is that it requires little study and time. Nearly anyone can grasp the principles in an evening. Among the enthusiastic students of my Course are thousands of prominent men in all walks of life — business men, preachers, lawyers, teachers, physicians, bankers, etc., etc.

Frederick Houk Law.

The Independent Corporation, publishers of "Mastery of Speech", Dr. Law's Course in Business Talking and Public Speaking, offer you the opportunity to learn in your own home how to Talk Convincingly. They are willing to send the entire course for free examination.

Send No Money

Just mail the coupon and, all charges prepaid, you will receive the Course. If you are not entirely satisfied send it back any time within five days and owe nothing.

But if you are pleased, as thousands of others have been, it will cost you only $7.00 in full payment. Act immediately before this unusual offer is withdrawn.

INDEPENDENT CORPORATION

Dept. L-1106, 319 Sixth Ave., New York City.

Independent Corporation

Publishers of The Independent Weekly

Dept. L-1106, 319 Sixth Ave., New York City.

You may send me the Course or Courses checked below. Within five days after receipt I will either remail the course (or courses) or send you the price indicated after each in full payment.

☐ Mastery of Speech ($7). By Frederick Houk Law

☐ Practical Course in Personal Efficiency ($7). By E. E. Purinton.

☐ Super - Salesmanship ($7). By Asthur Newcomb.

☐ Ferrin Home - Account System ($3.50). By Wesley W. Ferrin.

☐ Roth Memory Course ($7). By David M. Roth.

☐ The Lederer Art Course ($7). By C. Lederer.

☐ How to Read Character at Sight ($7). By Dr. K. M. H. Blackford.

☐ Independent Weekly ($5). (52 issues—15c per copy.

Name .....

Address .....

.....Elect. Exp. 6-20

RADIO APPARATUS

Distributors of Reliable Radio Apparatus for Experimenters in Every Branch of the Radio Field.

"Pittsco" the Sign of service.

PITTSCO

All we ask is a trial!

HONEY-COMB COILS

LITZENDRAHT WIRE.			(While they last.)
LL-75	330-1030	meters	$1.60
LL-100	450-1460	"	1.70
LL-150	660-2200	"	2.00
LL-200	930-2850	"	2.10
LL-250	1300-4000	"	2.30
LL-300	1550-4800	"	2.50
LL-400	2050-6300	"	2.80
LL-600	4000-12000	"	3.00
LL-750	5000-15000	"	3.20
LL-1000	6200-19000	"	3.50
LL-1250	7000-21000	"	3.90

Note:—These are the genuine De Forest litz coils.

Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.

Dept. D

12 Park Square, Boston 11, Mass.

SKINDERVIKEN BUTTONS $1

Radio Apparatus Bought, Sold, Built

C. McCONNELL
38 Warner Street
Springfield, Mass.

TELEGRAPHY

Both wire and wireless, and Station Agency taught thoroughly and quickly, BIG WAGES NOW PAID, some of our recent graduates procuring $138.00 per month to start. Great opportunities for advancement. Our school the oldest and largest—annual enrollment 600 students. Endorsed by railway, telegraph, wireless and government officials. Expenses low—chance to earn part. Catalog free. Write.

DODGE INSTITUTE, 22nd St., Valparaiso, Ind.

HERE AT LAST

A THOROUGH INTERESTING COURSE IN ELECTRIC WIRING, EXPLAINED AND ILLUSTRATED IN SUCH A WAY AS TO MAKE IT A PLEASURE AND NOT AN ARDUOUS STUDY.—WRITE H. K. BLATCHLEY, Electrical Engineer, P. O. Box 1477, New Haven, Conn.



WILCOX PANEL SWITCH

"The Best"

1½ In. Radius — Postpaid Price
Complete Switch, polished brass finish .50c
Complete Switch, nickel plated finish . . 60c
All kinds of Switches, Parts, etc., are listed in our loose-leaf Catalog "E." Sent for 5 cents in coin.

THE WILCOX LABORATORIES, Lansing, Mich.

STAMMER

If you stammer attend no stammering school till you get my big new FREE book and special rate. Largest and most successful school in the world curing all forms of defective speech by advanced natural method. Write today. **North-Western School for Stammerers, Inc., 2331 Grand Ave., Milwaukee, Wis.**

PERSONAL MAGNETISM WINS

Learn to use it successfully in all cases. It is priceless. Don't fail to get our advice. Send for "How to Win," 362 pp. $3. "How to Hypnotize," 126 pp. Illustrated. $1. "Health-Culture," gives vital force. 25c. Your money's worth or money back. **SCIENCE INST., D. E. 60—6435 N. Clark, Chicago.**



Printing Cheap

Cards, circulars, labels, book, paper. Press $10. Larger $30 Job press $120. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE, cards, etc. **THE PRESS CO., D-47, Meriden, Conn.**

Sub-Sea Talk Over Bare Wire

By DONALD MAC GREGOR

Late Captain, Signal Corps, U. S. A., Staff of Major-General George O. Squier.

(*Continued from page* 148)

Vail, where there is maintained a large laboratory, seemed to lend itself to this work, and, in consequence, General Squier, Colonel Mauborgne and others of the staff went there. They ploughed a furrow in which they placed a copper wire, covering it with earth.

The experiments with this, in which the same instruments were used, showed that "wired wireless" was possible for communication when wires were buried. The importance of this is evident when it is realized that no expensive pole line construction is necessary. The results when the wire was placed in the water were slightly better, however, than when the wire was placed in the earth.

With wires placed in the sea or in the earth it probably will be necessary to paint or enamel them in such a way as to prevent chemical reaction, but this is regarded as a minor detail which easily will be worked out. It is the establishment of a principle which is the chief concern to General Squier and the members of his staff.

Here, in General Squier's own words, is a description of the development, as recently presented by him to the American Academy of Sciences:

WHAT GENERAL SQUIER HAS TO SAY.

"The 'key problem' in the procurement of essential Signal Corps supplies in the United States during the World War curiously enough turned out to be the production of the necessary braiding machines for finishing insulated wire. The bare wire itself could be obtained, the rubber insulation could be obtained, even the cotton thread with which the braiding was made could be obtained, but the necessary machinery for braiding the thread, which finally led us into the intricacies of the procurement of steel, was never anything like adequate for the enormous demands required in the field.

"The braiding capacity of the entire United States, as of September 1, 1918, was about 8,000 miles of twisted pair insulated wire per month, while the requirements for the American forces alone at that date were about 40,000 miles a month. On October 1, 1918, the Allied Council reached the decision that beginning March 1, 1919, it would be necessary for the United States to furnish all of this type of wire used by the Allied armies in the field, and the estimated minimum requirements for this purpose were equivalent to four times around the earth a month. To supply this amount of insulated wire would have required cargo space for overseas shipment in the amount of 14,000 ship tons a month, but had it been possible to use single conductor *bare* wire in place of the twisted pair insulated wire, the space required would have been reduced to 2,500 ship tons a month, thus releasing the balance for transportation of food, and other vitally necessary supplies.

"Since we can already communicate by radio means between one submarine and another submarine, both completely submerged, it was considered that connecting two such stations by a submerged copper wire could have no other effect than to facilitate the propagation of the electric waves between the stations.

"It was considered possible that the behavior of earth or water under the action of high frequency currents might exhibit greatly different properties from those

Radio Diagrams and Formulae in Loose Leaf Form

The publishers of the CONSOLIDATED RADIO CALL BOOK have completed the preparation of diagrams and instructions on:—

Measurement of Capacity of a Condenser. (Substitution Method.) Calibration of a Variable Condenser. Two Diagrams and Curve.....No. 1
Measurement of Inductance of a Coil or Circuit. Two Methods—Two Diagrams.....No. 2
Measurement of Distributed Capacity of an Inductance. Diagram and Curve.....No. 3
Measurement of Fundamental Wavelength of an Antenna. Three Methods. Three Diagrams.....No. 4
Measurement of Wavelength of Distant Transmitting Station. Two Methods. Calibration of a Receiving Set. Two Diagrams....No. 5
Measurement of Effective Antenna Capacity. Two Methods. Two Diagrams.....No. 6
Measurement of Inductance of Antenna and a Third Method of Measuring Effective Capacity of Antenna. One Diagram.....No. 7
Measurement of Antenna Resistance. Substitution Method.....No. 8
Schematic Wiring Diagram of Regenerative Audion Receiving Set Suitable for Receiving High Power Undamped Wave Stations. Connections shown are those used in most Navy and Commercial Receivers.....No. 50
Table giving the value of LC (Product of Inductance and Capacity) for wavelengths from 300 to 20,000 meters. Inductance in Microhenrys.....No. 100
Table same as above but with Inductance in centimeters.....No. 101
Schematic Wiring Diagram of Signal Corps Type SCR-68 Radio Telephone Transmitting and Receiving Set.....No. 51
Schematic Wiring Diagram of Type CW-936 (Navy Submarine Chaser) Radio Telephone and Telegraph Transmitter and Receiver. No. 52
Schematic Diagram of Type S.E. 1100 (Navy Flying Boat) Radio Telephone and Telegraph Transmitter.....No. 53

These diagrams and instructions are the most CLEAR, CONCISE, COMPREHENSIVE and CONVENIENT form of instruction that has ever been presented. They are printed on pages size 8½ x 11.

Complete Set of 14 Sheets as described, sent postpaid 75c

CONSOLIDATED RADIO CALL BOOK CO., Inc.
41 Park Row, New York, N. Y.

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 22 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 80 Big Pages, 300 illustrations, 200 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 22 measures 6" x 9". Weight ½ lb. Beautiful stiff covers.

WIRELESS

Send 6 cents in stamps or coin for which we will send our latest Cyclopedia Catalog No. 22 as described.

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

CATALOG J.

Contains 24 pages of reliable apparatus, standardized parts and raw materials. Complete line switch points, knobs, switches, rod, aerial wire, etc.

Send 5c in stamps for your copy today.

Shotten Radio Mfg. Co., P. O. Box 3, Scranton, Pa.

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; edrn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address **The Veritas Science Institute, 1400 Broadway, New York, Desk 15.**

with which we are familiar at direct or low frequency currents.

"It was realized that whatever high frequency energy losses might occur in the case of bare wires laid in earth or water, yet the over-all efficiency would be higher than in the case of radio space transmission where the plant efficiency is so very low.

"It was noted by the writer in September, 1910, and discust by him in April, 1912, that the three-electrode audion could be used as a potentially operated device on open circuits. This arrangement was considered suitable for the reception of the signals over bare wires in earth or water.

"The most promising hope of improving the line construction for ocean cables is believed to be, to abandon the present method of design and construction and to start with the simple case of bare wires in water using high frequency currents and study the necessary changes to produce optimum transmission.

"The use of a high frequency 'carrier' has the inherent advantage that the distortion phenomena accompanying present methods of long distance transmission are eliminated, and we are principally concerned with the problem of reducing attenuation. The most suitable voltage may be employed and present multiplex methods may be utilized. The electron tube is available for both the generation and the reception of the waves.

THE FIRST EXPERIMENT.

"The first experiment was an extremely simple one as follows: A bare No. 18 phosphor bronze wire, such as is used for the Signal Corps field antenna, was laid across the Washington Channel of the Potomac River from the War College to the opposite shore in Potomac Park. It was paid out from a small boat with sufficient slack to lay on the bottom of the river. A standard Signal Corps radio telephone and telegraph set was directly connected to each end of the wire, one set serving as a transmitter and the other as a receiver. *At the receiving end of the line the bare wire was directly connected to the grid of the receiving set and the usual ground connection left OPEN.* A frequency of about 600,000 cycles a second was used and the line tuned at each end by the usual methods. Excellent telegraphy and telephony were obtained. Care was taken to make this preliminary experiment as simple and basic as possible and precaution taken to insure that the wire itself should be bright and clean and entirely free from any grease or other insulating material.

"The success of this simple experiment immediately led to more thoro consideration of the entire subject.

AUDION AS A POTENTIALLY OPERATED DEVICE.

"One of the questions to be investigated was the general efficiency of the electron tube when used as a potentially operated instrument. The following experiment was made:

"A strip of wire netting was buried in the snow outside the office of the Chief Signal Officer in Washington and a wire attached thereto leading to the second story of the building. The upper end of this wire was connected directly to the grid of an electron tube. The reason for connecting the grid to the upper end of the antenna is of course obvious if we are to use the tube as a potentially operated device. It was necessary for maximum sensitiveness to connect it to the point of maximum potential of the antenna, which in the case of a linear oscillator occurs at the open end. *By this arrangement, messages were readily received from distant points in the United States.*

"These two simple experiments, above described, demonstrated the possibility of transmitting electromagnetic waves along *bare* wires submerged in water and the use of an electron tube as a *potentially operated device* for the reception of signals.

"ASK ANYONE WHO HAS USED IT"

WHAT OUR PATRONS SAY

"I have had my phones about three years, and they still can make "POZ" (Nauen) roar." (Name on Request.)

BRANDES WIRELESS HEADSETS

CLEAR TONE LIGHT WEIGHT
DEPENDABLE SERVICE

Score 100% efficiency in actual use. Sharp, Unblurred, Readable Signals assured by



"Superior" Set, 2,000 ohms, $7

"BRANDES MATCHED TONE"

Exactly matching the tone of both receivers in each set and thus eliminating all confusion due to unmatched harmonics.

TRIAL OFFER

Buy a Brandes Superior Headset and use it critically for ten days. Then, if it doesn't come up to our claims or your expectations, return it and your money will be cheerfully refunded. Test it—compare with others—for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphragms toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.

SEND 4c FOR CATALOGUE E

C. BRANDES, Inc.
Room 814
32 Union Square
New York City, U. S. A.

WIRELESS RECEIVER SPECIALISTS

Complete Line of Brandes Receivers for those in Canada. Send stamp for Pamphlet "E"
Scientific Experimenters, Ltd., 11 St. Sacrament Street, Montreal, P. Q., Canada

Are Your Instruments Arranged Systematically?

We offer the very newest type of receiving and transmitting apparatus assembled in our new type

SECTIONAL UNIT CABINETS

AUDION CABINETS, TUNING CABINETS, AMPLIFIER CABINETS

Send stamp for our new Supplement—4c stamp for 55-page Catalog

YOUNG & McCOMBS Dept. 67 ROCK ISLAND, ILL.

WIRELESS TELEPHONE COURSE

Covering Theory and Practice of Electricity—Radio—Blue Print Reading and Wireless Telephony. 4 in 1 Course. The small payment of $5.00 starts you in this easy, interesting course. Immediate action will assure you of a good future. Don't delay.

FREE Audion tube, experimental electrical outfit, and other apparatus furnished each student, FREE. Write TODAY to

CHICAGO ELECTRICAL ENGINEERING CO.
DEPT. W. 1000 DIVERSEY PARKWAY CHICAGO, ILL.

WIRELESS AMATEUR

Send a 2c stamp for full description of the most efficient detector in the wireless field today.
Tested by Marconi Wireless Telegraph Co. and U. S. Government. Instantly adjustable at a constant pressure.
L. STEWART BARR, Inventor, Vice-President of The Service Radio School
THE BARR MERCURY-CUP DETECTOR Dept. A, The Wyoming, Washington, D. C.



Be an Automotive Electrical Expert

$50 to $100 a Week

For Specialists in Starting, Lighting Ignition and Storage Batteries

YOU can qualify quickly for a big paying position as electrical expert on automobiles, motor trucks, tractors, motorcycles, aircraft, farm lighting plants, etc. Men are needed at once to specialize in this clean, interesting work.

There are high salaried jobs open everywhere with automotive manufacturers, service stations and garages. Our Free Employment Bureau helps you to a good position just as soon as your training is completed. Or you can go into business for yourself supplying motorists with electrical repair service.

In Three Months You Can Master

all systems of starting, lighting, ignition and storage batteries. Come to America's greatest institution of electrical education and learn by practical work on actual models of automotive electrical equipment in our splendid big laboratories. Personal instruction by well-known experts.

EARN WHILE YOU LEARN

Twelve weeks' intensive, full-time training makes you a thorough master of all types of Automotive Electrical equipment. Or you can earn your own way while you are learning by devoting half time to a well-paying position which we will secure for you. Low tuition fee; dormitory and other special privileges.

Big Book Free Write today for handsome, illustrated Book telling all about the great opportunities for Automotive Electrical Experts, our quick, intensive method of training you and our Earn While You Learn plan. Do not miss this splendid chance to step into a $50 to $100-a-week position. Send postcard or letter today

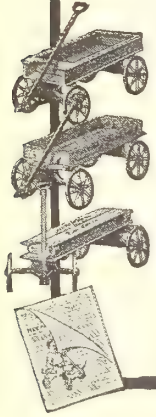
School of Engineering of Milwaukee
Dept. 16—373 Broadway, Milwaukee, Wis.



"Get the Coaster Wagon With 'Auto-Wheel' on the Sides-Tom"

Don't let them sell you any other kind. The Auto-Wheel is the genuine Coaster wagon—and it's the only Coaster that will admit you to our Auto-Wheel Club.

With the Auto-Wheel you can join our club and take in all our good times. You know it's a big, speedy coaster—so strong that it will carry a 1,000 pound load with ease—so fast that it will beat any other wagon made.



Prize Contests

Our new MAGAZINE for boys tells of the prize contests we are holding periodically. We'll send you a copy of the magazine if you will send us the names of three coaster dealers, mentioning which one handles the wagon with

"Auto-Wheel"

on the sides. We'll also send you a booklet telling you all about our Auto-Wheel Club, which you can organize.

The Buffalo Sled Co.,
163 Schenck Street,
N. TONAWANDA, N. Y.

In Canada: Preston, Ont.

REASONS FOR USING BARE WIRES.

"For military reasons, if for no other, the Signal Corps has recently undertaken certain investigations in the phenomena connected with the transmission of high frequency electromagnetic waves over bare wires in earth and in water.

"In carrying out these investigations and in attacking the problems from various angles, the research staff of the Signal Corps laboratory at Camp Alfred Vail, Little Silver, New Jersey, was directed to carry out experiments on bare wires laid on the surface of moist ground and also buried in earth. The staff at the Signal Corps research laboratory at the Bureau of Standards was directed to investigate fundamentally the transmission of electromagnetic waves over *bare* wires in *fresh* water.

"Telephone and telegraph communication has been established between Fort Washington, Maryland, and Fort Hunt, Virginia, across the Potomac river, below the city of Washington, *over a distance of about three-quarters of a mile* (nearly 4,000 feet), by the use of a bare No. 12 phosphor bronze wire laid in the water to connect the stations. The transmitter consisted of an electron tube oscillator which delivered a current of about 270 milliamperes to the line at a frequency of about 600,000 cycles a second. At the receiving end of the line an electron tube and a 6-stage amplifier were used without any ground connection. With this arrangement good tuning was obtained at both ends of the line, and telegraphic and telephonic transmission secured over bare wires immersed in fresh water.

RESONANCE WAVE COIL DEVELOPED.

"A resonance wave coil has been developed. The coil is in the form of a long helix wound with a large number of turns on which stationary waves are produced by the incoming radio signals. An electron tube is used as the detector, the grid being connected to the point of maximum potential on the coil. The wave coil may be used either as a part of the usual antenna system or a part of a line wire, or it may act itself as the antenna for picking up the energy of the signals. In the latter case the coil may be either free at both ends or grounded at one end. Good results have been obtained in either case. It has been also found that the open coil has directional properties and can be used as a goniometer not only for horizontal measurements but for vertical measurements as well. This form of radio goniometer has the great advantage that it permits not only of determining the plane where the signals are strongest but also the direction from which such signals proceed.

"Telegraph and telephone communication has been also established between two stations at the Signal Corps Research Laboratories at Camp Alfred Vail, Little Silver, New Jersey, using a bare No. 16 copper wire buried in the earth to a depth of about eight inches to connect the stations. The distance between the two stations was three-quarters of a mile. Frequencies as high as one million cycles a second were used. Similar communication has been carried on over a bare wire one and three-quarter miles long laid on the surface of moist earth. The current at the transmitting station in these installations was about 100 milliamperes. It has been shown that a bare wire buried in moist earth *with the distant end open,* can be tuned both at the transmitting end and at the receiving end."

As many radio experimenters today have available vacuum tube oscillators suitable for transmitting by radio telephony or undampt radio telegraphy, this field of experiment should prove interesting. There is also another phase of this work which could be experimentally tried out without Audions, at least for telegraphic signals, and that is by means of a buzzer such as those used by the signal corps in carrying out field telegraphy.

For Homes, Offices, Factories, Farms

Complete Wall Set Magneto Telephone

Western Electric Type



$7

This is a complete commercial telephone station. They were bought from telephone exchanges who put in Central battery types. Slightly used but guaranteed to be in A1 working order. The cabinet is of polished oak, piano finish, within which is contained the powerful magneto, the 300 Ohm polarized ringer, an induction coil. The magneto is exceptionally efficient, being of the two bar type with brass gear transmission. The extra sensitive microphone, mouthpiece and two gongs are mounted on the front of the cabinet, giving the entire instrument that desirable appearance of compactness and efficiency. Guaranteed to work over 20 miles. The telephone receiver is a double poled one, and has a hard rubber case. Seven binding posts are provided for connections.

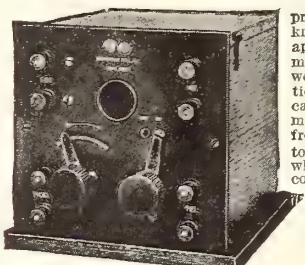
The instrument is one which we can offer with pride to our patrons at a ridiculously low price. It is unobtainable anywhere else at less than $15.00 and is an instrument unequaled in value for the price we ask. Size over all 11x10x8 in.

Long Distance Telephone Set—
One station.....$7.00
Shipping weight, 15 lbs.
Two stations
Shipping weight, 25 lbs.....**$13.00**

Send 6c in stamps for our big 160 page Wireless and Electrical Catalog No. 22.

The Electro Importing Co.
231 Fulton Street, New York

NOTICE TO AMATEURS:



Agent, Grebe Mfg. Co., Distributor for the South

We carry in stock practically every known piece of radio apparatus on the market today that is worthy of consideration, and in most cases can make immediate shipment from our stock. Due to circumstances over which we have no control, our catalog will not be ready May 1st, as advertised in QST. We will begin mailing out catalogs about the 15th of May. Send in your orders and they will be executed promptly. Catalog requests will be filled as soon as off the press. Catalogs positively will not be sent, unless 15 cents in stamps is remitted.

NATIONAL RADIO SUPPLY COMPANY
808 9th Street, N. W. Dept. 140 Washington, D. C.

CRIPPLES and those interested in the **Handicapped** will profit financially, educationally, by reading the only **MAGAZINE** published to help cripples. Large size, profusely illustrated, constructive, helpful. Year, $1.00; 6 months, 50c; copy, 15c. **150 H. S. BLDG., FARMINGTON, MICH.**

COPPER AERIAL WIRE

50c per 100 Feet

Our copper wire is still selling at the above price, altho the price of copper is rising steadily. The above is No. 14 gauge and is absolutely pure, solid copper wire. We also handle the wire in the No. 12 size at 80c per 100 feet. We accept no C. O. D. orders. Cash in registered letter, check or money order must accompany all orders. Be sure to include postage at the rate of 1 lb. for each 80 feet of the No. 14 and each 50 feet of the No. 12. Otherwise wire will be shipped by express collect.

Binding Posts

Regulation binding posts for wireless use. At present we offer three sizes at the prices listed below:

Style No. 11.....each 8c
Style No. 4.....each 12c
Style No. 3.....each 14c

Threaded Brass Rod

This material is enjoying a rapid sale among those amateurs who prefer to build their own equipment:

8-32 threaded brass rod.....per foot $0.16
6-32 threaded brass rod.....per foot 0.12

Receptacles for 4-prong Audions

These receptacles are made of aluminum and mounted on an attractive Bakelite base. Each $1.50

Switch Points

The above points are made in three sizes, all having heads ¼" in depth and diameter.

3/8" shank..... 1 dozen 35c 2 dozen 60c
1/2" shank..... 1 dozen 40c 2 dozen 70c
5/8" shank..... 1 dozen 45c 2 dozen 80c

Send 15c for our 64 page catalog. This amount will be refunded on first $1.00 purchase.

ELECTRICAL SPECIALTY COMPANY
Dept. E-48, 50 South Front St., Columbus, Ohio

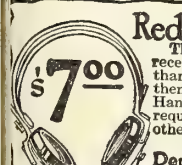
A ACE E "You'd be Surprised"

at the distance, strength of signal and freedom from Q. R. M. you get with Ace equipment. The type T. T. Tuner is the kind you want for that extreme long distance work thru the worst Q. R. M. Doc Ace has the right dope when he says, "You may pay more, but you can't buy better."

Type T. T. Regenerative Tuner, range 150 to 2,750 meters, F.O.B. Cincinnati—$55.00

THE PRECISION EQUIPMENT CO
2437 Gilbert Avenue, Department E, Cincinnati, Ohio

FREE



Radio Handbook & Catalogue

Contains much valuable radio information, tables and data. Describes a remarkable line of wireless instruments including "Red Head" 'Phones, Arlington Tested Minerals, DeForest, Murdock and Signal Apparatus. Write for this book today.

The Newman-Stern Co.
Dept. E. E. Cleveland, O.



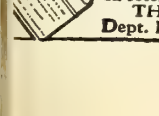
Red Head Radio Phone

$7.00

The accepted standard in wireless receivers. If they are not BETTER than anything you've ever seen return them for full cash refund. Our Radio Handy Book and Catalogue, free on request, describes them, and many other instruments.

The Newman-Stern Co.
Dept. E.E. Cleveland, O.

ARLINGTON TESTED CRYSTALS



Why buy minerals on a gamble? Be SURE when you put a crystal in your detector that it is EXQUISITELY SENSITIVE. Buy Arlington individually tested Minerals, Galena or Silicon, post paid on receipt of price.

35¢

THE NEWMAN-STERN CO.
Dept. E.E. Cleveland, O.

Signal Buoy for Ocean Ships

By EDWIN F. LINDER, M.E.

(*Continued from page* 131)

In most of these unfortunate calamities upon the high sea great loss of life has occurred due to lack of methods for keeping in communication with vessels speeding to help the shipwrecked passengers and crews. Not long after a ship had taken in enough water, usually the engine room and such machinery used for wireless became dead, and no means of further communication remained.

The buoy is intended to make up this deficiency as one of its chief features. Being a separate unit makes it possible to provide a system of this kind long after the vessel has sunk.

The searchlight plays probably the most important part in summoning assistance to those in the lifeboats and not alone flashes the signals upward into the sky where it can be easily seen by the navigators on the bridges of ships perhaps one hundred miles away, acting as a guide to the place where the survivors are waiting to be taken aboard, but it also makes it possible for the lifeboats to keep reasonably close to each other during the time of darkness, thereby lessening the chance of drifting apart and not being seen by the rescue ship. This was one of the difficulties in the *Titanic* disaster.

On having performed the work for which it is constructed, if possible it is hoisted aboard the steamer making the rescue, but should for reasons of impracticability it be found that it must be abandoned, a seacock is opened which gradually permits water to fill the entire buoy, sinking it so that it does not become a menace to navigation.

Eliminating the "Hello Girl"

By H. E. CLAPHAM

(*Continued from page* 146)

line follows the step-by-step method, that is, to pick out a particular line in an exchange, the major group is first selected, then a smaller group and so on, until the 100 line unit containing the desired line is reached, when the connection is extended finally to the line itself.

HOW CIRCUITS ARE SELECTED AUTOMATICALLY

As is generally understood, in the present telephone exchange, there is a pair of copper wires running to each subscriber, and connection between any two parties is effected by joining the individual circuits, and promptly separating or breaking them at the end of the conversation. Of course, the subscriber has nothing to do in this matter, but to give the desired number to "Central," who puts thru the connection.

The automatic system, as might be surmised, must have some arrangement at the subscriber's end of the line, by which he can call the party desired. This is here shown, as a numbered dial, secured to the base of the desk telephone, see Fig. 1. The numbers around the edge of the dial range from 0 to 9, thus enabling any combination of figures to be selected. The neat dial on the front of the telephone is all that the subscriber sees, but quite a wonderful mechanism is attached to that little dial, which is hidden inside the instrument. At the edge of the dial, as seen, there is a little fixt hook or protruding finger stop. In calling a number, the finger is placed in one of the openings in the perforated upper dial, directly above the specific number; then the dial is rotated in the clockwise direction toward the fixt stop aforemen-



"$1,000 Saved!"

"Last night I came home with great news. Our savings account had passed the thousand dollar mark!

"A few years ago I was making $15 a week and it took every cent to keep us going. Then one day I realized why I wasn't being advanced—I couldn't do anything in particular. I decided right then to invest an hour after supper each night in my own future, so I wrote to Scranton and arranged for a course of special training.

"Why, in a few months I had a whole new vision of my work! An opening came and I was promoted—with an increase. A little later another raise came—I could save $25 a month. Then another—I could save $50 each pay day. So it went.

"Today I am manager of my department. We have a thousand dollars saved—and there is a real future ahead!"

For 28 years the International Correspondence Schools have been helping men and women everywhere to win promotion, to earn more money, to have happy prosperous homes, to know the joy of getting ahead in business and in life.

You, too, can prepare right at home in spare time for the position you want in the work you like best. All we ask is the chance to prove it. Choose your career from this coupon and mark and mail it now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6237, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____



WANTED-Railway Mail Clerks

Average $145 Month

Hundred Men—Women Needed
Paid Vacation.
Life Job. Pull Unnecessary.

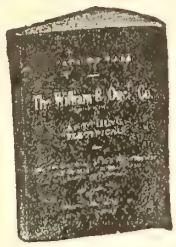
COUPON

FRANKLIN INSTITUTE
Dept. T101 Rochester, N.Y.

Sirs: Send me, without charge (1) sample of next Railway Mail Clerk Examination questions; (2) list of other government jobs open to men and women and (3) free book describing them.

Name .....

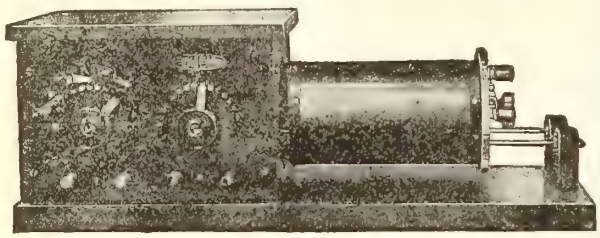
Address .....



DUCK'S

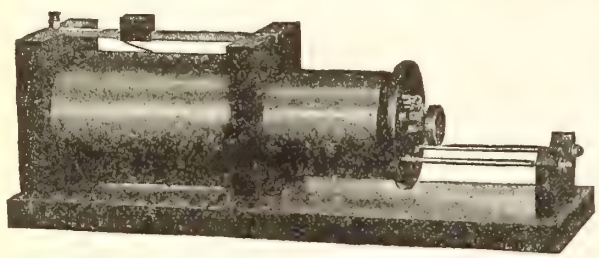
New Big-200 Page No. 14 Wireless Catalog and 100 Page Electrical Catalog

The wireless catalog mailed for 12c and the electrical catalog for 6c, either in stamps or coin, which amount you are privileged to deduct on your first order of $1.00. Catalog positively not sent otherwise. This edition of our wireless catalog is the most complete and elaborate we have ever put out. It embraces everything in wireless worth while. As an enclyclopedia of information it is invaluable. It is printed on excellent paper and with a beautiful cover. Your amateur friend will tell you that there never has been any wireless catalog to take the place of Duck's, and above all, that you can absolutely rely on the quality of every instrument listed in this catalog. In a word it is all worth while catalogs in one.



A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $23.50.

NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER



The secondary on our new type Arlington is divided into three sections with two dead end switches eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type permitting a looser coupling. It is a beautifully finished instrument.

Price only $12.50

OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio

The Acme Apparatus Company

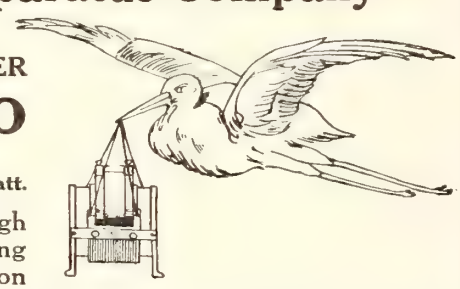
announces the birth of

Another RADIO TRANSFORMER

Named **ACME 250**

Weight 13 pounds

250 Watts, 250 miles—a mile per watt.



ACME 250 has inherited the high efficiency, excellent operating characteristics, rugged construction and attractive appearance of its older brothers, and has come to fulfill the demand for a transformer which, though it may not present as good a front, can make itself heard in any company.

The ACME cry is 800 cycles strong.

Price: $16.00 Dressed $13.00 Undressed—110 Volt—60 Cycles—¼ KW.

ACME APPARATUS COMPANY

28 WINDSOR STREET
CAMBRIDGE 39, MASS.

American Electro Technical Appliance Company

Dept. E, 235 Fulton Street, New York City

Partial List of What We Distribute:

Loose Couplers, $5.00, $10.00, $15.00, $19 00.
Tuning Coils, 4,000 Meters, $4.75; 1,250 Meters, $3.50.
Crystal Detectors, $1.75; DeForest Type, $2.60.
Murdock Variable Condensers, .001 MFD, $4.75; .0005, $3.75.
DeForest Variable Condensers Always On Hand.
Fixed Condensers, .002 MFD, 70c; .003, 90c.
Spark Gaps, 75c, 90c. $2.00.
Oscillation Transformer (Murdock Type), $5.00.
Oscillation Transformer (Signal Type), $16.00.
Lightning Switch, 600 V.-100 AMP., $3.94.
Switch Points 3/16"x3/16", Threaded Shank with Nut, 3c Ea.
Switch Points, 3/16"x3/16" with Machine Screw, 20c Per Doz.
Dials (Black), 3" and 3½", 75c; with Knob, $1.25.
White Metal Dials, 3", 50c.
Binding Posts, 9c, 10c, 12c and 20c.
Paragon Rheostats, $1.75.
Parkin Rheostats, $1.00.
DeForest Rheostats, $1.00.
All the Wireless Press Books.
All the Cole and Morgan Books.
Hawkins Electrical Guides
Marconi VT Bulbs, $7.00; Socket for Same, $1.50.
Murdock VT Socket, $1.00; DeForest Type, $1.50.
Western Electric Phones, $12.00.
DeForest Coils, All Sizes.
Complete Stock of DeForest, Murdock and Grebe Manufacture.
Oscillation Helex, Complete to Assemble, $3.00.
Loads of Other Apparatus On Hand.

tioned, when the finger is removed. Then the dial, propelled by a spring mechanism, flies back to its normal position, but in so doing a toothed segment, rotating with the dial, makes a certain number of electrical contacts, corresponding to the number at which the dial was released. Thus, if the dial was released with the finger in a hole number 7, then when it turned back its segment and contacts would send 7 distinct electrical impulses over the line to the "Central Exchange," where a special electromagnetic selecting device moves contacting fingers over certain contacts, suitably arranged, making the connection to the desired circuit.

The call of any number made up of more than one digit, is accomplisht by inserting the finger in the dial, rotating it to the fixt stop, and releasing it, for each number in succession.

The details of the automatic selector at the exchange will be understood from the following: In the drawing, Fig. 6, is represented, a simple selector or circuit finder, for an exchange of 10 subscribers. The 10 subscribers' lines or circuits terminate in the 10 pairs of metal plates or *bank contacts,* as they are called, arranged in the arc of a circle and numbered from 1 to 10, respectively. A ratchet wheel, R, is arranged with its center at the center of this arc of contacts, and carries a pair of springs, W, technically termed a *wiper.* The line of subscriber No. 1, for instance, by whom it is supposed that this machine is used, is represented as being connected not only to the first pair of *bank contacts,* but also to the wiper W; to the rotary magnets, and to the release and rotary push buttons.

Now suppose that subscriber No. 1 wishes to connect to line No. 2. To do this, he presses twice (theoretically speaking), the rotary push button (Rot. B, in drawing), located at his telephone instrument. This closes a circuit from the battery thru the *rotary* magnet. Each time that this circuit is completed the *rotary* magnet is energized and attracts its armature, A. This armature, in turn, carries at the end of its arm, the pawl or finger, P, which engages the ratchet wheel, R, and moves it, and with it the wiper, W, one step each time that the armature is attracted. Consequently, when A has been attracted and released twice in succession, the wiper, W, will have been moved from its normal position at the left of the first pair of contacts, and will rest upon pair No. 2, of gap between the terminals of line No. 1 and line No. 2. By means not shown in this diagram, subscriber No. 2 will be signaled (bell rung) and called to answer his telephone.

The arrangement of the apparatus is such that when the conversation is finisht, and calling subscriber No. 1 hangs up his receiver, the release magnet (Rel. Mag. in cut) will be momentarily energized, and so attract its armature, thus pulling the retaining dog, D, out of engagement with the ratchet-wheel, which is then instantaneously returned to its normal position by means of a clock-spring. This release is here shown as if actuated by the push button, Rel. B. In a similar manner subscriber No. 2 could readily call line No. 1. This explanation, tho simple, shows the principle upon which the more complicated selectors or electromagnetic switches in the larger exchanges operate. The proper sequence of electrical impulses for the actuating of the rotary control magnet, is automatically sent by the spring propelled drum and dial at the subscriber's instrument. While the dial is off normal the transmitter and receiver are shunted out by a pair of springs, in order to eliminate noise in the receiver and strengthen the impulses. Figure 7 shows the circuit of the calling telephone and its relation to the line relay of a switch.

A TYPICAL 100 LINE SYSTEM

A good understanding of the switching mechanism may be had from a consideration of a 100 line system. A 100 line switchboard consists of 100 lineswitches and a number of connector switches. The number of connector switches needed is based upon the greatest number of conversations carried on at any one time.

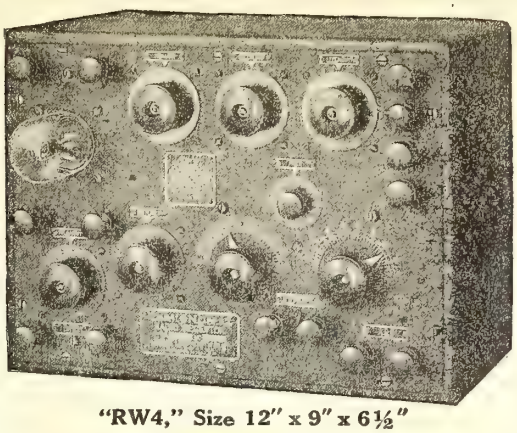
Each telephone line has its own individual *lineswitch.* The lineswitches are mounted on uprights in groups of 100, and placed in steel and glass cabinets, as shown in the photograph. When a subscriber lifts his receiver, the lineswitch associated with his line extends the line directly to a trunk leading to the line relay of an idle connector switch, and at the same time prevents any other line from using that particular connector switch. The lineswitch must be regarded as an efficiency device, since it makes possible the use of a small number of connector switches for a large number of lines, while without its use each line would have to be equipt with a connector switch. Since the cost of a connector is many times that of a lineswitch, the saving is very apparent. It must be remembered that the lineswitch operates independent of the calling device. It does its work and goes out of business immediately the receiver is lifted. See complete circuit diagram figure 5.

We now come to a consideration of the *connector switch.* The connector takes the place of the operator of a manual board in reaching and testing the desired line, starting the ringing, giving "busy" signals, releasing the connection and the many other things that an operator does in a manual system.

A connector switch (see photograph figure 3), consists essentially of a shaft carrying three wiper springs, which may be lifted by a step-by-step ratchet action, and which may at any step be similarly rotated. Within the mechanism and not shown are three magnets, one for lifting the shaft, a second for rotating it, and a third for releasing it. The relays shown mounted above the switch are for controlling its action. Mounted below the switch are shown what are known as *contact banks.* The lower or line bank contains 100 pairs of small brass punchings, each pair of which is connected directly to the telephone line at the lineswitch. These contacts are arranged in ten semi-circular levels and the numbering of each pair is based on the number of steps required to lift and rotate the lower pair of wiper springs until they rest on the pair of contacts. Thus the number of the lower left hand pair would be 11, since it requires one vertical step and one rotary step to reach it. See diagram figure 5.

The upper or private bank consists of 100 single contacts similarly arranged, which are for the purpose of protecting busy lines from intrusion. Each connector has its own banks of contacts and the line and private contacts are mutiplied from bank to bank. Now suppose we wish to call number 56 on this system. The first operation of the dial must serve to lift the wiper springs to the fifth level of contacts, while the second operation must rotate the shaft until the wipers rest on the contacts of the desired line.

It might be interesting to see just how the two *motor magnets* are operated by impulses from a common source. In figure 8 is shown a simple circuit of the two magnets and the relays which control their action. Lifting the receiver at the telephone extends the circuit of the line relay (L.R.) thru the line to the calling device mainsprings. When the line relay operates it closes the circuit to the release relay. A peculiar feature of this release relay is that it is somewhat slow to release. The slow release feature is secured by placing a heavy copper collar around one end of the core.



"RW4," Size 12" x 9" x 6½"

MIGNON "RW4" UNDAMPED WAVE RECEPTORS

NO Loose Couplers
Loading Coils
Variometers
Amplifiers

Strongest, Most Distinct Signals

IMPORTANT—NOTICE

Ernest C. Mignon, inventor of the famous disc-core undamped wave receptor, is no longer connected with the Mignon Wireless Corporation, of Elmira, N. Y., or their successors—the Universal Radio Mfg. Corp. Address all communications for Mignon apparatus to

MIGNON MANUFACTURING CORPORATION, Newark, N. J.

DAMPED AND UNDAMPED WAVE APPARATUS FOR ALL PURPOSES

Endorsed by Radio Department of D., L. & W. R. R. Co.

Write for Literature.

MIGNON MFG. CORP.

Dept. E

NEWARK, N. J.

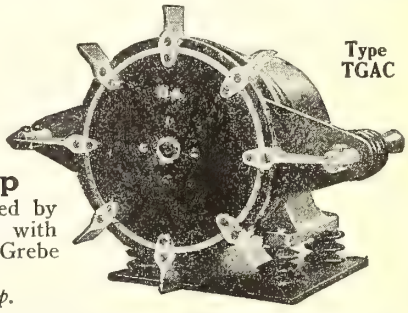
SUPERIOR MIGNON SYSTEM APPARATUS

Canadian Representative—Canadian Radio Mfg. Co., Bienville, Que.

Perfect Tone—Increased Range—Low Decrement

You have heard the piercing tone of a synchronous spark. You know the superior characteristics of synchronous spark transmitters. Heretofore the bulk and expense of a motor generator and the practical necessity of D. C. supply have prevented the use of such transmitters by amateur stations.

The GREBE RADIO



Type TGAC

Synchronous Rotary Gap

possesses all the advantages to be gained by the use of motor-generator equipment with none of the expense. You can use the Grebe Synchronous Gap on your A. C. Line.

Ask your dealer to show you this gap.

A. H. GREBE & CO., Inc., 70 Van Wyck Blvd., Richmond Hill, N. Y.

REMOVAL NOTICE

The undersigned desire to announce the removal of their offices from

19 PARK PLACE

to new and much larger quarters at

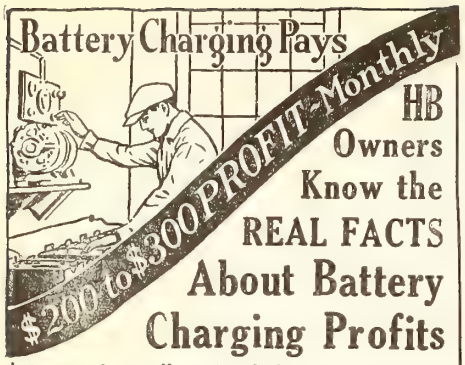
188-190 Greenwich Street, New York City

where they will be in a better position to accord their patrons more prompt and efficient service.

Send for catalogue as issued.

WIRELESS EQUIPMENT CO., Inc.
Manufacturers

COLE & MORGAN, Inc.
Publishers of the Arts and Sciences Series.



HB Owners Know the REAL FACTS About Battery Charging Profits

Letters from all parts of the country tell us about BIG PROFITS with HB Equipment, running from $100 a month as high as $300. Many make even more.

YOU, too, can have BIG PROFITS just like these

With an HB Charger, it costs you 10c to 15c each to charge batteries. Customer pays 75c to $1.50. Think of that for BIG PROFITS! HB Chargers have no delicate parts to wear out, no burn outs or expensive renewals. Built for hard, steady, money-making service. HB Equipment will be running long after less efficient chargers have been discarded.

Small Cash Payment Starts this Big Business

HB Charges are sold on long, easy terms extending over almost a year's time, and you can have one by making a small cash payment. The profits from your battery charging should easily pay the balance. If you find that your HB Charger is not suited to your needs you can return it any time within ten days and get your money back.

Choose the Size You Need USE THE COUPON!

There is an HB Charger to suit any size battery business. Pick the size you need and mark a cross on the picture in the coupon. Then tear out and mail. Remember you run no risk. Send the coupon TODAY.

TEAR HERE

HOBART BROTHERS COMPANY
Box 67E, Troy, Ohio

Send me complete information about the HB Charger marked (X), also details of your Easy Payment Plan.



Name .....

Address..... State.....

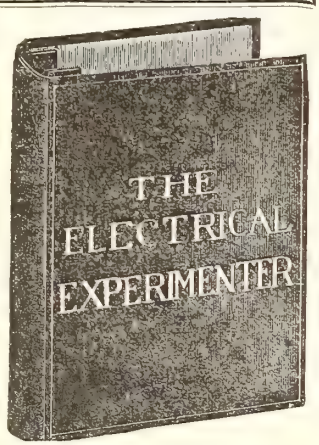
Handy Binder

For the Electrical Experimenter (Science & Invention)

Holds and preserves 12 issues, each of which can be inserted or removed at will. Made of heavy material, extra reinforced at the back.

65c

Add postage for 2 lbs.



Experimenter Pub. Co., Inc. *Book Dept.* 233 Fulton St., N. Y.

When the circuit of such a relay is broken the Eddy currents induced in the collar are sufficiently strong to oppose greatly the magnetic change which produces them, thus giving the armature a very noticeable lag. When the armature of the line relay vibrates in response to the impulses from the calling device, the release relay remains energized. Each time the armature of the line relay is released, a circuit is completed thru the slow acting series relay (B) and the vertical magnet (V.M.). The vertical magnet steps the shaft and wipers to the proper level, the series relay remaining energized during this operation. Immediately the shaft begins its upward motion, the springs S and "make-before-break" combination are switched by a cam. Now when the series relay releases, the circuit is prepared thru the rotary magnet (R.M.) and the slow relay A in multiple. The next series of impulses caused by dialling the second digit will operate the rotary magnet and step the shaft around to the contacts belonging to the called line. See also diagram figure 5. At this point one of two things may happen depending on whether the line is busy or idle. If the line is idle, the associated private bank contacts will be connected to the negative side of the battery and this condition will, upon the release of relay A, cause the operation of the ringing relay, which will automatically and intermittently ring the called party's bell until the call is answered, or until the connection is broken by the calling party. The operations of this relay also guards the called line from intrusion.

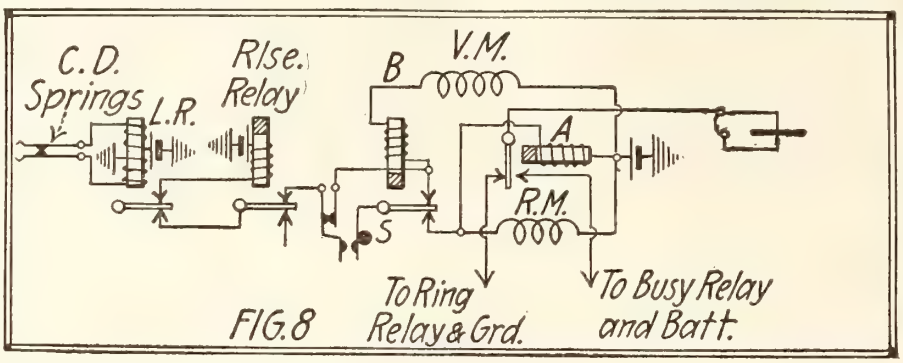


FIG. 8

Typical Automatic Telephone Circuit, Showing "Busy" Signal Relay and "Ringing" Relay

HOW THE "BUSY WIRE" SIGNAL WORKS.

If the desired line is *busy*, the associated private bank contacts are connected to the positive side of the battery. This condition, before the release of the relay A, causes the "busy" relay to operate, which places the familiar "busy tone" on the calling telephone and gives the calling subscriber the signal to hang up and attempt the call later.

The connections may be released at any time during this building up of a connection, by merely hanging up the receiver. This operates the release magnet in the connector switch, which trips the shaft and restores everything to normal, ready for another call. After a conversation is finisht the switches are released by the hanging up of both receivers. This quick release is one of the important features of automatic telephony and is in marked contrast to the release in manual switchboards, which depends upon when the operator *can find time to remove the plugs!*

A system of several hundred lines is built up by grouping together two or more of the hundred line boards just described. In the large exchange picture, figure 2, are shown several groups of lineswitch boards, with their associated cables and cable racks. To enable the calling subscriber to pick out the particular 100 line switchboard desired, it is necessary to provide trunking switches, or selectors, as they are called. The selector switch is mechanically similar to the connector switch, the chief difference being that while the shaft of a connector switch rotates in response to impulses from the calling device, the shaft of a selector rotates without regard to the dial.

Each subscriber in such a system has a *three digit number*. The trunks from the lineswitch boards now lead, not to connectors, but *selectors*. The first digit steps the shaft and wipers of the selector switch up to the level corresponding to the 100 line group containing the desired number. The wipers immediately and without regard to the dial, rotate until they rest on the contacts of a trunk leading to an *idle* connector switch serving that group. The last two digits operate the connector and pick out the line as before.

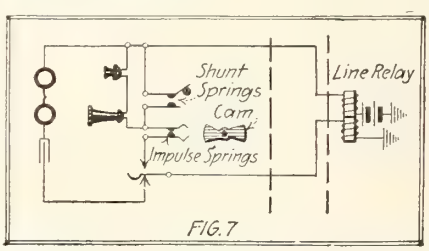
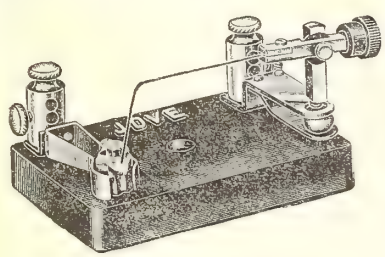


FIG. 7

This Shows the Circuit of the Calling Telephone and Its Relation to the Line Relay of an Automatic Telephone Switch.

The selector switches are usually grouped in shelves of twenty and mounted on trunk boards as illustrated in the accompanying photograph of an Automatic Exchange.

For very large systems, of say 100,000 lines ultimate capacity, still other selector groups of switches are provided, which serve to pick out the larger groups of lines. These groups are called *first* and *second selectors* to distinguish them from the others, which now become *third* selectors. Each number in such a system contains *five digits*. The first three digits operate the first, second and third selectors respectively —while the last two operate the connector switch. There are already several automatic systems now in operation which require *six figure numbers*, the ultimate capacity of the system being 1,000,000 lines.



(GHEGAN PATENT

Bunnell INSTRUMENTS Always Reliable

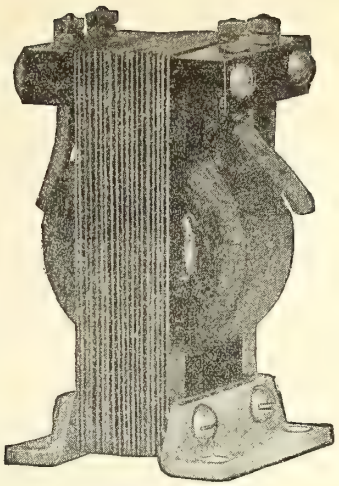
JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

Send stamp for new edition 42E Catalog.

J. H. BUNNELL & CO., 32 Park Place, New York



TRIODE
(TRADE MARK)
Audio Transformer Type P

This transformer provides a maximum of low frequency amplification and is superior to all others. It may be used with the Marconi and all standard vacuum tubes.
Permits reliable daylight reception from European stations.
Establishes new amateur long distance records.
Renders remarkable amplification of all signals.
Price $7.00 postpaid
WIRELESS SPECIALTY APPARATUS CO.
Engineers, Designers, Manufacturers
Boston, Mass., U. S. A.

Brooklyn
RADIO AMATEURS

If you want good standard wireless apparatus, we cordially invite you to examine our complete line of all famous Manufacturers: Radisco, Grebe, Murdock, etc. Everything for the Amateur from Contact Points to Complete Stations sold at catalog prices.

Agents for RADISCO Apparatus

Including Coils, "B" Batteries, Indicating Dials and other parts distributed by them. Mail orders given prompt attention.

Open Evenings until 9.30 P.M.

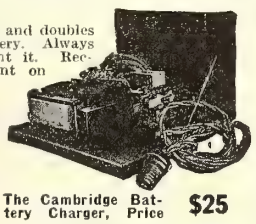
KELLY & PHILLIPS
312 Flatbush Avenue, Brooklyn, N. Y.

Charge Storage Batteries
For Convenience or Profit

From any alternating current lamp socket with the Cambridge Rectifier. For home or garage use. As simple as turning on a lamp and fully guaranteed.

Quickly saves its cost and doubles the life of your battery. Always ready when you want it. Rectifier Bulletin R sent on request.

Bulletin Y of Wireless Telegraph Apparatus sent for 3 cent stamp.



Clapp-Eastham Co.
131 Main St.
Cambridge, Mass.

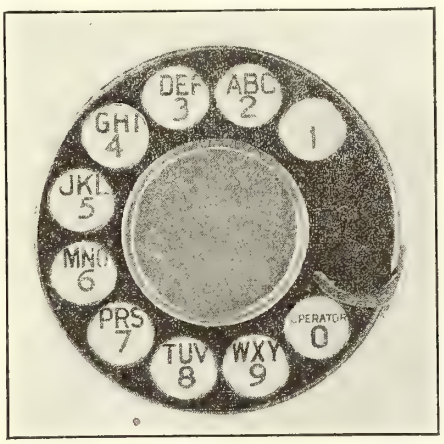
The Cambridge Battery Charger, Price **$25**

AMATEURS
YOU REQUIRE SWITCH POINTS AND BINDING POSTS FOR THAT NEW SET.
SWITCH POINTS THAT ARE ACCURATE.
¼" Diameter and ¼" High, Shanks for 6-32 Nut—SIZES as below, Postpaid.
This Month Only
⅜" Shank, Nickel Plaited, $1.00
½" Shank, Nickel Plaited, 1.00
⅝" Shank, Nickel Plaited, 1.00
Dependable Radio Equipment and Parts
See catalogue No. 9
DORON BROS. ELEC. CO.
Manufacturers, Hamilton, Ohio

The flexibility of the automatic system has been one of its most surprising developments. By making small modifications of standard equipment, automatic telephony has been able to take care of every kind of service that operating companies or subscribers have demanded.

Party line service is given with as many as *ten parties on the line*, and full selective ringing is secured by the use of *harmonic or tuned ringers*. The operation of calling a station on a party-line is no different from making any other call, since each station has its own number. Reverting calls, or calls between parties on the same line, are taken care of in a way that is even more satisfactory than that used in manual systems. Coin collections, meters, etc., that record effective calls, and disregard all calls made when the line is busy or when no reply is received, are in successful use.

Automatic telephony has been adapted to every class of service, rural communities and large cities alike, and its work is performed more rapidly and efficiently than is possible with manual systems.



Modified Automatic Telephone Calling Dial to Be Installed in New York City, Which Enables the Exchange Name to Be Called, Thanks to the Letters Provided As Shown.

That the future telephone systems of the country will be all automatic cannot now be doubted. Announcements of proposed conversions from manual to automatic in the larger cities of the world are appearing almost daily, and it is now a recognized fact that the automatic telephone system represents the only solution to the problems of giving adequate telephone service.

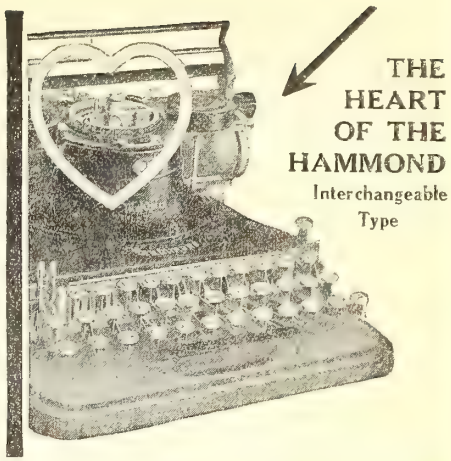
THE BELL SYSTEM IN NEW YORK CITY.

The Bell system is starting to install new automatic telephone equipment in New York City, and have worked out a very clever stunt for selecting the various exchanges. The new telephone books will have the exchange names printed as shown below. The calling is then carried out as follows:

Having secured the desired telephone number from the directory, which we will assume to be "PENnsylvania 5280," the subscriber will first remove the receiver and listen for the "dial tone," which indicates when the apparatus is ready to receive his call. He will then insert his finger in the opening of the hole over the letter "P," rotate the dial until the finger comes in contact with the metal stop shown in the picture and release the dial, which will automatically return to normal. He will then repeat this operation for the letters "E" and "N," and in turn for the four numerals 5-2-8-0.

Typical examples of new form of listing telephone numbers:

Arena Dr John, r, 2156 Bathgate av..**FOR** dham 4141
Arena Theatre, 623 8th av.....**BRY** ant 5409
Arend Ernest, A, Archt, 105 W 40....**BRY** ant 3231
Arend F J, 165 Bway.....**COR** tland 0940



THE HEART OF THE HAMMOND
Interchangeable Type

One of the Greatest Achievements of Science and Invention.

Hammond
MULTIPLEX

"Many Typewriters In One"

For the Mathematician, Engineer, Chemist, Astronomer, Surveyor, Navigator—there is no typewriter like the Multiplex Hammond! The Multiplex does many things that *no other typewriter* can do!

The Mathematical Multiplex contains the characters and signs used for writing in higher and lower mathematics, and for engineering, mechanics, etc., as well as for all the ordinary work that can be done on any typewriter. Just note these fine styles of Multiplex type—

TWO STYLES OF TYPE, or *two to five different languages*, carried on the machine AT ONCE. "JUST TURN THE KNOB" and change *instantly* from Roman Type, to *Italics*, or Miniature Roman, or our Beautiful Script Type, or from English to Greek, Russian, German, French, etc. *Any other type or language can be substituted in a few seconds.*

The above gives a slight idea of the versatility of the Multiplex which has literally revolutionized typewriting—has changed it from monotonous commercial work to the beauty of fine printing and engraving.

WRITE FOR FREE BOOKLET showing the many languages and type sets of the Multiplex—there's a type for every profession, every business, every science, including technical signs and symbols and chemical keyboard.

Fill out the Coupon and mail to us *now*—before you turn this page and possibly forget. You incur no obligation.



Also—an Aluminum PORTABLE Model
For Traveling—for home. Weighs about 11-lbs. Full capacity. Ask for special folder.

THE HAMMOND TYPEWRITER CO.
589 East 69th Street New York City
Name .....
Address .....
.....
Please write your occupation below.

THIS—the second

Announcement

since our entrance into the Radio and Electrical field, is published to acquaint you with the fact that we have been taken at our word as an organization specializing in

"Personal Service to the Consumer"

Our efforts will always tend to serve each one of you individually and promptly, thru our sales or mail order department, and to this end we have contracted with over ninety per cent of the leading manufacturers, which means that we will carry everything Radio from Contact Points to Complete Stations.

Among the serviceable and high quality Radio and Commercial Apparatus which we offer you are to be found the foremost products of

A. H. Grebe — **De Forest**
Clapp-Eastham — **W. J. Murdock**
Radio Craft Corp. — **J. H. Bunnell**
International-Radio Tel. Co. — **Amer. Radio & Research Corp.**

Manhattan Electrical Supply Co.; General Radio; Acme; Marconi; S. Cohen; Federal Tel. & Tel; Electrose; Brandes; Pacent Electric; Wireless Equipment; Wireless Improvement; Cole & Morgan, Books; Wireless Press, Books; Marko Storage Batteries and Endurance Storage Batteries; Standard V.T. Batteries; Adams Morgan; Dubilier Condensers; Firth; Omnigraph; Magnavox and others.

You have our most courteous invitation to spend a few moments in our spacious show rooms to look over our complete stock. We will gladly show you any instrument or part you may desire to examine. It will be a revelation to you, besides, it is part of our service.

Our word of honor to you is our guarantee. Let us prove it.

Write Dept. A1 for Literature and Price Lists

Continental Radio and Electric Corporation

J. DI BLASI, Secy. J. STANTLEY, Treas.

6 Warren Street **New York**

10¢ OR 25¢

Anti-Kamnia

AK

FOR HEADACHE, NEURALGIA, INFLUENZA AND ALL PAIN—

Ask For A-K Tablets

TABLETS

Arend F J, r, 813 5th av	PLA za	4226
Arends Katharine, MD, 178 W 97	RIV rside	0570
Arendt E, r, 156 W 86	SCH uyler	2861
Arendt Edwd & Son, Leaf Tob, 151 Water	JOH n	1635
Arendt Ellis, 151 Water	JOH n	1635
Arendt Simon, r, 29 E 129	HAR lem	4202
Arengee Co., 21 W 4	SPR ing	7224
Arens A, Leaf Tobacco, 182 Water	JOH n	4747
Arens Miss Adele, r, 29 W 84	SCH uyler	2493
Arens Burchard, Cafe, 520 8th av	GRE eley	5141
Arens Edgmont H, Bookseller, 17 W 8	STU yvsnt	0717
Arens F X, r, 119 W 80	SCH uyler	6347
Arens Max, Lawyer, 271 Bway	BAR clay	5786
Arensberg A, Drugs, 1002 So blvd	INT rvale	2925
Arensberg M, r, 961 St Nich Av	AUD bon	1520
Arensberg Walter C, r, 33 W 67	COL mbus	4826

DR. ROGERS, RADIO INVENTOR, HONORED.

Dr. J. Harris Rogers, of Hyattsville, Md., discoverer of the principle of underground and underwater radio, was recently extended a vote of thanks in a joint resolution unanimously adopted by the Maryland State Assembly. The resolution was introduced in the Senate by Oliver Metzerott and in the House by Clarence Roberts.

Dr. Rogers has been a student of electrical science for many years, and has achieved international prominence. For more than ten years he has devoted his energy to the development of radio.

At the outbreak of the war he tendered his inventions to the Government without reservations. An intricate system was worked out, with stations in various parts of the country. Communication was established between submerged submarines and airplanes, enabling the "subs" to attack to advantage. The system was used in the trenches, and at times was the only means of communication between dugouts and the rear.

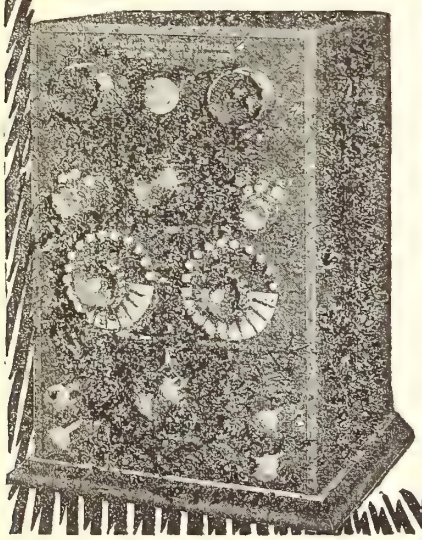
Dr. Rogers' work has won great recognition, and Senators France and Smith of Maryland are now co-operating to have Congress adopt a joint resolution recognizing his services.

DE FOREST

Here's a Receiver with Eight Distinct Advantages

DeFOREST Agencies are located in all Principal Cities. Ask your regular Electrical Dealer to get you DeFOREST Apparatus.

Combination Audion-Ultra Audion and One-step Amplifier; Type P-300. Size 12½"x9⅜"x7⅜". Price $73.50. Vacuum Tubes, $7.00 each extra.



A COMPLETE, compact and inexpensive Receiving Set having improvements and refinements which increase efficiency and eliminate many objectionable features of receiving apparatus.

No longer is it necessary for you to have two or three expensive, inconvenient and cumbersome tuners spread all over your operating table when working all wave lengths. With this new DeFOREST tuning system you can work any and all wave lengths with the one tuner shown at the right. This Set has distinct advantages of minimum table space and of convenience in coupling not equalled in any other type of apparatus. The entire Set is complete in the two cabinets shown here. The Genuine DeFOREST "Honey Comb" Coil System of Tuning is employed—no superior system has ever been invented.

This is a new DeFOREST production embodying a unique and superior tuning system. Possession of this Set means more efficient and satisfactory operation; more pleasure and practical benefit for every Amateur. Its price is remarkably reasonable for the quality of apparatus and the distinct advantages the Set offers. Find out more about it at once.

Send for a DeFOREST Manual

a 56-page book containing full information about this and many more DeFOREST instruments, as well as giving much useful information for the Amateur. Mailed anywhere upon receipt of 10 cents.

DE FOREST RADIO TELEPHONE AND TELEGRAPH CO.

Inventors and Manufacturers of High Grade Radio Apparatus.

1399 Sedgwick Ave., New York City

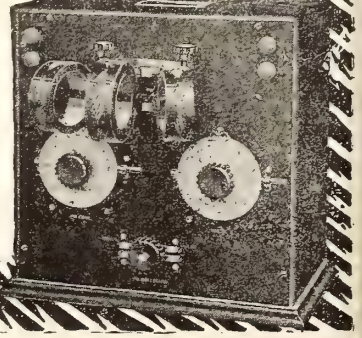
Lee De Forest, Inc., Western Distributors. 451 Third Street, San Francisco, Cal.
(Shipments Direct from San Francisco Stock)

These Eight Advantages

are not duplicated in any Receiving Set at double the price:

1—Responds to any wave lengths, 150 to 25 000 meters.
2—More flexible in coupling.
3—Lower distributed capacity: less high frequency resistance and decrement values.
4—Eliminates cumbersome switches, inefficient taps and losses from dead ends.
5—Vernier Air Condensers of unusual design.
6—Signals come in louder and clearer.
7—Superior in efficiency, workmanship, convenience and appearance.
8—Requires minimum table space; note sizes of cabinets.

Tuner: Type T-200. Size 13⅜"x12½"x8". Price $77.50 without Coils.



EDISON'S TELEGRAPH "SENDING" TO BE PRESERVED.

At the joint reunion of the Old Time Telegraphers and Historical Association and the United States Military Telegraph Corps held in Cleveland, Ohio, September 10-12, 1919, a resolution was presented by E. P. Griffith, superintendent of telegraph of the Erie Railroad Company, which had in view inviting Thomas A. Edison to place on phonographic record a message to telegraphers; Mr. Edison himself to send the message by means of a key and sounder, says *Telegraph and Telephone Age.*

Arrangements have now been made with Mr. Edison to carry the project to a reality, and he has agreed to have made a pure nickel master record which will last permanently and from which duplicates may be made.

Mr. Edison's Morse sending will be preceded on the record by an introductory speech by David Homer Bates, and it is the intention to have this record placed upon a machine for reproduction at future gatherings of the Old Time Telegraphers and Historical Association and United States Military Telegraph Corps.

Chicago Professor gave Foundation for Einstein's Theory

By ROBERT H. MOULTON

(*Continued from page* 144)

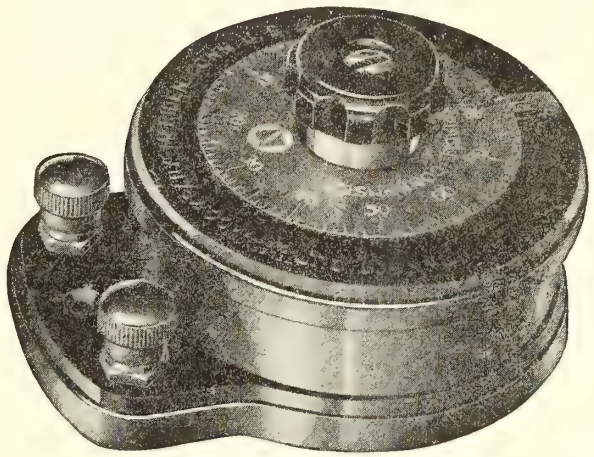
sion on weights and measures asked Professor Michelson to devise some method by which the meter length could be accurately reproduced. The meter is theoretically *one forty-millionth of the earth's circumference;* but this definition is not accurate enough for scientific purposes. Professor Michelson announced the length of the meter in terms of cadmium light waves, with a maximum error of one part in two millions! This definition will always enable scientists to reproduce the meter accurately, as long as cadmium light retains its properties—which is as long as the earth exists.

The first achievement to bring Professor Michelson's name to the attention of the scientific world was his accurate determination of the velocity of light, accomplisht also after overcoming tremendous experimental difficulties. Light is the fastest thing in nature; it represents the absolute limit of speed. After four years of work and study, Professor Michelson announced that light travels with a velocity of 186,330 miles per second. The maximum error in this figure does not exceed one-fortieth of one per cent. The accuracy of this may better be judged when it is stated that, altho light travels at a speed equivalent to more than seven times around the earth per second, the maximum error in Professor Michelson's figure does not exceed the distance a man could walk in a single day.

On the subject of *spectrum analysis,* Professor Michelson has devoted many of the best years of his life. Spectrum analyses are obtained by means of the *spectroscope.* Every substance when heated emits a characteristic light. By means of the spectroscope this light is analyzed and the elements giving off the light are thereby revealed. The spectroscope has enabled scientists to determine the elements in far distant stars. It has made possible tremendously important discoveries concerning the nature of atoms, the minute particles of which all matter is composed.

The difficulties of spectrum analysis will be realized when it is learned that a single atom of sodium emits 800,000,000,000 vibrations per second, of two slightly different kinds of light. Professor Michelson was engaged in spectrum analysis very long before he improved the spectroscope, calling the improved type an *echelon spectroscope.* This

CONNECTICUT RADIO



A New Variable Condenser —It Doesn't Get Out of Order

YOUR adjustments, once made with the new CONNECTICUT Variable Condenser, are secure—in any position. While delicate adjustments are easily obtained, the mechanism does not get out of order.

That's because of the simplicity of design—the kind of simplicity that comes from disregarding outworn tradition, and considering essentials only. And because that has been done, the CONNECTICUT Variable Condenser shows superiority not alone in design, but at every step in operation.

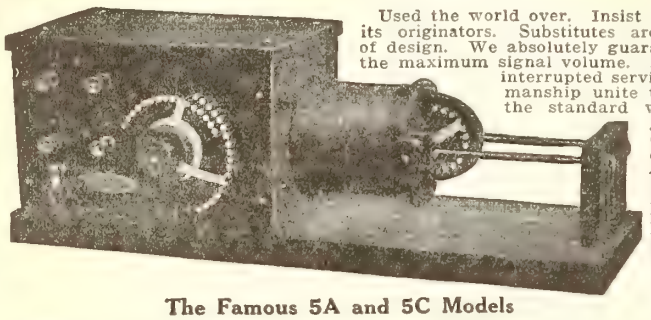
Our Booklet tells all about it and gives some interesting and important information about condensers in general. Send for your copy.

Mention your Dealer's name.

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut

TRACO QUALITY

RECEIVING TRANSFORMERS



Used the world over. Insist on the genuine, built by its originators. Substitutes are expensive, irrespective of design. We absolutely guarantee our tuners to give the maximum signal volume. Delicate refinement, uninterrupted service and high class workmanship unite to make TRACO tuners the standard whereby all others are judged. If your Dealer does not handle them, order direct from us.

LIBERTY DETECTOR VALVES. RADIO AMPLIFYING PHONES, type used by the **UNITED STATES, BRITISH** and **FRENCH GOVERNMENTS,** now in stock, for sale.

Send stamps for bulletins.

The Famous 5A and 5C Models

THE RADIO APPARATUS CO., Pottstown, Penna., U. S. A.

WIRELESS MANUAL-W12

Our 180 Page Combined Manual and Catalog Illustrates and Accurately Describes the Uses of Standard Radio Instruments.

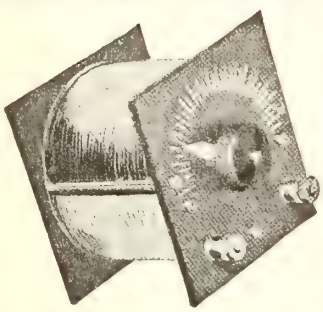
We Make a Charge of 25c for it, Issuing Coupon Receipt Redeemable on a Purchase of $5.00 or More.

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.

Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble. Ready about May 25. Send in your request now.

MANHATTAN ELECTRICAL SUPPLY CO., Inc.

New York—17 Park Place
Chicago—114 S. Wells St.
St. Louis—1106 Pine St.
San Francisco—604 Mission St.



Variable Condensors of the Better Type

Note the square end piece on the cut of our condensors, facing the operator, also these condensors are enclosed in clear glass cases. Scales on these instruments are calibrated to 2½ degrees.

Prices: R-35 21 plate.....$4.75
R-34 43 " 5.50

ALL Instruments absolutely Guaranteed

THE TEWNO COMPANY
150-152 Chambers Street New York City

VALUABLE OLD COPIES OF THE ELECTRICAL EXPERIMENTER 40% OFF

Vol. V (May 1917 to April 1918)

THRU a mistake at the bindery, some of these volumes have one copy missing and others have two copies of one issue. In no case is more than one month wrong. On account of this slight error, which does not impair their value for reference or as interesting reading one particle, they are offered at a reduction from $3.00 to $1.75.

These volumes contain hundreds of interesting articles and illustrations. They are a veritable gold mine of scientific ideas and electrical information. The material contained would cost thousands of dollars to assemble in any other form—even if it were procurable elsewhere.

Made to Sell for $3.00
Specially Offered
(while they last)
at only $1.75
plus postage for 8 pounds

EXPERIMENTER PUBLISHING CO.
233 Fulton St., N. Y. C.

Attractively and durably bound, stamped in gold, one of these bound volumes will be a splendid addition to your library. Such interesting reading cannot be bought elsewhere for any price. Here you have the opportunity of securing it at nearly half price.

Do not delay a single day. The more complete volumes will be mailed out first.

Send $1.75 and postage at once and you will receive this splendid volume by return mail.

STORAGE BATTERIE FOR WIRELESS SERVICE

Batteries especially adapted for the amateur operator are described and illustrated in our new Bulletin No. 175, copy of which will be furnished on request.

THE ELECTRIC STORAGE BATTERY CO.

The largest maker of storage batteries in the world
1888 PHILADELPHIA, PA. 1920

New York Boston Chicago Washington Denver San Francisco Cleveland
Atlanta Pittsburgh Minneapolis Kansas City St. Louis Detroit Rochester
Special Canadian Representatives, Chas. E. Goad Engineering Co., Ltd., Toronto and Montreal

wonderful machine divides light into its various constituents and makes possible their separate analysis.

The echelon spectroscope uses a glass grating—a piece of highly polisht glass on which is ruled from fifteen thousand to fifty thousand absolutely straight and equally spaced lines to the inch. To make these gratings Professor Michelson invented a ruling engine that is probably the most accurately constructed mechanical device in the world. It is operated in a room the temperature of which is kept constant to within one-hundredth of a degree, hour after hour—day after day.

To assist in analyzing the lines of the spectrum into their fundamental constituents, Professor Michelson invented the *harmonic analyzer,* a machine as complicated and as delicate as the linotype machine. By its use an assistant can—in a few minutes—make calculations that would take a skilled mathematical computer weeks to accomplish.

A Miniature "Sky"

By ROBERT H. MOULTON

(*Continued from page* 162)

observer, however, the effect is produced in exactly the opposite way, since, if this were not so, he would at times be put to the inconvenience of standing on his head. We know it is the rotation of the earth on its axis that causes the stars to move across the heavens, and that the sky itself does not move. In the Celestial Sphere the sky actually does rotate, being so mounted as to turn about the miniature earth, which we have imagined as being placed at its center.

There are certain parts of the sky which are never visible to observers at any given point. At Chicago, for instance, because it is north of the equator, we can at no time see the stars in the South Polar region. If one were to stand in a level field near Chicago and look straight south, just above the horizon, his line of vision would pass as close to the South Pole as is possible from this latitude. If he continued so to look for twenty-four hours, during which time the earth would make a complete revolution on its axis, his line of vision would describe a circle on the imaginary spherical surface called the "sky." This circle would enclose that part of the sky which is never visible to an observer at Chicago. In the Celestial Sphere that part of the spherical shell coming within the circle was omitted, thus leaving an opening for the entrance of the observer and for supporting trusses for the observer's platform. The omission of this part of the spherical surface in no way interferes with a correct representation of the sky for this latitude, since no part of the opening subtends an arc of 83° 40′, on the spherical shell, or twice 41° 50′, the latitude of Chicago.

The sphere is 15 feet in diameter and is constructed of very light galvanized iron, 1/64 of an inch thick, which has been pressed to the proper curvature and soldered to the equatorial ring and to a much smaller ring about the entrance to the sphere. Its total weight, exclusive of the wooden platform inside, is a little over 500 pounds. This weight is carried by a 2½-inch tube attached to the outside of the sphere, along the line of the equator, and resting upon three wheels, two of which are under the lower side of the sphere and the other just above the entrance door. The greater portion of the weight is carried by the two lower wheels, the upper one being designed to resist a certain thrust due to the inclined position of the sphere.

As this sphere was constructed for observers at Chicago, who are located on the surface of the earth at north latitude 41°

MURDOCK No. 55



2000 OHM SET.....$4.50
3000 OHM SET..... 5.50

That these Murdock No. 55 Sets have earned a nation-wide reputation for value, is due, not so much to the fact that they are, without question, the best low priced receivers obtainable anywhere, as it is to the recognized fact that they closely approximate in operation the sensitive performance of the most expensive sets.

The customary assurance of "Satisfaction or Money Back" affords the opportunity of proving the exceptional value of these 'phones at no risk to you.

Other instruments — MURDOCK MADE—of recognized merit at equally reasonable prices are illustrated in Bulletin 19B, a copy of which will be mailed on request.

WM. J. MURDOCK CO.
55 Carter St.
CHELSEA (BOSTON 50) MASS.
509 Mission St. San Francisco, Calif.

MEMORIZE CONTINENTAL CODE ALMOST INSTANTLY

This method THE short cut to success

COMPLETE CHART
and full instructions TWO DIMES
C. K. DODGE
Box 300 Mamaroneck, N. Y.

30 DAY SPECIAL OFFER

THE WIRELESS EXPERIMENTERS MANUAL (E. E. Bucher's New Book) Price $2.25
and one year's subscription to THE WIRELESS AGE $2.00

Both for Only $3.75
Postage outside U. S. 50c extra.
Send for catalog.

Wireless Press
326E Broadway
New York City

50', it would not, of course, give an accurate representation of the firmament to observers in other latitudes. Similar spheres constructed for other latitudes north or south would be placed at other angles and would represent other constellations.

For example, a Celestial Sphere for Buenos Aires would be constructed to represent the southern heavens and would be so placed that the observer would enter from the North Polar region. He would see the southern constellations, which are not visible at Chicago, but, on the other hand, would fail to see any of the constellations about the North Pole, which are visible from this latitude.

The rotation of the two wheels on the under side of the sphere, which are propelled by means of a small electric motor, attached to the steel structure supporting the sphere, causes the spherical wheel in turn to rotate. The electric light necessary for representing the sun is received at the north pole at a rotary contact, and carried by an insulated wire to the ecliptic, about which there is a wire on the inside of the sphere.

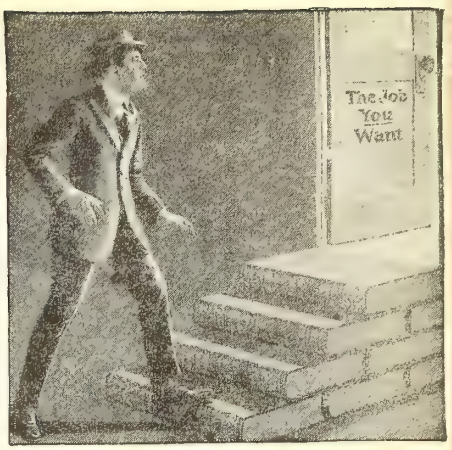
The fixt stars are shown by tiny perforations in the surface of the spherical shell, these perforations being of different sizes, according to the magnitude of the stars which they represent. The size and location of each star was determined by an instrument especially constructed for this purpose. Even the shifting positions of the planets, Jupiter, Venus, Mars and Saturn, among the constellations have been provided for, a number of openings representing the different positions of each of these planets at different times of the year serving this purpose. When not in use these extra openings are very readily covered.

The sun is represented by a small electric light, to give it greater brilliancy than that possest by the other heavenly bodies. The moon is represented by a similar light enclosed in a circular box, and by means of an ingenious device its different phases can be shown. The box enclosing the light is provided with a slot into which opaque discs may be inserted to cover portions of the moon's face, so that it can be exhibited at full, three-quarters, one-quarter, etc., as desired. The lights representing the sun and moon are movable, so that these bodies may always be kept in their appropriate places.

From an educational standpoint, the Atwood Celestial Sphere undoubtedly will prove of the greatest value. For a long time the Chicago Academy has appreciated the increasing interest in the stars, and the difficulty which every one meets in trying to become familiar with even the brighter stars and more commonly known constellations. The means heretofore provided for aiding students, such as flat star charts and globes on the outside of which stars are sometimes represented, are unsatisfactory and often confusing to the untrained observer.

Thru the use of the Celestial Sphere it is possible to become familiar with all the constellations that are ever visible in the latitude of Chicago, and they can be studied at any time. Very few people have had an opportunity of seeing all of these constellations, for not only do atmospheric conditions serve to conceal many of them but their apparent motion is so slow that it would require many hours of careful watching to see all of those visible on a single and perfectly clear night.

The use of the sphere also makes perfectly simple many of the mathematical conceptions necessary for the study of descriptive astronomy, which so often discourages the beginner, as well as many of the fundamental ideas in mathematical geography necessary in the younger school children, who can not become familiar with the chief constellations, their apparent movements, the brighter stars and the real and apparent movements of the sun, moon and planets.



Step Up to a Better Job!

That better job and the bigger pay that goes with it—the job *you* want—is within your reach. It's only a step to the really big jobs from where you are. That step is simply "knowing how." The practical books for self-training described below will give you that "know how." They are the steps by which you can reach the job you want.

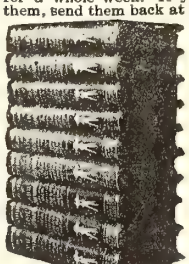
Some of the best authorities in the world wrote these books in plain, everyday language. Anyone who can read and write English can understand them. Thousands of pictures, diagrams, etc., make difficult points as plain as day. Over 1,000,000 volumes have been sold.

Pay-Raising Books at Greatly Reduced Prices

Automobile Engineering, 6 volumes, 2600 pages 2000 pictures. Was $36.00.....Now $24.80
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $30.00.....Now 21.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures. Was $54.00.....Now 34.80
Accountancy and Business Management, 7 volumes, 3000 pages, 2000 pictures. Was $42.00...Now 29.80
Fire Prevention and Insurance, 4 volumes, 1500 pages, 600 pictures. Was $24.00.....Now 16.80
Electrical Engineering, 8 volumes, 3800 pages, 3000 pictures. Was $48.00.....Now 29.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures. Was $36.00.....Now 24.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was $42.00.....Now 24.80
Law and Practice (with reading course), 13 volumes, 6000 pages, illustrated. Was $78.00.Now 49.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was $24.00.....Now 16.80
Sanitation, Heating and Ventilating, 4 volumes, 1454 pages, 1400 pictures. Was $24.00..Now 16.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blueprints, etc. Was $24.00.....Now 16.80

Send No Money
Shipped for 7 Days' Trial

Write the name of the books you want on the coupon and mail it today. We will send the books at once, express collect, and you can use them just as if they were your own for a whole week. If you decide you don't want to keep them, send them back at our expense.



50c a Week

If you like the books, as thousands of other men have after examination, just send us $2.80. You can send the balance of the special reduced price the same way—$2.00 each month (50 cents a week). Send $3.00 a month if you order the Law books.

Step up to a better job with bigger pay. MAIL THE COUPON NOW. It's your first step.

AMERICAN TECHNICAL SOCIETY
Chicago, U. S. A.

American Technical Society, Dept. X-25A, Chicago, U.S.A.

Please send me set of .....

.....

for 7 DAYS' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $2 each month ($3.00 for Law) until I have paid the special price of $..... If I decide not to keep the books I will return them at your expense within one week

Name.....

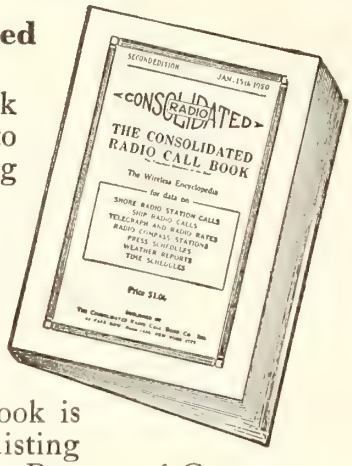
Address .....

Reference.....
(Please fill out all lines.)

The Second Edition of the

Consolidated Radio Call Book

Has Been Unavoidably Delayed



owing to the vast amount of work involved in bringing it right up to date and in compiling the big amateur section that will be a special feature. We urge all those who have placed their orders to be patient—you'll be glad you waited when you receive your copy, which will be very soon.

The Consolidated Radio Call Book is the only book in print officially listing all the radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.

All Amateur Calls Also Lister

SPECIAL

Given Free with Each Copy

A Wireless Map of the World **in colors** is given absolutely free with each copy. This map shows the locations of all the high powered RADIO stations in the world, including the time signal stations. In addition it tells at a glance how far away any of these stations are. Of greater interest are the time zones, which enable the amateur to compute instantly the correct time for the zone in which he is located from any time signal station.

Price $1.00 Prepaid

Either Direct from us or for sale by the following responsible Dealers:

American Electro Technical Appliance Co., 235 Fulton St., New York, N. Y.
Atlantic Radio Co., 34 Batterymarch St., Boston, Mass.
L. Bamberger & Co., Newark, N. J.
J. H. Bunnell & Co., 32 Park Place, New York City
California Electrical Supply Co., 643 Mission St., San Francisco, Cal.
L. W. Cleveland Co. 441 Congress St., Portland, Me.
Cutting & Washington Co., 6 West 48th St., New York City
De Forest Telephone & Tel. Co., 1391 Sedgwick Ave., New York City
Dewey Sporting Goods Co., 268 West Water Street, Milwaukee, Wis.
Doubleday Hill Electric Co., 719 Liberty Ave., Pittsburg, Pa.
A. T. Hovey, 61 Belvidere St., Boston, Mass.
Lester I. Jenkins, 923 Purchase St., New Bedford, Mass.
Klaus Radio Apparatus, Eureka, Ill.
Arno A. Kluge, 638 So. Figueroa St., Los Angeles, Cal.
Manhattan Electrical Supply Co., 17 Park Place, New York City. 114 S. Wells St., Chicago, Ill. 1106 Pine St., St. Louis, Mo. 604 Mission St., San Francisco, Cal.
McCarthy Bros. & Ford, 75 W. Mohawk St., Buffalo, N. Y.
A. C. McClurg & Co., 218 So. Wabash Ave., Chicago, Ill.
Mohawk Electrical Supply Co., 325 So. Warren St., Syracuse, N. Y.
National Radio Supply Co., 1405 U St., N. W., Washington, D. C.
Newman-Stern Co., 1874 E. Sixth St., Cleveland, Ohio.
Nola Radio Co., 134 Chartres St., New Orleans, La.
E. P. Noll & Co. 21 No. 7th St., Philadelphia, Pa.
George W. Parezo & Co., 808 Ninth St., N. W., Washington, D. C.
Pioneer Electric Co., 137 East 5th St., St. Paul, Minn.
F. D. Pitts Co., 12 Park Square, Boston, Mass.
Precision Equipment Co., 2437 Gilbert Ave., Cincinnati, Ohio
Radio Corporation of America (Marconi Co.), Gay and Pratt Sts., Baltimore, Md.
Radio Distributing Co., 4 West Park St., Newark, N. J.
Radio Engineering Co., 827 Madison Ave., Baltimore, Md.
Radio Equipment Co., 630 Washington St., Boston, Mass.
Reuter Electric Co., 34 East 6th St., Cincinnati, Ohio.
Rudolph Schmidt & Co., Inc., 51 Main St., E., Rochester, N. Y.
Shaffer's, 107 Granby St., Norfolk, Va.
Shotton Radio Mfg. Co., Scranton, Pa.
Smith Novotov Electric, Inc., 20 West 5th Street, Charlotte, N. C.
Southern Electrical Co., Third and E Sts., San Diego, Cal.
H. E. Williamson Electric Co., 316 Union St., Seattle, Wash.
Young Men's Christian Association, 715 South Hope Street, Los Angeles, Cal.
Jos. M. Zamoiski Co., Baltimore, Md.

Published by

Consolidated Radio Call Book Co., Inc.

41 Park Row, New York City

The Stereoscopic "Movie" Screen

By JOHN J. FURIA, A.M.

(*Continued from page* 134)

from a hyperboloidal one. This distortion is not produced by a true hyperboloidal mirror.

The results of Dr. Pech's investigations were communicated to the *French Academy of Sciences,* at Paris, where a great deal of interest was aroused. As a demonstration of the correctness of the theory, Dr. Pech built a movie screen hyperboloidal in shape, and of a curvature empirically determined to most nearly give the same distortion as does the retina of the average eye. Flat images from the film were projected on the screen, which distorted them as the eye does images of objects in nature. The result was, picture with nature's depth! Audiences to whom the screen has been exhibited have been agreeably surprised at the lack of eyestrain and fatigue, even after prolonged observation of movies on the *Glifograph screen.* The question is always asked, "Why should pictures distorted not produce more strain rather than eliminate it?" When a person views a picture projected on a flat screen, the brain attempts to interpret depth into the picture which is flat, because experience has taught the brain that the objects represented by the pictures do have *depth.* This results in fatigue. If the picture is not flat, but possesses curvature corresponding to that which images on the retina have, the interpretation is natural and no strain or fatigue results.

A person coming toward us on the flat screen grows larger and larger in an unreal manner. On the Glifograph screen the curvature compensates to a large extent the tendency of the image to grow larger and larger as it approaches, and the approach is a natural one.

The Glifograph screens constructed by a French-American Corporation to which Dr. Pech has assigned all patents and rights by its construction causes the spectator to receive the same impression from the "Movie" as he does from nature. They are manufactured to suit theater conditions in accordance with the formulæ derived with the theory, taking into account projecting distance, lens constants, pitch of throw, etc. Hooks are placed at regular intervals on a wood frame so as to form *arcs of hyperbolæ* and the sheet (gummed canvas) is stretched and laced to the hooks. No two are alike except under identical theater conditions.

An astounding peculiarity of the new screen is that it is immaterial whether the screen is placed vertically or inclined, with concave or convex side front, the pictures still seem natural, give the impression of depth, and relieve eyestrain and relief. This is as might have been expected. The theory requires that a *progressive change in curvature* is interpreted by the brain as depth, and not the curvature *per se.*

If we are artistic our sense is soothed on seeing the new element of reality injected into "Movies." If we own a motion picture theater our income is increased by the availability of the extra front and side seats. If we are plain ordinary movie fans, we are happy to be able to go to see Charlie Chaplin and cast our business and domestic troubles into oblivion with feeling that there is "always a hitch in it" (eyestrain and fatigue) with the inevitable headache the morning after.

An engineer named Tarnovsky, says a Moscow wireless message, has discovered a method of salting fish by means of electricity.

Summer Radio Course

Classes Now In Session

You may begin at once our complete course preparing you for commercial radio license. Rapid progress, individual attention, classes of limited size.

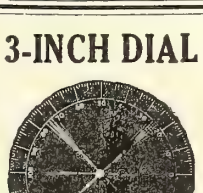
Ask for new descriptive booklet

Y. M. C. A. RADIO SCHOOL

Marcy Avenue near Broadway
Brooklyn, N. Y.

Telephone, Williamsburg 3800.

3-INCH DIAL INDICATOR



Black Composition with Brilliant White Filled Engraving

No. 66 Dial only.....75 cents
No. 67 with Bakelite knob...$1.30
Sent postpaid.

OUR NEW CATALOG now ready for distribution. Contains 24 pages of News, Illustrations and descriptions of all standard radio parts.

Sent anywhere upon receipt of 10c.

For sale at all RADISCO Agencies and by

A. H. CORWIN & CO.
4 West Park St. Newark, N. J.

BUILD YOUR OWN WIRELESS RECEIVING SET



You can **SAVE** at least **$25.00** By buying parts and assembling yourself

Think of the pleasure and practical experience you will gain in making your own set, with wavelength range from 170 to 2,500 meters.
We furnish full-sized Blueprint and complete detailed instructions for making this set and prices of parts for $1.00.

Write today and get started

K. & G. WIRELESS SUPPLY CO.
Dept. 15A, 152 Chambers Street, New York City



HERE IT IS

A sign for your den. Exceedingly attractive. Printed in bright red on white cardboard. No electrical bug should be without it. 7¼" x 11¼". 10c each in coin ONLY. Send stamp for postage.

LEONARD BECK, 1298 Carroll St., Brooklyn, N. Y.

CHEMICALS AND APPARATUS

necessary to perform the experiments in this issue are listed in our catalog. Sample prices: **6" Test Tubes, Doz., 35c 1 lb.; Ringstand and 2 Rings, 90c 5 lbs.; Alcohol Lamp, 35c 1 lb.; 4 oz. Ribbed Funnel, 25c 1 lb.** Allow postage for above weights. Catalog 5c, or free with 25c order.
Mathewson Laboratory Supply Co., No. Weymouth, 91, Mass.

"E.E." IN THE CLASS-ROOM.

Editor Electrical Experimenter:

I have been a silent reader of the EXPERIMENTER for over three years; up to about a year ago from newsstands and since that time as a subscriber, and it certainly has filled all of my needs as a science enthusiast.

I am a student in the pre-engineering course in Illinois College, and you cannot know what an aid the monthly copy of the EXPERIMENTER has been: the electrical "wrinkles" and especially the technical articles in chemistry and physics which appear from time to time. My professors are always very interested in all the articles and it may interest you to know that several, such as Prof. Mace's article on magnetic photographs, the articles on inductance by Secor and Cohen, the Berkeland-Eyde process by Cohen, and several others have been read in the chemistry and physics classes, while the table of solubility given by Wilsdon, helped several of us thru "exams."

JOHN R. MARTIN.

Jacksonville, Ill.

Low Voltage Soldering Irons

By H. H. PARKER

(*Continued from page* 169)

ficulty experienced with this form of appliance is in keeping a good contact at the ends of the carbon; when the point grows cold the resistor loosens up, but by always pressing down on the central rod before turning on the current this trouble is obviated. Figs. 4 and 5 show medium and heavy types of soldering irons of this type.

In closing, it might be well to ascertain, before using a storage battery for this purpose, whether it is able to supply a current of 20 to 30 amperes, tho almost any lighting or starting battery ought to stand up under intermittent use of this kind. If, however, alternating current is at hand, a small step-down transformer attached to a convenient lamp socket is by far the most convenient source of current. Connections for A. C. supply and transformer is shown at Fig. 6.

Master "Movie" Thrills

(*Continued from page* 145)

swim, row, shoot, ride and do perhaps a score or more other things; that is why this picture has made such a "hit," as Pauline Curley can do all this and more.

In the scene shown, the heroine is in the act of sending a wireless message of warning telling the location of a stolen vessel so that detectives and police can immediately be dispatched in an attempt to regain it. During the entire play the heroine is thot to be in company and affiliated with the "Crime Trust" operating in the Far West.

Marino, in the rôle of a detective, is attempting to put the "Crime Trust" out of business, but he meets with many failures. Not alone must he contend with the "Crime Trust," but also with *Annie*, captivatingly played by Miss Pauline Curley.

Numerous indeed are the times when she comes to the detective's rescue. Strange to say, the detective does not seem to realize this nor is he aware of the fact that Annie is also a member of the detective service, who has been delegated to help him round up the gangsters, until, at the end of the serial, they join hands at the altar in the holy bonds of matrimony, and live happily (we "movie fans" like to think "for ever after") until the director calls for the next scene.



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6236, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____ 7-25-19

Present Occupation_____

Street and No._____

City_____ State_____

Radio Parts Supplies

Bakelite-Dilecto sheet, rod, tubes. Hard fiber sheet, rod, tubes. Copper and brass sheets, rods and tubes, brass and iron machine screws, brass wood screws, molded knobs, switch points, and levers. Binding post, sheet aluminum. Hard rubber sheet, tuning coil cylinders, etc., etc.

Complete price list sent for 5 cents in stamps.

KEYSTONE RADIO COMPANY
Drawer 307 Greenville, Pa.
Formerly O. L. Bortz Machine Co.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section ten cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the August issue must reach us not later than June 22.

The Circulation of the Experimenter is over 150,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Agents Wanted.

Young men to sell genuine Toyo Panama Hats. Hustler can make big money. No experience necessary. Hat folds to carry in pocket, unbreakable, and can be blocked to any size or shape. Send $1.65 for sample; sold up to $10 at stores. Act immediately—season just starting. Tropical Importing Co., 140 West 42nd Street, New York City.

Men and Women make big daily cash profits in handling our Patented "Stick-On" Window Lock. Locks window when open for ventilation. Stops rattling. Instantly attached or removed. No screws or tools necessary. Prevents children from falling out of open window. Big demand; sells on demonstration; as many as one dozen to each home. Whole or part time. Mail 10c. for sample and proposition. Address Room 202, 147 Fourth Ave., New York City.

Wanted. Agents to call on garages and service stations. Best line of testing instruments and publications on the market. Complete catalogue. H. E. Phillips & Company, Service Division, Union City, Ind.

Make $30.00 next Saturday. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Michigan.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Make and sell your own goods. Formulas by Expert Chemists. Manufacturing Processes and Trade Secrets. Write for Formula Catalog. Chapin Mystic Company, Washington, D. C.

Mexican Diamonds flash like genuine, fool experts, stand tests, yet sell for 1-50th the price. Few live Agents wanted to sell from handsome sample case; big profits, pleasant work. Write today. Mexican Diamond Imptg. Co., Box F1, Las Cruces, N. Mex.

Agents—$40-$100 week; free samples; gold sign letters; anyone can put on store windows; big demand; liberal offer to general agents. Metallic Letter Co., 433-Z, N. Clark, Chicago.

Wonderful Chance. Men's shirts and Furnishings at wholesale rates, or make $10 daily as agent starting real business. Goodell Co., 109 Duratex Bldg., New York.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Signs for store and offices. Entirely new; $50 week easily made. Chicago Sign System, G, 326 River St., Chicago.

"Noo-Soot-en" Cleans furnaces, stoves, pipes, "SOOTLESS" guaranteed. Agent's outfit 35 cents. Charles Beavis House, Pineville, Kentucky.

Insyde Tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts; quickly applied; cost little; demand tremendous; profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinati, Ohio.

Help Wanted.

Firemen, Brakemen, Baggagemen, $140-$200, Colored Porters by Railroads everywhere. Experience unnecessary. 897 Ry. Bureau, East St. Louis, Ill.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Dollars Saved. All kinds of used correspondence courses sold. (Courses bought.) Lee Mountain, Pisgah, Alabama.

Detectives Make Big Money. Travel, be your own boss. Either sex. We instruct, small cost. Write Johnson's Detective School, 232 Sheldon Ave., Grand Rapids, Michigan, Dept. A.

Men-Boys-Girls, 16 or over. Get ready for Railway Mail Clerk Examinations, $100-$150 month. List positions obtainable—free. Franklin Institute, Dept. T-26, Rochester, N. Y.

Agents Wanted—(Continued).

Be a Mirror Expert. $3-10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Detectives Earn Big Money. Excellent opportunity. Particulars free. American Detective System, 1968 Broadway, New York.

Detectives and Investigators are in demand. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. American School of Criminology, Dept. E, Detroit, Mich.

Auto Experts—$75 week. Earn while learning. Sample lessons free. Franklin Institute, Dept. T-806, Rochester, N. Y.

Ralph P. Koehler,
1961 So. Hoover St.,
Los Angeles, Cal.

ELECTRICAL EXPERIMENTER,
New York City.

Gentlemen: Enclosed you will please find copy of classified advertisement which you are hereby authorized to run "T.F.", starting in the June issue of the ELECTRICAL EXPERIMENTER. *You will recall that our three-time contract has expired with the May issue.*

I may add that I have been delighted with the results obtained from your advertising columns during the past three months. I am pleased with your magazine in every respect.

Trusting this letter will reach you in time to insert the ad in the June issue, I am, with best wishes,

Yours very truly,

RALPH P. KOEHLER.

Salesmen Wanted.

Sell low-priced Auto Tires direct to car owner. 30 x 3 non-skid $11.75; other sizes in proportion. Guaranteed 6,000 miles on liberal adjustment basis. Big profits; wonderful opportunity. Auto Tire Clearing House, 1524 West 15th St., Chicago.

Salesmen—City or traveling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment services rendered members. National Salesmen's Training Association. Dept. 158 G. Chicago, Ill.

Salesman—Side or Main line, to sell low priced 6,000-mile guaranteed automobile tires; 30 x 3½ non-skid sells for $13.95; other sizes in proportion. Good money-making proposition for live wires. Master Tire Co., 1414 So. Michigan, Chicago.

Side-Line Salesmen—We have an attractive line of premium assortments for live salesmen. Commission from $5.00 to $20.00 per order. If you want an up-to-date line, write today. Canfield Mfg. Co., 4003 Broadway St., Chicago, Ill.

Auto Accessories.

Wanted—Good live selling agents for our garage testing instruments and publications. Write for catalogue and particulars. H. E. Phillips & Company, Service Division, Union City, Ind.

Tires—Direct to you prices. Exclusive representatives wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Bond 8,000 Miles. Sample Sections furnished. Mellinger Tire Company, 980 Oak, Kansas City, Mo.

Fords run 34 miles per gallon with our 1020 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all Motors. Runs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee. 30 days' trial. Air-Friction Carburetor Co., 270 Madison Ave., Dayton, Ohio.

Battery Charging pays big profits. City current or gas engine operates. Easy terms. Hoberts, Troy, Ohio.

Automobile Brakes—Double their life, use Brak-rite, new patent compound for old or new brakes, no relining, powerful grip, no squeak. Sample can 60c (no stamps). Agents wanted. Brak-rite Mfg. Co., Dept. C, Amsterdam, N. Y.

Blueprints. Automobile Armatures. See ad under "Electrical." Charles Chittenden.

Auto Motor Supplies—Buick, Michigan, Stoddard Dayton, Cadillac, Overland, E. M. F. Continental and Buda Motors all types $50 each and up. Special high tension 2 and 4 cylinder Magnetos, $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for late catalogue. Address Motor Sales Dept., 12 West End, Pittsburgh, Pa.

Power increased, carbon eliminated; results guaranteed. Write for booklet. No-Leak-O Piston Ring Co., Baltimore, Md.

Save-All Carburetor Attachment makes Fords run better. Gives more miles, power and speed. Free trial. Savall Company, 3716 North Clark Street, Chicago.

American Made Toys.

We Offer an Opportunity to manufacturer with facilities for large production, also to homeworkers on smaller scale, to manufacture Metal Toys and Novelties. Unlimited field and enormous business open for ambitious people. No experience required. No tools needed. Our castingforms turn out goods complete. Since the different Toy Expositions, manufacturers are covered with orders until December. You can enter this field now, by manufacturing "American Made Toys." We furnish castingforms for Toy Soldiers, Army, Navy, Marine, Cannons, Machine Guns, Indians, Cowboys, Warships and other novelties. Castingforms, complete outfit, $3.00 up. We buy these goods, direct from manufacturers. Yearly contract orders placed with reliable parties. We pay very high prices for clean painted goods. Samples furnished. "Bird-Whistles," great seller, just added to our stock list. Booklet, Information, Instruction free, if you mean work and business. No others invited to write. Toy Soldier Manufacturing Co., 32 Union Square, New York.

Personal.

The Salesman Win$. Thousands of positions open. We teach traveling salesmanship by mail and guarantee offer of position or refund tuition. For interesting particulars address Kansas Vocational Bureau, Miltonvale, Kansas.

Be Popular. Make People Like You. Make more money; develop winning personality. Send 50c for "Success Secrets." Tells How." Madame Vivian, Box 175 E2, Chicago.

Instruction.

Cartooning Comics and Lettering. Complete Course only $5, postpaid. Over 300 illustrations. Stamp brings easy lesson. Cartoonist Ernie, Elyria, Ohio.

Crystal Gazing—The Craze. Send self-addressed stamped envelope for Free instructions. Zancigs Studio, Asbury Park, N. J.

ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

Vol. VIII. Whole No. 87 July, 1920 No. 3

JUL 8 - 1920
U. S. PATENT OFFICE

Compressed Air for the Sick

By GEORGE WALL

THERE are many people today who believe with the Christian Scientist, that there are at least a number of better ways for treating and curing the sick for the various ailments our human flesh is heir to than by pumping into the unfortunate victim's stomach a continual string of herbs, pills and oils.

One of the very latest scientific developments of a radical nature in medical practise is the invention here shown of Dr. O. G. Cunningham of Kansas City, Missouri. In a few words, Dr. Cunningham believes in placing the ailing patients in various compartments in this long tubular compressed air steel hospital, where each patient has a different air pressure applied to their body, depending upon the particular ailment from which they are suffering.

The original steel tunnel comprising the compressed air sanitarium as designed by Dr. Cunningham measured 88 feet in length by 10 feet in diameter. This steel chamber is located outdoors, and the interior of the model now in use, is fitted with sleeping compartments, after the fashion of the standard railway sleeping coach sufficient to accommodate 72 patients.

The length of the compressed air treatment which is applied to the whole body varies from three to twelve hours daily and the pressure applied to the patient varies from 5 to 20 pounds per square inch above atmospheric pressure, which is approximately 15 pounds per square inch as we know.

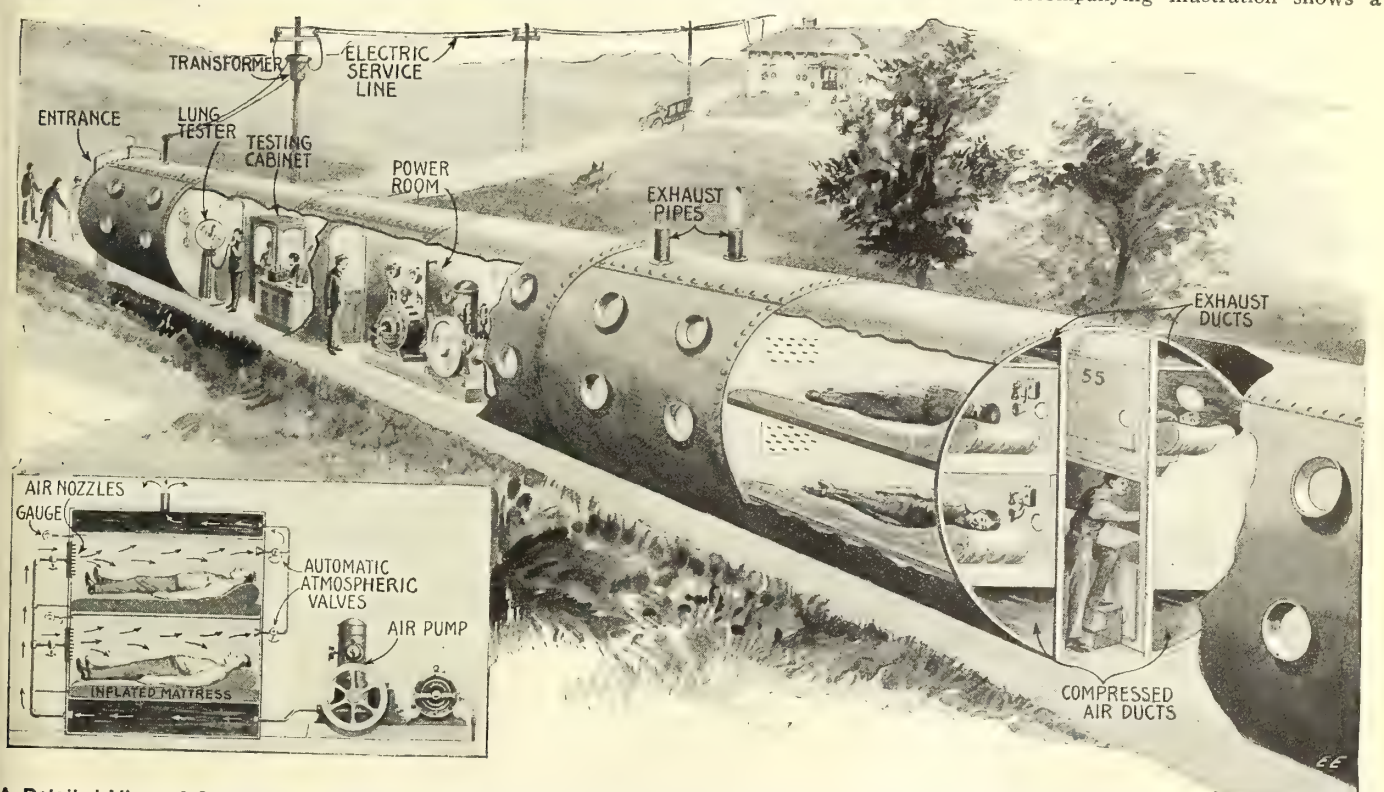
Some of the interesting effects claimed for this radical and promising treatment for human ailments are a distinct and very noticeable stimulation of bodily energy, a general quietude of the nerves, an increase of appetite, and together with this very desirable remedial feature there is obtained restful sleep for the patient.

HOW THE INTERIOR OF THE COMPRESSED AIR HOSPITAL IS ARRANGED.

The accompanying illustration shows a more fully developt arrangement and layout of Dr. Cunningham's compressed air sanitarium, which is somewhat larger than the 88-foot model now in use. There are many features, however small, among these being a scheme of using round glass port holes, the same as on shipboard, which provide light for the various berths or sleeping compartments, etc.

As will be seen, the length of the tubular chamber is divided off into several of these compartments, the majority of these comprising treatment chambers for the patients.

(*Continued on page* 313)



A Detailed View of Compressed Air Hospital (Built Out-of-Doors), showing the Three Different Divisions Contained Therein, viz.: One for the Physician's Offices, Where Patients Are Examined; the Second for the Power Room, Where Compressed Air Is Generated; and the Third Division, which Provides Separate Sleeping Compartments for Each Patient. It is Claimed This Compressed Air Treatment Is Far More Beneficial than Some of the Present-day Treatments Employing the Use of Medicines and Drugs.

Foiling the Diamond Smuggler

By H. GERNSBACK

WE were sitting in the luxuriously upholstered, oak smoking salon of the *Lusitania*. This was in the days shortly before the great war broke out. A number of diamond dealers were returning from France and Belgium, having purchased their regular supply of stones for the coming winter season. Of course, the usual smuggling stories were swapt by them and many clever accounts came to light of how a certain class of citizens, "gifted" with a perverted ingenuity, will go to extremes trying to beat Uncle Sam out of duty.

On all cut diamonds the Government collects a duty of 20 per cent. In other words, on a thousand dollars' worth of diamonds the United States collects $200. As there is keen rivalry in the precious stone business, it is of course little wonder that the attempt is frequently made to save this 20 per cent simply by smuggling in the stones.

Right here we may mention that the regular diamond merchant or dealer very seldom is willing to risk his good name and business by smuggling gems. It is usually the amateur or otherwise—altho rarely—an accomplice to a shady diamond merchant who tries to smuggle in the stones. Rich tourists are known to be the worst offenders, and women particularly take great pride in "putting one over" on Uncle Sam. These women are usually rich, and ought to know better, but they seem to look for excitement; hence the art of attempted smuggling by the rich runs into large proportions. But to come back to where we started:

Mr. S———, a well known diamond merchant of Maiden Lane, New York, told us a vivid account of most of the usual methods of smuggling diamonds, and how they are accomplisht.

The women, he claims, go to almost any extreme, and carry the gems in the most unheard of places; thus they often baffle the cleverest custom house sleuth. Were it not that the Treasury Department maintains a foreign office that records all sales of gems made to Americans, perhaps the United States would lose a great deal more than it actually does. As the matter stands, Uncle Sam has agents in Paris or Antwerp, the centers of the great diamond activities, and as soon as a sale is recorded, the fact is immediately cabled to the United States, and nine times out of ten the person who brings the diamonds or gems into the United States is known at the time the ship docks. And in case the diamonds are not declared, the traveler is detained and a search made.

In the case of the ladies, diamonds will be found hidden in the hair, inside of powder puffs, buried in powder boxes, even hidden in lip rouge sticks. Then we have the case where a toilet mirror has its handle cunningly hollowed out, and the diamonds or pearls cleverly inserted. In this way a prominent American smuggled, not so many years ago, several dozen priceless pearls. Even the corset is used, in which the diamonds or gems are sewn in; here the top part of the bodice is usually resorted to. Then we have the ladies' millinery, which affords a convenient and safe storage for the gems. The heels of the shoes are of course old offenders, and this method of smuggling is still in use, but only by amateurs, because the seasoned smuggler would never think of such a foolish hiding place for it is here that the search usually begins.

As for the gentleman smuggler, there is hardly an object which he has not used in the past for smuggling purposes. Thus we have the inside of smoking pipes specially made for the occasion. Concealing stones in the barrels of fountain pens is an old trick. So is the tooth paste tube, backs of ebony hair brushes and clothes brushes, handles of shaving brushes, etc. Then we have the clever trick of hiding the stones or jewelry inside the knot of a four-in-hand tie, which might be overlooked by an unambitious custom house sleuth.

Some years ago one of the cleverest international smugglers frequently made trips during the winter. One day while his steamer docked in New York, one of his fur-coat buttons became entangled in a



Smuggling Diamonds Is an Art Just Like Any Other Art, so It Would Seem. Certain People With a Perverted Sense of Ingenuity Go to Almost Any Means Imaginable to Defraud Uncle Sam of Customs Duty. The Above Illustration Shows a Few Tricks Resorted To, of Which There Are Many Thousands. Tooth-Paste Tubes, Handles of Mirrors, Ladies' Powder Puffs, Baby Rattles, Cigars, Smoking Pipes, Overcoat Buttons, Backs of Books, Umbrella or Cane Tips, Opera Glasses, Tops of Corsets, Four-in-Hand Ties, All Have Been Used for Smuggling Purposes in the Past. But This No Longer Is Possible, Thanks to the Searching Eye of the X-Ray. The Accompanying Story Will Make This Quite Clear.

wire netting at the dock and one of the buttons ripped off. This man was watched by a custom house officer, as he made a much too elaborate dive for such an innocent object as an overcoat button. The Customs Inspector, however, beat him to it, and before returning the button he noticed something shiny on the inside where it was sewn to the coat. An investigation followed, and it was found that each and every one of these big buttons contained two or three fairly large cut diamonds. As there were six buttons, each containing gems, Uncle Sam was being heavily cheated of thousands of dollars duty on each trip.

Then we had the fastidious gentleman smuggler who had an elaborate toilet set containing many bottles for all sorts of medicines, ointments, etc. Of course he would not be so foolish as to place the stones inside of the ointment, because here it is where the custom house officials would search first. This particular smuggler had the corks of the bottles hollowed out and simply hid stones inside of the corks, which latter were masterpieces of deception, and served their purpose for a good many years.

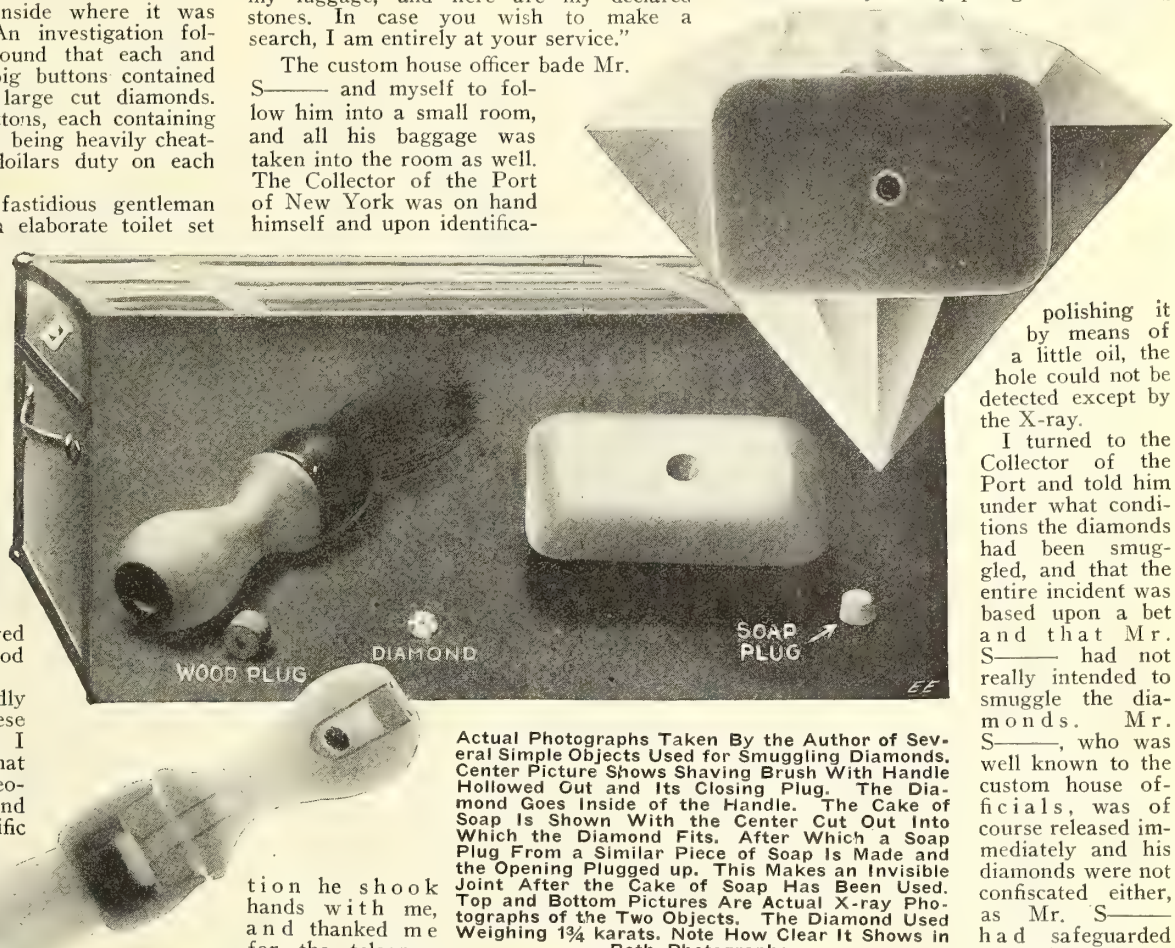
I listened interestedly and attentively to these various accounts. I casually mentioned that if the custom house people were on the alert and used up-to-date scientific methods, such smuggling would be relegated to the stone age, because science has means today of combating just such smuggling. My assertion was greeted with a general ha-ha, and every one of the men present stated that if they really wanted to do smuggling, which of course they would not (Oh, no!), they certainly would find means of doing it. I thought this would be a good occasion for making good their claims, so I wagered one of the spokesmen one hundred dollars that I would be able to detect any smuggling upon his arrival in New York, no matter how cleverly he hid the diamonds. The only condition I made was that he was to bring the diamonds on shore himself hidden away somewhere either on himself or in his luggage. In other words, no trick was to be resorted to of using an accomplice to smuggle out the diamonds *afterward*. This condition was accepted and the wager placed with Mr. S———.

There were as yet two days left before the *Lusitania* was to dock at its Chelsea piers in New York. That evening I sent a simple telegram, not coded either, to the Collector of the Port of New York, and retired, dead sure of my hundred dollars.

The *Lusitania* duly docked in New York, and when our baggage was searched I casually strolled over to one of the Customs Inspectors and brought him over to Mr. S———. I mentioned that I had reasons for suspecting that Mr. S——— was attempting to smuggle in certain diamonds without having declared them. Mr. S——— stood by and grinned broadly and said nothing. The custom house men ran over the declaration papers of Mr. S———, on which many diamonds had been declared. Turning to Mr. S——— he said, "I understand there is a charge against you by this gentleman that you are trying to smuggle diamonds into the United States. What have you to say?"

Mr. S——— shook his head. "Here is my luggage, and here are my declared stones. In case you wish to make a search, I am entirely at your service."

The custom house officer bade Mr. S——— and myself to follow him into a small room, and all his baggage was taken into the room as well. The Collector of the Port of New York was on hand himself and upon identification he shook hands with me, and thanked me for the telegram and the information it contained therein.



Actual Photographs Taken By the Author of Several Simple Objects Used for Smuggling Diamonds. Center Picture Shows Shaving Brush With Handle Hollowed Out and Its Closing Plug. The Diamond Goes Inside of the Handle. The Cake of Soap Is Shown With the Center Cut Out Into Which the Diamond Fits. After Which a Soap Plug From a Similar Piece of Soap Is Made and the Opening Plugged up. This Makes an Invisible Joint After the Cake of Soap Has Been Used. Top and Bottom Pictures Are Actual X-ray Photographs of the Two Objects. The Diamond Used Weighing 1¾ karats. Note How Clear It Shows in Both Photographs.

We were taken into an adjoining room in which was a medium-powered X-ray outfit. At the sight of this Mr. S——— slightly raised his eyebrows, while the Collector of the Port winkt at me knowingly. The Customs people quickly went thru Mr. S———'s baggage, and selected such objects as they thought were of particular interest to them. They probed and shook his shoes to see if there were any concealed stones in the heels, and set them carefully aside along with all the other objects. One of the men then started the X-ray apparatus and inspected each and every suspected object thru the fluoroscope. Shoes, hair-brushes, pipes, etc., were soon eliminated, but when the operator came to a cake of toilet soap, he smiled broadly and laid it aside. Several more objects gave negative results until he came to the shaving brush. One look and more broad smiles. Finally Mr. S——— was asked to stand in front of the bulb and he was carefully X-rayed, not a part of his body escaping the merciless rays that search out everything. But there was nothing hidden on Mr. S——— as far as could be learned.

The operator then shut off the current and turning on the light again, which had been turned off while the search was going on, he took the cake of soap and broke it in two. Sure enough, inside of it there was a 1¾-karat diamond hidden in a hole neatly cut out by means of a penknife. From another piece of soap a plug had been fashioned, the hole closed up, and after Mr. S——— had washt his hands a number of times no one could have told that the cake of soap contained almost a thousand dollar diamond.

The case of the shaving brush was almost identical. Mr. S——— had whittled a hole into the handle of the brush and had hidden therein one big diamond. The hole had then been closed by a wooden plug from a similar piece of wood, and after carefully sandpapering the end and polishing it by means of a little oil, the hole could not be detected except by the X-ray.

I turned to the Collector of the Port and told him under what conditions the diamonds had been smuggled, and that the entire incident was based upon a bet and that Mr. S——— had not really intended to smuggle the diamonds. Mr. S———, who was well known to the custom house officials, was of course released immediately and his diamonds were not confiscated either, as Mr. S——— had safeguarded himself by sending another radio shortly after mine had left, informing the custom house officials of the circumstances, *stating that he was smuggling diamonds on a bet and declaring their value ahead of his arrival.* For that reason, of course, there was no legality for confiscating the diamonds, altho technically there had been an attempt at smuggling.

My bet having been paid, we shook hands all around and departed.

The moral of the story is that today diamonds cannot be smuggled successfully, no matter how cunning the plan. The X-ray will show up a concealed diamond, pearl or other precious stone, as clearly demonstrated by the accompanying photographs, which are those taken of a genuine 1¾-karat blue-white diamond hidden in various ways.

A peculiar thing in connection with such X-ray pictures is the fact that it is not necessary that the diamond shows up very strongly. As a matter of fact, a perfect diamond without any flaws at all does not show very well in an X-ray photo. Nevertheless a smuggler would be convicted by the fact that even if the stone does not show, the cavity in which it is hidden does. No matter how carefully the plug is made, it is never possible to make it so that it will exactly follow the original grain of the substance. This is clearly shown in the above photographs.

Pearls, rubies, emeralds, etc., show up somewhat clearer under the X-Ray than diamonds.

Well meaning but misguided smugglers will take heed and divert their ingenuity to more fruitful channels.

The Aurora Borealis

By LINDLEY PYLE

Professor of Physics, Washington University, St. Louis, Mo.

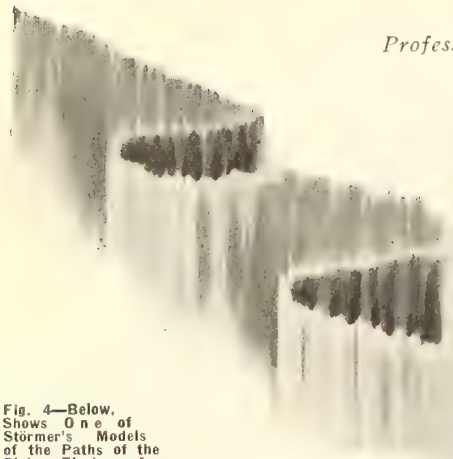


Fig. 4—Below, Shows One of Störmer's Models of the Paths of the Flying Electrons from the Sun, as They Approach the Earth, Forming the Aurorae Which We See.

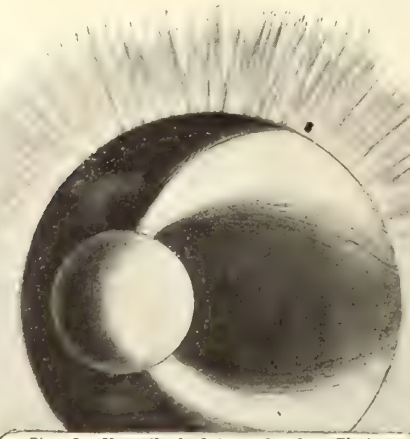


Fig. 3.—Magnetized Sphere Causing Electron Streams to Curve Like the Aurora Borealis —A Striking Experiment by Birkeland.

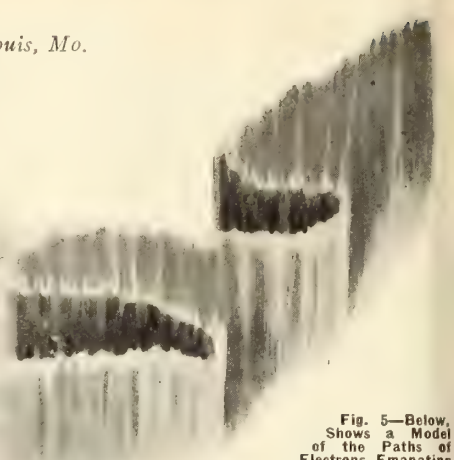
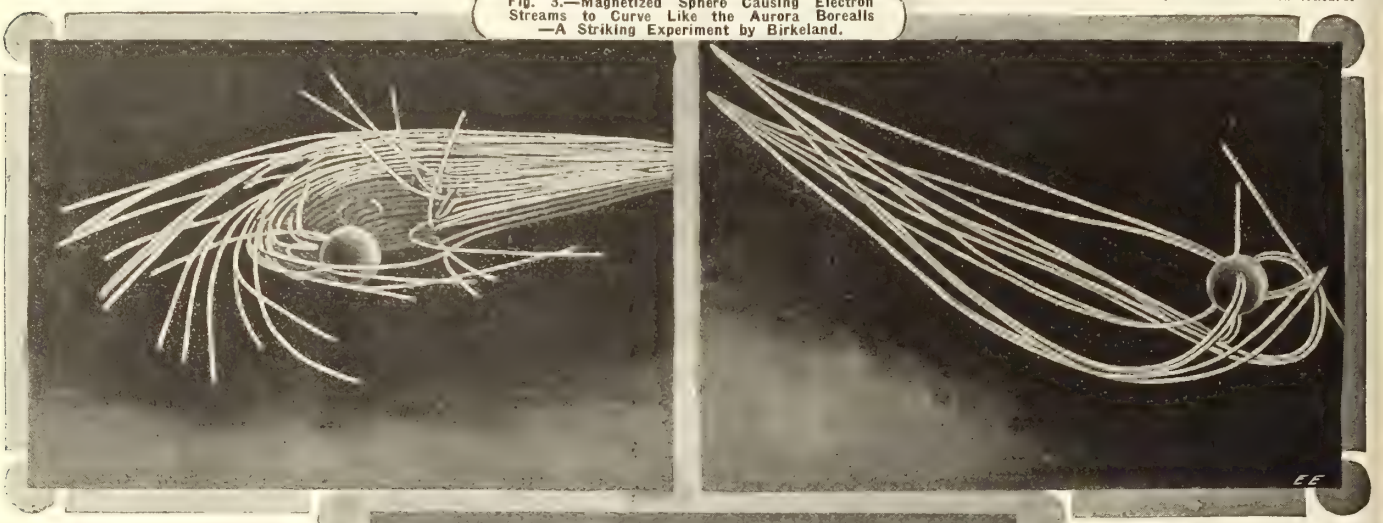


Fig. 5—Below, Shows a Model of the Paths of Electrons Emanating from Two Points Near Each Other, as Shown in the Model Built by Störmer, of the Aurorae and Its Production in Nature.



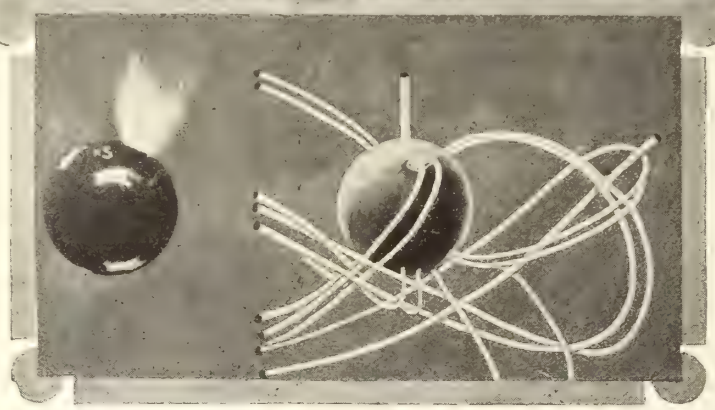


Fig. 6—Showing a Close-up View of the Electron Stream Trajectories of Fig. 5. The Model Shows How the Paths Penetrate Into the Earth's Atmosphere Near the North and South Magnetic Poles. The Illustration at Left Shows the Luminous Patches Obtained by Birkeland on the Magnetized Globe, When Exposed to a Stream of Electrons Artificially Produced, by a Cathode Ray Discharge.

AURORAL displays constitute one of the most beautiful and awe-inspiring of natural phenomena. Tho representing a type of electrical discharge, they lack the deadliness of the terrifying lightning bolt, and one may enjoy their loveliness without fear of bodily harm. Only in recent years has a theory been developt that seems adequate to explain the observed facts.

A study of the spectrum obtained by passing the auroral light thru a prism identifies the phenomenon as the luminescence of low-pressure gases emitting light under the impact of high-speed electric-charges. The most plausible theory of auroral formation is largely the result of the joint contributions of two Norwegian scientists, Kristian Birkeland and Carl Störmer. Birkeland assumes that electrons (the ultimate and indivisible negative charges of electricity) are shot off from the heated surface of the sun. Entering the earth's magnetic field with a speed of possibly 50,000 miles per second, or more, the electrons are deviated thereby into certain paths or trajectories. At an enormous expense of labor Störmer has calculated the forms of the possible paths of the flying electrons and has fitted theory to fact to a most astounding degree. Variations in solar activity, sun-spots, etc., would necessarily vary the intensity of emission of the electrons and, according to the Birkeland-Störmer theory, one readily links up with variable solar activity a corresponding variation in auroral display, as well as terrestrial magnetic storms which usually accompany the aurora.

Figures 1 and 2 are reproduced from Jean Becquerel's article in the February, 1920, issue of the ELECTRICAL EXPERIMENTER. These photographs have a direct bearing upon the Birkeland-Störmer auroral theory in that they show the path followed by cathode rays (high-speed electrons) when projected into a *uniform* magnetic field where the lines of magnetic force are respectively perpendicular (Fig. 1) and oblique (Fig. 2) to the line of projection of the electrons. Now, the lines of force of the earth's magnetic field converge as they enter the polar regions, hence electrons entering the magnetic field obliquely will, under proper initial conditions, follow a conical, spiral trajectory toward one or the other of the earth's magnetic poles.

Fig. 3 is a photograph of a remarkable experiment performed by Birkeland. Suspended in a highly exhausted vessel is a magnetized sphere. To the right and beyond the limits of the photograph is a negatively charged disc, highly electrified. Under the intense electric forces near the disc the electrons associated with the molecules of the residual gas in the evacuated space are hurled away from the vicinity of the disc at tremendous speeds, constituting a so-called cathode ray discharge toward the magnetized sphere. Now the sphere is surrounded by a magnetic field similar to the field of the earth and the photograph presents beautiful evidence of the action of the field in concentrating the cathode stream into the regions near the magnetic poles.

Figure 4 is one of Störmer's models of the paths of the flying electrons from the sun as they approach the earth (dark sphere in the model). Figure 5 is a model of the paths of electrons emanating from two

points near each other and Figure 6 is a nearer view of the same trajectories, the model showing how the paths penetrate into the earth's atmosphere near the north and south magnetic poles. The *right* side of Fig. 6 shows Störmer's *calculated* paths of the luminescence-producing electrons; the *left* side of Fig. 6 shows the luminous patches obtained on the Birkeland magnetized globe when exposed to a stream of electrons artificially produced by a cathode ray discharge. The agreement of experiment with theory as to the locations on the globe of the artificial auroral displays is most remarkable indeed.

Figures 7 to 10 inclusive give one an excellent idea of the appearance of certain characteristic types of auroras. These are photographs of the actual auroral and they embrace the entire sky from horizon to zenith. The auroral colors, which do not reproduce in these photographs, are silvery-white, yellow, green, and red. It is stated on good authority that an imaginary line connecting the center of the corona and the observer's eye is quite closely in line with the dip-needle,—that is, in line with the magnetic lines of force of the earth's field. Figure 9 is an excellent example of auroral *curtains* or *draperies.*

In 1913 at Bossekop, Norway, Störmer obtained some remarkably fine auroral photographs. His purpose was to determine the height and position of the aurora in space. One camera was located at Bossekop and another camera at Store Korsnes, about fifteen miles distant. By aid of telephonic communication the same auroral feature was photographed simultaneously from the two stations. Knowing the distance between the two stations, as well as the angles, the distance of the auroral point from Bossekop could be computed by a simple trigonometrical formula. The altitude above the earth could then be readily calculated. In one month 447 successful pairs of simultaneous photographs were thus taken. Störmer states that the year 1913 was a very marked minimum year for the frequency of solar activity, auroras, and magnetic storms; hence that it is probable that the very high lower limit of 87 kilometers was due to the small penetrating power of the electric corpuscles emanating from the sun,—the corpuscles being stopped in the outer parts of the atmosphere. From previous altitude measurements it seems that the lower limit of the auroral displays is much lower during years of maximum frequency.

It is well known that magnetic disturbances accompany auroral displays, especially when the aurora appears well down in the temperate zones. Telegraph companies report "earth currents" involving hundreds of volts. In one case Störmer was able to examine in detail the magnetic disturbance accompanying an auroral display of great brilliancy in which an auroral curtain, or drapery, appeared in the west and moved overhead and into the northeast at a mean height of 60 miles. The data recorded shows that *in four minutes the drapery moved across the sky approximately* 280 *miles,* which is an average speed of over a mile a second—twice the speed of a rifle bullet. Fortunately a magnetic observatory at Haldde, seven miles west of Bossekop (Norway), was able to furnish automatic records of the accompanying local magnetic storm, as explained by the writer in the January issue of the Electrical Experimenter. It should be understood that the magnetic disturbance did not arise primarily from the motion of the auroral drapery across the sky but *took its origin in the descent into the earth's atmosphere of electrified particles emanating from the sun and deviated from their original course by the magnetic field of the earth.* Now a moving electrical charge is equivalent to an electric current and is accompanied by magnetic lines of force whose direction are dependent upon the direction of motion of the charge and the sign of the electrification—positive or negative. It was found that the magnetic disturbance accompanying this particular auroral display was such as would be produced by *positively* charged particles penetrating downward into the atmosphere of the earth. Yet in the case of the Ryder Polar Expedition (1891-92) it was noted many times that an auroral curtain passing rapidly overhead from south to north deviated a compass needle in such a way as to correspond to the penetration into the atmosphere of *negatively* charged particles.

It seems not unreasonable that both of these phenomena may be accurately reported in that both positively and negatively charged particles may play rôles in auroral phenomena. Professor Vegard of the University of Christiania has publisht data in favor of the positively charged particle theory, whereas Birkeland has supported the negative charge theory. Vegard states that it is hardly possible to doubt that electrical radiation from the sun is the main cause of the aurora, and he offers rather convincing reasons that the particles emanating from the sun are the same as the so-called alpha-particles discharged from radioactive substances—in other words, simply positively charged helium atoms. Vegard uses Störmer's calculations

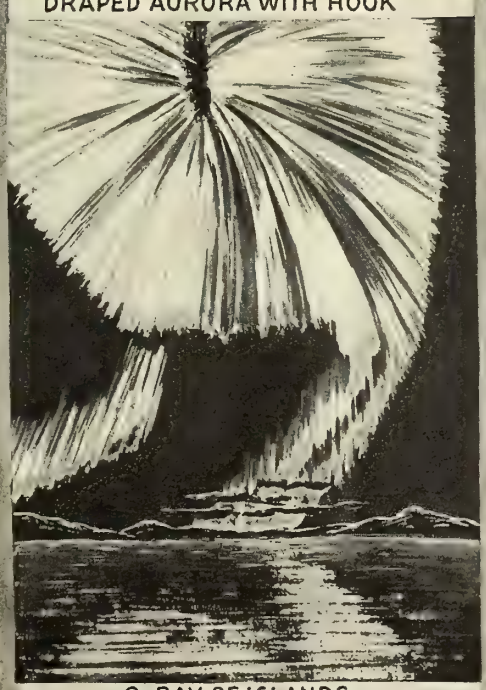
(*Continued on page* 345)



9. BAY OF ISLANDS
WESTERN HALF OF A CORONA BOREALIS



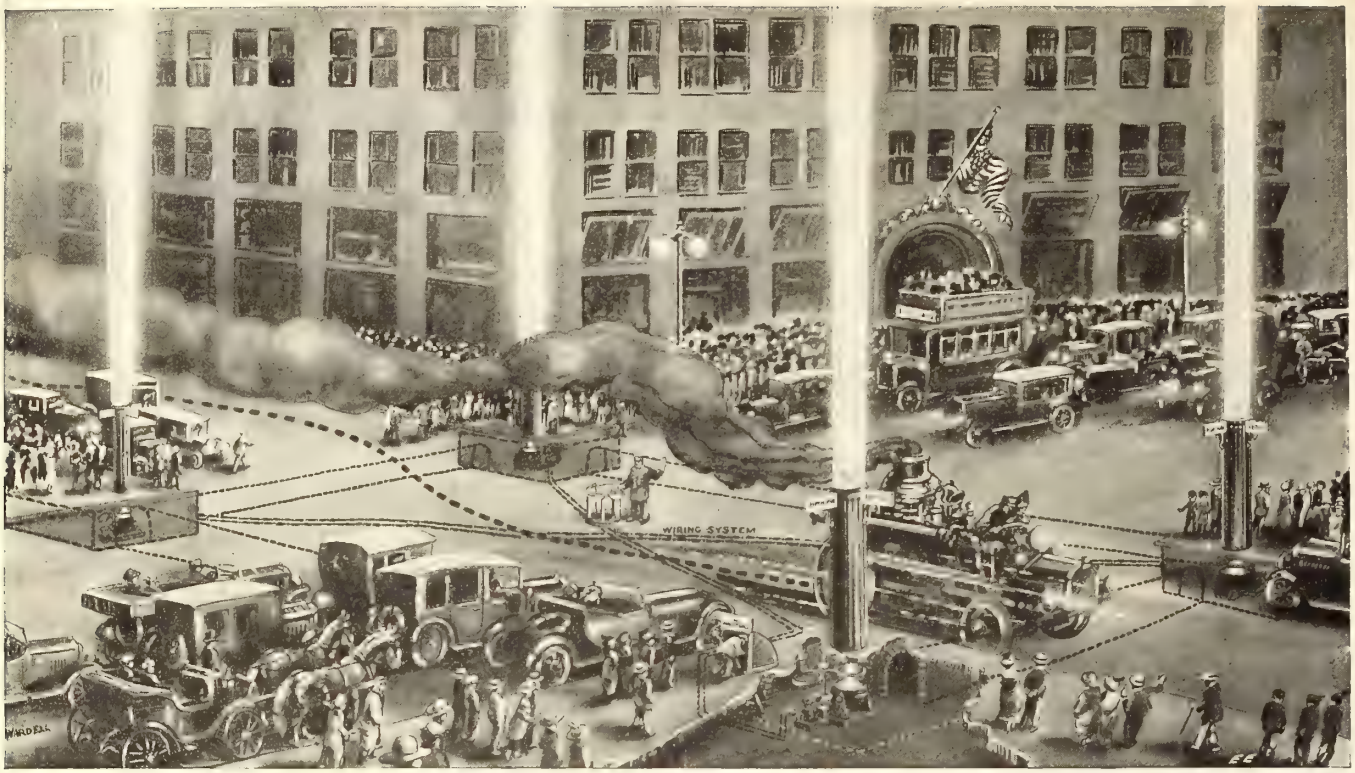
10. BOSSEKOP
DRAPED AURORA WITH HOOK



8. BAY OF ISLANDS
EASTERN HALF OF A CORONA BOREALIS



7. PARIS. DRAPED AURORA



Copyright—1920—by E. P. Co.

An American Inventor Here Proposes a Clever Idea for a Traffic Signal On a Street Crossing in Large Cities, Which Instead of a Large Tower Erected in the Center of the Street, As Now Used On Fifth Avenue in New York City, Involves the Use of Four Vertical Searchlight Beams Placed On Four Corners in the Manner Illustrated. Different Colored Beams Could Be Thrown Upward, Or White—To Go Ahead; Red—To Stop; and Possibly a Third Color, Indicating the Signal to Clear the Street Or Leave a Channel for the Purpose of Fire Or Ambulance Apparatus.

Shafts of Light Regulate Street Traffic

By EDWIN F. LINDER, M. E.

THE problem of regulating the traffic of the fast motor-driven vehicles in the congested districts of large cities is becoming more difficult with the rapid increase in the number of automobiles, motor-cycles and buses being substituted for other less efficient transit appliances. The change of conditions brought about by the introduction of modern methods of travel has recently made it necessary in 5th Ave,, New York to install mechanical devices to assist the traffic officers in controlling systematically this endless chain of vehicles and the many thousands of pedestrians for whom the crossings at times must be kept free, to prevent accidents and possible loss of life. At night it is extremely difficult to co-operate satisfactorily with the officials, as the apparatus now in use for the purpose of signaling is not conspicuous enough, and does not give warning to such as may be at a considerable distance from the traffic station.

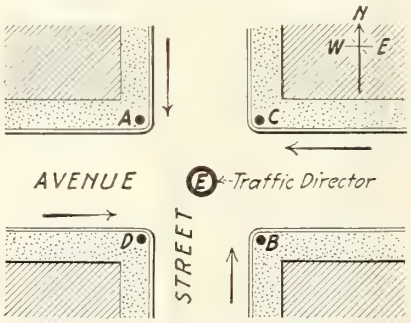
VERTICAL LIGHT SHAFTS TO REGULATE STREET TRAFFIC.

To improve the present methods it is proposed to send up vertical shafts of *white* and *red* searchlight beams, which would stand out in sharp contrast to the glitter of myriads of electric lights of many colors and the usual street lights along the sidewalks.

At the crossings where this type of installation is to be made an under ground chamber is constructed at each of the four street corners; they are connected with passages to enable a man to pass from one to the other and to gain access to the system one manhole is placed conveniently above one of the chambers. On the surface, close to the curb a hollow column is mounted thru which the beam of the search light is directed. The height of this column is twelve feet from the street level. This arrangement keeps the other wise blinding rays of light above the heads of the people. Glass covers the top of the columns.

SIZE OF SEARCHLIGHT PROPOSED.

In each chamber, directly underneath the



This Diagram Shows How the Searchlight Traffic Regulating Scheme Proposed By the Author, Works Out. The Method of Applying It, is Simple Indeed. The Traffic Policeman, Stationed in the Center of the Street Cross-over, Has a Push-button Switch Control mounted On a Pedestal Beside Him, By Means of Which He Can Regulate the Colors Flashed from the Searchlights.

columns is mounted a searchlight capable of projecting a beam of approximately eighteen inches in diameter. As the beam is always directed vertically, this apparatus can be of simple construction and is rigidly mounted on a suitable platform along with the other necessary mechanisms. An electric motor operates a duplex frame; one wing of which contains ruby glass for producing the red shaft of light, when placed over the top of the search-light, and the second wing is covered with sheet metal which serves as a shutter and obstructs the light from passing thru the signal column overhead. The searchlight is equipt with the usual auxiliary devices necessary for its operation as a unit from a central controlling station, preferably a pedestal mounted upon a small circular platform, located in the middle of the intersecting streets. It is on this platform that the "traffic officer" stands to direct the movements of the vehicular and pedestrian traffic. On the top of the pedestal are attached push-buttons operating the various switches to set in motion the mechanisms in each of the four signal chambers. By the means of these pushes it is possible for the officer to quickly send forth any signal or combination he finds necessary during the performance of his duties.

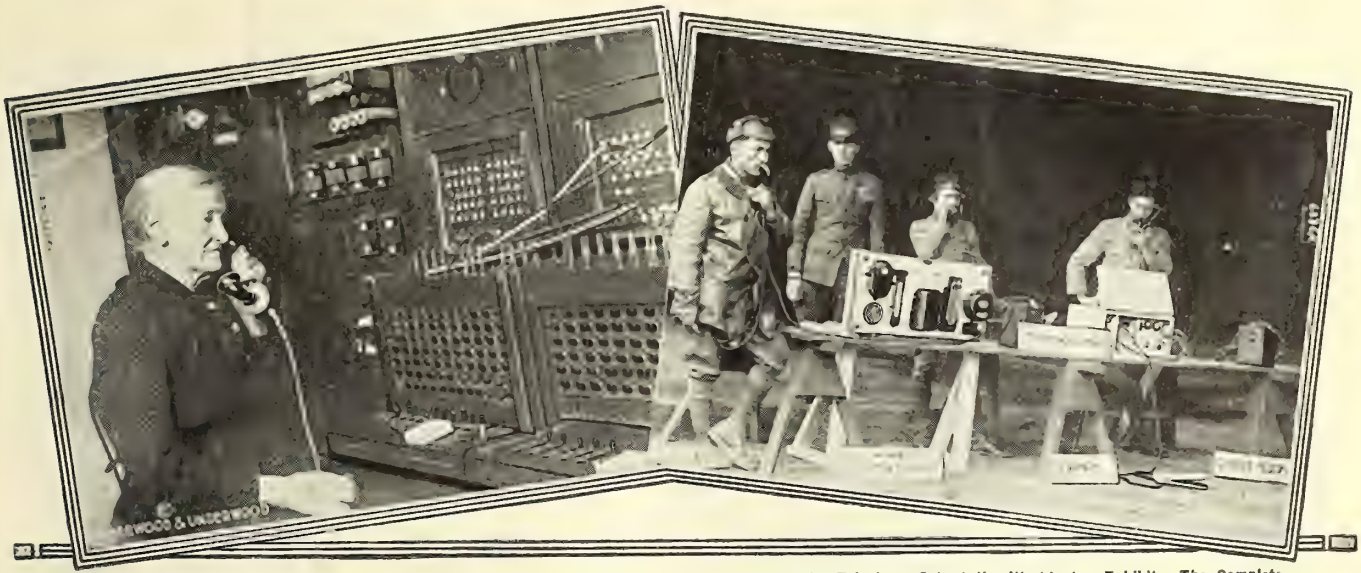
HOW THE LIGHT SIGNALS WORK.

To get a clear idea of the working of this system a practical example with the accompanying diagram is given. The signal columns are marked respectively A, B, C and D. The officer is located on the raised platform E. Arrows show the customary direction in which traffic takes place.

Assume that the officer in charge takes his station to commence directing the night traffic. He pushes down a switch in the pedestal lighting up all four searchlights, at the same time pressing the button which operates the motors of all four duplex frames, simultaneously flashing forth out of the four columns the "all stop" signal; then at A-B-C- and D, four red shafts of light will be seen extending upward and which can be noted at a great distance.

(*Continued on page* 345)

Science In Latest Pictures



At the Age of 80, After 21 Years of Service, Mrs. Elizabeth Andrews, England's Oldest Telephone "Girl," Has Just Retired. She Has Served at an Exchange at Ferriby, About 10 Miles from Hull, and Celebrated Her 80th Birthday a Month Ago. Her Hearing Is Still Fairly Good But Her Sight Causes Her Increasing Trouble So She Has Sent In Her Resignation.

Complete Radio Telephone Set at the Washington Exhibit. The Complete Radio Telephone Set Used at the Annual Army Air Tournaments at Bolling Field, Washington, D. C. For Handling All the Events, Including Plane Races, Stunts, Combats, Etc. The Apparatus Was Demonstrated by Experts in the Aerial Service of the Army.



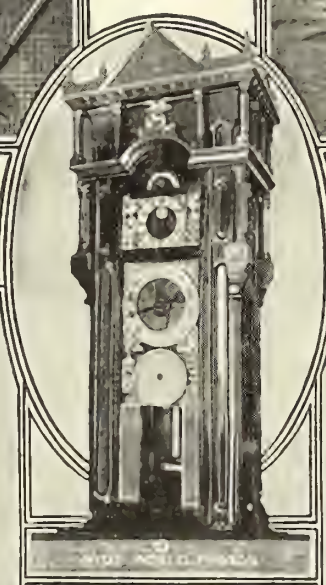
The Dendrograph That Measures a Tree's Growth by Recording on a Drum Showing from Week to Week the Actual Growth of the Tree. The Other Parts of the Apparatus Are the Collar and Belt of the Block Which Encircles the Tree and the Recording Rod Which Marks the Tree's Growth on the Cylinder. The Photo Shows the Dendrograph Installed to Measure the Growth of a Tree.



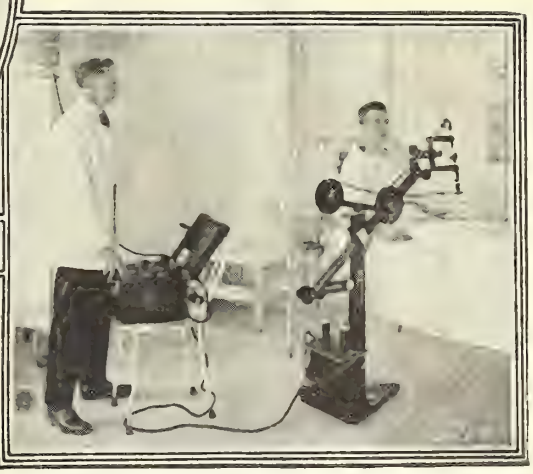
A New Type of Air-Propelled Boat Built by the French Which Makes a Speed of 74½ M.P.H. on a Half Mile Basis. This Speed Performance Probably Constitutes a World Record. Various Types of Gliders Are Now Practicing on the Seine for the Coming Monaco Races. The Photo Shows the De Lambert Glider, Which Has Been Designed for Passenger Service on Shallow Waters, Driven by an Aviation Engine.



Motion Picture Camera Mounted on Gimbals Devised by C. E. Shurtleff, for Purposes of Taking Motion Pictures on Shipboard. The Contrivance Was First Tried Out in the Filming of the All-Star Production of "The Mutiny," from Jack London's Novel, "The Mutiny of the Elsinore." It Keeps the Camera Level, No Matter How Rough the Sea. C. E. Shurtleff, the Inventor, Appears at Left.



The Calendar of This Clock Is Arranged for 10,000 Years, Even the Double Leap Years Being Provided For. The Upper Dial, Two Feet In Diameter Marks the Time with Absolute Accuracy and Is Governed by an Eight Day Movement. There Are Twenty-four Other Dials Showing the Hours Variation in Time at 127 Principal Cities of the World. Above the Time Dials Are the Moon Frame Giving the Phases of the Moon and the Earth and Its Revolutions About the Sun, Variations of the Seasons, the Months, and Days in the Month. Another Dial Gives the Longitude East and West of 127 Degrees of Principal Cities of the World.



Dr. W. D. Coolidge and His Associates in the Research Laboratory of the General Electric Company Have Recently Perfected a Remarkable Portable X-Ray Outfit. The U. S. Army Portable Outfit Which They Devised Rendered Service of a High Order in the European War. It Is Now Possible For Any Doctor to Transport the Entire New Outfit, Packed in Four Hand-borne Units, to Any Home Wired for Electricity and Produce Radiographic Results as Good as Those Secured in a Completely Equipt X-Ray Laboratory.

Nature's Jewels

By WILLIAM M. BUTTERFIELD

The Wonderland of Crystals

EVERY jewel, even MAN—the jewel without a price—is a nature jewel; therefore our title, "Nature's Jewels" is a breach of tautology which should be explained to the indulgent reader at the outset of this investigation. In defence of this intentional *ology* we hasten to say that our contribution must, at the beginning at least, be presented to the usual critical audience with the common assumption that there are jewels and jewels.

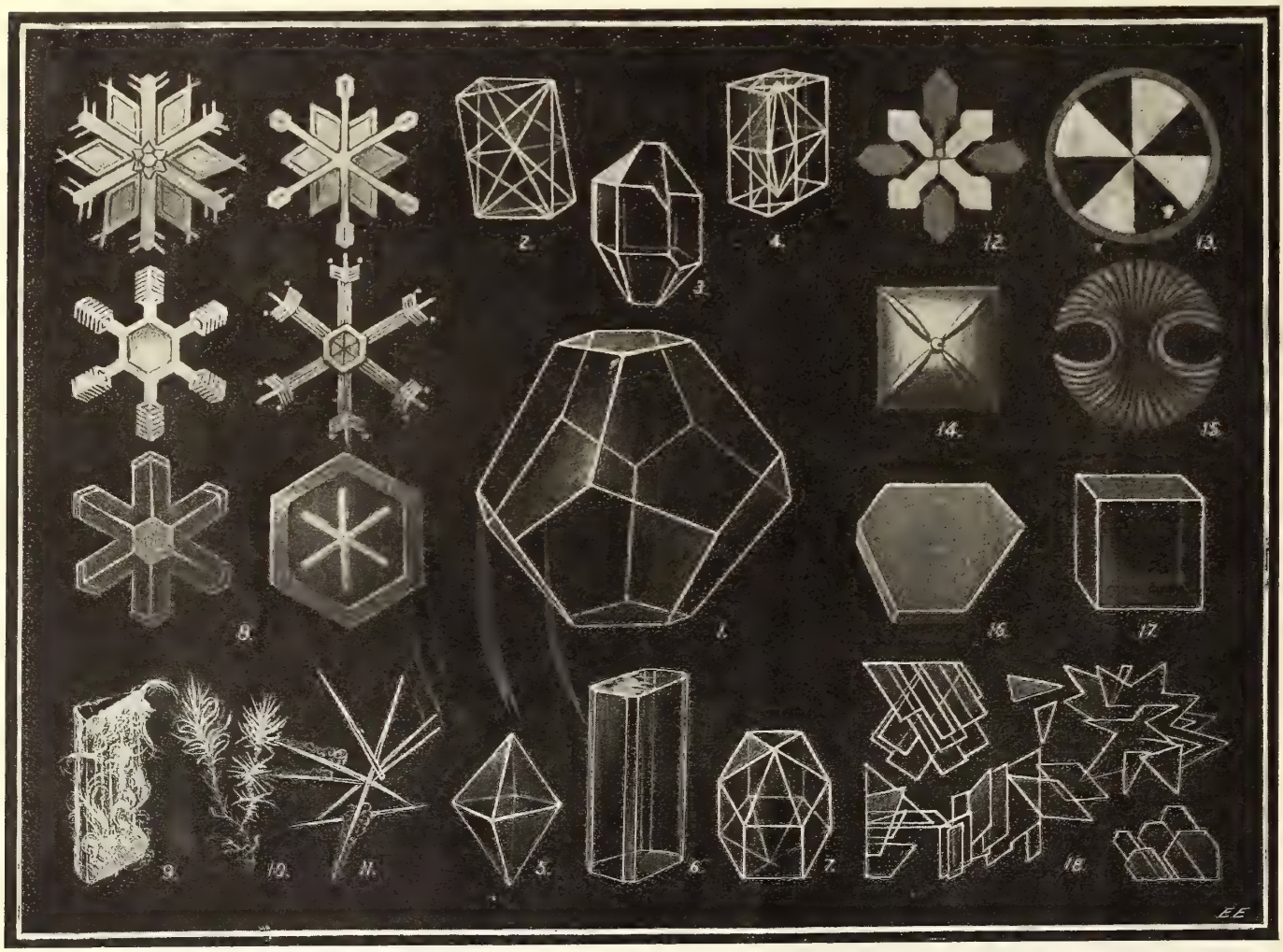
Some for instance, that man calls precious stones, those which lapidaries chip and polish to suit his peculiar tastes. Then there are some which we will describe that are manufactured by Nature—unassisted by man—which he, we are forced to say, has never considered particularly pleasing in their undecorated state. For certain obvious reasons our reasonable reader must willing admit that in these enlightened days one must not trespass too freely upon the field of popular understanding.

Jewel is derived from the Italian "gioja" meaning joy. But it will require an extreme optimist to find anything approaching that hilarious sentiment attached to the pebbles men call diamonds, rubies, emeralds or the like. Man has always resented the encroachment of nature upon what he is pleased to consider, his superior domains. As a jewel maker or as a jewel namer he claims to stand in a class by himself. In the naming we are willing to award him the palm for exceptional ability, but as a regular maker of jewels we are afraid it is necessary to deny his claims in taste. The best he has ever been able to do is to hack off the corners or otherwise manhandle the products of nature. At the cost of much treasure; at times after rivers of human blood have been made to flow, he (as with the Kohinoor diamond) obtains one of nature's rare products. This he cuts, forming numerous faces, fashioned in the highest possible state of his skill, but his exceptionally delicate ornamentation of the stone, fine as it really is, does not equal in finish or line the common forms of nature's own jewels, strange as it seems.

Even in manufacturing imitation jewels, such as the glass or paste kind, he is compelled to seek nature's help to provide him with the materials from which these commonly supposed artificial products are formed. And She practises jewel making right before his eyes, usually without his being aware of the fact. No rigid substance, not even the bone or other hard parts of the human body, is formed without Her singular aid.

Jewel-making on a scale sufficiently large to include the original of every solid substance in the universe is surely considerable of a task. Yet this is only a part of Nature's work in their construction. We shall find that solids are first formed from liquids, and it is just at the time when the liquid is turning into a rigid form that Her jewels are made—a process sometimes called the "crystallizing of solids" or "crystallization." These creations, which by their countless numbers and growth form a solid are what we call "Nature's jewels."

(*Continued on page* 325)



LEAF-LIKE OR FOLIATE CRYSTALS.

Fig. 8. Six Compound Snow Crystals.
Fig. 12. Compound Crystal Sulfate of Iodo-quinine.
Fig. 13. Crystal of Quinidine (Under Polarized light).
Fig. 18. Varieties of Cholesterine Thin Crystals.

THREAD-LIKE, FIBER OR NEEDLE CRYSTALS.

Fig. 9. Soft, Wool-like Crystals of Asbestos (Amianthus) Hornblend.
Fig. 10. Tufted Foliage Crystals of Flowers of Benzoin (Benzoic Acid) from Gum.
Fig. 11. Microlithes (Belonites) from Pitchstone.

Fig. 15. Common Dumb-bell Crystal from Oxalate of Lime.

KNOTTED OR GRANULAR FORMS OF CRYSTALS.

Fig. 1. Garnet Crystal (Perfect Dodecahedron).
Fig. 2. Amethyst crystal.
Fig. 3. Quartz crystal.
Fig. 4. Crystal of Potassium.
Fig. 5. Diamond Crystal (Perfect Octahedron).
Fig. 6. Sanidine Crystal (Tabular Form).
Fig. 7. Quartz Crystal.
Fig. 14. Oxalate of Lime Crystal (Octahedral form).
Fig. 16. Titaniferous Iron Crystal.
Fig. 17. Cube Crystal of Sodium Chlorid (Salt).

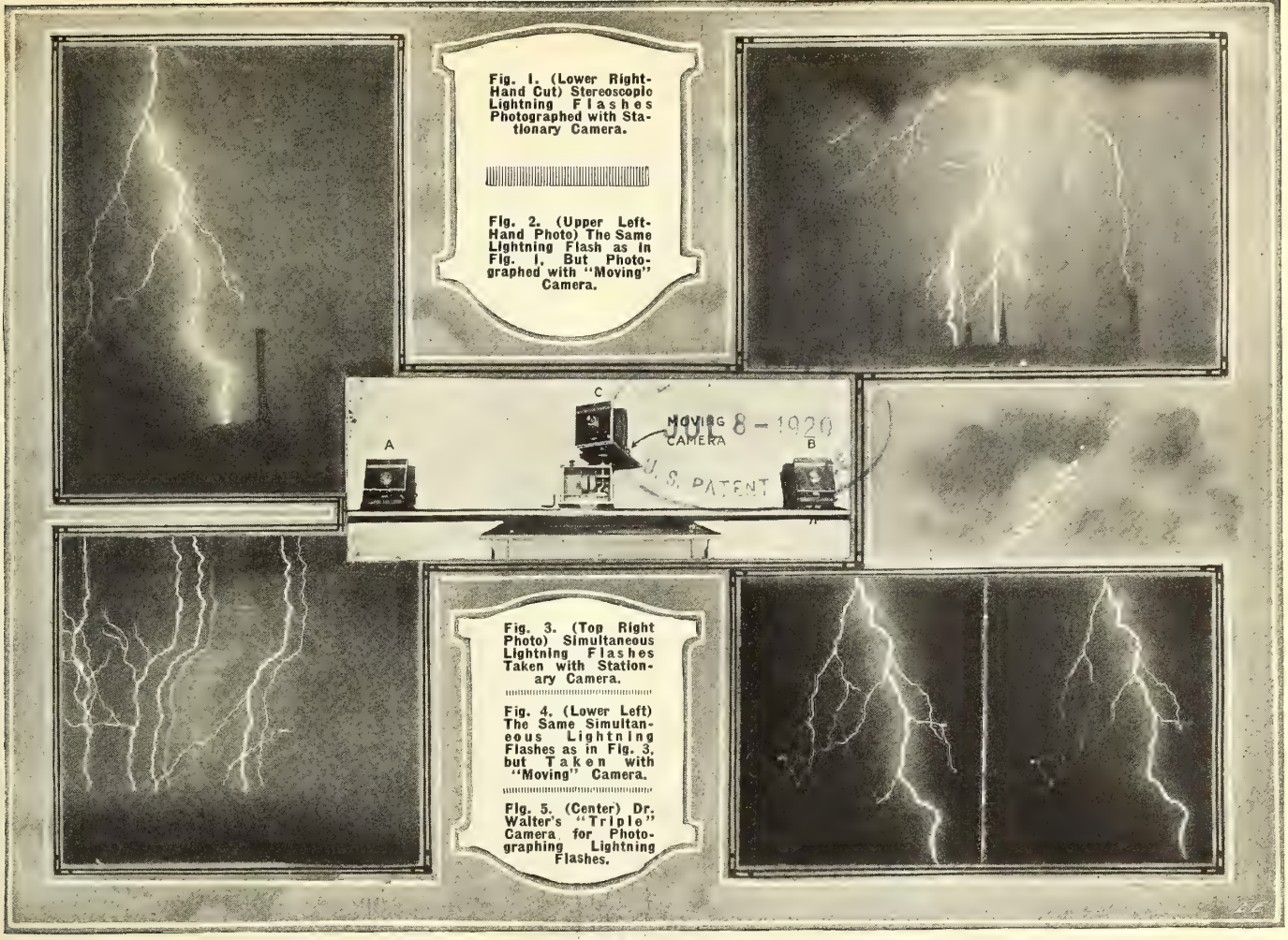


Fig. 1. (Lower Right-Hand Cut) Stereoscopic Lightning Flashes Photographed with Stationary Camera.

Fig. 2. (Upper Left-Hand Photo) The Same Lightning Flash as in Fig. 1. But Photographed with "Moving" Camera.

Fig. 3. (Top Right Photo) Simultaneous Lightning Flashes Taken with Stationary Camera.

Fig. 4. (Lower Left) The Same Simultaneous Lightning Flashes as in Fig. 3, but Taken with "Moving" Camera.

Fig. 5. (Center) Dr. Walter's "Triple" Camera for Photographing Lightning Flashes.

Triple Camera Photos Lightning Flashes

By DR. ALFRED GRADENWITZ

EVEN those photographs of lightning flashes by Night which, as far back as about 40 years ago, were made with ordinary stationary cameras, would in some cases give evidence of the complex nature of the phenomenon of lightning, made up of several successive discharges following up one another by jerks and, as a rule taking the same course thru the air. With some of the very first photographs of this kind, a strong wind would drive the air particles on the path of the lightning flash so rapidly in front of itself, that the successive discharges passing one *after* the other thru the same were reproduced in the space *beside* one another on the photographic plate. This suggested the idea of analyzing the lightning flash, even without the intervention of the wind simply by imparting to the camera a convenient motion. The first photographs of this kind were made by Prof. Weber, of Kiel, who simply held his camera between his two hands, thus imparting to it a slow oscillating motion and causing its optical axis to describe a conical surface.

THE MOVING CAMERA FOR LIGHTNING PHOTOS.

This method was eventually improved upon by Prof. B. Walter, of Hamburg, who by placing the photographic camera on a convenient clockwork, caused it to perform a very slow rotation around a stationary axis. The distance between the individual discharges on the plate, allowed the time interval passing between them to be calculated. By systematically developing this method, Prof. Walter provided a ready means of submitting any lightning flash to an accurate *time analysis,* which was one of the greatest advances ever made in this branch of physical science.

The most striking feature of the lightning photographs reproduced in the accompanying figures is that the appearance of the flashes, as a rule, is quite unlike the traditional *zigzag* figure, and rather resembles a large river as it appears on a map; branching out on both sides at irregular intervals and allowing (in the original photos) even the tiniest branch discharges to be detected.

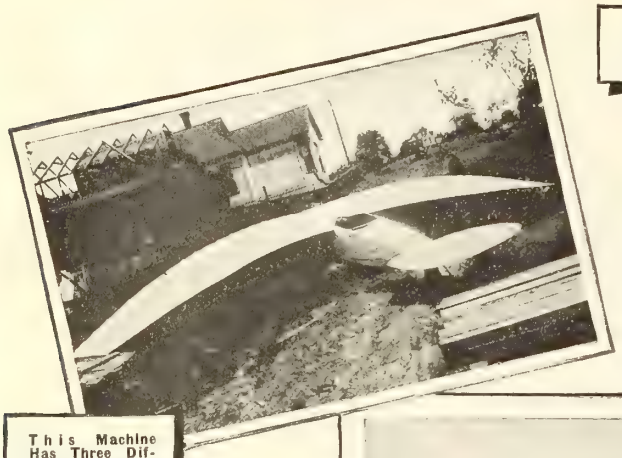
THE ADVENT OF THE TRIPLE CAMERA.

Another important step forward was made when Walter, some years afterwards, hit upon the idea of combining his moving camera with a set of two stationary cameras arranged at the ends of a table 4 meters long, in the center of which the moving camera was placed. The pictures obtained with the two stationary cameras would, when glued on pasteboard beside one another, *constitute a stereoscopic picture.*

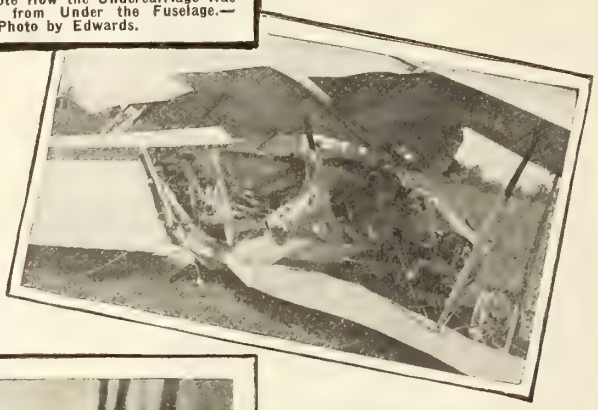
Stereoscopic lightning flash photographs, Figs. 1-a and 1-b (lower right-hand cut), *allow the distance of each lightning flash from the observer to be ascertained.* Furthermore, each of these pictures in conjunction with the third one, viz., the picture obtained with the movable camera (Fig. 2), will give any time difference between the various discharges. On the other hand, the two pictures obtained with the stationary camera, provided the distance between the latter bears a proper ratio to the distance of the lightning flashes, are very well adapted for stereoscopic inspection and this brings out some further interesting facts about the constitution of lightning flashes. In fact, on examining Figs. 1-a and 1-b in the stereoscope, those branches, which in each individual picture cross one another, *are seen to be entirely separated in space,* and accordingly, *to be entirely independent branches of the main flash!* Stereoscopic inspection also shows that in the present case, far behind the strongest left-side ramifications of the main flash, another self-contained flash of lightning has occurred whose origin in the cloud is readily found, which has turned to left in order, it seems, to terminate in another cloud. From the dimensions of the original picture, the distance of the main flash of lightning from the observer is found to be about 500 meters, and that of the flash of cloud lightning several kilometers. That the latter really is a discharge entirely independent of the main flash of lightning is, by the way borne out by the third picture of the phenomenon, the one obtained with the moving camera (Fig. 2), the main flash of lightning being practically instantaneous, while the cloud lightning is made up of two partial discharges, with maxima following up one another at 0.0905 second interval.

(*Continued on page* 346)

Freak Airplane Photos



This Is the Result of "Pancaking," When Landing. Note How the Undercarriage Has Been Driven from Under the Fuselage.—Photo by Edwards.



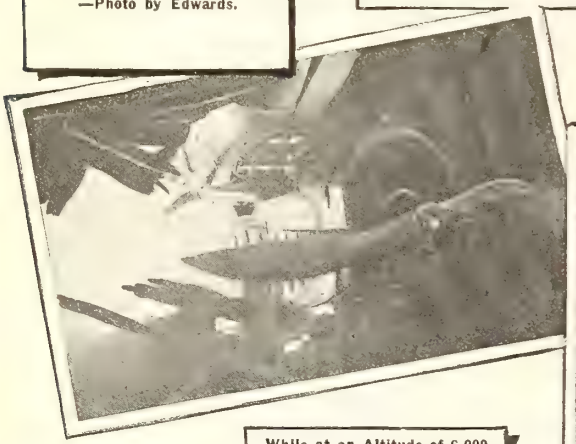
This Machine Has Three Differently Inclined Surfaces with respect to Each Other, in Such a Way That They Can Be Varied According to the Air Resistance and the Center of Gravity.—Photo by P. A. Wall.

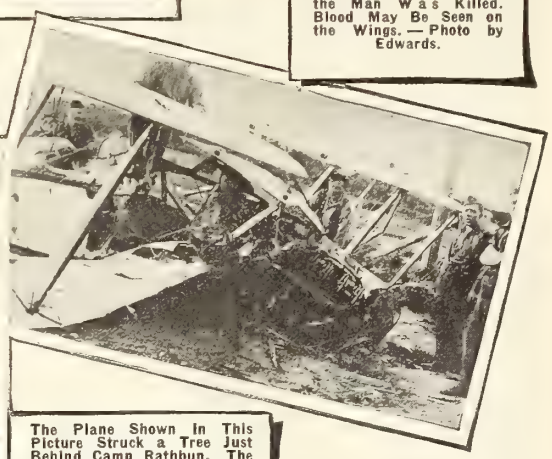


This Photo Was Taken on a Dark and Cloudy Day, and Shows How Bright It May Be Above the Clouds Altho a Storm Is Gathering on the Plains Below.—Photo by Edwards.

This Plane Tried to Enter a Hangar "Thru the Roof," but Stuck When Part Way Thru. —Photo by Edwards.

This Is a Bad Crash and Shows What Happens to the Man in the Front Seat When a Plane Crashes. In This Case, the Man Was Killed. Blood May Be Seen on the Wings. — Photo by Edwards.

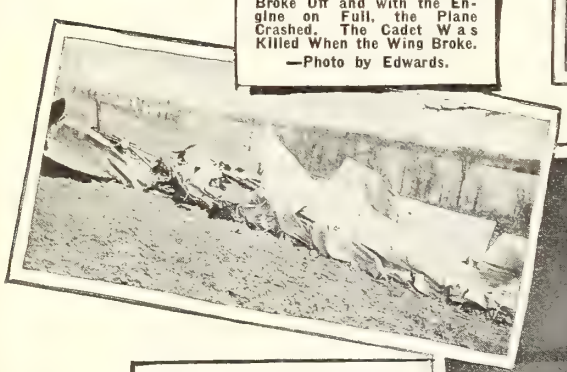


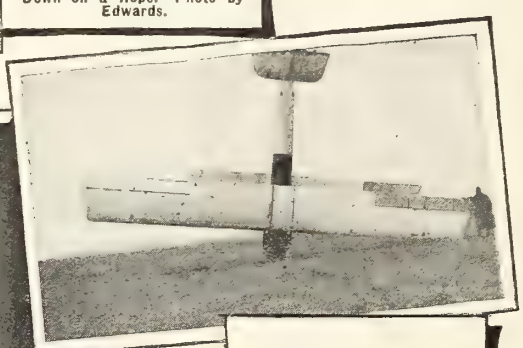


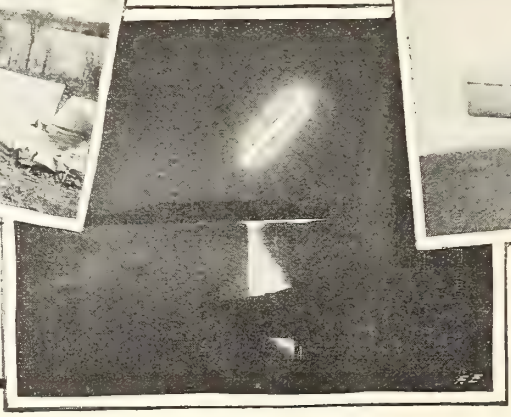


While at an Altitude of 6,000 Feet, One Wing of This Plane Broke Off and with the Engine on Full, the Plane Crashed. The Cadet Was Killed When the Wing Broke. —Photo by Edwards.

The Plane Shown In This Picture Struck a Tree Just Behind Camp Rathbun. The Only Injury the Plane Received, Was a Hole Thru a Lower Plane. The Pilot Came Down on a Rope.—Photo by Edwards.







Looks Just Like a Gigantic "Zeppelin" Illuminated at Night and Sailing Over the Lake, Doesn't It? Well, It Is Not a Photograph of a Comet nor a Zeppelin After All, but Simply the Result of a 35 Minute Exposure of a Beautiful Moonlight Scene Taken on a Small Lake. — Photo by George H. Walter.

This Is the Result of Landing When the Nose of the Machine Was Down. The Planes usually turned completely Over, but This One Was Rather "Self-Balancing." — Photo by H. Edwards.

Copyright, 1920, by E. P. Co.

The T-Tube "Sub" Locator



Photo by International Film Service

An Invention That Promises To Be of Inestimable Value in Naval Warfare Has Been Made Public by the Navy Department. It Is Called the M. V. Type Hydrophone. With This Device It Is Possible to Detect and Locate Enemy Vessels and Icebergs Within a Radius of 100 Miles.



Photo by Underwood & Underwood

Actual View of "T-tube" Operator in the Hold of a Submarine Chaser Listening for Enemy Submarines Which Are Detected by the Sound Produced by the Rotation of Their Propellers. One Tube on Either Side of the Boat Leads to the Right and Left Ears, Respectively.

How the Fate of Doomed Submarine Crews Were Ascertained by the Use of a Simple Mechanical Device

THE "T" Tube, also called the "C" tube by naval men, was installed on every submarine chaser forming squadrons which operated in the Submarine Zone. These "T" Tubes were in reality a very simple device making use of sound waves. Two individual "T" Tubes were installed on each ship, one on the port side, and one on the starboard side directly under the wheel house in the ship's magazine as shown in Fig. 1. Two operators were constantly on watch, even while under way.

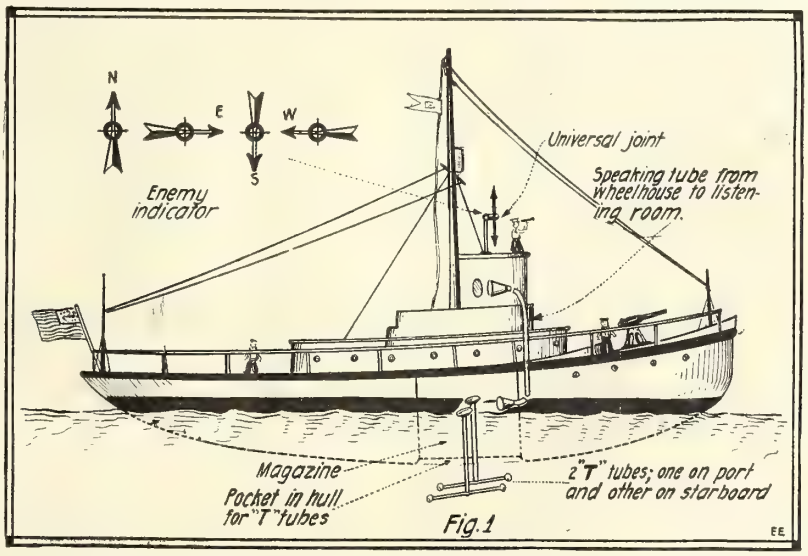
The "T" Tube itself consists of a long tube not unlike an inverted "T". By studying Fig. 2 it will be noted that on each end of the extended arm are rubber balls fitting tightly on the tube and watertight. Any slight sound in the vicinity of the ship causes minute depressions against the ball, and these slight deviations are accurately reproduced in the listening operator's ear by means of a sensitive device identical to the stethoscope. Normally, the air pressure on the operator's ear is 15 pounds per square inch on each ear, and the slightest pressure or vibration upon either of the rubber balls causes a slight increase of pressure on the one or the other of the listening operator's ears. By swinging the "T" around by means of the operating wheel shown in diagram, the operator is able to swing both ends of the "T" in such a position as to secure maximum reproductions of the sound waves, until an equal intensity on both ears is obtained. Having accomplisht this procedure, it is then an easy matter for the operator to note the position of the "T" in respect to the bow of the ship and thereby read the general direction of the sound waves.

The other operator of course follows the same procedure as the first and the position he secures is plotted against the other, so that the point of intersection of the two general lines gives the approximate spot from which the sound is issuing. In other words both "T"s are used jointly for the purpose of "checking up." Fig. 3 illustrates the general manner in which this "checking up" is accomplisht.

It will be seen from the above description that the "T" Tube depends entirely upon the principle of an easily applied acoustic arrangement. Sensitive electrical sound amplifying devices were used, even vacuum tube amplifiers were brought into play in an attempt to increase the sensitiveness of the "T" Tube, but without any great success, as it was found that it operated best with variations in air pressure alone.

The device, of course, could only be used when the ship was at full stop and all members of the crew and machinery at a standstill. Another instru-

(*Continued on page* 331)



This Illustration Shows the Arrangement of the Two "T-tubes" on Either Side of a Submarine Chaser, Together with Semaphore Arrow for Indicating the Position of the "Enemy" to Other Vessels in the Pursuing Fleet.

New Suspended Monorailway

WE have become so accustomed to see railroad trains, electric street cars, and elevated trains travel along on top of their rolling wheels,—that it comes almost as an electric shock to our imagination, perhaps, to consider for the moment, the suspended electric railway such as that shown on our front cover, and in the accompanying photographs.

With the rapidly mounting cost of building electric or other railways and also the higher operating cost from day to day, shortly, perhaps, be served with the very latest development in this unique and novel form of transportation, which is ideally adapted to the efficient movement of both passengers and freight.

Two of the accompanying photographs present views of the oldest suspended electric railway in the world, that of the Langen type operated at Elberfeld, Germany, known as the Barmen-Elberfeld Monorailway, which has been in operation over its 8½ mile run, since March, 1901, or nearly 20 years. This line has proven very successful and cheaper than any other form of transportation in its lengthy period of operation. This line is now carrying about 10,000,000 passengers every year, and it has carried a total of well over 150,000,000 passengers, with not a single passenger or employee injured or killed during the entire extent of its operation.

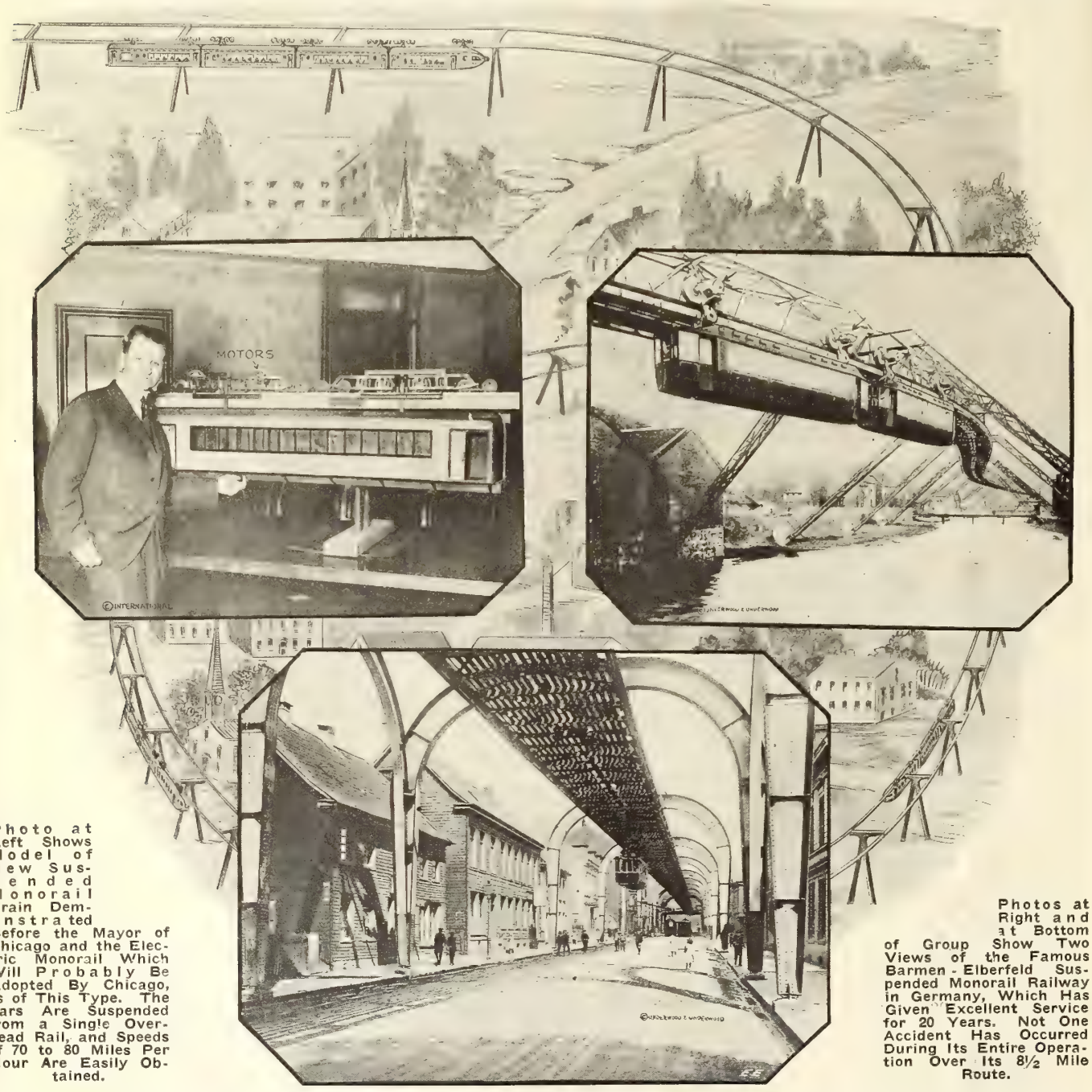


Photo at Left Shows Model of New Suspended Monorail Train Demonstrated Before the Mayor of Chicago and the Electric Monorail Which Will Probably Be Adopted By Chicago, Is of This Type. The Cars Are Suspended from a Single Overhead Rail, and Speeds of 70 to 80 Miles Per Hour Are Easily Obtained.

Photos at Right and at Bottom of Group Show Two Views of the Famous Barmen-Elberfeld Suspended Monorail Railway in Germany, Which Has Given Excellent Service for 20 Years. Not One Accident Has Occurred During Its Entire Operation Over Its 8½ Mile Route.

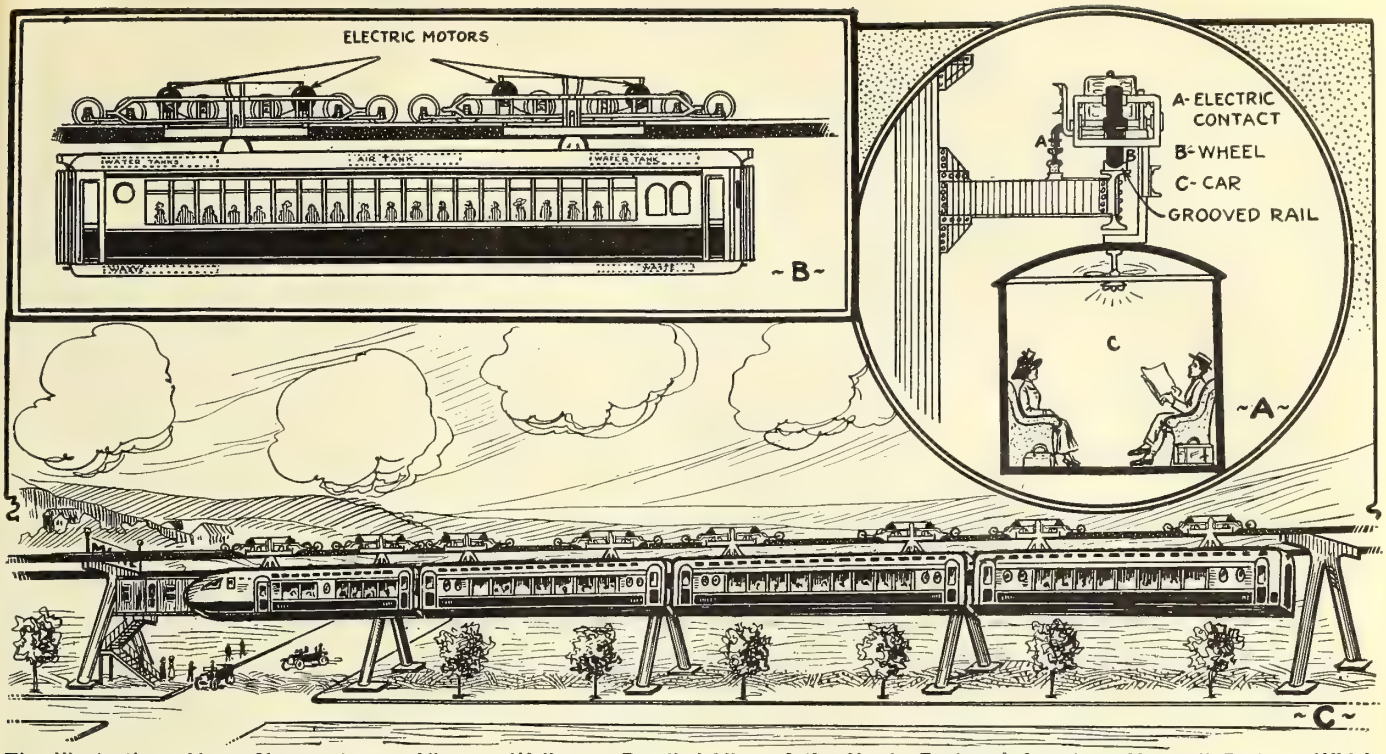
American engineers who have been endeavoring to solve some of the tremendous traffic problems of the great city of Chicago—the "Gate-Way to the West"— have found the advantages of the electric monorail, with suspended cars as here shown, worthy of their most earnest consideration. The photographs herewith show in a vivid manner, just why the monorail of this type has made such an impression on American engineers; in fact so much so, that the city of Chicago and its environs will very

OUTSTANDING FEATURES

Looking at the accompanying photograph, one will see that there are indeed a great number of revolutionary features possest by this system of railroading which are not to be found in any other form of rail transportation. Among the advantages of particular prominence, we find:

1: A medium weight train can be operated at high speed over the suspended monorail system with the same stability as at present obtainable only by the use of very heavy trains with their low center of gravity. The big point here, is that with our heavy trains, we continually need more horse-power to move them, and more speed means more weight. This is not the case with the suspended monorail train, it being possible to operate it at from 70 to 80 miles an hour with only medium weight in the cars, necessitating, therefore, only a fair amount of horse-power in the electric motors to propel the trains.

It may be said here, that the system of propulsion is very simple, the electric current being taken from a so-called third-rail, which is nothing but an insulated bare electric conductor, mounted either on top or at the side of the steel I-beam track, on which



The Illustrations Above Show a Larger View as Well as a Detailed View of the Newly Designed American Monorail Railway Which It Is Proposed to Adapt in Chicago and Environs to Help Relieve the Severe Traffic Congestion in Chicago. Instead of Using Grooved Wheels on Which to Suspend the Cars, Crowned Wheels Travel Along in Circular Grooves on Top of the Rail Beam. The Arrangement of the Third Rail and Contact Shoe Is Also Clearly Shown.

the wheels carrying the weight of the suspended cars travel.

In the newly proposed American form of suspended monorail, the wheels from which the cars hang, instead of being fitted with a flange as in the Langen or foreign system, are designed to travel in a deep circular groove, formed in the rail on top of the I-beam track structure, as one of the accompanying illustrations clearly shows. This illustration also shows the arrangement of the third-rail shoe thru which the current is taken, and after passing thru the motors, it then flows thru another wire and out thru the wheels to the rail on which the cars are suspended, and back again to the power house.

2: The second big feature of the suspended monorailway is that there are no *grade crossings,* and also with the highly perfected electric interlocking block system now used, improved signals, etc., there is practically no danger whatever from rear-end collisions or head-on collisions between trains on this system.

3: Due to the peculiar mechanical features involved in this system, the cost of giant bridges crossing rivers, chasms, etc., is reduced to one-half or one-quarter the usual cost. Instead of erecting a massive bridge containing perhaps 1,000 tons of steel with wood flooring and cross ties, etc., all that is required to carry the monorail trains over a considerable span of river or chasm is a single, well-supported steel girder, as our front cover shows.

On the average run along land, the columns supporting the monorail track would be placed about 100 feet apart.

4: The maintenance cost of the suspended monorail is only about 25% of what it is on our steam and electric railways and the operating expense can probably be reduced to about 50% of the present value, in order to handle the same amount of traffic, either passenger or freight. It is also figured that about 25% of the present accidents, which are always a large expense conundrum for railroad lawyers to settle annually, will be eliminated entirely by the beautiful simplicity of the suspended monorail train, as it speeds along with airplane velocity over country roads, brooks and even cities, as in Germany.

5: Snow, washouts, or other forms of natural impediments which arise now and then to interfere with the operation of both steam and electric railway trains, as well as street cars or trolleys, do not affect the monorail of the type here illustrated. They hold no terrors whatever for the flying monorail train as it speeds along over the snow banks.

SUSPENDED MONORAIL TRAINS OPERATE SMOOTHLY AT HIGH SPEED

In the Barmen-Elberfeld Monorailway, the trains operate at speeds varying from 22 to 35 miles per hour, but in the newly proposed American system, such as that which Chicago is contemplating installing in order to relieve the severe traffic conditions now prevailing, the speed, at least on suburban runs where the train is given a chance to gain headway, may easily be raised from 70 to 80 miles per hour.

Engineers who have investigated both the Langen and the proposed American system believe that these higher speeds could be reached not only with very safe running conditions as regards curves (and by the way, these trains do not have to slow down on curves at all), but also these suspended trains could be speeded up to these higher velocities at a reasonable and highly efficient operating cost. This is directly the opposite with the modern steam and electric railway systems such as we have in operation today, as when speeds of 80 miles an hour are desired, we obtain these velocities only by utilizing extra heavy locomotives and coaches, which become quite necessary in order to cause the train to hold itself on the rails and also to aid in giving it a low center of gravity.

The law of design of the modern steam engine gives the key to this situation at a glance. If you want a certain traction exerted between the driving wheels and the rails then what you get, is a certain percentage or about one-fifth or 20 per cent. of the load placed on the engine drivers. Thus, with a 600,000 H.P. engine, a traction of about over 80,000 to 100,000 pounds may be attained. With the monorail, all the weight is centered on the overhead wheels, and as can be readily seen, even by the lay man, this downward tractive effort is high indeed, which obviates any extra loading of *useless, dead weight,* as is the case with our modern railway systems, into the railway cars and engines in order to obtain the necessary stability at high speeds.

DETAILS OF ROLLING STOCK

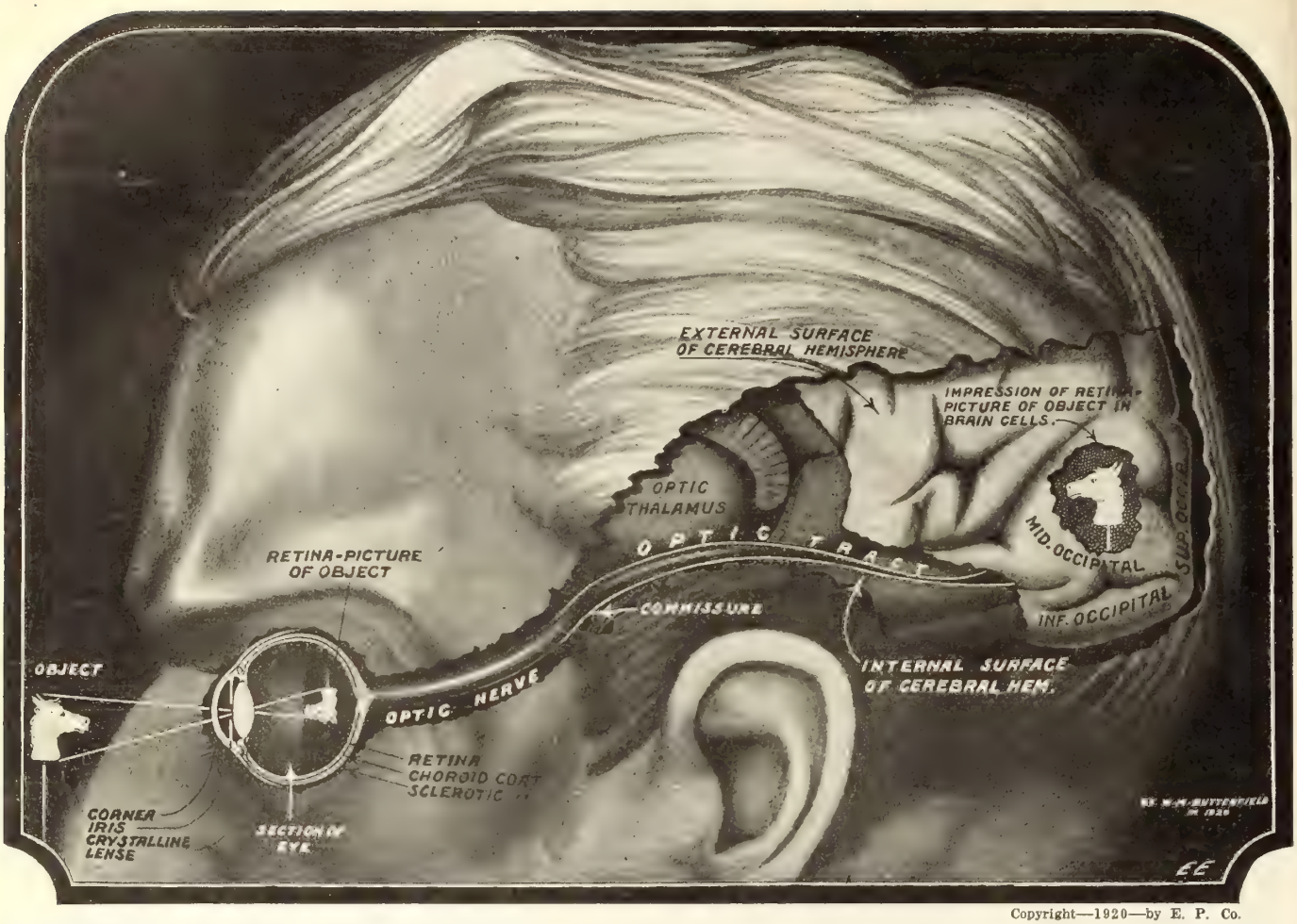
One of the accompanying photographs shows a model of the proposed American type of suspended monorail cars, as demonstrated before the Mayor of Chicago and engineers connected with the city government.

As will be seen, the track and wheel arrangement on top of the car by means of which the passenger carrying compartment is suspended, is entirely different from the German type. Instead of having but two wheels driven by an electric motor as in the Langen type of car, the new model involves the use of a series of wheels,—six on each truck in the present case, the advantage of this arrangement being, as the engineers have pointed out, that the load is more evenly distributed over a track span, equal to the length of the car itself.

In other words, the two trucks with their 12 wheels for each car, will be distributed over as great a length approximately as the car itself. This works out advantageously in many ways, and it is one of the big items that reduces the estimated cost of the American system to less than one-half that of the Langen system. This is so because there is much less steel required in the rail structure for one thing. Again, there is a markedly greater traction manifested between the wheels and the rail, with a consequent greater grade climbing ability, than is the case where but two wheels or even four for the car, is used, as in the Elberfeld railway.

Of course, the cars are fitted with Westinghouse air brakes and all the other niceties of modern electric railroading.

The coaches for this class of service are constructed of steel and are to be just as comfortable and luxuriously furnisht as the best cars operated by the steam railroads. It is understood that in the German system there is considerable noise at times, especially when the cars run around sharp curves, due to a "squealing" of the wheels, but in the American system this slight objection, as we might really call it, is to be eliminated, as these trains *operate entirely noiselessly.*



Copyright—1920—by E. P. Co.

In Accordance With the Latest Theory of Human Vision, It Is Thought That We Actually "See" by Electrical Means. The Rods and Cones In the Retina of the Eye Correspond, It Seems, to Selenium or Photo-electric Cells. Thus When Different Gradations of Light Impinge Upon Them, They Cause Currents of Varying Strength to Pass Along the More Than 2,000,000 Fibers Comprising the Optic Nerve, Like the Wires in a Telephone Exchange, to the Proper Sight Cells in the Brain, Energizing Them.

Do We "See" Electrically?

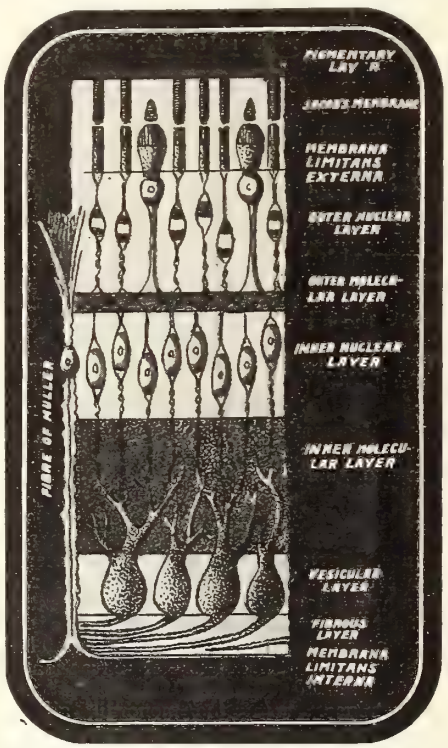
By H. WINFIELD SECOR

Associate Member, American Institute of Electrical Engineers

THE interesting article—"Is Life Electrical?" by Prof. Rusk, in this issue, prompts the illustration and theory presented herewith, of the human eye and the optic nerve, which connects it with the *sight center* of the brain, lying at the rear of the organ of thought.

The study of physiology opens up whole worlds of unbelievable *magic*, yet most of us wander along thru our daily lives not paying any particular attention to the various bodily functions and organs. We hear, smell, taste, feel and SEE, not thinking for a moment as to how we actually do these things! At some later date, we hope to present some recent theories and aspects of the other senses, besides that of *sight*, but for the present we will confine ourselves to this most wonderful of man's endowments.

As to *how* we see, there is this much to say: The image on which the eye is focused is carried into the inner chamber of the eyeball thru the iris and crystalline lens, as our physiologists teach us. Here, a most unique phenomenon takes place, viz: the image is cast upon the retina of the eye in an *inverted* manner. If the function of seeing performed all its operations at this juncture, we would naturally see houses, trees and other objects, upside down! But here is where *part* of the great mystery of sight begins—a mystery which some of our greatest physiologists have not as yet unravelled. The action in the eyeball is only the *beginning* of sight!



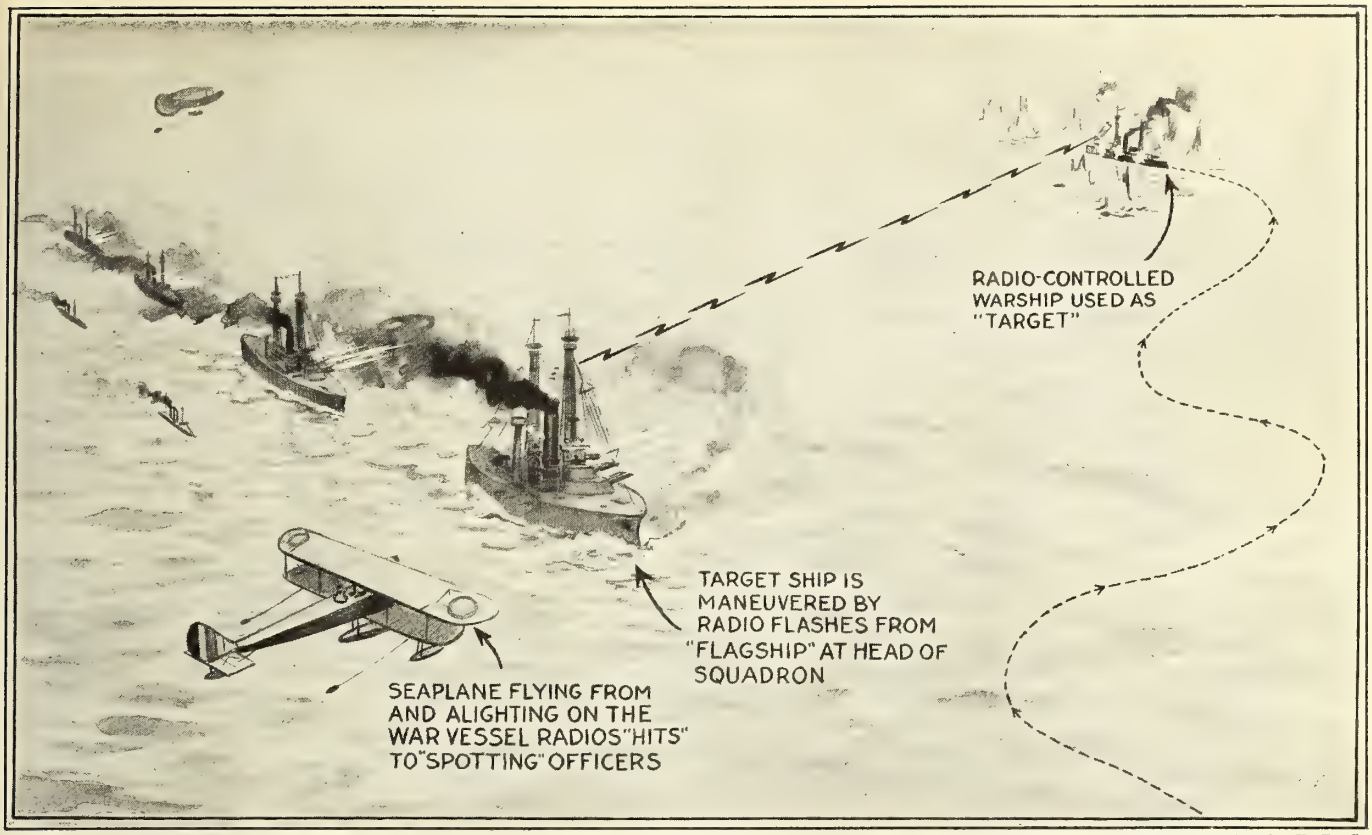
This Sectional View of the Retina Illustrates the Telegraphic Arrangement—With Wires (Fibers) Connecting Retina and Brain.

The light and shade values of the image cast on the retina, fall on a series of what are now supposed to be minute photo-electric cells, covering the rear inner-hemisphere of the eyeball and there are over 2,000,000 of these cells or rods and cones, as the physiologist calls them. Each one of these light-sensitive cells connects to one of the more than 2,000,000 fibers constituting the *optic nerve*,—the great nerve of sight, which passes up thru the head to the rear of the brain or region of sight. The hundreds of thousands of optic nerve fibers, each corresponding apparently to a fine electric wire in a telephone exchange, terminates at a certain cell in the brain. Thus when we see an image, a person's face, for example, there is simultaneously stimulated in the brain a complete pattern of particular cells; which probably reconstruct the image perceived. And the result is that we do not see the object we look at, upside down, but *right-side up!*

It is now thought that when the various points of light pass thru the lens of the eye on to the rod and cone layer of the retina at the rear of the eye, that extremely minute electric currents are set up and pass along the respective nerve fibers (remember, there are over 2,000,000 of them) to the cells of sight located in the brain, and it is at this point where we interpret the image or picture which the eye beholds, and *not in the eye itself*, as is often popularly supposed.

In other words, if one should receive an injury at the top or rear of the head in

(*Continued on page* 310)



Copyright—1920—by E. P. Co.

The Accompanying Illustration Shows One of the Latest Naval Ideas Which Invokes the Aid of "Radio Wave Control" for the Purpose of Maneuvering a Target Ship Over a Circuitous Course. By This Means The Gunnery Officers in Charge of the Test Can Control the Target from the Flagship of the Squadron. The Range in Actual Practise Is, of Course, Much Greater Than Would Appear from the Illustration, as the Ship Cannot be Shown Large Enough Over any Great Range in a Picture Like This.

Radio Guides Ship Target

Unless plans of naval experts fail the old battleship *Iowa*—in its day pride of the American fleet and flagship of the late "Fighting Bob" Evans—will be used as a moving target for modern dreadnoughts, its movements directed by powerful wireless apparatus.

The *Iowa* is about thirty years old and is of no further use as a fighting machine. The "shooting up" of the veteran battleship, therefore, will be a slight loss to the navy. On the other hand, by sending the *Iowa* out to sea under wireless control and maneuvering the vessel as if she were in battle with our more modern ships, valuable data will be accumulated for future naval use.

Most targets of this kind in the past have been fixed. Targets also have been towed by other ships at the end of long cables. But a target moving under such conditions furnishes only a minimum of action. If plans work out as the experts expect, the *Iowa* will move around as if she were under her own steam with a full crew.

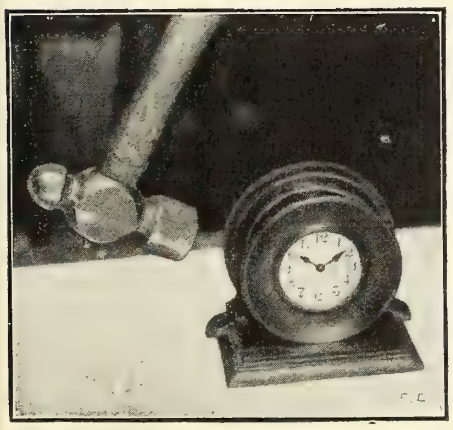
The contrivance to be employed in the experiment is that of John Hays Hammond, Jr., for the wireless control of torpedoes from land, with some modifications. For example, it is probable that the movements of the *Iowa* will be controlled not from shore but from a warship.

Other radio experiments are also under way. The battleship *Ohio* has been fitted with new and powerful wireless instruments and during the next few weeks will engage in extensive experiments. Other nations are working along this and other lines. In fact, radio promises to become more and more important in future warfare on both land and sea.

After the armistice the War Department allowed it to become known that the army had perfected radio control of airplanes and had sent them as far as 100 miles.

Shock-proof Rubber Clock

One of the latest advances in the world of clocks, is the new travelers' or desk clock,—a neat, inexpensive as well as decorative contrivance, to say the least.



This Rubber Clock Will Stand All Kinds of Knocks and Falls. Great for Travelers.

This novel clock is enclosed in a flexible rubber case which muffles the ticking of the clock to a great extent, and in the event of a fall, absorbs the effect of the shock, preventing injury to the glass and works. On actual test, when this shock-proof timepiece was thrown three feet to the floor, its working mechanism was in no way damaged, thereby demonstrating its efficacious merit.

One of the special features of the rubber casing is that it constitutes the entire ornamental superstructure of the clock, thus eliminating what would otherwise be a bulky addition.

Owing to its shock absorbing qualities, this clock can be mounted on movable machinery, in automobiles, motor boats, trains, airplanes, etc., and in fact can be used to advantage any place where vibration and shock would deter the accuracy of the ordinary time-piece.—ROSE HARRIS.

Ironing Hats by "Juice"



The Old Panama Hat Is Dampened and Ironed, and Its Pristine Shape Is Brought Back in Jig Time—Thanks to the Electric Iron. Photo by Edna Purdy.

Alarm Number 18

By CHARLES S. WOLFE

FENNER paused with his hand on the gate, and turned an interested face toward the oncoming juggernaut. I, too, watched with lively interest the exciting spectacle.

With wailing, shrieking siren and clanging bell, the roaring fire truck bore down on us. She swept by with a deafening staccato bellow of unmuffled exhaust, and we caught a glimpse of the nimble, rubber-coated crew clinging with precarious hold on to the hand rails.

Fenner gazed wistfully after the speeding demon. "I guess I'm just a kid, at that," he laughed, whimsically. "Whenever I see one of those babies burning the breeze I just want to run after her."

"Same dog bit me," I admitted, cheerfully, "I still get a lot of thrills out of a fire."

"Oh, well," Fenner's tones were rueful, "We can't go, because it's not dignified for big boys to tag after chemical engines. Let's get up stairs and give that circuit a hitch."

"Let's," I agreed, the spell of the clanging gong still on me, and we moved listlessly into Fenner's house.

As we mounted the stairs to the rooms that housed Fenner's wireless outfit, he remarked reflectively, "Insurance rates will be going up in this burg if we're not careful. Seems to me that makes about umpteen times that fellow's beat it by here in the last couple of days. If things continue like this, we will be enjoying a firemen's strike presently."

"Oh, well," I returned, carelessly, "Let 'em earn their money. Let's see that diagram."

Fenner tost me the blue-print, and I fell to studying the "hook-up" we were about to try out. Engrost, I paid little heed to the ringing of the 'phone bell, being vaguely aware that Fenner was answering the call.

I was aroused by a tap on the shoulder. I glanced up to find the scientist-detective grinning at me mischievously. "Put away the dope sheet, Bill," he laughed. "We are summoned to the throne room."

"Throne room," I echoed, blankly, "What's the large idea?"

"His Royal Highness, Chief of Police Davidson commands us to a séance at the Hall. Guests will please appear without side arms, and are to refrain from shooting crap with the plain clothes men" bandied Fenner, "Trot along, Bill, and watch the Big Boss sputter."

"Why sputter?" I asked, as I prepared to accompany my friend.

Fenner grimaced. "He sounded like 'static' in that 'phone," he said, "I was afraid he'd jar out the residual magnetism. Something has evidently gone aglee with the machinery down there, and Davidson thinks he sees a job for me. He seemed in a hurry. Guess we'd better take a trolley."

We hastened to the street, and caught a down town car. Fenner continued his stream of persiflage all the way down, and we were both laughing as we entered Davidson's office.

It took but a glance to tell us that Davidson was indeed angry. He glared at us from over his desk savagely, and hurled his unoffending cigar at a nearby cuspidor. "This thing has got to stop," he bellowed, shaking his burly fists at us in a threatening manner.

The jesting retort died unspoken on Fenner's lips. We realized that the chief was in no mood for chaff. He was in a towering rage.

"What's the matter?" queried Fenner, giving me an eloquent glance, which, by the way, was totally unnecessary. I have no desire to fool with buzz saws.

"Matter?" howled Davidson, "Some one's going to find out what's the matter. Believe me, if I get my hands on this cuckoo he's going to think it's resurrection day."

"What cuckoo, Chief?" asked Fenner, patiently.

"The cuckoo that thinks the city fire alarm system is a plaything," yelled the infuriated police head. "Look! Look at this!" He waved a typewritten sheet under our noses, "Eighteen alarms of fire in forty-eight hours, seventeen of them false. Oh, some yap thinks he's brilliant, all right, but he's riding to one devil of a fall."

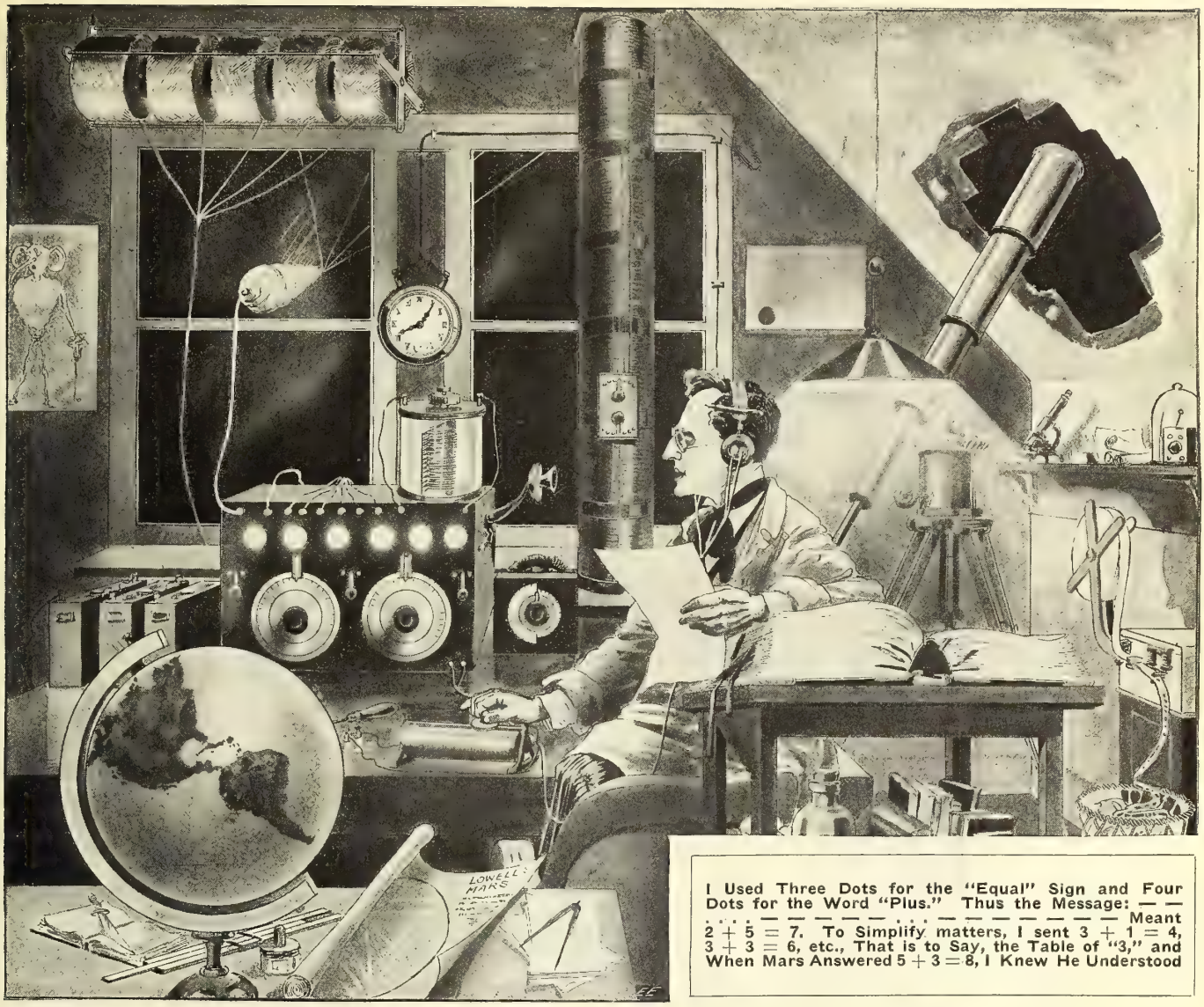
Fenner whistled interestedly. "What particular box do these fake alarms come from?" he queried, mildly.

"From no particular box," snapt Davidson. "One time it's a box over in the west end, next time it comes from the northern section. Then you get one in the business center. I'm getting tired of it, I tell you. This gang of Sherlocks I've got around here are numb from the necktie up. One of them thought he had a clue. He took the rest of the pack over to box 15 and covered the territory for three blocks around it. Then while the whole mob of

(*Continued on page* 335)



". . . Suddenly the Quiet of the Neighborhood Was Broken By the Wailing Shriek of a Siren. A Clamor Arose Below Us in the Street, as With Bell Clanging and Siren Screaching, Number Eight Rolled By in Answer to An Alarm. Instantly the Youngster Was on His Feet and Was Leaning Half-Way Out of the Window. 'There She Goes,' He Yelled Over His Shoulder,—His Eyes Burning Feverishly, 'Oh, Lord, How That Fellow Does Beat It.' . . ."



I Used Three Dots for the "Equal" Sign and Four Dots for the Word "Plus." Thus the Message: — — . . . . — — — — — — . . . — — — — — — — Meant 2 + 5 = 7. To Simplify matters, I sent 3 + 1 = 4, 3 + 3 = 6, etc., That is to Say, the Table of "3," and When Mars Answered 5 + 3 = 8, I Knew He Understood

My Message To Mars

By CLEMENT FEZANDIÉ

Explaining a simple method of teaching an intelligent Martian by wireless, to understand our measure of length, area, volume and weight, our time, our alphabet, and a working knowledge of the English language

CHUCK PETERS and I had spent weeks in preparing my wireless set in order to get it of sufficient power to send a message to Mars. At last all was ready, and for a week we had been sending out our call which consisted of three slow dashes repeated ten times. We kept repeating this call at intervals of exactly two minutes.

And then one day, while I was at the instrument, the answer came in a pitch that could not be mistaken for any wireless on earth. Mars—for it *was* Mars as I afterwards learned by ascertaining the direction of the waves—repeated my call. For a few minutes we amused ourselves by sending this call backwards and forwards. Then I proceeded to teach him our numbers. I sent one dash for the number one, two dashes for number two and in this way proceeded to count from one to nine. Then I began over again. Mars repeated the list after me. The fifth time I sent the list, I did not stop at nine but proceeded to twelve and to my joy Mars answered by counting up to *fifteen!*

It was a simple matter now to teach "Marty" (for so I called my new correspondent) simple sums in addition. I used three dots for the "equal" sign and four dots for the word "plus." Thus the message: --....------...------- meant $2 + 5 = 7$. To simplify matters, I sent $3 + 1 = 4$, $3 + 2 = 5$, $3 + 3 = 6$, etc., that is to say, the table of "3," and when Mars answered $5 + 3 = 8$, I knew he understood that four dots meant "plus" and three dots meant "equals." I then sent simple examples: multiplication, using five dots for the word "times" and when Marty telegraphed $4 \times 3 = 12$, I knew he had caught on. Substraction and division I did not teach till later, tho they would have been just as easy to understand. From division I taught fractions: thus, one-half $= 1 \div 2$, and one-tenth $= 1 \div 10$.

To teach the word "zero" or rather the cipher, I wirelest: $4 + 0 = 4$, $7 + 0 = 7$, etc., and Mars soon understood.

Right here, I had to do what we often have to do in teaching, rub out all we had learned and start afresh. The system of numeration was getting too complicated when twenty-seven dashes were needed to express the number 27. So I taught Mars the continental code for the numbers. This knowledge of the equality sign served me here. I telegraphed: $3 =$ ...--, and when I had repeated all the numbers from 1 to 9, I made sure he understood the new code by sending him simple additions and multiplications using the continental code. Then I proceeded to count up to 99. Marty had a little difficulty at first, due, as I soon learned, to his using the *duodecimal* system of numeration, instead of our decimal system. That is to say, the Martians count by twelves instead of by tens. Then number 97 means nine twelves plus seven units or our number 115.

(*Continued on page* 318)

How to Talk With Mars

Of late we have heard and read much about talking with Mars. Suppose we DO send or DO receive signals. How can we make ourselves understood, or how do the Martians hope to make themselves understood? Hundreds of famous scientists are having a hot battle over the subject—and fail to agree.

The author of this article gives us a method written in a delightful vein, devoid of all technicalities. It's so good you can't fail to read it—you'll enjoy it thoroly—especially the little surprise.—EDITOR.

The Story of Glass

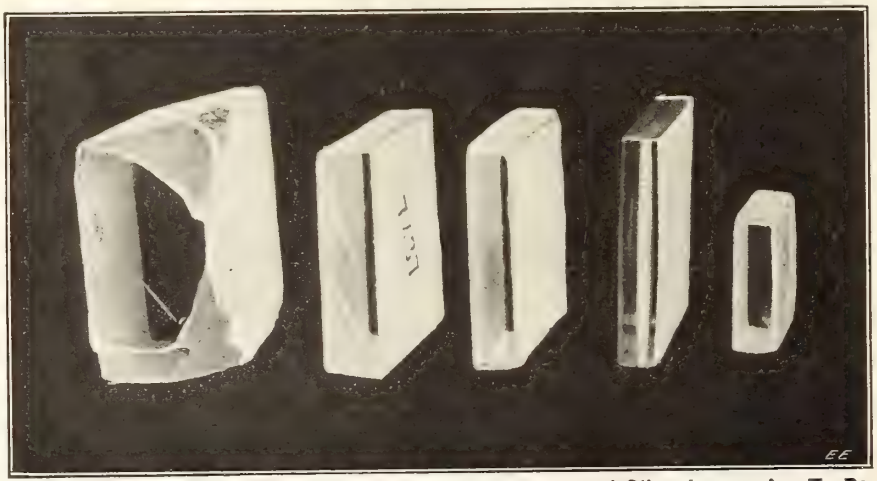
By PROF. FLOYD L. DARROW



The Glory of the Glass Maker Is Undoubtedly Reflected in the Large Telescope Lens, the One Here Shown Being One of the Most Perfect of Its Kind in the World, and Measuring 40 Inches in Diameter. The Reflection of the Man's Image at the Extreme Right Will Be Noticed on Close Inspection. Frequently a Great Many Batches of Glass Have To Be Run Off Before a Sufficiently Perfect Block of Glass from Which to Grind the Lens of This Type Is Obtained.

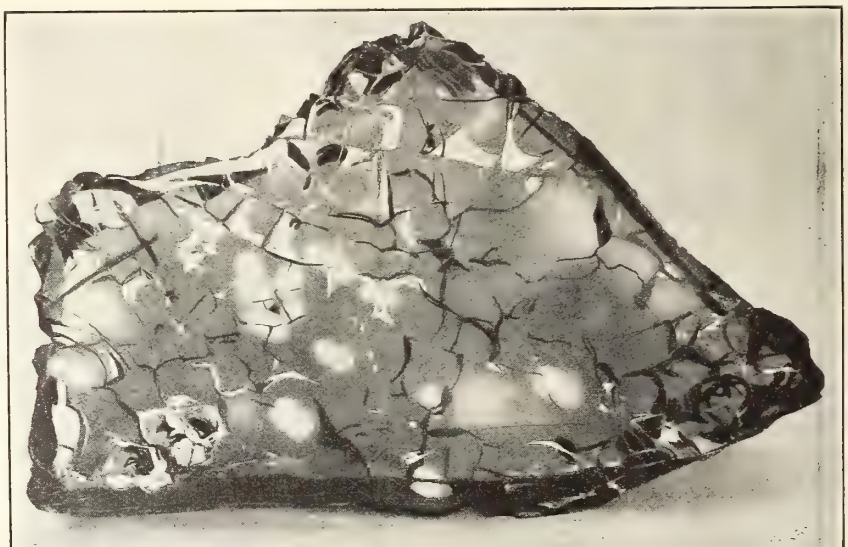
GLASS MAKING is one of the very earliest arts known to the human race. Its discovery antedates recorded history. Certain it is that for long centuries before the Christian Era, the Egyptians, Babylonians and even the Chinese had mastered the art of fusing the basic materials into glass and had acquired marvelous skill in blowing it. From Egypt this knowledge past to the Phoenicians and Greeks and later to the Romans and Central Europe. Necklaces and articles of ornamentation from ancient Egypt, at least six thousand years old, are to be seen in our museums, and window panes, buried for nearly twenty centuries beneath the ashes of Pompeii, have recently been excavated. The beautiful color effects in the stained glass windows of Old World cathedrals even point to the coloring of glass as something of a lost art.

But if the modern world must stand in awe before certain masterpieces an ancient art, it is equally true that the tremendous progress in the manufacture and working of glass, made during the last century, eclipses all that was ever done in all preceding time. Indeed, very much of our boasted present-day civilization would have been impossible without an abundance of glass and the multitudinous articles of commerce and instruments of science dependent upon glass for their manufacture. Did you ever stop to consider the innumerable points in which glass touches your life and enters into your well-being? If not, a brief review will convince the most skeptical of the very great debt he owes to the expert craftsmen engaged in this industry. Glass admits the light and genial warmth of the sun to your dwelling. In the form of chimneys, lamp bulbs and shades it diffuses the light from our artificial sources of illumination. The powerful silvered reflector of some coastwise lighthouse projects its beams across the harbor and guides your ship to a safe anchorage. The head-lights of your automobile are also made of glass. In the form of eyeglasses this wonderful substance corrects your erring vision and restores your dimming sight. In the camera it preserves familiar scenes and the faces of your friends in imperishable records of truth and beauty. And more, it makes possible the marvelous illustrations of modern books and magazines. In the projection lantern and the moving picture machine lenses of glass afford a countless host of individuals with a form of pleasure and recreation without a parallel. The X-Ray and all that it has meant to medicine and surgery would have remained forever undiscovered without glass tubes, at once impermeable to gases and transparent to light. Without lenses the telescope, and the spectroscope, those wonderful astronomical instruments which have so immeasurably increased our knowledge of the universe and broadened it to infinite dimensions, could never have been made. So too, the microscope, which, penetrating the universe in the opposite direction, has revealed systems of life and matter as truly marvelous as the infinite depths of space.



This Shows Blocks of Optical Glass from Which Camera and Other Lenses Are To Be Eventually Ground.

In the Great War immense quantities of glass became imperative for the making of range finders, gunsights, periscopes, searchlight mirrors, photographic lenses and binoculars. Go into a chemical laboratory and inspect the vast array of glassware essential to the analysis of the raw materials and finished products of chemical manufacture and then, if never before, you will appreciate the tremendous importance of glass.



A Block of Glass Which Has Undergone "Devitrification." The White Spots Represent Crystals of Wollastonite. Photo Courtesy of Geophysical Laboratory, Washington.

Glass is made from the commonest of materials and comprises three principal varieties—Crown glass, Bohemian glass and Flint glass. Crown glass is common glass. From it windows, bottles and plate glass are made and also some lenses. The ingredients that go into it are silica, or ordinary sand, lime and soda. Bohemian glass



This Shows the Older Method of Blowing Bottles, Incandescent Lamps and the Thousands of Other Forms of Glass By Blowing Them Into Shape While Hot. The Breath is Blown Thru a Tube Into the Glass, Causing It to Expand to the Desired Size.

is chemical glass. It contains the same raw materials as crown glass, except that potash is substituted for soda. Flint glass is used for making optical instruments and for ornamental and cut glass. It contains silica, potash and lead oxid. The presence of lead accounts for the great weight of cut glass articles and also their high lustre.

In the making of any kind of glass the ingredients are mixed in the proper proportions in huge melting pots of clay and fused to a thin liquid During this process chemical changes take place by which silicates of soda, potash, lime or lead result. Therefore glass is defined as a mixture of metallic silicates. Silica alone, when fused, is transparent and resembles glass in the physical appearance.

To tell briefly the story of optical glass in America and the creation of this new industry will cover the main points in the manufacture of glass and the high degree of skill that must be exercised in its manipulation. As early as 1853 John J. Bausch, the pioneer in this field, opened a small shop in Rochester, New York, and began the grinding of superior lenses that soon attracted the notice of New York opticians. They were even better than those imported from Europe and Bausch found a ready market for all that he could make. But altho Bausch could grind lenses exhibiting the highest craftsmanship and perfect optical qualities, he was dependent upon Europe for his supply of glass. The demand for this kind of glass was so small and its composition so shrouded in mystery that no one here had attempted to make it.



The Fine Grinding of a Camera Lens. The Lenses Are Mounted in Polishing Heads and By Means of the Handle, the "Head" is Given a Circular Motion in a Polishing Trough, With Rouge and Certain Other Fine Abrasives Used as Grinding and Cutting Agents.



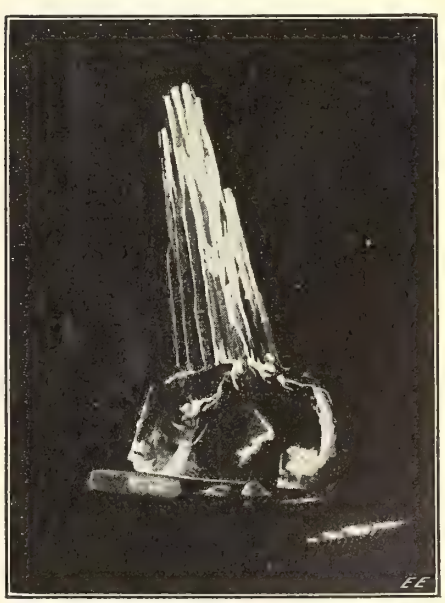
Testing the Curvature of Polished Surface of a Camera Lens. As Will Be Seen Several Lenses Are Mounted in a Polishing Head and These Are All Ground Down and Polisht Together. The Test of Curvature is Made With a Special Device.

But to Bausch this was a most disconcerting feature of his work. He wanted to be independent. Long and persistently he sought to solve the problem of making glass that would meet the high requirements of his art. His son William Bausch also became even more interested in solving this problem. But when he looked about for skilled workmen having a knowledge of the process, he could not find even one in all America. He persistently advertised in trade journals thinking that perhaps some workman from the optical glass works across the water might have drifted to our shores, but it was a vain hope. At length, however, he did succeed in finding a Belgian, whose father had made optical glass in Europe, and he was engaged for the difficult task. A very small plant with one oil-fired furnace was built on the banks of the Genesee River. With great expectation the first batch of raw materials, selected with the utmost care, were mixed in the melting pot and fused in the furnace. But to their keen disappointment the product was found to be a beautiful emerald green and utterly worthless for optical purposes.

(*Continued on Page* 342)



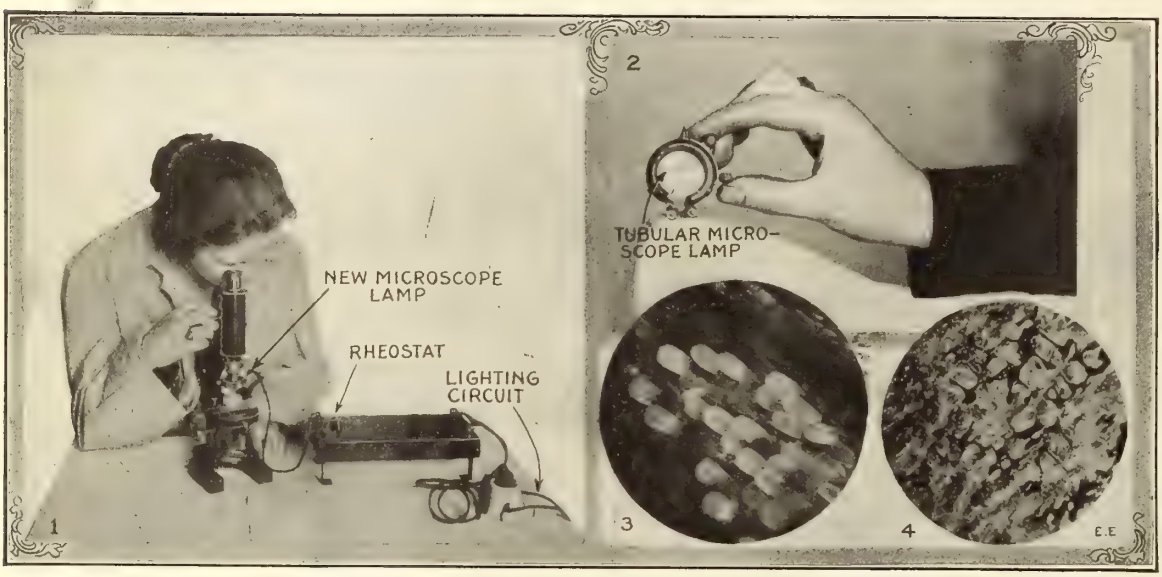
A Block of Well Annealed Glass, Free From Crystallization, As It Appears When the Melting Pot Has Been Broken Away. From Geophysical Laboratory, Washington.



The Cylindrical Core of a Block of Glass Left When the Outer Portions Broke Away. From Geophysical Laboratory, Washington.

More Light for Microscopes

By MERRILL M. HUNTING



The Illustrations Show the Latest Electric Light for Microscopes, Which Promises to Lend Itself Admirably to all Classes of Microscopic Work. The Lamp Itself Comprises a Glass Tube Containing a Long Straight Filament Running the Length of the Tube. A Rheostat Permits any Degree of Illumination To Be Obtained at Will. Figs. 3 and 4 Show Two Micro-Photographs Taken by Means of This Light, Which Indicate the Extremely Clear, Even Illumination Which Is Obtained.

THE invention of Professor Alexander Silverman of the University of Pittsburgh, which virtually consists of a new "eye for microscopes" has benefited the technique of microscopy to a wonderful degree. This new illuminator makes possible a clearer picture for the eye to see, and takes away any image, such as a lamp filament or other interference that tends to cast a cloud or haze on the picture. The invention offers new possibilities.

The extra eye, originated by this Pittsburgh professor is a new design of illuminator for the microscope which consists of a quarter-inch glass tube, containing a single tungsten filament. This tube is shaped into a circle and the lamp itself held by a holder having three iris-like fingers, which fasten securely to the objective of the microscope by a clamping action. The lamp is silvered, throwing light downward on the subject under observation. No light goes where it is not needed.

When in use, the "new eye" uses a rheostat for utilizing current from a 110 or 220 volt lighting circuit. The lamp operates at 0.9 ampere and 13 volts for visual work, by simply pushing the button switch. For photographic work it is operated by pushing a spring switch and uses 1.01 amperes and 18 volts current. This lamp is made in two glass colors, either colorless or blue (daylight) glass at nominal cost.

In the taking of photographs especially, much time is saved over the older designs of illuminators, the vertical for instance. After once attached to the examining lens no further adjustment is necessary as it is raised and lowered with the objective of the device in use. Photographs are taken in from 10 to 40 seconds. This long exposure is possible because of the fact that the illuminator is attached to the microscope and moving with it, tends to eliminate any vibration, should it occur.

With it, examinations of objects in deep hollows can be easily carried on.

Dr. Langmuir Has New Theory of Matter

An entirely new theory of the structure of matter was recently presented at the concluding session of the annual gathering of the National Academy of Sciences by Dr. Irving Langmuir of the General Electric Company research laboratory. Explaining that his conclusions led to a new conception of energy, force, time, space, magnetism and all the general properties of matter, Dr. Langmuir asserted that "space and time have a structure analogous to that of matter."

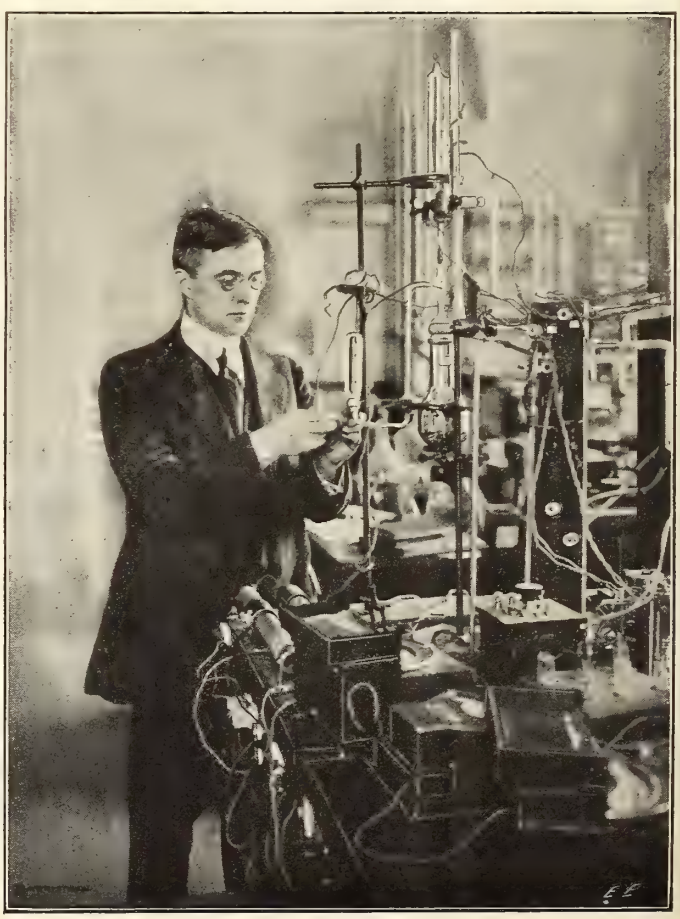
Heretofore, the speaker said, the usual conception of the relative order of the components of matter has been atoms, molecules, electrons and particles. His observations add a new division, smaller even than the electron, which he has named the "quantel."

It consists of two parts, he said, positive and negative, present everywhere in space moving in all directions with the velocity of light and capable of passing thru matter. They constitute, he added, what has heretofore been known as the "ether of space" and cause all of the phenomena of light, electricity, mass and energy.

"The structure of everything that is" can be built up out of his conception of the quantel, Dr. Langmuir said. The theory explains all of the mysterious relationships heretofore known to exist between spectral lines, he asserted, predicting that it would lead to the discovery of many new relationships.

His observations also demonstrated a new principle of reversibility, Dr. Langmuir declared, that leads to the deduction that light proceeds in straight lines from atoms, that it does not radiate but proceeds from each atom to a fixt objective.

Dr. Langmuir's theory was based, he said, on the theories of several other scientists, and that he had already gone far enough with his experiments to derive the most fundamental mathematical formula and to see by what was to him a simple process, a development that would help to explain all the phenomena relating to the properties of matter. His experiments were predicated on the Einstein special theory of relativity, Dr. Langmuir said.

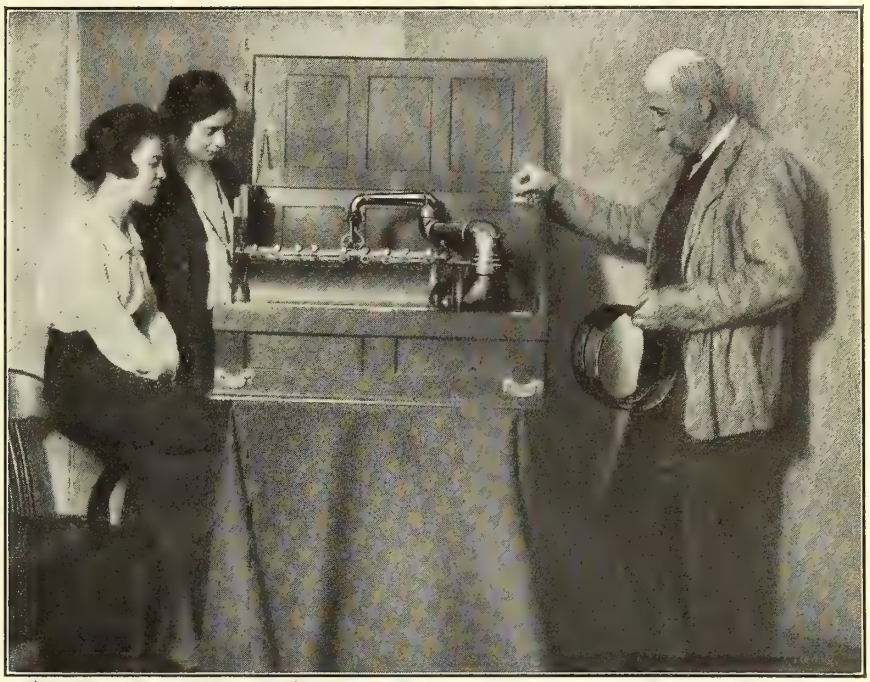


Dr. Irving Langmuir, an American Scientist, Whose Theory of a New Construction of Light, Energy, Matter and Magnetism May Rival Newton's Discovery of Gravitation. His Theory, Which He Read Before the National Academy of Sciences in Washington, D. C., Discloses the Smallest Division of Matter, Smaller Even Than the Atom, Which He Calls the "Quantel." Dr. Langmuir Is Only 39 Years Old and Was Born in Brooklyn, N.Y. He Is a Graduate of Columbia University and Received His Doctor's Degree from the University of Göttingen.

New Phonograph Talks One Hour

The photograph shows Mr. George W. Bowers, mechanical and consulting engineer, of Boston, Mass., listening to his wonderful new phonograph which will reproduce continuously or intermittently for an hour or more, and will stop automatically at any predetermined time or spot, and will render a concert of one or more hours' duration, made up of records varying from three minutes to one hour's duration. It plays from record to record automatically and is said to have a tone far superior to any machine now on the market. Six years' time and many thousands of dollars have been spent in its preparation and it is said eighty-four patent claims, many of them basic, have been allowed. While designed to play specially made records, it will also play regular records.

As shown in the photo, the records as designed by the inventor are short cylindrical affairs, but the machine can be arranged to play any record of the orthodox flat type. The records used by the inventor, one of which he is shown holding in the photo, shows how the music grooves are recorded around the outer perifery or surface of the composition ring. Such phonographs are now in demand for many different locations, such as in large private ball rooms, dance halls, community houses, soda water parlors, and in fact everywhere that it is desirable to play a series of records thru a period extending over an hour or more.

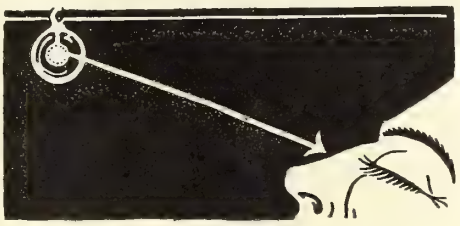


The Accompanying Photograph Shows a New Automatic Continuously Playing Phonograph Which Can Be Set Up to Play a Dozen Records One After the Other. The Machine Takes Special Records, Two of which the Inventor Is Shown Holding in His Hand, but It Can Be Adapted to Play Standard Records.

Radium Sleep Button

This latest "invention" comes from Germany. People are having so much trouble there now that they simply cannot fall asleep, hence we have the radium button as shown. This is actually being advertised in a high class German periodical and is supposed to work as follows:

The button, which is nothing but an ordinary "Radiolite" button such as are sold in this country, is placed in such a position that while lying in bed you gaze at it fixedly. This is supposed to auto-hypnotize you and within a few minutes you are sound asleep. Anyway it sounds very good, and is worth while trying. If you have not a Radiolite button you may try your watch if it happens to have its hands coated with radium paint.

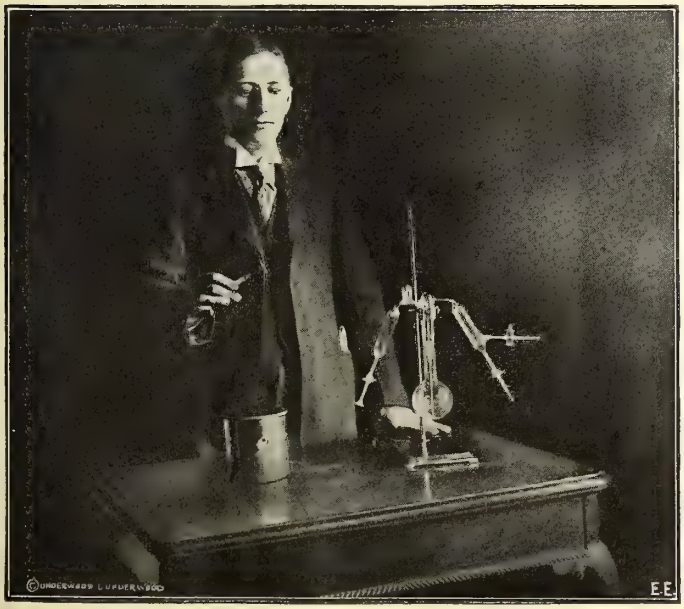


Radium Bank Starts With $375,000 Capital

Physicians and surgeons are gradually learning more and more about the curative and therapeutic properties of radium, especially in the treatment of cancer, as time goes on. A few years ago there were a great many doubts exprest as to whether radium would ever actually cure cancer or carcinoma, but the results obtained in many different clinics at some of our leading hospitals and sanitariums show that radium will and does produce curative results in such cases which are permanent.

In cancer of the throat the tube is held in the throat or back of the mouth for a short period of time, once or twice a day, while the treatment is taken. Where incisions have been made to get at cancers or other growths, the tubes containing the radium bromid are laid directly in the incision so that the powerful penetrating rays shot forth from the radioactive salts can work their miracles, with the highest efficiency possible.

All of which brings to mind a most peculiar and almost tragic incident which happened several years ago to a patient who was taking radium treatment for cancer of the throat. Several tubes of radium, valued at many thousands of dollars, were anchored at the end of a thread in the throat of the patient. Owing to the unusual conditions, the patient suddenly exercised a muscular spasm and swallowed the radium tubes! Two serious things could have happened: The radium might have been lost forever; and the patient might have died sooner or later! But neither of these two things actually occurred. The radium tubes eventually past off, the doctor recovered his precious little glass tubes, and the patient still lives to tell the tale.



On the Table in the Photograph Is a Container Which Has Half of the $375,000 Worth of Radium To Be Used in the Foundation of the First "Radium Bank," Which Will Distribute to American Physicians and Scientists to Use in Therapeutic and Research Work. The Inventor and Patentee of a Secret Process Which Made It Possible to Mine This Element from American Mines is Dr. S. A. V. Sochocky (Shown in Photo, Holding in His Hand a Tube Containing Approximately $5,000 Worth of This Element in the Tiny Capsule the Size of an Ordinary Pin). The Photo Was Taken at the Annual Meeting of the New York Medical Society at the Waldorf-Astoria.

Overcoming Gravitation

By GEORGE S. PIGGOTT

Startling Electrical Experiments by the Author in Actually Suspending Gravitation Which Present a New Aspect of Gravitation

FOR some time past there has been quite a controversy going on regarding the subject of interplanetary communication by means of electric waves. I have been very much interested in the above on account of experiments which I have made and data collected pertaining to gravitation effects on high frequency oscillations and electronic discharges in general. A series of experiments which I conducted during the year 1904, caused me to formulate the theory that interplanetary transmission of electrical impulses was an impossibility on account of the sun's resisting and absorbing influence which virtuallly isolates our planet from all other electrical vibrations of a lesser tension or power.

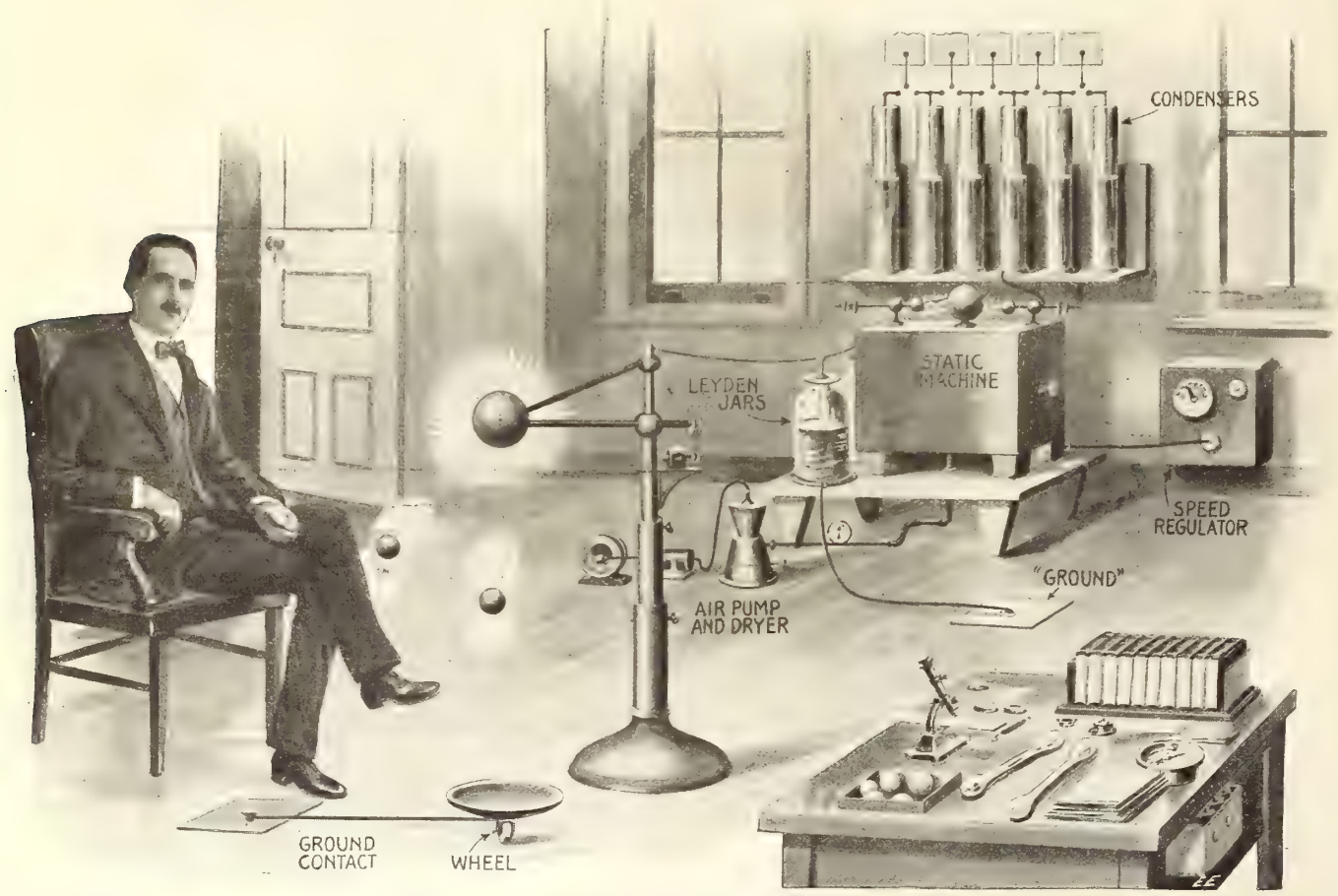


Fig. 1. This Picture Shows Mr. George S. Piggott, the Author, and His Laboratory With the Powerful Electrical Apparatus Used, Whereby He Was Enabled to Carry on Successful Experiments in Nullifying the Effects of Gravitation. In Other Words, He Was Able to Suspend Small Balls and Other Objects in the Manner Shown, the Silver Balls Actually Used Having Weighed 1.3 Grams. The Diameter of the Balls Was 11 mm.

GRAVITATION SUSPENDED IN EXPERIMENTS.

The above theorem was arrived at after I had succeeded in sustaining a metallic object in space by means of a counter-gravitational effect produced thru the action of an electric field upon the above object. A strong electric field was produced by means of a special form of generator and when the metallic object was held within its influence it drew up to approximately a distance of 1 mm. from the center of the field, then was repelled backward toward an earthed contact, going within 10 cm. of the same when it was again attracted toward the field's center but this time getting no nearer than 5 cm. from the polar nucleus. This backward and forward movement continued for some time until the metallic object at last came to a comparatively stable position, about 25 cm. from the field's center where it remained until the power was shut off. While the metallic object was suspended, I was able to study the effect of the surrounding field and found by means of a powerful microscope, assisted by the insertion of a vacuum tube within the field, that the metallic object (having of course a certain electrical capacity) became fully charged and gave off a part of said charge to and against the surrounding field which tended to hold said object in space, apparently without any other sustaining influence. Around the outside of the metallic object and extending to a distance of about ½ cm. was a completely dark belt or space in which there appeared to be no electrical agitation due, possibly, to neutralization caused by the contact of the large incoming energy supply from the field's center, with the small oscillating radiations from metallic object. The ever changing action of attraction and repulsion resulted in the overcoming of gravitation. Going farther I willl state that the dark belt above mentioned after many tests gave no sign of electrification, a most astonishing phenomenon, inasmuch as its width was but ½ cm. In fact, a dark line was shown in the vacuum tube when it was introduced between metallic object and center of field. It is my firm conviction that somewhere on the outer confines of our planet there exists a similar counteracting belt thru which naught but the gravitational vibrations of the sun penetrate, and these vibrations absolutely annihilate or absorb all other less powerful ones.

Therefore, after making many experiments to ascertain as nearly as possible the absolute facts and conditions as they exist, I have come to the conclusion that all electrical disturbances not due to our own radio oscillations on this globe are due to the sun's electrical activities in semi-inductional contact with our polar extremities.

DETAILS OF "DEFYING GRAVITY."

The illustrations 1 to 4 will possibly give a fair idea of the apparatus used, and the manner in which the experiments were carried on.

Fig. 1 shows general scheme of arrangement of devices. In the lower left hand corner is shown the "ground contact," which can be turned around and placed in any po-

sition found necessary, in fact, when metallic object is in suspension, this *ground* can be entirely eliminated.

I have found that any substance within the limits of my experiments can be held in suspension, viz: water globules, metallic objects, and insulators being among those tried. Some materials such as cork and wood exhibit peculiar activities when suspended; a piece of green maple would not rest in one position within the field, but oscillated backard and forward continuously, going to the field's center, then back to ground.

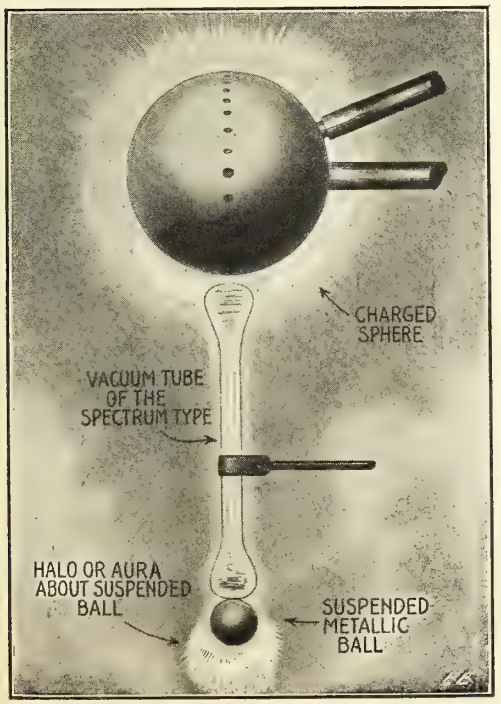
Heated materials exhibited equally peculiar characteristics: A silver ball 11 mm. in diameter when heated, remained farther away from the field's center than when at normal temperature; upon cooling it gradually drew up to the position it would occupy if unheated.

Fig. 2 shows a generator of the Wimshurst type (improved), the generating or collecting units being entirely enclosed in an insulating case and operated under a pressure of 3 atmospheres; completely dry air *only*, entering case thru drying device attached to air pump shown in Fig. 1. Interior parts of generator will retain quite a powerful charge for a long period of time.

Fig. 3 illustrates suspension stand and field producing electrode, the latter can be revolved in any direction by means of a spring motor shown on upper section of stand.

The small apertures seen in electrode, which is hollow, are there for the purpose of ascertaining the action of the reduced field tension at these points, and are also made use of to hold different sized metallic discs, which are cemented to insulating plates, forming condensers, the function of which is to create weak opposite polarities at these points and thus show a reaction on the suspended object and also a greater ocular effect in the vacuum tube.

Fig. 4 is a detailed drawing of the vacuum tube principally used; this is of the spectrum type, without sealed-in electrodes and when introduced into the electric field, glows very brightly at its extremities, especially giving a sharp line bordering the dark space around the metallic object. A very high vacuum is sustained in the tube and it is found necessary to build it of a very perfect insulating glass; the bulb must be kept absolutely dry on its outer surface.



Different tubes have been used beside the above; corrugated, spherical, cone shaped, and cylindrical, with various results.

The electric field produced for suspension experiments is very powerful and intense, being detectable with a vacuum tube at a distance of over 6 meters (19.68 feet).

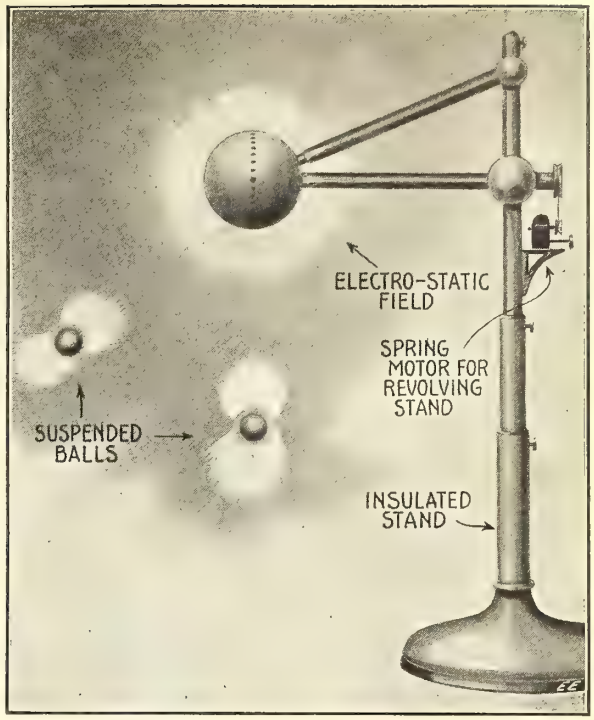


Fig. 3. A Close-up View of the Charged Metal Sphere Mounted on a Pedestal Together With a Spring Driving Motor, Whereby the Electrode or Charged Ball Could be Rotated. The Two Small Silver Balls Are Shown Suspended in Mid Air, the Earth's Gravitational Pull Having Been Nullified.

In conjunction with the above and drawing an analogy between the same, I am of the opinion that cometary motion is undoubtedly due to the activity of its compositional elements and their susceptibility to changes of polarity, which, when the comet is far distant from the sun, would be opposite in sign to that of the latter, or when in close proximity to the central orb, would be of the same sign and therefore repelled.

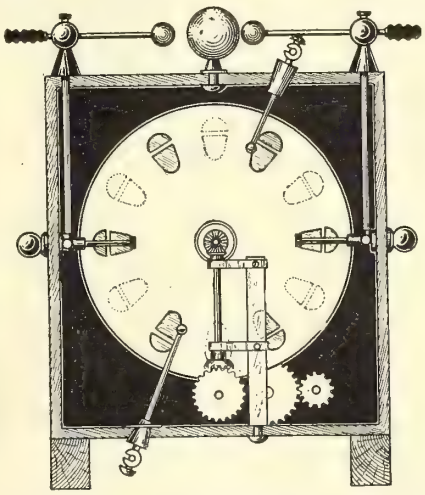


Fig. 2. Special Electro-static Machine Used by Mr. Piggott in His Gravitation Nullifying Experiments, Which Was Inclosed in a Heavy Air-tight Compartment, So That it Could be Operated Under Several Atmospheres of Air Pressure.

All bodies in process of formation possibly have their cometary stage, and doubtless future experiments will reveal this fact.

Fig. 4. Close-up View of Vacuum Tube of the Spectrum Type Used in Studying the Aura Surrounding the Suspended Silver Balls, While They Remained Suspended in Space.

ACTUAL RESULTS ACHIEVED BY MR. PIGGOTT

The total power required to operate generator, which was run by electric motor, was about ¼ K. W. generator; the machine voltage was in the neighborhood of 500,000 when the electrodes were separated beyond sparking distance. The electrostatic charge left on the suspension electrode retained the average object in space for a short length of time, about 1¼ seconds after machine ceased rotating.

Some objects such as copper and silver balls, which are of course good electrical conductors, and very nearly homogeneous, when falling toward the earth, after power had been shut off, seemed to slow down when they neared same, and hovered about 2 c.m. above contact for approximately 1 sec. of time before striking same; this was due no doubt to the inductional change of polarity which was imparted to balls almost at the instant of earth contact.

The aura, shown in figure 3, near suspended balls (which in this experiment were made of silver) extended outward to a distance of about 1 c.m. and covered about one-half of the upper hemisphere and a trifle more of the lower hemisphere.

This bluish emanation appeared to be made up of numerous infinitesimal dots or darting particles, each apparently separated from the other by *a very narrow, glowless belt.* Everything was, however, in a constant state of agitation and it was quite impossible to get an absolutely perfect view microscopically, of an individual particle. Different substances have different aura both in length and breadth, and also in luminosity.

The silver balls used in these experiments had an actual gravitational weight of 1 3/10 grams (nearly .05 oz., avoirdupois) and were the heaviest objects suspended at this time, their diameter being 11 mm. as before mentioned in another part of this article.

The largest object suspended was a cork cylinder 10 c.m. long by 4 c.m. diameter (approximately 4 by 1⅝ inches) which had a copper wire pusht thru its center, and extending beyond its ends to a distance of 3 mm. The weight of above cylinder was ¾ gram (.002645 oz. avoirdupois).

The behavior of metal spheres used in above experiments was a most interesting spectacle, silver and copper balls floated very steadily in one position and when suspending electrode was revolved, would follow and turn slightly axially, but would not revolve entirely around same, there being a peculiar "slipping" effect not entirely accounted for.

"Home Electrics"

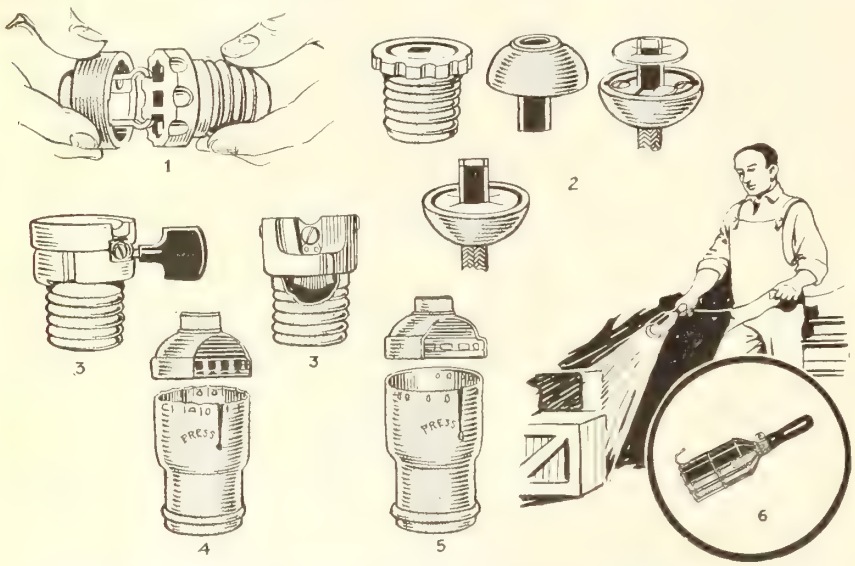
By G. L. HOADLEY, M. E.

THE EXTENSION CORD.

ONE of the handiest little articles around the electrically lighted home is an extension cord. It will naturally be one of the first things wanted.

Procure a *new re-enforced flexible* cord of the desired length—25 feet will be about right for most purposes—and a *new* plug and socket of your electrical dealer as the needed material. Then, with a screwdriver and knife as the tools, an extension cord that will give good service for a long time can be made by following the instructions given. You are doubtless wondering why *new* material is emphasized. Because the two or three pieces of old twisted wire you have laying around can't be spliced together and connected to one of several old sockets you have on hand, which were replaced some time ago. The reason is of course that they were either partly worn out or defective in some other way. Perhaps you have some nearly new twisted pair telephone wire and desire to use it. *Don't do it.* An extension cord gets the hardest kind of usage and even with the very best materials used it is very much more dangerous than the other wiring used in your home.

The extension cord is a necessity, otherwise it would *never* be allowed by the Underwriters. It is a curious fact that wires used in houses must be kept apart at least 2½ inches unless enclosed in a metal raceway, and must be at least ½ inch from the surface wired over, yet in the extension cord the outer insulation is cotton or some other material which will easily catch fire and the two wires are twisted together as closely as possible. Is it any wonder then that the Underwriters require that the very best re-enforced cord should be used? Each wire in the cord is made up of tiny strands to secure flexibility, so the cord will assume any position needed. Furthermore, the tendency to break the wires, which is caused by the bending back and forth of the cord with use, is greatly reduced by using stranded wire. How many times will a solid copper wire such as used in telephone work bend back and forth before it breaks? Certainly not often, while the stranded wire will stand considerable abuse before the outer strands break, and even then the re-enforced insulation will be difficult for these broken strands to penetrate and come together, thus finally causing trouble. The ordinary insulation of the spliced pieces of twisted cord allow the broken strands to easily get together, however, and the pulling, tramping on, and other abuse an extension cord receives will quickly break this cord where it would not injure the re-enforced cord.



1—One Form of Approved Separable Attachment Plug. 2—Another Form of Separable Plug. 3—"Insides" of Key and Keyless Lamp Socket. 4—Well-Known Type of Socket Shelf and, 5—Another Form. 6—Illustrating Useful Reflector and Lamp Guard for Use With Extension Cord.

WITH this issue we are starting a new department entitled "Home Electrics." We could tell you a whole lot about this department, but we believe that the words "Home Electrics" are sufficiently explanatory. The average householder, and the average man or woman owning a house or living in apartments as a rule are not electricians. Very often some sort of electric work is needed, usually too trivial to call in an electrician. It is for such people that this new department has been started, and we hope our readers will like it.

—Editor.

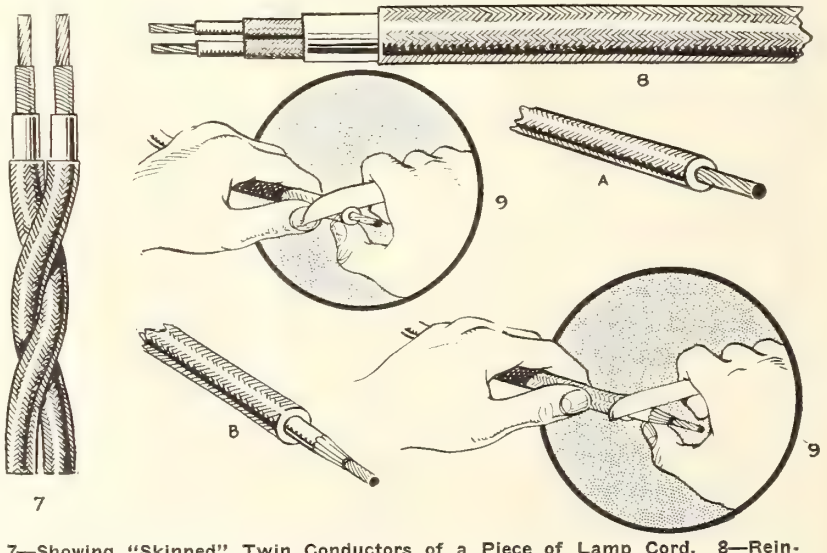
If an old worn or partly defective socket or plug is used, the temper of the user is apt to be sorely tried, to say the least, as just when a light is needed in a hurry the thing won't work and considerable time has to be spent examining it and having a screw tightened here or something else adjusted before it will work. Frequently, too, severe shocks are received from defective sockets and plugs and the blowing of fuses results from their use. Other good reasons could be advanced to show the necessity of using new material for the extension cord. Enough have been stated, however, to show why scraps won't do.

Both the socket and the plug should be of material that is not easily broken. For example, porcelain sockets will break the first time they drop on the floor. A socket made of brass and a plug of moulded composition material or one of hard rubber will give satisfactory service. The plug should have a separate cap and preferably to be of the type known as the "Separable Attachment" which will break or pull out at any angle as indicated in Fig. 1, so that an accidental jerk on the cord can do no damage to the fixture, wires or appliance. Children and even adults are apt to trip up or run against an extension cord when in an unusual place temporarily, and this separable attachment plug is of more importance than it really appears at first glance.

In selecting the plug and other parts of the extension cord, get materials which have the approval of the Underwriters. You are certain then that the device is safe after being completed. A plug, for instance, having a cap like that shown in Fig. 2, never will have the wires pull loose from the cap itself—a common source of trouble in cheap wiring—because of the "strain relief" wiring shown. In the illustration, Fig. 2, the two wires are carried around thru easily wired channels forming a perfect "strain relief." This does away with the necessity of a knot in the cord also.

The socket may be either of the keyless type or it may have a key interior as shown in Fig. 3, and the socket shell may be any one of the approved fittings of the Underwrites. Figs. 4 and 5 show two very good

(*Continued on page* 308)



7—Showing "Skinned" Twin Conductors of a Piece of Lamp Cord. 8—Reinforced Lamp Cord With Ends of Two Conductors "Skinned", Ready to Connect to Socket or Ceiling Rosette. 9—Right and Wrong way to "Skin" Copper Wire, Either Solid or Stranded. Cut in on an Angle—Not Directly in at Right Angles, As the Wire Will Invariably Be Nicked or Many of the Strands Cut Off.

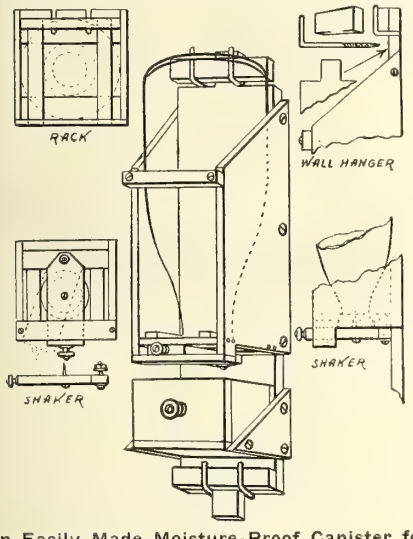
Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

THE editors believe that there are a great number of readers of the "Electrical Experimenter"—(Science and Invention) who will enjoy a monthly page devoted to "Mechanical Rinktums." Something Useful one can build on that odd half-day off and withal a device that can be built from wood or metal stock usually to be found about the home work-shop. We have arranged with Mr. Butterfield to conduct this monthly feature—and we want it to be "your" department. Letters containing suggestions on what you want to see described here will be forwarded to Mr. Butterfield.

MOISTURE PROOF CANISTER.

A shaker for holding salt, sugar, ground coffee or similar dry materials, and thus protecting them from moisture, is shown in the sketch herewith. It is constructed of half-inch wood made as illustrated, with a suitable glass bottle, say an ordinary quart milk bottle, as the container—the wooden parts forming a convenient wall bracket holder, a shaker for pulverizing and releasing the material in the container; and a box for receiving said material.



An Easily Made Moisture-Proof Canister for Holding Salt, Sugar, Etc. It Is Provided with a Shaker for Damp Days.

The back piece is 16¼ inches long by 3⅞ inches wide. This forms the foundation for the device; at their end a tongue is made for attaching the shaker to frame of a door or window. Each tongue is 1 inch long by 1½ inches wide, made by sawing away the corners as shown. The sides of the bottle holder are 4⅜ inches wide and 10¼ inches long; at the front, lower edge of each, a tongue is made to form a guide for the shaker block. These tongues are ⅝ inch long and 1¼ inches wide, with a block screwed to their lower edge as shown. A rack for holding the neck of the bottle is provided, the front and back parts of which make the top edge of the shaker-block guide and form the support for the rear end of same, supported as shown with a ⅜-inch screw-bolt. The top ends of the sides are sawed at an angle, with a retaining block for holding bottle placed in the position illustrated in the drawings.

The shaker block is ½ inch thick, 4⅝ inches long and just wide enough to completely close the opening of the bottle when centrally placed, say 2¼ inches for a milk bottle. The bottle rides on the block and as the latter is moved from side to side, as shown in the dotted lines on a small drawing, an opening first at one side and then the other in the throat of the bottle is formed. To pulverize the material should it become caked after being placed in the bottle, one or more nickel plated iron screws are screwed thru the block so as to extend an inch or more up into this glass container as shown. A box, with a suitable shelf support, is provided to catch the material thus released.

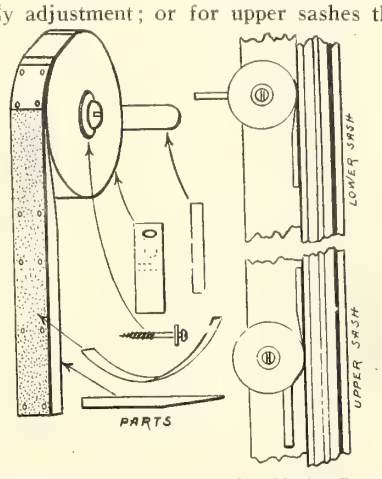
The container may be placed in its frame by using the cardboard cap that covers the milk; this is afterward removed when in place, or by placing the frame inverted over the container as it sets right side up on a table, it is an easy and quick adjustment in either case, once you get the hang of it. This shaker is particularly suited to those living along the seashore or in damp locations.

AUTOMATIC HOMEMADE WINDOW LOCK.

A window lock that operates automatically, is simple and inexpensive, and can be made at home in numbers sufficient for the largest house, is seen in the illustration. Each lock consists of a 2 inch thick wood wheel suspended on a ⅜ inch screw in such a way that its rounded surface is brought against the inside face, or one side of a window sash at the top rail, thus allowing the lock to operate along the full length of the sash as it is moved up and down in the process of operating this part. Suspended from and nailed to this rounded surface, is the doubled end of a strip of emery cloth, of the roughest grade as we have shown; this strip also carries nailed to it a ½ inch thick wood wedge of the same width as the thickness of the wheel. On the opposite side of this disc a ½ inch iron bar is driven into a hole in its edge to act as a weight to hold the disc by force of gravity in a way to cause the wedge to remain at the first entering position between the wheels and the face of the window.

The rough emery cloth takes hold of the wood with increasing force as the wedge is forced home by the movement of the sash, causing it to bind with such tension in its frame as to lock the window. It will, however, become operative when the bar is released, so the sash can be said to be continually locked.

Such a lock as is here shown will be useful for sashes, provided with the regulation fasteners, but which are liable to be left unsecured thru carelessness in their daily adjustment; or for upper sashes that can be reached from other buildings as is often the case in New York or other crowded locations. We show the reverse mechanism for an upper sash lock in one of the drawings.

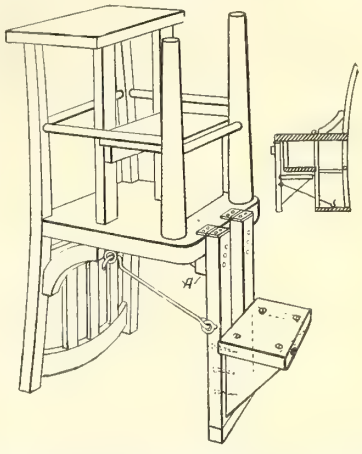


Self-Wedging Window Locks Made From a Wooden Wedge, a Drum, and a Piece of Emery Cloth.

The important features are, to have the screw hole in the center of the wheel; to have the wheel move freely on the screw when in place, so that the upper weight or wedge can function properly; and to have the rough face of the wedge take quick and firm hold of the wood sash.

CHAIR STEPLADDER.

Here we have a method of converting an old wood bottom chair into a "safe" four-stept ladder. This can be accomplisht with little or no expense and thus give the "overall" or Economy Movement another boost. The required materials for accomplishing this transformation are three feet of ¼ inch wire, four screw eyes large enough to take in the wire, two 1 by 2 inch hinges of the style shown, and some ¾ inch lumber.



Here's a Clever Idea—a Step-Ladder Made From an Old Kitchen Chair. Anyone Handy With Hammer, Saw and Screw-driver Can Readily Build This "Chair" Step-Ladder. It's Stronger Than You Imagine and Very Stable—a Trait Seldom Found in Many Expensive Ladders of This Type.

It will be impossible to give definite widths, lengths and so on, as the chairs all differ in size, but a fine suggestion may be given to aid the prospective builder. It will be advisable to make and attach the lower step first, even to fixing the wire and screw eye side-straps; when this is done the building of the upper part is more easily accomplisht. One important suggestion is to have the block "A" very securely fastened, using three screws or nails in each end as shown; this block holds the front of the chair. The step with its end brackets must also be put on securely, using screws in preference to nails in the manner illustrated; another important precaution should be mentioned, that of making it impossible for the straps to become unfastened when hooked in place; these straps are vital in preventing stepladder accidents.

The top step is put on after sawing off ¾ inch from each back leg of the chair, or screwed to the legs and supported in front by two uprights that are fastened to both the step and the chair bottom. These also form the support for the third step, carrying the cleat on which the back edge rests. A front support made of a board is provided for this step; the second step is formed by the chair bottom.

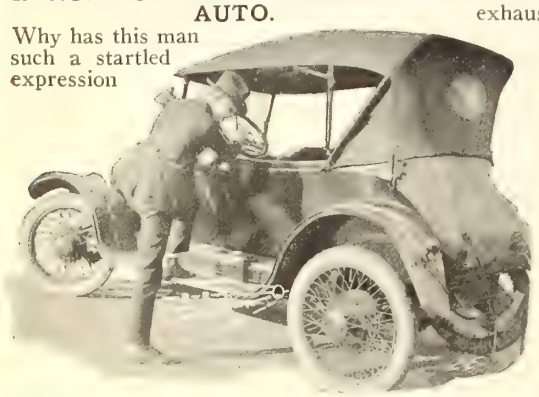
The chair ladder, if the steps are spaced correctly, will now fold up in the manner shown in the small drawing, the top steps remaining permanently as shown by shaded lines.

AUTOMOBILE "STUNTS"

FIRST PRIZE $25.00.

ELECTRIC "THIEF ALARM" FOR AUTO.

Why has this man such a startled expression



Step on This Running Board and the Klaxon Wails Out Its Warning.

on his face as he steps into the car not his own? The reason is a wildly screaming automobile horn partly concealed under the running board where it joins the rear fender. The owner purposely put it there. When the running board is stept on, a circuit is completed and the horn yells its warning.

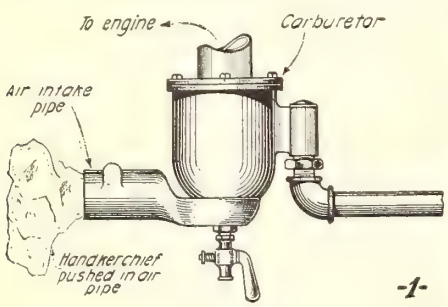
Contributed by EDNA PURDY.

SECOND PRIZE $15.00.

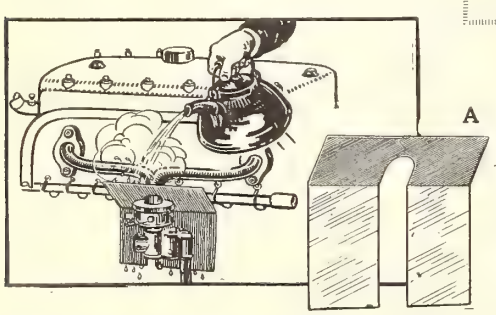
STARTING THE ENGINE IN COLD OR DAMP WEATHER.

The accompanying illustration shows two stunts which I have found very useful in starting the engine, even in very cold weather. They have also proven very efficacious and valuable in the spring and summer, especially on damp, cool evenings when the engine has thoroly cooled and is stubborn when trying to start it.

The first one I invented after ascertaining that a rich mixture is the best for starting and as the air regulator did not close down tight, I hit upon the idea of pushing a handkerchief or other piece of cloth (but NOT waste) into the opening of the air intake pipe on the carburetor.



To Cut Off All Air in Starting up Stuff a Handkerchief or Rag in the Air Intake Pipe.



In Cold or Damp Weather Starting Is Made Easy by Pouring Hot Water on the Intake Manifold.

In this case, the air intake pipe was open, but in some cases this may be closed so as to be well nigh inaccessible owing to its attachment thru a "stove," attached to the exhaust pipe, for the purpose of heating the air fed to the carburetor, as many cars do.

The second illustration shows a stunt which has proven efficient on the coldest mornings, when the engine refused to turn over even after a thoro priming. Simply use hot water right out of the tea kettle, the hotter the better. A piece of tin or asbestos sheet should be bent around the carburetor, so that the hot water does not run all over and possibly into it thru some opening, and thereby cause no end of trouble. The heat from the hot water rapidly warms the intake manifold pipe leading from the carburetor to the engine cylinders, and permits the gaseous mixture supplied by the carburetor mechanism to easily and more readily vaporize.

Contributed by EVERETT ACKERSON.

$50.00 In Prizes

Beginning with this issue, we start on this page a new automobile department entitled "Automobile Stunts", and we will pay $50.00 in prizes for the three best articles received each month.

A great many of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. Almost every other automobilist some time or other invents a little device or does something to his car to make it better than it was before. "Experimenter" readers want to duplicate these stunts, and that is just what this new department will be for. In other words an exchange of ideas. Note that the idea does not necessarily have to be electrical in any way. You may have a new stunt or trick how to patch a blown tire that was not described before. You may have a new idea how to prevent your spark plugs from carbonizing, and thus short circuiting. You may know of a new stunt how to refill or charge a storage battery. If you have a town car, you may have thought of some simple trick how to signal to your chauffeur, so he will know where you will want to go.

There are hundreds of such ideas, and we will pay $50.00 a month to get them. Of course, we would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. If no photograph can be furnished—altho we would like to have it—a simple sketch will do showing the essential parts, etc.

We will pay the following prizes:

FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

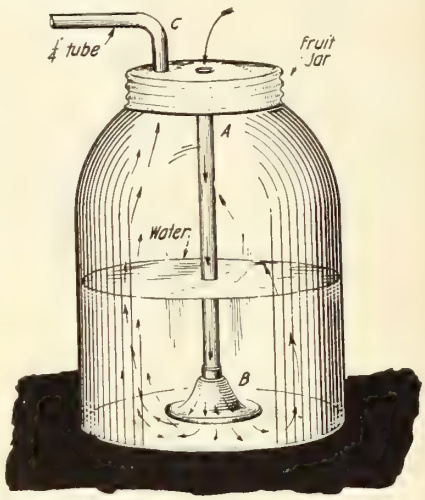
All other accepted articles, which win no prizes will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to "Editor, Automobile Stunts," care of this publication.

THIRD PRIZE $10.00.

A COMBINED ECONOMIZER AND CARBON ELIMINATOR.

This is a very simple device, which has been thoroly tried out by the author, with great success. The method employed is that of passing air thru water and thence into the engine cylinders.

The air is very moist and therefore has a tendency to produce steam when heated. The steam thus formed keeps the cylinders free from carbon and gives greater power on less fuel, hence greater efficiency, which we are all striving for. Actual tests show an increase of five miles per gallon of gasoline, and a loss of 50 per cent of the carbon, with an appreciable increase in power!



A Gain of 5 Miles per Gallon of Gas Is Claimed for This Simple Economizer and Carbon Eliminator.

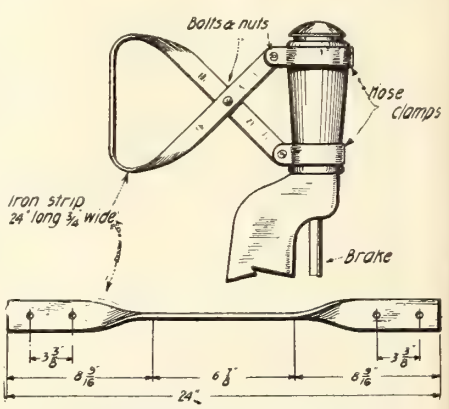
The container is an ordinary quart fruit jar with a brass top. A is a ¼-in. brass tube past thru the cover and soldered. B is a common bath sprayer soldered on the tube A. A ¼-in. copper tube is extended from C thru the dashboard to a valve which can be operated from the driver's seat. From here it goes to the intake manifold. The valve is for the purpose of turning it off when "starting" in cold weather.

It will be well worth any automobilist's time to construct this simple device, since by utilizing this, his car and pocketbook will be greatly benefited.

Contributed by A. BRILHART.

EXTENSION HANDLE FOR EMERGENCY BRAKE.

The device illustrated is an extension handle for the emergency brake. This handle is an aid to short people, who experience difficulty in reaching the emergency brake, also to help them keep their eyes



Short Armed People Will Find This Extension Brake Handle Invaluable.

on the road when pulling upon the brake in a traffic jam, or in any other situation equally as dangerous.

This device can be used on practically every make of car on the market, and will undoubtedly prevent many heretofore unavoidable accidents, and is also of great help to women who have been restrained from driving cars owing to this handicap.

Contributed by FRED SMITH, JR.

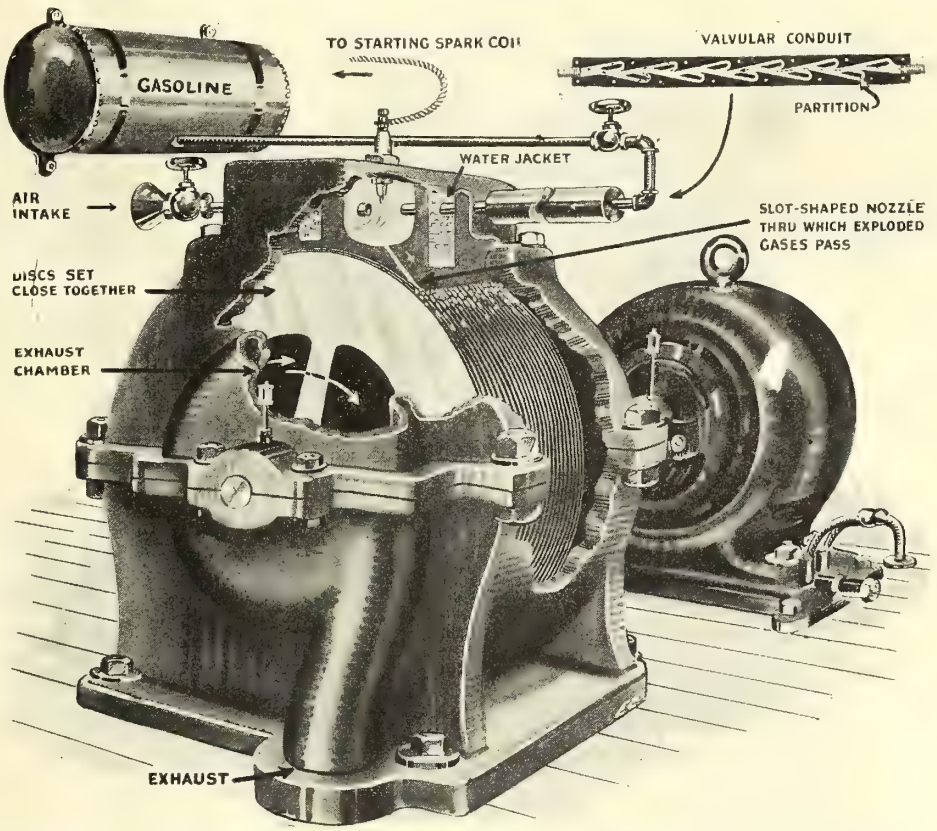
The Tesla Gasoline Turbine

By JOSEPH H. KRAUS

A Revolutionary Gas Engine That Requires No Spark Plug, No Carburetor, No Valves and No Pistons.

An immense amount of work has been done during the past fifteen or twenty years by engineers who have endeavored to produce a simple and practical *explosive gas turbine,* but the mechanical and thermal hindrances have been so great that up to the present time no signal success has been achieved. The turbine is an ideal prime mover; simple in principle, but the accessory apparatus for operating it explosively is very complex and liable to great wear. Thus the products of an explosion must affect the rotor, during which time a number of operations have to be performed.

Fuel and air must first be admitted thru separate channels into a combustion chamber; the mixture is then ignited, all inlets and outlets closed. The comprest gases thus exploded must be directed thru a nozzle to the rotor plates or buckets and the chamber cleaned and made ready for the admission of a fresh mixture.



The Very Latest Invention in the Gasoline Engine Field Is the New Tesla "Valveless and Bucketless Gasoline Turbine," Here Illustrated. Two of the Main Features of This Remarkable Invention Are That the Usual Carburetor or Vaporizer Is Done Away With and, Secondly, No Buckets Are Necessary on the Turbine Blades, the Latter Simply Comprising a Series of Flat Steel Discs, Placed a Short Distance Apart. The Successive Explosions of the Gaseous Vapor Are Projected Thru a Nozzle on to the Blades, Thus Causing the Rotation of the Blade Members and the Shaft to Which They Are Connected. A Dynamo Is Shown Connected to the Turbine at the Right of the Picture Herewith. This Article Was Prepared in Collaboration with Dr. Tesla.

All these operations are controlled by *valves* which must be opened and closed at precise moments and therefore are generally controlled by the motion of the turbine rotor itself. Irrespective of the difficulty of keeping the valves in good order at high temperatures, at which they must operate the apparatus taken as a whole, is so complicated that the ordinary form or reciprocating type gasoline engine is more preferable.

Doctor Nikola Tesla, whom the readers of this publication know very well and whose amazing work in the various scientific fields is also universally recognized, again comes into the limelight with a very remarkable explosive gasoline turbine perfected by him recently which he describes in detail in a patent just granted. This remarkable turbine does away with all the troubles and complexity of the former attempted types. Stated briefly, the invention consists in the production of a peculiar shape *conduit,* thru which the gases are admitted into the turbine, and which has the singular property of permitting their passage in that direction only; in other words, uni-directionally.

This device when used in connection with his *bucketless* turbine produces an engine which may be explosively operated by gasoline, alcohol or other fuels and is absolutely *devoid of all valves.* It is the simplest internal combustion motor conceivable. Owing to the tremendous output of the Tesla turbine, one single disc being practically equivalent in performance to a whole bucket-wheel, a very small machine of this kind is capable of developing an astonishing amount of power. The principle of the operation will be clearly understood by the aid of the accompanying diagram.

Referring to the detailed view of the conduit, we first note a casing of metal or other suitable material which may be milled or prest from sheet metal into the desired form. From its side walls extend alternately projections terminating in buckets which in order to facilitate manufacture are congruent and spaced at equal distances.

In addition to these there are independent partitions, the purpose of which will presently be made clear. There is a nipple at each end provided for pipe connections. The bottom is solid and the upper or open side is closed by a close-fitting plate. When desired any number of such pieces may be joined in series, thus making up a valvular conduit of such length as the circumstances may require.

In elucidation of the mode of operation let it be assumed that the medium under pressure be admitted at the right. Evidently its approximate path will be as indicated by the dotted line, which is nearly straight, that is to say, if the channel be of adequate cross-section the fluid will encounter a very small resistance and pass thru, freely and undisturbed, at least to a degree. Not so if the entrance be at the opposite end.

In this case, the flow will be smooth and continuous, but intermittent, the fluid being quickly deflected and reversed in direction, set in whirling motion, brought to rest and again accelerated, these processes following one another in rapid succession. The partitions serve to direct the stream upon the buckets and to intensify the actions, causing violent surges and eddies which interfere very materially with the flow thru the conduit.

Examining more closely the mode of operation, it will be seen that in passing from one bucket to the next in the direction of disturbed flow the fluid undergoes two complete reversals or deflections upon itself thru 180 degrees, while it suffers only two small deviations of about 10 to 20 degrees when moving in the opposite sense. In each case the loss of head will be proportionate to a hydraulic coefficient dependent on the angle of deflection, from which it follows that, for the same velocity, the ratio of the two resistances will be as that of two coefficients. The theoretical value of this ratio may be 200 or more, but must be taken as appreciably less altho the surface friction too is greater in the direction of disturbed flow. In order to keep it as large as possible, sharp bends should be avoided.

The illustration shows in perspective cross-section a turbine which may be of any type but is in this instance one invented and described by Dr. Tesla, and familiar to engineers. Suffice it to state that the rotor of the same is composed of flat plates which are set in motion thru the same and viscous action of the working fluid, entering the system tangentially at the periphery or outer circumference, and leaving it at the center.

Such a machine is a thermodynamic transformer of an activity surpassing by far that of any other prime mover, it having been demonstrated in practise that each single disk of the rotor is capable of performing as much work as a whole bucket-wheel of the ordinary type. Besides, a number of other advantages, equally important, make it especially adapted for

(*Continued on page* 316)

Is Life Electrical?

By ROGERS D. RUSK, M. A.

LOOK at the accompanying diagram, Fig. 1, of a living cell in the process of dividing into two cells. What is the force causing the cell to live, grow, divide and grow some more? One theory is that it is electrical. Life, electricity and gravitation are the three most mysterious forces in nature, and life is the most mysterious of the three. Electricity can be isolated and studied; gravitation follows rigorous laws which are partially known, but the secret of life has defied the efforts of science.



Fig. 1. "A." The Force Which Causes a Living Cell to Reproduce by Dividing in Two is First Manifested in the Part C Called the Centrosome. "B." By Some Mysterious Attraction, Which is Possibly Electrical Minute Bodies in the Fibres of the Nucleus (Called Chromosomes) Are Split In Two and Pulled to the Two Parts of the Centrosome. "C." Then the Outside Cell Wall Divides and the Two Cells are Formed.

The human body is made up of countless millions of these living cells. The simplest one of them can do all and more than man can do in his finest scientific laboratories. Every cell builds easily the most complex chemical compounds which it needs to support life, and what some of the lower animals can do is astonishing. The gymnotus, or electric eel, has been known to generate in its body enough electricity to give a severe shock, and at times enough to kill a horse. The firefly generates a kind of light without heat which man cannot imitate. The deep sea angler is one of the curiosities of science as it carries its own electric light on a long proboscis so it can see to eat in the dark. The angler is shown in Fig. II, and the light is generally carried so as to illuminate its protruding jaws.

In order to discover what life is the first problem is to discover where it is. This is a discouraging task. The biologist examines a living cell in the highest powered microscope but fails to discover the secret. The chemist then studies the compounds of which the cell is composed and decides the search must be carried still deeper. The physicist begins where the chemist leaves off and searches among the atoms and the minute electrical particles of which they are composed only to find the answer has slipt thru his fingers.

Life could not exist without the chemical changes which take place in the cell, but what is it that causes these chemical changes? The startling developments of electrical science have shown us that all forms of matter, both living and non-living, are composed of minute electrical particles called electrons, and it is these which are the probable causes of all chemical action. One of the most important chemical processes in the body is catalysis. This is the wonderful property of a minute amount of various substances to cause chemical change without being used up themselves. Examples of this are plentiful. The enzymes of the body cause the digestion of food in this way. Ptyalin in the saliva changes starch to sugar similarly. A small amount of invertase may transform two hundred thousand times its own weight of sugar. Various glands in the body secrete fluids such as adrenalin, which have a similar action and which are the accelerators of the body. It is on this basis that Dr. Serge Voronoff recently suggested taking glands from apes and supplying new accelerators to the body when the old ones are worn out, thereby renewing youth. This process of catalysis is a familiar one to the chemist, and if chemical change is due to the electrical nature of atoms, then catalysis which accelerates these changes must also be electrical in nature.

Growth and reproduction are the essentials of life, and evidently in reproduction the living force is passed on by the parent to the offspring. How this is done in a single cell is shown in Fig. I. The three most important divisions of the cell are the body of the cell, the nucleus, and the centrosome. When one cell gives birth to another by dividing in two, the dividing process is first noticed in this part of the cell called the centrosome, which is shown in the figure. This centrosome divides in two and the parts slide around to opposite sides of the nucleus where by some strange attraction they pull the nucleus into two parts, and the whole cell divides, forming two small cells which in turn grow and divide the same way. This is about all we know about life except that all inherited qualities are carried from one cell to the next by small particles called chromosomes which are found in the fibrous network of the nucleus as shown.

The electrical theory of this process of reproduction is that the two parts of the centrosome, which are the first to divide, take on opposite electrical charges and thereby attract the chromosomes from the nucleus by electrical attraction. This is an interesting theory and whether it is the true explanation or not remains to be proved. Scientists have been able to do wonderful things but they have not been able to produce life from non-living matter which does not contain the germ of life. This has been often tried. By chemical means all the compounds of which the cell is composed have been analyzed, then by still more exacting and laborious work all of these compounds have been reproduced by artificial means in the laboratory. A chemical cell can actually be made which is like the original cell in every way except that it will not assimilate food. The chemical compounds are there but the mysterious spark of life is absent.

Not long ago Prof. Loeb announced that he had succeeded in making a non-fertile frog's egg hatch and the frog grow by chemical means. This was done by catalysis, the chemicals stimulating the egg to growth. But it was a real egg, and contained the spark of life to begin with even if it had not been fertilized. The frog was short lived and evidently the chemical stimulus was only momentary instead of continuous as life is. The same experiment has been tried on artificial eggs made in the laboratory, but no evidence of life is found.

Molecules of living matter are for the most members of a class to which the name organic is given because it was one time thought they did not exist except in living bodies. This is now known to be untrue as the chemist has shown, but one outstanding fact is that these seemingly complex molecules are really made up of combinations of a few very common elements, the four most important of which are carbon, oxygen, hydrogen and nitrogen. There is nothing mysterious about these elements by themselves more than there is about any other elements. In fact in living organism they often do not seem to have as much energy as they do in some other form. For example, nitrogen as a constituent of high explosives is imbued with tremendous energy and is a giant in strength, while in living organism it is meek and mild in character, its tremendous energy lying dormant or being diverted in some manner.



Fig. 2. A Fish that Carries Its Own Electric Light. The "Deep Sea Angler." The Source of the Energy Supplying the Light Is Thought to Be Basically Electrical; or of Nervous Origin, Which Is Considered Now-a-Days as Closely Akin to Electricity in Nature, if not Wholly So.

The most striking property of matter that has yet been discovered is radioactivity. Even some of the commoner elements have been found to be radioactive, and it is doubtful whether there are more than a few elements, if any, to which this property does not belong, at least to some minute degree. If this is true it may be that radioactivity is one of the forces at work in the living cell and such a discovery would open up a new realm of study and investigation.

Life is so familiar and fundamental a process that it is almost impossible to define. There are no words more fundamental in which to explain it. It has been said that life is the capacity for self-movement; that it is the force which resists death; that it is the property of growing things; that it is a reaction continually adjusting the body to its environment, and so on. These all express a part of the true meaning of life, but the strange thing is that the most of these would also apply to non-living matter. The atoms of a gas have the capacity for self-movement, for they are constantly moving and their energy seemingly never dies. Crystals grow into definite forms, and a stretched spring reacts and pulls back against a force, moreover in time it tires just as a muscle does.

Not only biology, but chemistry, physics and all the other sciences have contributed their share in the effort to solve the problem of life. A single living cell may be composed of billions of atoms, each atom made up of electrons. Study the cell by itself, or the atom, or the electron, and the mystery of life eludes us. It is not in a single electron or a single atom. Neither is it in any mathematical formula or physical law. The ultimate causes back of the phenomena of life are too fundamental to be expressed in this way, and perhaps too fundamental to ever be grasped in their entirety by the finite mind of man. Certain it is that the trend of science as a whole is toward the view that the electron and electricity are basic factors in all processes, either organic or inorganic.

PUBLISHER'S ANNOUNCEMENT

THE ELECTRICAL EXPERIMENTER was founded in May, 1913, seven years ago, to supply an insistent demand for a class of literature that was not represented adequately in America at the time.

The experimenter, electrical and otherwise,—that vast horde of intellectual Americans, in whom the physical progress of the country is centred—had but scant literature to choose from, back in 1913. The ELECTRICAL EXPERIMENTER filled that want and filled it completely. Its success was instantaneous, which is best shown by the fact that it doubled and tripled its circulation year after year, till at this moment it has reached a total of close to 200,000 copies a month.

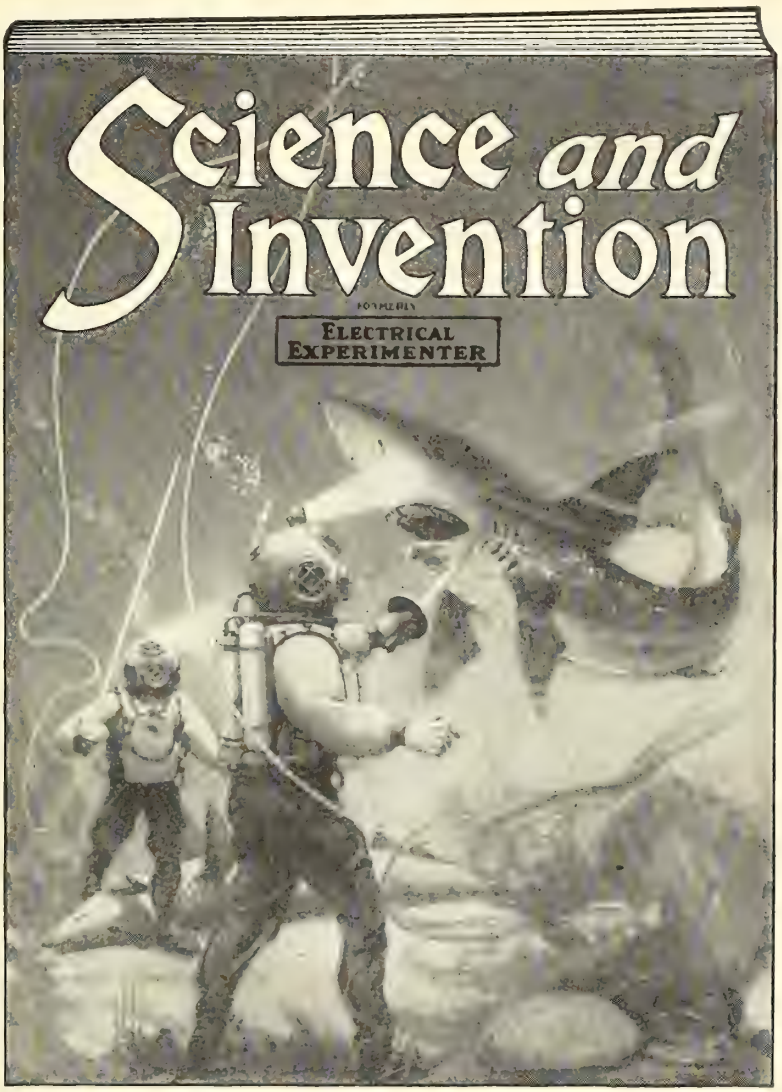
But your average experimenter wants more than experiments. He wants to know the latest word in science, the newest invention, the latest developments in the realm of human endeavor. He wants to know what the scientists and his fellow workers are doing the world over, and he wants these facts in plain English, adequately illustrated.

This was made plain to us during our second year, and we began adding a "general" section, being urged insistently to do this by our readers. We kept on adding department after department, such as physics, chemistry, astronomy, etc., until by the end of the fourth year, our title *"Electrical Experimenter"* had become a misnomer. While we have constantly kept on increasing all of our electrical departments, keeping true to our original editorial policy, there came a period a few years ago, when thousands of general readers — the "non-experimenters," suddenly discovered a strong appetite for our magazine, even tho its title did not fully describe its contents.

The business man, the manufacturer, the doctor, the professor, the student and countless others found in the ELECTRICAL EXPERIMENTER an intellectual gold mine, second to none. The ELECTRICAL EXPERIMENTER always has and always will appeal to the thinking class.

When we found out two years ago that the general public began buying the magazine, we added the sub-title "SCIENCE and INVENTION," which portrayed the contents of the magazine more adequately. There was, of course, no change of policy at that time, except that we kept on enlarging and bettering the magazine as you well know. We kept all of our old friends and supporters—the ones who buy the ELECTRICAL EXPERIMENTER mostly for the experimental section, and we added besides many thousands of new readers who derived their greatest pleasure from the other "general science" departments.

But we are out for the half million mark, because we know from past experience that the greater the circulation the better we can make the magazine, the more text we can give, the better we can satisfy *all* readers.



But our old misnomer, the title ELECTRICAL EXPERIMENTER, was constantly in our way. To be sure, if we could once get a man to take a peep at the inside of the magazine, nine-tenths of our battle was won. But the general public would look at our cover and the cryptic words ELECTRICAL EXPERIMENTER, would shoo them away!

For August

Electrocuting Sharks. By H. Gernsback.

The Master Key—A bit of Scientific Fiction that Will Hold Your Interest to the Very Last Word. By Charles S. Wolfe.

A Popular Explanation of the Fourth Dimension and Hyper-Space. By Frank M. Gentry.

How the Loud-Speaking Telephone Served the Republican Convention.

First Electric Welded Building. By H. B. Payne, Electric Welding Engineer.

Movies of the "Unseen"—How Students Can Now Actually see Electric Currents in Electro-Magnets and Dynamos. By Jerome Lachenbruch.

Man-Made Rubies — How the Chemist Constructs Synthetic Rubies Which Cannot be Told from a Genuine Stone. By O. Ivan Lee, B. Sc. Chemistry.

Of course, we could have stuck to the old title and in years the public would have come to us in increasing numbers, but at a large and useless cost to us. So we decided to reverse our titles, and beginning with the August issue, your magazine will be known officially as "SCIENCE and INVENTION." As a sub-title we will continue with our good old standby ELECTRICAL EXPERIMENTER, as you can readily see from the accompanying illustration, which represents our *August* cover.

There will, of course, be no change in our Editorial policy. We will continue bettering and enlarging the magazine just as we have always done. We will have more pages and better ones for the experimenter, and more and better Science and Invention pages for the general reader in quest of information and who can not properly exist in this changed world without keeping abreast of everyday science.

ELECTRICAL EXPERIMENTER (*Science and Invention*) has become an American institution today. It is probably the most authoritative magazine of its kind in the world. It reaches every land of the globe and is read everywhere. Our articles have and are being translated constantly into French, German, Italian, Spanish, Japanese, Dutch and even Arabian. In America there is no first-class periodical or newspaper that does not very frequently quote from our pages. Publications such as *Literary Digest,* New York *Times,* all of the Hearst papers, New York *World,* New York *Sun and Herald,* New York *Tribune,* New York City *Mail,* New York *Evening Post,* Chicago *Tribune,* Philadelphia *Inquirer,* Boston *Post,* St. Louis *Globe-Democrat,* Cincinnati *Enquirer,* Cleveland *Plain-Dealer,* San Francisco *Chronicle,* Pittsburgh *Gazette-Times,* Boston *Globe,* Minneapolis *Star,* Albany, N. Y., *Argus,* De Moines *Capital,* Washington, D. C., *Times,* Syracuse, N. Y., *Herald,* Pittsburgh *Press,* Dallas, Texas *Times-Herald,* Rochester, N. Y., *Herald,* Lancaster, Pa., *Intelligencer,* Rome, N. Y., *Sentinel,* Sterling Vermont *Free Press,* Attleboro *Sun,* Knoxville *Tribune,* Buffalo *Commercial,* Atlanta *Constitution,* Baltimore *News,*—nearly every Sunday magazine newspaper section, and hundreds of other smaller papers, too numerous to mention, *constantly* quote from our columns.

There is, of course, a good reason for this. ELECTRICAL EXPERIMENTER (*Science and Invention*) "has the goods." Moreover, your magazine almost invariably has the *news first*—the same items appearing later in other periodicals. That is why we lead and why *Science and Invention* shall continue to lead and to serve you.

We have won your confidence in the past, and we believe that we will keep it.

We thank you for your past generous support and we know that you will not find us wanting. —*The Publishers.*

Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory

The Motions of the Heavenly Bodies

THREE hundred and twenty years ago Giordano Bruno was burned at the stake for his audacity in believing in the existence of other worlds. A few decades later the famous astronomer Galileo was forced to publicly recant his belief that the earth moved. Yet the truth could not long be suppressed by such means, and since those dark days man's advance in knowledge has been so rapid that it seems to us to-day in this wonderful age of scientific discovery almost inconceivable that man ever believed that the earth, a tiny planet of a vast solar system, was "the hub of the universe," the fixt and immovable center about which revolved all the heavenly bodies. Very reluctantly, however, and with bitter feeling in the light of overwhelming evidence man finally gave up his long cherished idea of terrestrial importance, and when finally forced to move his fixt center of the universe, he moved it only so far as the comparatively nearby sun.

This center he then regarded as fixt in space, still holding to his belief that the stars, set in an imaginary celestial sphere were "fixt" in space as well and all at the same distance from the sun. So, scarcely two hundred years ago we find that the astronomer Bradley was endeavoring to measure this common distance of the "fixt stars." Tho he failed in this attempt he made the important discovery that the observed positions of the stars are affected by the fact that the velocity of light is not infinite but takes a definite finite interval of time to travel a given distance. As a result the stars always appear displaced in the direction of the earth's motion around the sun, the amount of the displacement depending upon the velocity of the earth and the velocity of light. This "aberration of light," as it is called, furnished additional proof that the earth revolves about the sun and was one more nail driven into the coffin of the old Ptolemaic theory that the earth was the center of the universe. Bradley also discovered that the positions of the stars were affected by the wabbling of the earth's axis called its "nutation."



At Right: The Pleiades—A Slowly Drifting Star Cluster in the Milky Way Comparatively Near to the Solar System. It Is Believed That the Nebulosity Surrounding These Stars Shines Partly by Reflected Light from the Stars with Which It Is Associated. All of the Pleiades Are Very Brilliant Suns from Ten to Two Hundred Times More Luminous Than Our Sun. Alcyone Is the Brightest.

Left and Center Views:—A Spiral Nebula.—It is Estimated That More Than Seven Hundred Thousand of These Objects Are Within Reach of Great Telescopes. They Are the Subject of Much Discussion at the Present Time. It is Unknown Whether They Are "Island Universes" Far External to the Milky Way System of Stars and Similar in Form to It or Whether They Are Subordinate to Our System of Stars. Both Views Have Their Strong Supporters Among Foremost Astronomers of To-day. If They Are "Island Universes" We Have Here an Excellent Model of the Milky Way System of Stars to Which Our Sun Belongs as Viewed at Right Angles to the Line of Sight. Viewed Edgewise the Spirals Appear Greatly Flattened and Surrounded by a Band of Dark Absorbing Matter. They Are Moving in the Edge-wise Directions with an Average Velocity That is Twenty-five Times the Average Velocity of the Stars or 480 Miles Per Second. They Are the Most Rapidly Moving Bodies in the Heavens and Lie Exterior to the Milky Way in the Direction of Its Poles. Their Distances Are Not Yet known.

Altho in the days of Bradley neither the methods of observation nor the instruments were sufficiently accurate to show the minute shifts in the positions of the stars that reveal the individual motions of the stars and the distances of those nearest to us, yet the discovery of the two large displacements in the positions of all the stars, due to the aberration of light and the nodding of the earth's axis were of the greatest value, for they were a necessary step in the direction of the precise measurements of modern times. It is only thru measurements of the greatest refinement and accuracy that it is possible to detect the motions and distances of the stars and to discover the wonderful truths about the nature and structure of the universe that they are revealing to us to-day.

After unsuccessful attempts extending over several centuries the distance of one of the nearest stars, the faint 61 Cygni, as it is catalogued, was finally determined by the astronomer Bessel in the year 1838.

This star is about ten light years distant from the earth which places it about six hundred and thirty thousand times farther away from us than the sun: that is, we would have to travel six hundred and thirty thousand times the distance from the earth to the sun to reach this very close stellar neighbor 61 Cygni. The *nearest* of all the stars is over two hundred and seventy thousand times the distance from the earth to the sun. It is, therefore, little wonder that the early astronomers believed that the stars were fixt in space since even the nearest is so far away that viewed from opposite positions in the earth's orbit its angular displacement amounts to only one and a half seconds of arc. Two stars separated by *one hundred and sixty times* this angular distance might possibly be glimpsed as two distinct stars by a person with good eyesight tho to most of us they would appear as one star. Upon the measurement of such minute angles depended a knowledge of the distances of the nearest stars.

It is to Sir William Herschel that we owe the discovery, more than a hundred years ago, of the motion of the sun thru the universe. From the consideration of a long series of observations of the positions of the stars this famous astronomer discovered that the stars in the direction of the constellation Hercules were separated by much greater angular distances than the stars diametrically opposite in the heavens. In other words, the stars were spreading

apart in one portion of the heavens and crowding together in the opposite direction and he rightly interpreted this to mean that the sun was moving in the direction of the constellation of Hercules. It was not until the spectroscope was applied to the study of the heavens in the latter part of the nineteenth century that the amount of this motion of the sun was found to be about twelve and a half miles per second or four times the distance from the earth to the sun in a year.

It is to Sir William Herschel that we also owe the discovery of binary systems of stars in which two stars are in mutual revolution about their common center of gravity.

Our first conception of the immensity and grandeur of the universe dates from the time of the older Herschel only a century or so ago. The mysterious nebulæ and star clusters were then discovered, the wonders of the Milky Way were explored, a new planet and satellites in our own solar system were discovered. It was found that the sun and the stars as well as the planets were in motion. Neither sun nor earth could be regarded any longer as a fixed point in the universe.

With the application of the spectroscope to the study of the heavens toward the end of the nineteenth century the key to a treasure-house of knowledge was placed in the hands of the astronomers of modern times and as a result we are now learning more, in a few decades, about the wonders and mysteries of the heavens than was granted to man to learn in centuries of earlier endeavor. Yet it is the feeling of the astronomer of to-day that he is only standing on the threshold of knowledge and that the greatest of all discoveries, that of the nature of matter and of time and space is yet to be made.

It is the spectroscope that tells us so many wonderful facts about the motions of the stars, nebulæ and star clusters. It tells us also practically all we know about the physical condition of our own sun and of the other suns of the universe, their temperature and age, and the peculiarities of their atmospheres.

Some of the most wonderful astronomical discoveries that have been made in the past few years relate to the distribution and velocities of the heavenly bodies as revealed by the spectroscope.

From a systematic study of all the various types of stars it has been found that the velocity with which a star is moving thru space is intimately associated with its type of spectrum (see Table I). The most slowly moving of all stars are the extremely hot bluish Orion stars with an average velocity of eight miles per second. The most rapidly moving stars are the deep-red stars with an average velocity of twenty-one miles per second, and there is a regular progression of velocity with type for all stars. The reason for this close association of type of spectrum with velocity still remains undiscovered.

The spectroscope has also told us some astonishing facts in recent years about the velocities of the spiral nebulæ.

According to the measurements of Dr. V. M. Slipher of the Lowell Observatory, these mysterious objects are moving with the tremendous average velocity of *four hundred and eighty miles per second,* which exceeds the average velocity of the stars fully twenty-five fold. They possess, moreover, internal motions of rotation that are almost as high as their velocities thru space. These results have been corroborated, also, by other observers and they strongly support the theory that spiral nebulæ are far distant objects of enormous size and mass exterior to our own universe of stars and similar to it in form.

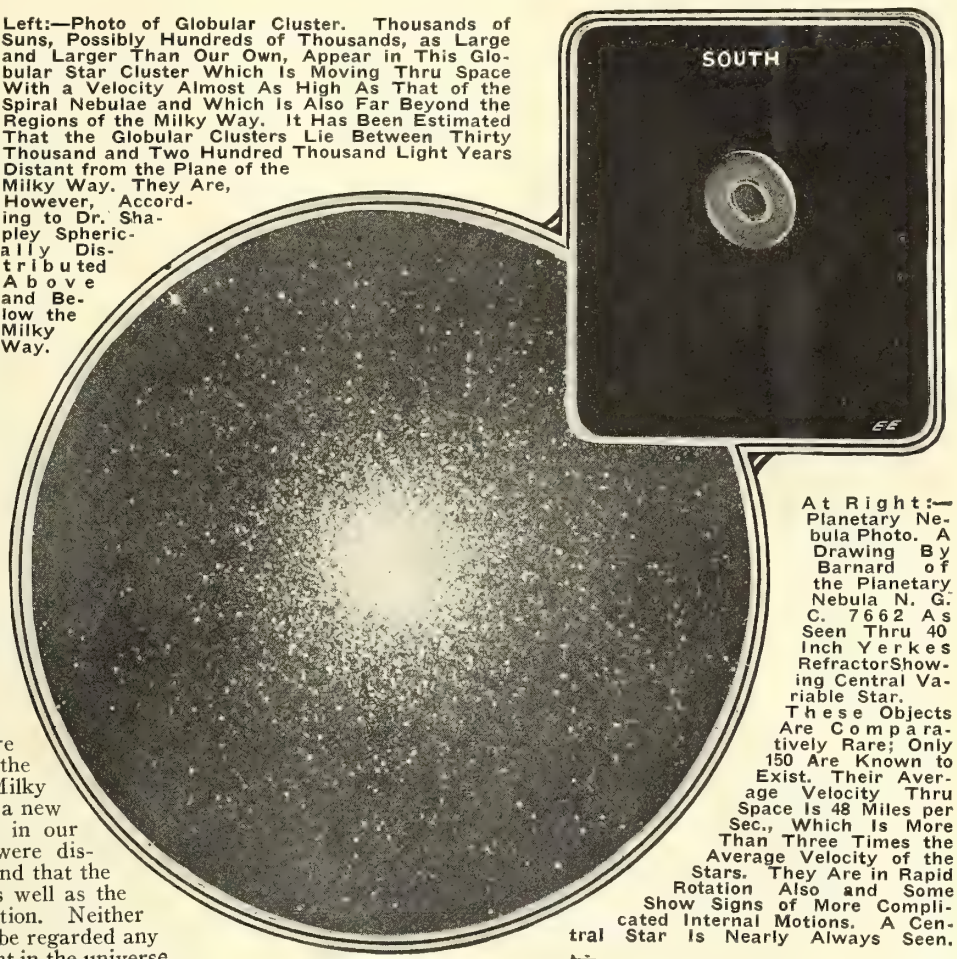
Certain observers have gone so far as to attempt to determine the motion of our own stellar universe as a whole relative to these spirals and have obtained the tremendous velocity of three hundred and seventy-five miles per second. For the universe of the "fixt stars" and the immovable sun or earth of the astronomers of a few centuries ago we find that modern astronomical discovery is substituting the vision of a universe of inconceivable grandeur and immensity in a state of ceaseless flux and change.

Our earth, an atom spinning about on its axis and revolving rapidly around a huge sun that is equal in volume to more than a million earths, is carried onward with this sun thru a vast universe of suns.

Only an average-sized star among several hundred million other stars is this huge sun of ours moving with its planet family thru the regions of the Milky Way, where are to be found not only moving clusters and groups of stars, speeding along their way in obedience to the laws of motion of the system to which they belong, but also strangely formed nebulæ covering vast stretches of space, whirling and seething internally and shining with mysterious light, and still other stretches of dark absorbent matter shutting off the rays of suns beyond.

The extent and form of this enormous system of stars and nebulæ and the laws that govern the motions of its individual members are among the problems that the astronomers of today are attempting to solve. On both sides of these regions of the Milky Way wherein lies our own solar system, lie other vast systems, such as the globular star clusters, composed of thousands, possibly hundreds of thousands, of suns, the Magellanic clouds which resemble detached portions of the Milky Way and the much discussed spiral nebulæ, the possible "island universes" similar to our own. All of these external systems are characterized by extraordinarily high velocities. Not only is their speed on the average twenty-five times as high as the speed of the stars in the Milky Way system of stars, but they are also in extremely rapid rotation. Assuming that these vast systems are independent of and analogous to our own universe of suns, we are led to the conclusion that our sun is but a stellar atom in a huge spiral star system flattened toward the plane of the Milky Way and that the individual

(*Continued on page* 312)



Left:—Photo of Globular Cluster. Thousands of Suns, Possibly Hundreds of Thousands, as Large and Larger Than Our Own, Appear in This Globular Star Cluster Which Is Moving Thru Space With a Velocity Almost As High As That of the Spiral Nebulae and Which Is Also Far Beyond the Regions of the Milky Way. It Has Been Estimated That the Globular Clusters Lie Between Thirty Thousand and Two Hundred Thousand Light Years Distant from the Plane of the Milky Way. They Are, However, According to Dr. Shapley Spherically Distributed Above and Below the Milky Way.

At Right:—Planetary Nebula Photo. A Drawing By Barnard of the Planetary Nebula N. G. C. 7662 As Seen Thru 40 Inch Yerkes RefractorShowing Central Variable Star. These Objects Are Comparatively Rare; Only 150 Are Known to Exist. Their Average Velocity Thru Space Is 48 Miles per Sec., Which Is More Than Three Times the Average Velocity of the Stars. They Are in Rapid Rotation Also and Some Show Signs of More Complicated Internal Motions. A Central Star Is Nearly Always Seen.

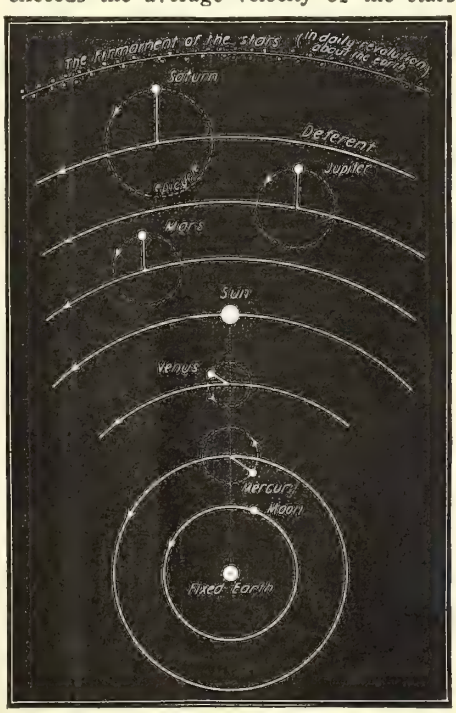


Diagram I.—The Motions of the Heavenly Bodies As Represented By the Ptolemaic System of the Universe and as Universally Taught and Accepted for Over Fourteen Centuries (150 A. D. to 1600 A. D.). The Earth Was the Fixt Center of the Universe About Which Revolved in Order, the Moon, Mercury, Venus, Sun, Mars, Jupiter and Saturn.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

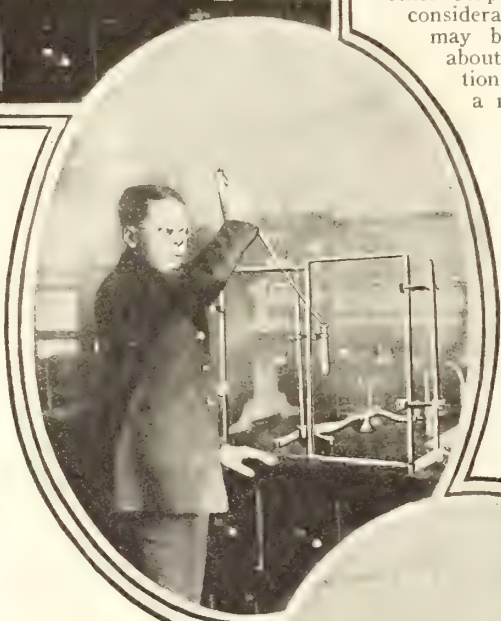
HOME-MADE FIREWORKS.



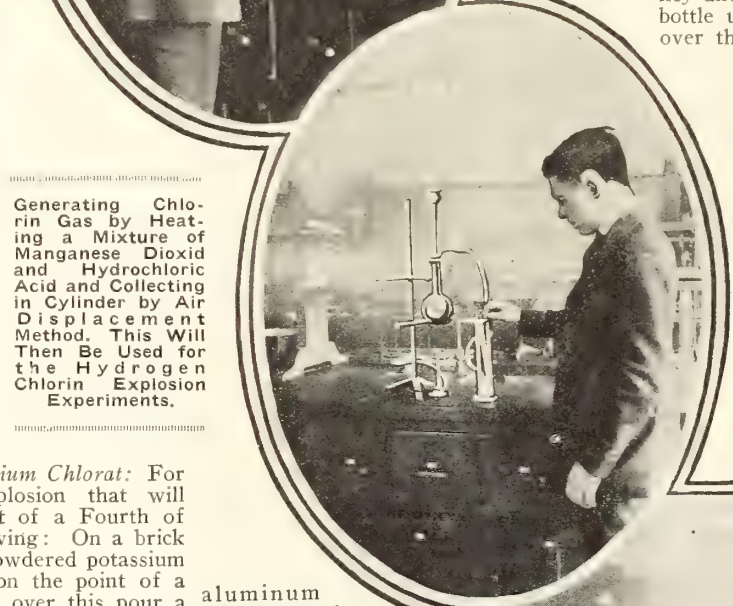
Generating and Collecting Hydrogen and Oxygen for Explosion Experiments. The Bottle Is Filled With Water, inverted, and the Gas Collected by Displacement Method. Two Parts of Hydrogen by Volume and One of Oxygen, Are Used.

OF all the interesting demonstrations possible for the amateur chemist, there are none that make a stronger appeal to his imagination than those which have to do with fireworks and explosions. And now, too, that the old-fashioned Fourth of July celebration has been largely banned, there is all the more reason for having an elementary knowledge of the chemistry of "Pyrotechnics." Therefore, I propose to give in this number a large quantity of ammunition, suitable for punctuating the outbursts of youthful patriotism and for satisfying that very legitimate desire for explosions and Noise!

Phosphorus and Potassium Chlorat: For a good roof-lifting explosion that will satisfy every requirement of a Fourth of July stunt, try the following: On a brick or anvil place as much powdered potassium chlorat as you can get on the point of a small knife blade. Then over this pour a few drops of a strong solution of yellow phosphorus in carbon disulfid. Wait for the solution to evaporate. This will leave phosphorus in finely divided state thruout the potassium chlorat powder and presently a very sharp report will occur. In case the explosion is slow in coming, strike the mixture with a hammer held in the gloved hand but under no circumstances touch it with the fingers. To make the solution of phosphorus, pick up a piece about the size of a pea with pincers, dry it gently with a piece of filter or blotting paper and quickly drop it into a small stoppered bottle of carbon disulfid. Shake for a few moments and the solution will be ready for use. Always keep phosphorus under water, cut it under water, and *under no circumstances touch it with the fingers.* In case of an accidental phosphorus burn, bathe it immediately with potassium permanganat solution and continue to do so at frequent intervals.



Exploding a Mixture of Aluminum Dust and Sodium Peroxid With a Drop of Water. Two Glass Plates Are Held in a Vertical Position by Means of Clamps in Front of the Test-Tube Containing the Mixture.



Generating Chlorin Gas by Heating a Mixture of Manganese Dioxid and Hydrochloric Acid and Collecting in Cylinder by Air Displacement Method. This Will Then Be Used for the Hydrogen Chlorin Explosion Experiments.

Explosion of Aluminum Powder and Sodium Peroxid: Another explosion of considerable violence may be brought about by the action of water on a mixture of aluminum powder and dry sodium peroxid. Make a mixture of the two powders in a dry test-tube and clamp the test-tube to a ring stand or other support placed behind a glass screen. See Fig. 1. Then allow one drop of water to fall on the mass from the end of a long glass tube. The water and sodium peroxid react to form oxygen which unites with the hydrogen liberated by the action of the resulting sodium hydroxid on the aluminum. The result is an explosion, *which shatters the test-tube!*



Exploding Hydrogen and Nitrogen by Means of an Electric Current, Weighted Protective Boxes Are Placed Around the Flask Containing the Mixture, so as to Prevent Injury Due to the Force of Explosion.

Explosion of Lead Nitrat and Sulfur: Place in an unglazed mortar or on an anvil equal quantities of finely powdered lead nitrat and flowers of sulfur. Holding a pestle or hammer in the gloved hand, rub the mixture vigorously and the result will be a rapid oxidation of explosive violence.

Explosion of Hydrogen and Oxygen: Hydrogen and oxygen mixed in proper proportions unite with tremendous energy, accompanied by a very loud report. To prepare the oxygen and hydrogen arrange apparatus as shown in Fig. 2. Fill an 8-ounce bottle or a small flask with water and invert it in a basin of water. First start the hydrogen generator, using zinc and dilute sulfuric acid and fill the bottle two-thirds full of hydrogen. Then start the oxygen generator, having in the tube a mixture of potassium chlorat and manganese dioxid, and fill the remaining one-third of the bottle.

Keeping the bottle mouth downward, lift it from the basin and quickly insert in it a solid rubber stopper carrying about it a loop of No. 30 iron wire. To the ends of the wire fasten two 3-foot lengths of No. 18 copper wire and connect them with a key and a half-dozen dry cells. Place the bottle under a small thin walled box and over this place a larger heavier box raising it on blocks about an inch from the floor or table as shown in Fig. 3. Close the circuit and the iron wire, heated to incandescence by the large flow of current, will ignite the mixture of hydrogen and oxygen. The explosion will give a very loud report and will probably shatter the inner box. (It will be safest not to connect the cells until the bottle has been covered.)

Nitrogen Iodid: An explosive of extreme sensitiveness and one which will give no end of amusement can be made from the reaction of iodin and strong ammonia water. Place a few cubic centimeters of the

strongest ammonia in the bottom of a test tube and mix with it an equal quantity of very concentrated tincture of iodin. The tincture of iodin can be made by shaking crystals of iodin with a little alcohol and continuing to do so until a considerable

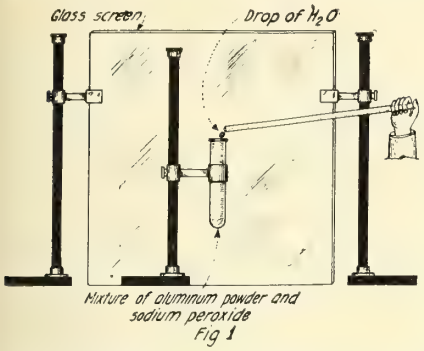


Fig. 1—Technique Employed in Exploding Aluminum Powder and Sodium Peroxide by Means of a Drop of Water.

quantity has been dissolved. When ammonia and iodin solutions are mixed, a precipitate of nitrogen iodin in the form of a black powder immediately separates.

This compound, however, is not at all explosive unless it is thoroly dry. But in that condition it is exceedingly unstable and only a very small amount is necessary to demonstrate this instability and the large quantity of energy that it contains. Therefore, shake up the contents of the test tube and pour successive small portions onto folded filter papers. To dry these will require at least two hours.

When dry tickle one of the papers with a long feather and even this slight friction will cause the nitrogen iodid to explode with a sharp report.

Blow upon another portion thru a long glass tube and the sudden puff of air will cause it to explode.

Hold one of the papers with the tongs and quickly depress it over a Bunsen flame. The violence of the explosion will extinguish the flame.

If placed on chairs or tables of a room any unusual jar like that caused by the shutting of a door or heavy treading upon the floor will cause the iodid to explode.

Always make these explosions at long range and when you are thru with them be sure that none of the stuff is left lying about.

Old-Fashioned Gunpowder: Before the days of modern high power explosives gunpowder was the product of sulfur and charcoal, two easily oxidized substances, together with the strong oxidizing agent, potassium nitrat. Therefore, to prepare powder of this sort, thoroly mix 30 grams of finely pulverized potassium nitrat with 5 grams each of powdered charcoal and flowers of sulfur. Place the mixture on a square of asbestos and ignite with a long wax taper.

Spontaneous Combustion: Over a filter paper or some piece of absorbent paper pour a little of the solution of carbon disulfid and yellow phosphorus used in the first demonstration described in this article. Then wave the paper to and fro in the air and in a few moments it will begin to smoke and spontaneously take fire. As the carbon disulfid evaporates, it leaves the phosphorus in a finely divided state over the surface of the paper, and its rapid oxidation soon generates enough heat to bring the phosphorus to its kindling temperature.

Touch Paper: For use as fuses in a number of the ignition experiments in this article, a quantity of touch paper will be found desirable. It can be made by saturating strips of filter paper or blotting paper in a strong solution of potassium nitrat and allowing them to dry. One of these strips will burn like the fuse of a firecracker and it cannot be extinguished by blowing. See Fig. 4.

Red Fire: In separate containers finely powder 1 gram of potassium chlorat and 11 grams of strontium nitrat. (*They must not be powdered together.*) Mix them with 4 grams of flowers of sulfur and ½ gram of lampblack. Place the mixture on an asbestos square and insert in the top of the conical heap a fuse of touch paper. Upon ignition an intensely red flame results and one of great brilliancy in a darkened room.

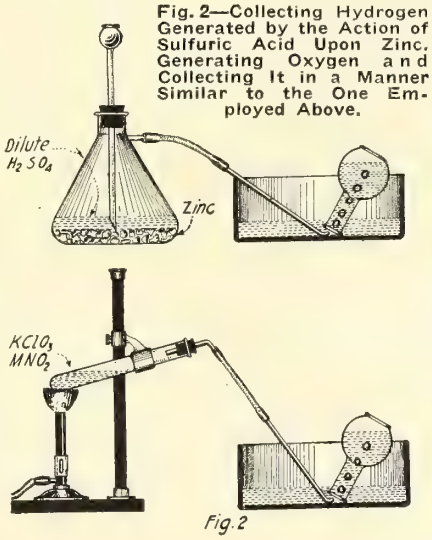


Fig. 2—Collecting Hydrogen Generated by the Action of Sulfuric Acid Upon Zinc. Generating Oxygen and Collecting It in a Manner Similar to the One Employed Above.

Green Fire: Observing the same precautions as in the previous experiment, mix 3 grams of pulverized potassium chlorat with 8 grams of finely powdered barium nitrat and 3 grams of flowers of sulfur. Place the mixture on asbestos and ignite with touch paper. A brilliant green results.

Purple Fire: Mix in finely powdered condition 2 grams of copper sulfate, 2½ grams of flowers of sulfur and 15 grams of potassium chlorat. Ignite on asbestos with touch paper or a long taper.

A blue flame may be obtained by igniting a mixture of 2 grams of powdered charcoal, 2 grams of cupric chlorid and 4 grams of potassium chlorat.

Flash Powder: A flash light of blinding intensity can be produced by the ignition of a mixture of equal parts by volume of finely powdered potassium chlorat and magnesium dust. *In lighting this mixture, however, never attempt to do so with a match.* Instead use a long wax taper or a piece of touch paper. The combustion comes with great suddenness and otherwise a severe burn would be incurred. Flash powder made in this way will give excellent results in photography work.

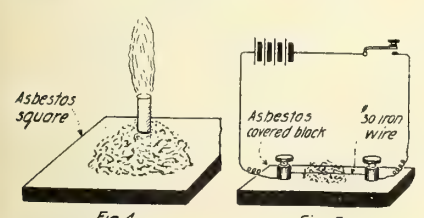


Fig 4—The Very Simple Method Employed in Igniting Powder With Touch Paper.
Fig. 5—Igniting Flash Powder by Means of Electricity.

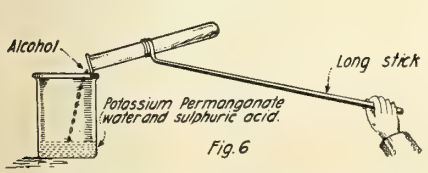


Fig. 6—Combustion of Alcohol in an Atmosphere of Ozone. The Alcohol Is in a Test-Tube at the End of a Protective Stick.

Ignition by Electricity: A very safe method and an interesting one, too, for igniting a combustible mixture is by means of electricity. Cover a six-inch square of wood with asbestos paper and mount on it two brass binding posts. Between the posts

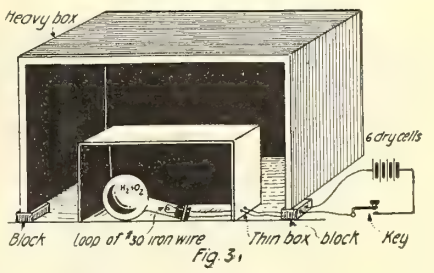


Fig. 3—Showing the Position of the Flask and the Protective Boxes, Preparatory to Closing the Circuit Which Will Explode the Mixture of Hydrogen and Oxygen in the Flask.

insert a piece of No. 30 iron wire and on this wire place the heap of combustible powder, whatever it may be. Then connect with the binding posts by means of medium size copper wire a half dozen dry cells, inserting a key of some sort in the circuit. Upon closing the key the iron wire will be heated to incandescence and the mixture will ignite. See Fig. 5.

A Sparkler: If a stick of potassium chlorat is rubbed on the igniting surface of a safety match box, a shower of sparks will be thrown off.

Combustion in Ozone: In the bottom of a tumbler place 1 gram of powdered potassium permanganat and moisten it with a few drops of water. Into the bottom of the tumbler pour 2 cubic centimeters of concentrated sulfuric acid and follow it with 1 cubic centimeter of alcohol poured from a test-tube attached to the end of a long stick as in Fig. 6. A combustion of almost explosive violence follows, due to the presence of ozone.

Sift a pinch of sulfur into another tumbler prepared in the same way and it will immediately be ignited.

Into a third tumbler of the mixture dip a glass rod and touch it to the wick of an alcohol lamp. It will ignite at once.

Combustion of Sugar and Potassium Chlorat: Being careful to avoid friction carefully mix equal quantities of finely powdered potassium chlorat and cane sugar. Then saturate a small piece of asbestos paper with concentrated sulfuric acid and holding it with the tongs drop it on the mixture placed on a square of asbestos board. A very rapid combustion accompanied by an intensely blue flame results.

Explosion of Sodium Peroxid and Charcoal: Mix equal quantities of dry sodium

(*Continued on page* 315)

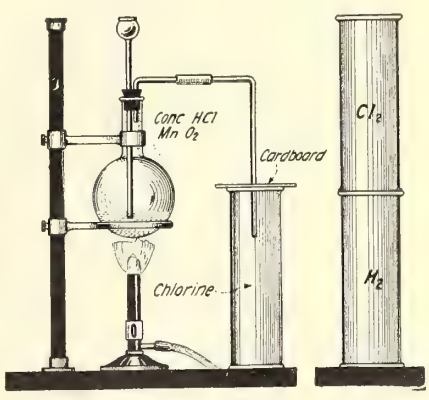
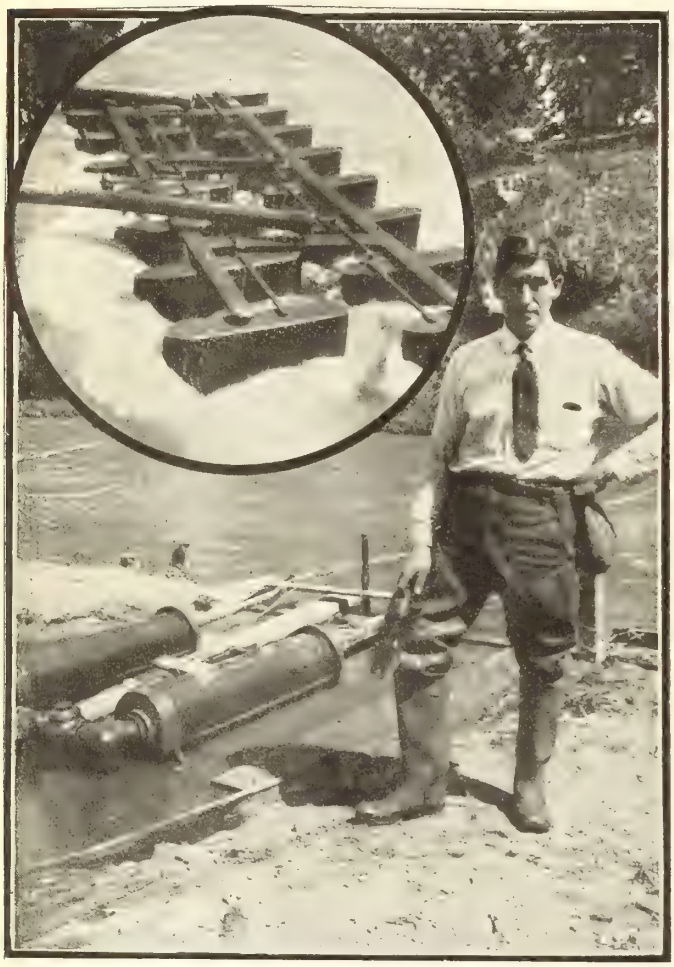


Fig. 7—Generating Chlorin and Placing It Into a Cylinder by Displacing the Air, Chlorin Being a Much Heavier Gas, Pours Downward Very Readily.

Electricity From Water-Power

By H. WINFIELD SECOR



The Two Photographs Herewith Show One of the Latest Inventions In Water-Power Utilization, as Devised by Mr. F. L. Gilman, of Los Angeles, Cal. The Device Is so Constructed That When Anchored in Midstream the Pivoted Floats, of Which There Are Two Series as Shown in the Photos, Are Caused to Sway Back and Forth, and in Doing so This Action Causes the Operation of Two Pistons. The Pistons in the Model Here Illustrated Have a Stroke of 22 Inches and Pump 80 Gallons of Water Per Minute Thru a Three-Inch Pipe to a Height of 18 Feet. See Also the Diagram Below.

How to Compute the Horsepower of Streams and Build Water-Wheels

AS the Springtime rolls around, the young experimenter's fancy lightly turns not to "thoughts of love," as the poet has it, but frequently to more scientific thoughts, and where the dreamy thoughts of Spring are influenced by a babbling brook, the minds of those with a scientific trend cannot resist the temptation to harness the power constantly going to waste in brooks, rivers and ponds.

Some time ago, or to be exact, in the July and August, 1916, issues of this journal, the writer had the pleasure of presenting an exhaustive article dealing with the design and the construction of water-wheels both large and small, as well as complete electric generating plants driven by water-power. In the present discussion the highly technical and mathematical features necessary in carrying out a first-class design of high efficiency water-wheel will be ignored, and those interested in these details can consult their back numbers or look the matter up in the files at their local library.

A NEW WAVE AND CURRENT MOTOR

Considering the development of water-power from streams, rivers and even the motion of the ocean waves, we may before going further take notice of the invention shown in two of the accompanying photos and also in diagram at Fig. 1. This new water-power plant is the invention of Mr. F. L. Gilman, of Los Angeles, Cal. It is so constructed that when anchored in midstream the pivoted floats, of which there are two, are caused to sway back and forth, and in doing so this action causes the operation of two pistons. The pistons of the model here shown have a stroke of 22 inches and pump 80 gallons of water a minute thru a three-inch pipe to a height of 18 feet.

In the diagram Fig. 1 a modified arrangement of this water-power engine is shown, according to the writer's idea, whereby the alternate action of each of the two or more pistons is caused to compress air. Each pulse of air from the respective cylinders is forced into a large air storage tank. From here the comprest air under a considerable pressure enters the pneumatic engine or motor, which in turn may drive a dynamo or operate machinery directly connected to the prime mover. In this way a steady pressure of air is available at all times to operate the pneumatic engine or motor which would not be the case if the fluctuating air pulses coming directly from the air pumps on the shore were utilized directly.

This scheme can also be utilized in the way Mr. Gilman is now using it; that is, by pumping the water, but instead of pumping it into a reservoir for drinking or other purposes a large battery of these pumps could be employed, all of them pumping water into a large tank or reservoir elevated at an appreciable height, so as to give the water a good head pressure. The water can then be taken from this reservoir thru a suitable penstock or pipe to a water turbine, and in this way the intermittent character of the water impulses transmitted from the wave-operated shore pumps would be eventually transformed into a steady power, owing to the great quantity of water impounded into the reservoir as becomes clear on second reflection.

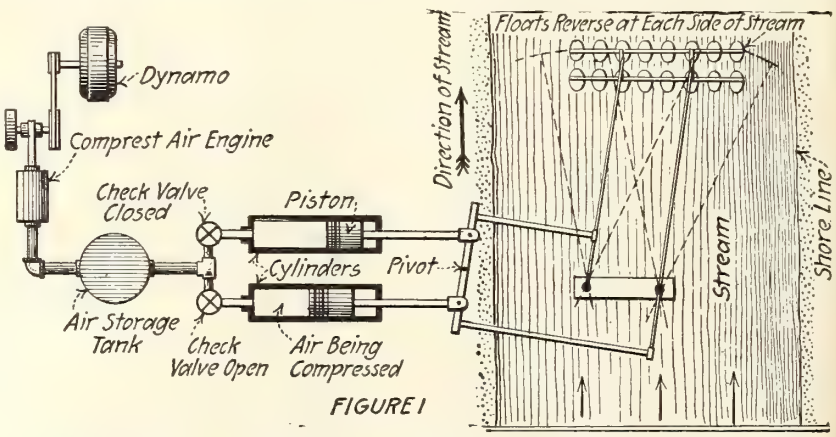
COMPUTING THE HORSE-POWER OF STREAMS.

Resuming the subject of developing water-power by wheels or turbines, we may turn to the commonest arrangement met with in practise, that of harnessing a brook or small river to a turbine. One of the simplest ways of doing this is seen at Fig. 2, where a dam is placed across the stream far enough up-stream from the turbine to get sufficient head in feet to operate it. Every foot head of water creates a pressure of .433 pound per square inch. Hence a 20-foot head or drop in the water would give 8.66 pounds pressure per square inch, etc. This relation is clearly shown in table No. 1 at the end of this paper.

One of the first considerations in placing a water-power plant of any size is to see whether or not a sufficient quantity of water is available in dry seasons, etc., to operate the wheels or turbines. Firstly, the gallons or cubic feet of water per second or minute required to operate the turbine is required to be known. This is given in the tables here presented, or also it may be obtained from the manufacturers of turbine wheels.

Secondly, the amount of water available per second or minute, etc., from the brook or stream is to be ascertained if the plant is to run regularly, regardless of dry seasons and the like. We know that the cubic feet of water flowing per second is found by multiplying its velocity by a given point in feet per second by the cross-sectional area of the stream at that point in square feet or the "wet-perimenter" as it is termed.

Hence, if we place a wood float consist-



Diagrammatic View of Mr. Gilman's New Invention Showing the Position of the Anchored Float Levers in Midstream and How the Alternate Swinging to and fro of the Floats Cause the Pistons to Work in and out of the Two Cylinders. Instead of Pumping Water, the Author Suggests the Pumping of Air Into a Storage Tank, Which Could Then Operate a Compressed Air Engine and Dynamo, to Supply Electric Lights, Etc. The Floats Reverse When They Reach One Side of the Stream, and Then Swing to the Other Side; Then Reverse Again and Go Back, Et Cetera.

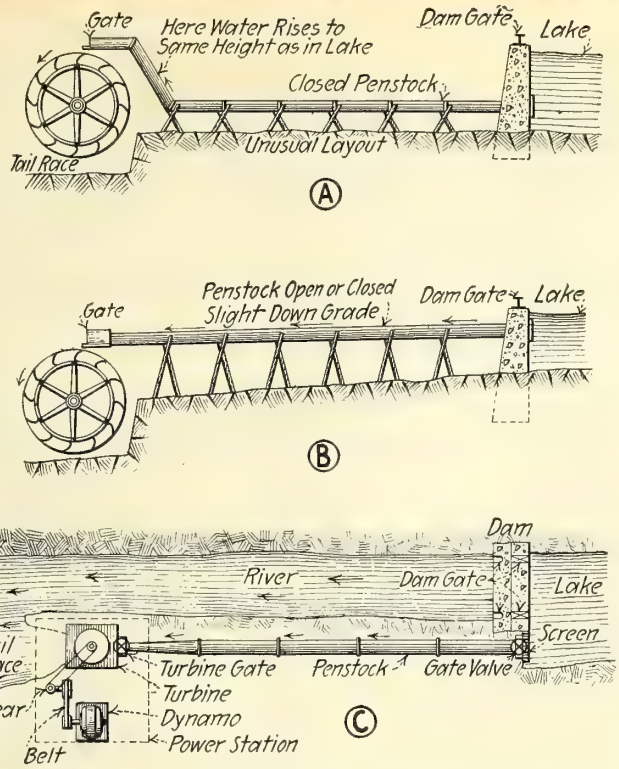


FIGURE 2

Fig. 2. This Illustration Shows Several Modern Features of Small Water Power Plants Which Should Be Studied Carefully Wherever Water Power Is to Be Supplied. Various Arrangements of Overshot Water Wheels as Well as Small Turbines Are Shown at Figs. A, B, C and D. Water Power Is One of our Greatest Natural Resources and One Which We Constantly Ignore, Preferring to Buy Coal or Gasoline for Driving Engines, All of Which, of Course, Represents an Unpardonable Waste of Natural Power. Brazil Has Developed Its Natural Water Power More Than Any Other Country.

ing of a round stick, weighted at its base so as to just clear stones, etc., at the bottom of the stream, and we time this float as it is carried down-stream from one fixt point to a second fixt point, then its speed and also that of the current of water is readily deduced. A common figure for streams is 6 to 15 second feet, meaning that the float when timed traversed a distance of 6 feet in one second. Several time values should be observed at various times of the season and an average of the lot taken. Sometimes the minimum value determined is taken. The current velocity having thus been found, the volume of water passing per second in cubic feet is found by multiplying its value by the average width and depth of the stream in feet at the section timed.

The quantity of water is generally measured on small streams by means of the "Wier," which is explained together with formulas for its use in any text-book on the subject.

The plant layout is shown at Fig. 2. An overflow gate is best placed on the dam, but some builders arrange for the water to spill over the dam only when the lake is full. The dam can be made of concrete, stone or stone and earth, wood, etc., as convenience dictates. The penstock feeding the turbine or water-wheel enters the stream as shown, preferably placing a gate at the head of it and a screen of iron bars in a wood or metal frame to prevent sticks, stones, etc., from entering the penstock is placed ahead of the gate as shown. The penstock is depicted at Fig. 3-A and B in detail. It can be either open or closed. The open ones are commonly made of white pine tongue and grooved planking, concrete, steel, etc., and the closed ones are usually of steel pipe or wooden staved pipe, strengthened with iron hoops around it. Of course, the penstock must have a pitch downward toward the turbine, and it is carried sufficiently far down-stream, so that the pressure head obtained at the turbine wheel is sufficient to drive it at the required speed and torque. The head in feet is the "vertical height" the water drops thru in descending from the entrance to the penstock to the turbine wheel. For small plants it is well to figure the penstock to carry about twice the cubic feet of water per minute required by the turbine as the penstock probably will not always flow entirely full.

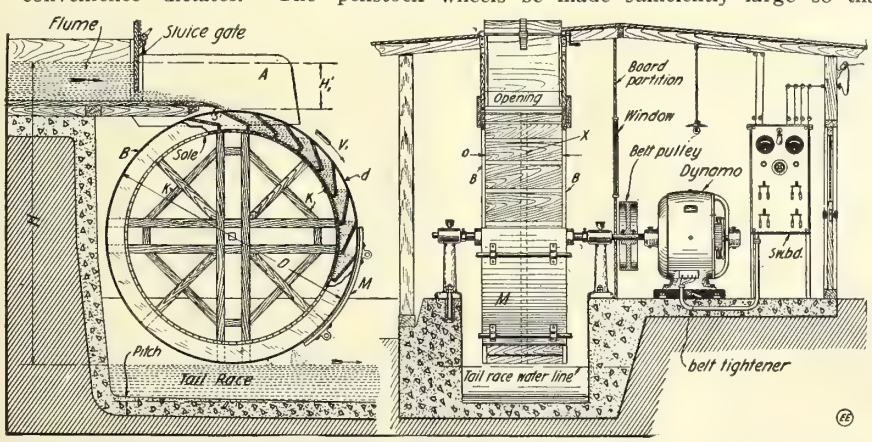
It is very important that the tail-race or passageway provided for carrying away the discharged water from turbines and water-wheels be made sufficiently large so that the water can readily pass away without causing "back pressure" on the turbine. The discharge pipe if provided should be as large at least as the discharge opening in the motor. No great pressure is present here, so a sheet iron pipe is sufficient for small motors.

The theoretical or full horsepower of a given stream is calculated as follows: First, having found the amount of velocity in feet per minute of the water which is equivalent approximately to 75 per cent of the observed velocity by means of floats, owing to the fact that the water near the edges and deeper down in the stream does not move as fast as that of the main channel, we multiply this value by the cross-section in square feet which gives us the number of cubic feet available in the stream per minute. We next multiply the number of cubic feet per minute by 62.3 pounds (the weight for a cubic foot of water) times the head or drop in feet and then divide this by 33,000.

EXAMPLE OF STREAM H.P. DETERMINATION.

Let us take an example: suppose we have a stream two feet deep by five feet wide and that the average mean velocity observed by watching floats dropt into the water and passing over a measured distance between two stakes is three feet per second or 180 feet per minute. Then, following the rule just given, we multiply 1,800, the number of cubic feet per minute times 62.3 times the head which, let us say, is 10 feet. Dividing the total product of these terms by 33,000, we obtain 33.9 or nearly 34 horsepower. The average efficiency of a water-wheel is about 75 per cent and hence the actual horsepower which we may realize from such a stream, giving us a steady flow of water under the above depth, width and velocity dimensions—then 75 per cent of 33.9 h.p. gives us 27.2 net horsepower. Referring to tables giving the horsepower of standard makes of water turbines, we find that to develop this horsepower it would be required to use a 27-inch diameter special steel turbine wheel of the Jonval type. This wheel would, under a 10-foot head, at 220 revolutions per minute, consume 1,854 cubic feet of water per minute and deliver 26.34 h.p. at the shaft. This size turbine will use 172 square inches of water at the intake. If a water-wheel, either home-made or of the regular commercial type, constructed of steel or wood is to be employed, then we will have to figure out in accordance with some of the rules and simple formulæ given in the previous article referred to above how to determine the

(*Continued on page* 312)

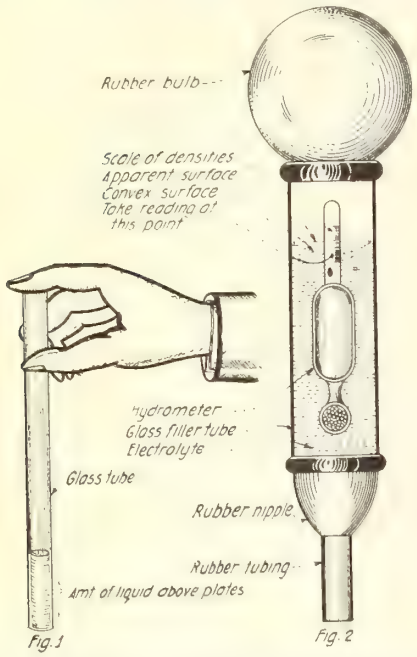


Side and Front Views of a Typical Overshot Water Wheel Which Can Be of the Home-Made Type. It Is Shown Driving an Electric Lighting Generator. It Is Best, However, to Drive the Dynamo with a Belt and Connect It Indirectly to the Water Wheel Unless a Very Steady Supply of Water Is Available for Driving the Wheel; Otherwise, There Would Likely Be Too Great a Fluctuation in the Voltage, Which of Course Would Be Noticeable at the Lamps. The Next Installment Will Illustrate and Describe a Very Excellent Arrangement for Dynamo Drives, Together With an Automatic Speed Regulator To Be Connected to the Sluice Gate.

Care of Lead Plate Storage Battery

By JESSE J. HIPPLE
CHIEF MACHINISTS' MATE, U. S. N.

MOST of the small storage batteries are constructed to give a heavy initial output required for auto starters, auto ignition, etc. This type of battery is usually of the 1300° *Specific Gravity* class. In other words, the specific gravity of the electrolyte should be over 1300° when the battery is fully charged. The cells composing a battery of this type are very compact and there is very little room for electrolyte. It is on account of this lack of space that the gravity of the electrolyte is higher than the larger type of battery called the 1200° battery. In the 1300° type, the voltages run anywhere from 4 to 12 volts per battery, depending, of course, upon the number of cells. In the 1200° class the voltage varies according to the use that the batteries may be put to, but where they are intended to be easily handled, each cell is separated. In both types of battery the voltage for a single cell immediately after full charge is from 2.3 to 2.2. After a short time this value drops to about 2 volts. The amperage of the 1300° battery ranges from 40 to 80 amps, while that of the 1200° battery may be anywhere from 100 amps per hour up, depending upon the size and quantities of the plates. The principal use of the 1200° battery is for electric lighting outfits and in all places where long usage before recharging is of more importance than portability.



The Hydrometer Syringe. Figure 2, Is a Handy and in Fact Indispensable Device for Testing the Specific Gravity of Battery Electrolyte. It is Particularly Useful for Ignition Batteries.

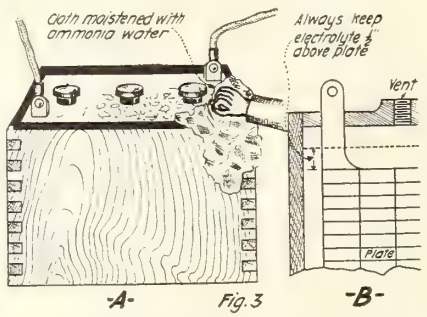
Fundamentally both types of batteries are the same as far as the component parts are concerned. Of course the 1300° battery is much lighter than the 1200° battery and is therefore more desirable for *radio work*, requiring a battery that is easily carried.

This article will deal then with the care of the 1300° battery, but all that will be said in connection with it may be applied to the 1200° battery with the exception of the hydrometer readings. For the 1200° battery the hydrometer readings should be 100° lower than those for the 1300°.

The first rule to be carefully observed is *Cleanliness*. The battery should be at all times free from acid on the top. When acid is accidentally spilled, it should be carefully removed by wiping with a cloth that has previously been moistened with a solution of ammonia water. See Fig. 3-A. Keep the top of the battery clear from dust or metal filings. The vents in the filler caps should be kept free and clear to allow the generated gases to pass off freely. All outside metal parts such as lugs, terminals, connectors, handles, etc., should be lightly coated with vaseline or grease. If a cover is provided for the battery, it should be kept in place except when charging. When charging, the covers and the filler plugs should be removed.

It is very important that the level of the electrolyte in the battery should be at all times at least ½ inch above the top of the plates, as shown in Fig. 3-B. To make this observation the writer has made use of a piece of glass tubing about 8 inches long (Fig. 1). This tube was inserted in the filler hole and allowed to touch the tops of the plates perpendicularly. The index finger of the hand holding the tube was clampt over the top opening and the tube withdrawn. The amount of liquid in the tube represented approximately the height of the surface of the electrolyte above the plates. It might be well to say that in very few places is tap water of sufficient purity to be used in storage battery work and in most cases it would prove disastrous to the battery. Under no circumstance allow sea water or any water strongly impregnated with chlorin salts or metallic salts to come in contact with the interior of the battery. Electrolysis of solutions of chlorin salts liberates nacent chlorin, which is a deadly and highly corrosive agent. Metallic salts tend to form an internal short-circuit and change the character of the plates. For those interested in the chemical change when sea water is decomposed, the following reaction is given.

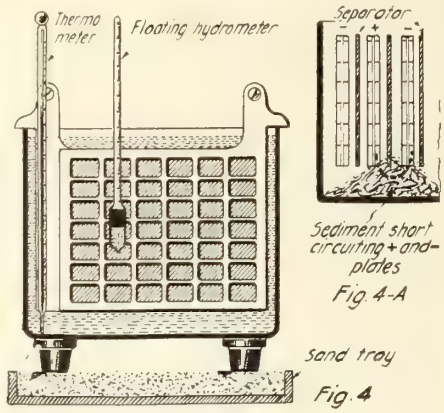
$$2\,NaCl + H_2SO_4 = 2\,Cl. + Na_2SO_4 + 2H$$



Wipe Off Storage Cells With Cloth Dampened in Ammonia Water to Obliterate Acid and Dirt, Which Often Causes Short-Circuits and "Leaks".

To be absolutely safe, use only distilled or rain water.

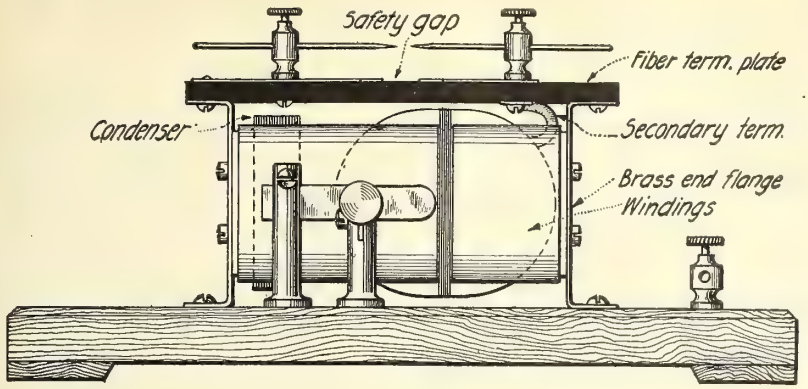
After a battery has been fully charged, the specific gravity should be around 1350°. This will drop to about 1300° after the first few minutes of use. These readings are made with a hydrometer, usually one of special construction for just this kind of work. (Fig. 2.) As the energy of the battery is withdrawn, the specific gravity gets lower and lower until it registers about 1250°. It is then time to re-charge, for the drop from this point is very fast and the battery tends to sulphate heavily when discharged past 1250°. Never add acid to a battery to try to bring up its gravity. Bear in mind that very little of the acid evaporates, and if it is ever necessary to replace any of the electrolyte by reason of spilling or some other cause than evaporation, the electrolyte used to replace that lost should be mixed to the same gravity as the cell it is intended for. Roughly, the proportion should be four parts water to one part acid. Only use chemically pure sulfuric acid for batteries. **When mixing acid with water, the acid should be added drop by drop to the water and the water should be constantly stirred! If the water should be added to the acid a dangerous explosion would occur and the least of the damage would be acid splattered clothing and hands, not to speak of burned face and eyes!** Always use a glass or porcelain vessel to mix electrolyte, and as the mixture of sulfuric acid and water generates heat, the temperature should be watched so that the vessel does not crack. Never take electrolyte from one battery to add to another. Mix fresh if necessary.



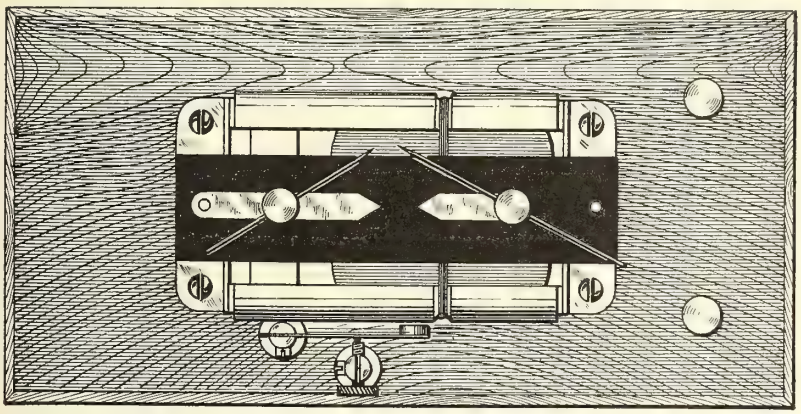
The Use of the Thermometer and Floating Hydrometer is Clearly Shown Here. Also How Sediment Collections May Short-Circuit Plates.

When taking a hydrometer reading, the following procedure should be observed. The filling tube should be rinsed out with distilled water and then sufficient electrolyte should be sucked up from the filler hole in the battery to float the hydrometer. (Fig. 2.) The reading of the gravity

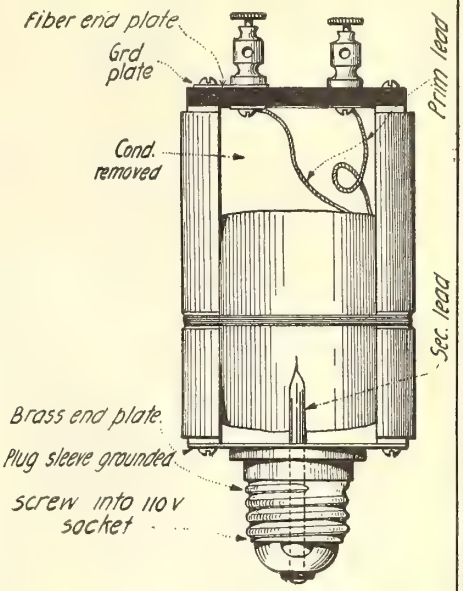
(Continued on page 322)

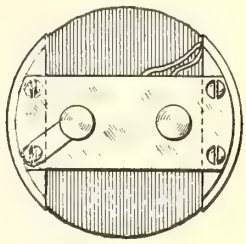


Wiring not shown for sake of clearness same as any induction coil except one end secondary grounded on core.



Magneto Armature Made Into Induction Coil (D.C)





Magneto Armature Utilized as Low Voltage A.C. Transformer EE

The Drawings Herewith Show Two Practical Uses for Old Magneto Armatures, Especially Those of the "High Tension" Type, Which the Electrical Experimenter Will Find Interesting. One Idea Shows How to Make an Induction Coil and the Other, a Step-Down A.C. Transformer for Running Bells, Lighting Miniature Night Lamps, Etc.

Utilizing An Old Magneto Armature

By H. H. PARKER

An armature taken from an old "junk" magneto, provided its windings and condenser are in good shape, may be converted into a first rate small induction coil for experimental purposes. The illustration suggests an arrangement, though the exact details would depend upon the make of the magneto from which the armature was taken. Both heads with their stub shafts and gears are removed; then two stationary heads are cut out of heavy sheet brass and screwed to the armature, using the same bolts or screws that fastened the regular heads. The lower ends of the sheets are bent over and drilled for screws to attach the coil to a baseboard, while the upper ends are bent over to form attaching lugs for the fiber block which holds the high tension binding posts. The most compact condenser arrangement is where the armature contains a space for it at one end, as shown; if the condenser is separate, it may be set into the bottom of the wood base.

A vibrator will be necessary; a separate one may be used, though a fairly efficient one can be made as shown. The vibrator head is set near the center of the coil and nearly touching the outside of the armature core. Such a vibrator works in exactly the same manner as on a regular induction coil. For the sake of clearness no connections are shown, but they will be the same as the conventional coil connections, tho it should be remembered that both primary and secondary coils are grounded on the core.

A safety gap to protect the secondary winding will be just as necessary as on the magneto and one is shown constructed of two brass strips incorporated into the secondary terminals; one is extended to meet the brass screw from the end plate in order to form the ground connection for the secondary terminal as well as for the gap. The gap should be made of the same length as the one on the magneto. The other secondary terminal must be far enough away from the core, screws and other metal parts to preclude the possibility of a spark jumping across. The core can be either left open, as shown, or surrounded by a fiber tube.

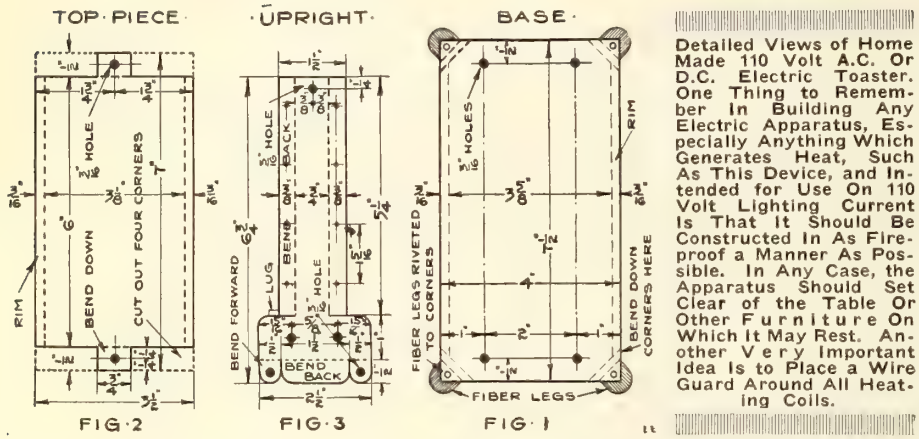
About six volts will operate the coil; dry cells or a storage battery.

LOW VOLTAGE TRANSFORMER FROM ARMATURE.

Another use to which a magneto armature may be put is a *low voltage transformer* operated off a 110 volt house lighting circuit. The sketch shows a sheet brass disc screwed to one end of the armature and a screw base, taken either from a burned out bulb or an attachment plug, soldered to it. The insulated secondary terminal is carried down and attached to the center terminal of the screw base. A corresponding fiber disc is screwed to the other end to take the low voltage binding posts; one of them is grounded on the core by a strip of brass. The regular *secondary* coil now becomes the transformer primary, while the magneto *primary*, or coarse wire coil, becomes the transformer low voltage, or secondary, coil. The low voltage obtained will depend upon the amount of wire on the armature, and this differs with different makes of magneto, but enough current should be obtained to ring a bell or light a three-volt flashlight bulb; if not enough current is produced, some more wire, say No. 25 B & S, preferably enameled may be wound around the outside of the coil and connected in series with the primary, that is, the coarse wire, coil of the armature; no attempt should be made to change the fine wire winding. In most cases the fine wire coil will carry 110 volts without overheating.

A 110-Volt Electric Toaster

By JOHN C. DAVIS, Jr.



FIG·2 FIG·3 FIG·1

Detailed Views of Home Made 110 Volt A.C. Or D.C. Electric Toaster. One Thing to Remember In Building Any Electric Apparatus, Especially Anything Which Generates Heat, Such As This Device, and Intended for Use On 110 Volt Lighting Current Is That It Should Be Constructed In As Fireproof a Manner As Possible. In Any Case, the Apparatus Should Set Clear of the Table Or Other Furniture On Which It May Rest. Another Very Important Idea Is to Place a Wire Guard Around All Heating Coils.

THE frame of the toaster is made of No. 24 galvanized sheet iron. For the base cut a piece 7½" x 4" and bend down the corners. Draw a line across each end, parallel to and ½" from each end. On each line, 1" from the ends of the line, bore two 3/16" holes. Next bend down a 3/16" rim on each edge, to strengthen it, making the width 3⅝". The legs are semicircles of heavy fiber, ½" in radius, riveted to the inside of the corners. (See Fig. 1.)

The top must be 7" x 3½". Cut down the ends until it is 6" long, leaving tabs in the middle of each end ½" long and ¾" wide. Bore a 3/16" hole in the center of each tab and bend down. Round off the corners of the top, and, for stiffness, bend down a 3/16" rim, as with the base, making the actual size of the top 6" x 3⅛" (see Fig. 2). Cut a piece of No. 26 sheet copper just small enough to fit under the top-piece between its edges. This will tend to throw the heat downward and outward, which otherwise would rise directly up.

For the two uprights cut out a piece of the iron 6¾" x 2½". The bottom part of the upright is 2½" wide by 1" high with tabs ½" long folded over the bolt to the base. The upper part of the upright, 5¼" long, is cut down to 1½" wide. The edges of this part are then bent in so that they nearly meet, forming a slot for the mica units to rest in and making the outside width of the upper part of the upright ¾". Bore a 3/16" hole near the top of each upright. These are for bolting onto the top-piece by means of the tabs on the same. (See Fig. 3.)

The element may be made up of the proper length of "Nichrome," "Climax," "Advance," or any other good resistance wire having a high melting point and a comparatively high resistance.* I used 12 feet of No. 28 "Nisil" wire. It draws about 5 amperes on 110 volts. The wire is wound on three strips of extra heavy mica, 5⅞" x 1¼". It is best to use three or four pieces of mica as it will be apt to burn right thru where a red-hot wire touches it. Slots are cut in the edges of the mica ⅛" deep, making the turns of wire 1" long. When assembling the toaster the three mica strips (connected in series) should be placed, one above the other, in the slots formed by the edges of the uprights. As there is altogether 12 ft. of wire, 4 ft., or twenty-four 1" turns must be put on each of the mica strips. However, if the wire were spread evenly all over the toasting space (4½" x 5½"), the result would be very uneven toasting. Owing to the tendency of the heated air to rise the bread would toast much sooner at the top of the slice than at the bottom. To counteract this the wire should be wound as follows: Bottom unit, 28 turns; middle unit, 24 turns; top unit, 20 turns. When half of each strip has been wound the winding should be reversed and the remainder of the unit wound in the opposite direction, as a continuous winding would be apt to induce a strong magnetic flux which would decrease the efficiency of the element, especially on A.C. circuits. The ends of the wires should be brought down to one corner of the toasting space and there terminate in copper lugs, which are clamped under the nuts on the back of the lead pegs. (See Fig. 4.)

For the lead pegs cut two pieces 3/16" brass rod 1" long. For a distance of ¼" from one end file or turn them down to ⅛" in diameter. Next procure four ⅛" rather thin brass washers, the outside diameter of which must be ⅜". The small ends of the rods must then be threaded. Halfway (½") up in the base, or wide part, of one of the uprights, bore two ¼" holes, each 15/16" from one edge, making them ⅝" apart. In assembling the pegs onto the frame use three or four thicknesses of mica washers as insulation from the frame. (See Fig. 5.)

Before assembling the uprights bore four 1/16" holes equally spaced in the inside edges of each upright. These are to support the grids or wire guards which prevent the bread from coming in contact with the naked heating element. The grids are composed of four horizontal pieces of No. 16 or 18 (B. & S.) brass wire, connected in the middle by one vertical piece. They should be placed as near as possible to the heating element without danger of actual contact with the same (not farther than ⅜"). It will be found easier to spring the grids into place after the rest of the toaster is assembled, as otherwise they would be apt to interfere with the proper placing of the units. (See Fig. 6.)

As for the holders for the bread they are so many and so varied that perhaps it would be best to let the constructor choose his own. The simplest method is to build the grids at a slight angle, with a rest at the bottom, so that a slice of bread will lean against them. Or a holder may be made similar to the majority of standard makes of toasters, hinged at the bottom and provided with a stiff spring to hold the bread against the grids. With a little ingenuity a holder of the "Turn-over" or "Flip-Flop" type could easily be constructed.

If trouble is experienced due to the warping of the mica units when heated it can be obviated by fastening short pieces of stiff wire at various points on the grids so that one end will touch the mica between the turns and prevent it from bending.

The appearance of the toaster would be greatly improved, for table use especially, if it could be given a coat of nickel-plate. The parts must be nickel-plated before assembling if this is to be done.

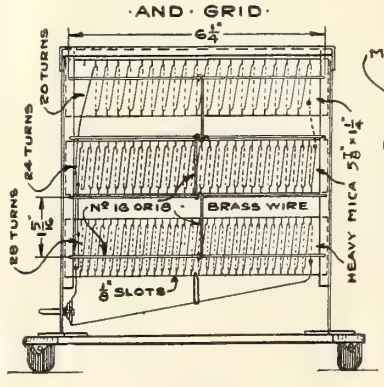
The Home Electrician, after a little experimenting with the construction of electrical apparatus of this nature, will find it an easy matter to construct electric heating units or else purchase them and build into regular type percolators, chafing dishes, tea pots, curling irons, etc.

It should be remembered that resistance coils made from ordinary wire will not prove satisfactory as such wire, after a few heating and cooling applications, will heavily oxidize. This is the case when copper, iron or even German silver wire is used for constructing heating units where a high degree of temperature, say 200 to 400 degrees Fahr., above room temperature, is desired.

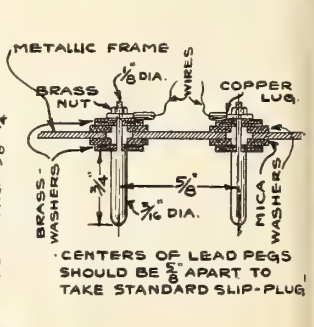
There are from fifteen to twenty different classes of special resistance wire available on the market for constructing resistances, heating units, etc., from, and at least several which are markedly efficacious for the purpose. One of the best is Nichrome wire, but it is practically impossible to obtain it under any ordinary conditions, as it is only supplied to licensed manufacturers who build apparatus containing this patented material. A very excellent resistance wire which possesses practically identical properties to Nichrome is *Calido*. It has a resistance of about 58.5 times that of copper wire, size for size.

* Note.—On receipt of a stamp the editor will be glad to furnish addresses of several manufacturers of resistance alloys suitable for use on heating apparatus.

This illustration Shows the Assembly View of the Toaster and the Three Heating Elements. The Heating Units Are Composed of Three Strips of Mica Having a Fine Resistance Wire Wound Around Them In Suitably Spaced Notches Or Slits In the Manner Shown. The Three Resistance Units Are Connected In Series and Finally Joined to the Mica Insulated Terminal Posts Shown At Fig. 5.



·FIG·4&6



·FIG·5·

An Efficient Primary Battery

By W. S. STANDIFORD

THERE are two types of electric batteries used by experimenters, viz., open and closed circuit cells. The former are used for ringing door bells and other intermittent work, while the closed circuit cells are used for charging storage batteries,

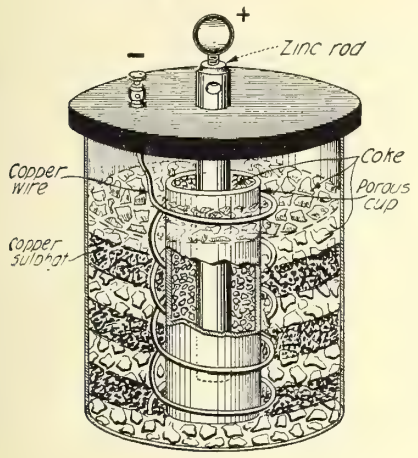


Fig. 1

The Author Describes Some Interesting Results Of His Experiments With a Modified Form of Daniell Cell, Which He Has Found Suitable for Use On Both "Open" and "Closed" Circuit Work — the Great Battery Goal of All Experimenters! The Parts Necessary for Making This Battery Can Be Obtained At a Nominal Cost from Any Electrical Supply House or Dealer.

running small electric motors, Christmas tree lights, electro-plating and general experimental work where a continuous current is desired. As a general rule closed circuit batteries don't work well on open circuit, and they cannot be put away without using, on a shelf for a month or so, unless the binding posts are connected with resistance wire so as to allow a very small current to flow; this keeps the battery in order—but also wastes chemicals and the zinc electrode.

What the amateur electrician desires, most of all, is a battery that will give either a constant current when it is wanted, or one that can be used on an open circuit, such as ringing door bells, etc., and one that can be laid away until wanted for use. The usual type of Daniell Sulphate of Copper battery in both the ordinary and gravity forms, gives a continuous current until the chemicals are exhausted, it being an admirable battery where a steady current of long duration is desired; the drawback being that they cannot be used for open circuit work as copper is deposited upon the zinc, causing the latter to be eaten away rapidly when the cell is not in use. The writer has found out after some experimenting that by making a few modifications in the original design of the Daniell cell, it can be used either for closed or open-circuit work; it always being ready for use when wanted. Procure from an electrical supply house a glass jar and porous cup of the size wanted, one nickel-plated binding post, a zinc rod containing a binding post on the top, such as is used on the ordinary sal-ammoniac open-circuit battery, 6 feet of No. 14 insulated copper wire, 2 lbs. paraffin wax, a small round brush, and also some coke and 3 lbs. sulfate of copper. Melt the wax in a saucepan, being careful that it doesn't get on fire, then dip the bottom of the porous cup into the wax, letting it extend ½ inch up the side. Do the same with the open end of the cup. Also dip or paint the top of the glass jar for a distance of 2 inches. The object of the wax coating is to prevent the chemicals from creeping up the sides and over the top of the jar and also porous cup, the bottom of the latter being insulated by the wax. Make a cover out of a ¾-inch board, the cover to have a rabbet or cleats nailed on its under side so as to prevent its sliding sideways; a round hole for the zinc electrode should be bored in the center.

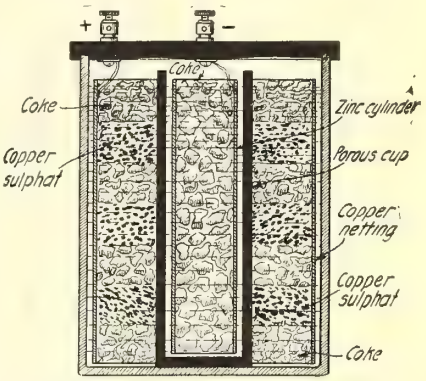


Fig. 2 Above Shows An Improved Form of the Battery Delineated at Fig. 1 by Mr. Standiford; This Suggested Form of the Battery Being the Editor's Idea. Instead of the Copper Wire Electrode Used At Fig. 1, a Piece of Copper Netting Is Here Used.

After completion, boil the cover in the hot wax for 30 minutes, drain and let it cool. After it is cold, take your brush and put an extra amount of wax on the inside of the hole for insulation, or, if desired, a porcelain tube of sufficient diameter to hold the zinc electrode can be used as an insulator. Stand the cup in the center of jar. Break the coke into pieces the size of coffee grains and put a layer on the bottom of the jar surrounding the porous cup. Screw

(*Continued on page* 324)

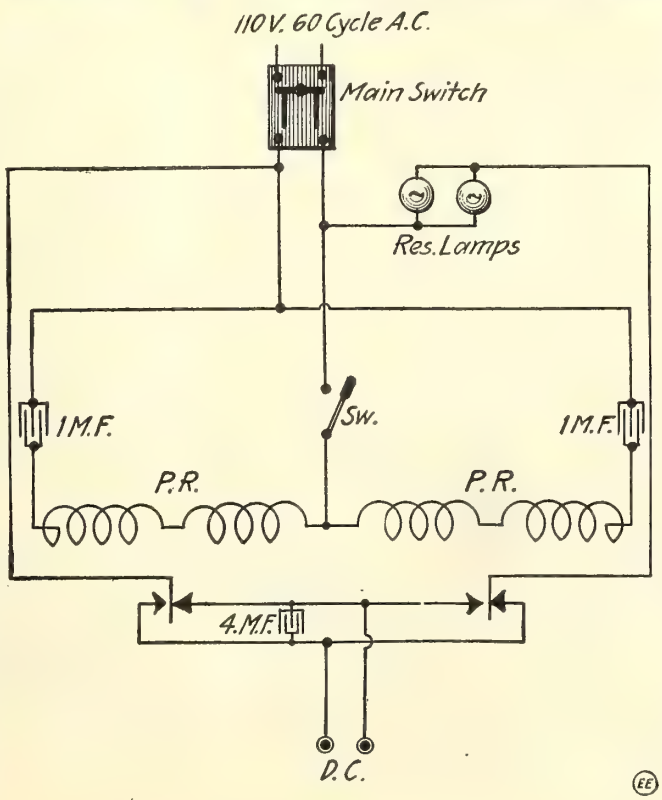
How to Build a Mechanical Rectifier

Herewith is given a sketch of a mechanical rectifier which may be of interest to "E. E." readers. In making some electrical tests it was necessary for me to have direct current of about 50 volts and the only current available being 110 volts 60 cycle, A. C., it was necessary to construct some type of rectifier. Two of the old style, double-contact polarized relays were used, each having a 1 M.F. condenser connected in series with the coils, as this was the only way they would operate satisfactorily without sparking at the contacts. The relays being of the double-contact type, opposite contacts were connected together, which rectified both waves of the A.C., which was necessary on account of using the current to operate relays and other direct current apparatus. When used for this purpose the D.C. leads are connected thru impedance coils which are not shown in the diagram. Lamps were connected in the A.C. side to regulate the current. A 4 M.F. condenser is connected across the D.C. leads.

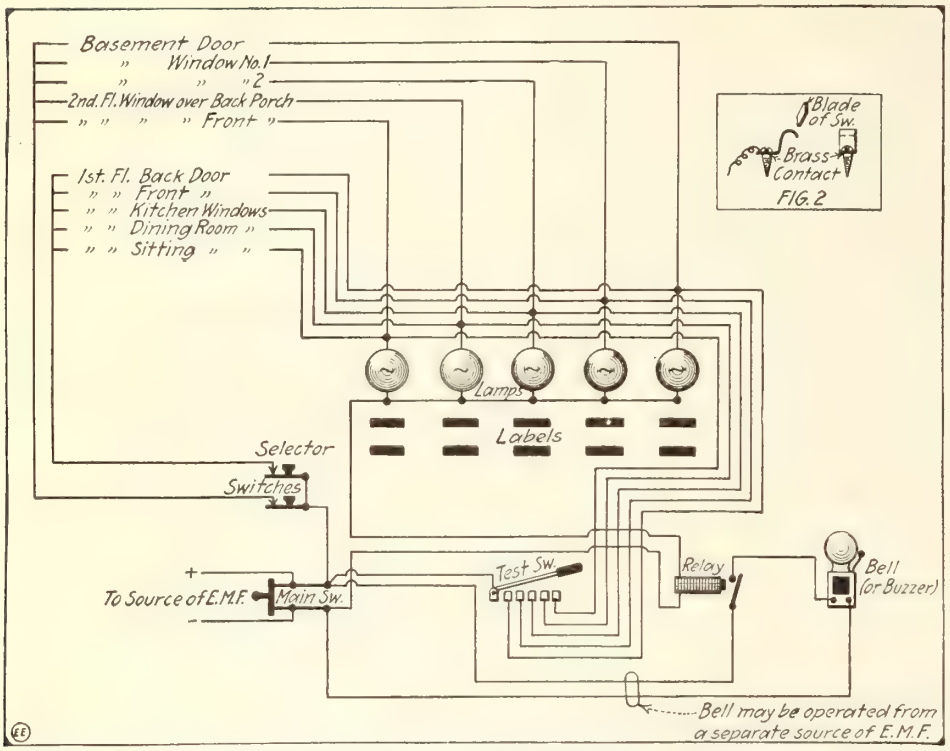
Contributed by
ROBERT M. WEAVER.

There Are Rectifiers and Rectifiers, But Perhaps One of the Easiest to Construct Is That Here Suggested by Mr. Weaver, and for Building Which He Gives Full Details in the Accompanying Article. As Mr. Weaver Says, "In Making Some Electric Tests It Was Necessary for Me to Have a Direct Current of About 50 Volts and All That Was Available Was a 110 Volt 60 Cycle A.C. It Was Therefore Necessary To Construct Some Type of Rectifier and I Employed Successfully Two Double-contact Polarized Relays, Each Having a 1 Microfarad Condenser Connected in Series With the Coils.

"This Was Found to Be the Best Way to Operate Them Satisfactorily, Without Sparking On the Contacts. The Relays Being of the Double-contact Type, Opposite Contacts Were Connected Together Which Thus Rectified Both Waves of the Alternating Current." The Resistance Lamps Used Can Be of the 110 Volt Type; the Higher the Candle-power of These Lamps, the Greater the Current That Will Flow Thru the Circuit.



Electric Burglar Alarm



Now In View of the Fact That There Are So Many Burglaries In Offices and In Private Homes, Electric Burglar Alarms Have Come Rapidly Into Favor. The One Shown Here Possesses the Distinct Advantage of Requiring But Very Simple Apparatus and Also the Wiring for the System Has Been Reduced to a Minimum, Considering the Fine Results Obtained.

In making this burglar alarm I used 48 ohm telephone switchboard lamps and a small telephone relay, but any kind of lamps may be used, provided you have a relay that will work in series with them and use the proper voltage. The best kind of relay to use is one that must be reset by hand, then if the burglar opens a window and shuts it again the alarm will continue to ring until the relay is reset. The test switch is made by taking the blade of a small single pole switch and mounting it on a base with five contacts made of thin brass strips (like the detail drawing, Fig. 2) in such a way that when the switch is closed it will make good contact with each of the five brass strips. It is best to use a bell or buzzer of the same voltage that the rest of the system works on, but it is not necessary, the bell being connected to a separate circuit, i. e., I have my system working on 50 volts and my bell on 110 volts. My bell is mounted on the outside of the house where it will wake up the neighbors, as well as myself.

In putting the system in operation at night you want to test it well. To do this you should first put in the main switch. If the alarm rings, there is a window or door open somewhere. How to find the exact place will be told below. If the alarm does not ring, the system is "O. K." Next you test out the lamps by throwing in the test switch. If the lamps all light, they are all right. If any of them fail to light, they are burned out. You shouldn't leave the test switch in over a couple of seconds or the current going thru the five lamps in multiple will cut the resistance down enough to damage your relay.

Suppose a burglar tried to enter the basement door. He would close the contact on the door, light the fifth lamp and ring the alarm. Now the fifth lamp serves the "first floor back door" as well as the "basement door." To find out which it is you press down the first selector switch. The lamp will still burn so you know it is not on that circuit. Then you press down the second selector switch which in this case will open the circuit and put the light out. Read across the second row of labels to the the one under the fifth lamp, and it will indicate that it is the "basement door" that is open.

You can readily see that this system can be built up to any size by merely adding a selector switch and a row of labels for each five outlets.

I have my system all mounted on a box measuring but 5" x 6" x 3", so you can readily see it doesn't take up much space. It can be mounted on the wall at the head of the bed or set on a chair.

Contributed by F. P. FOULK.

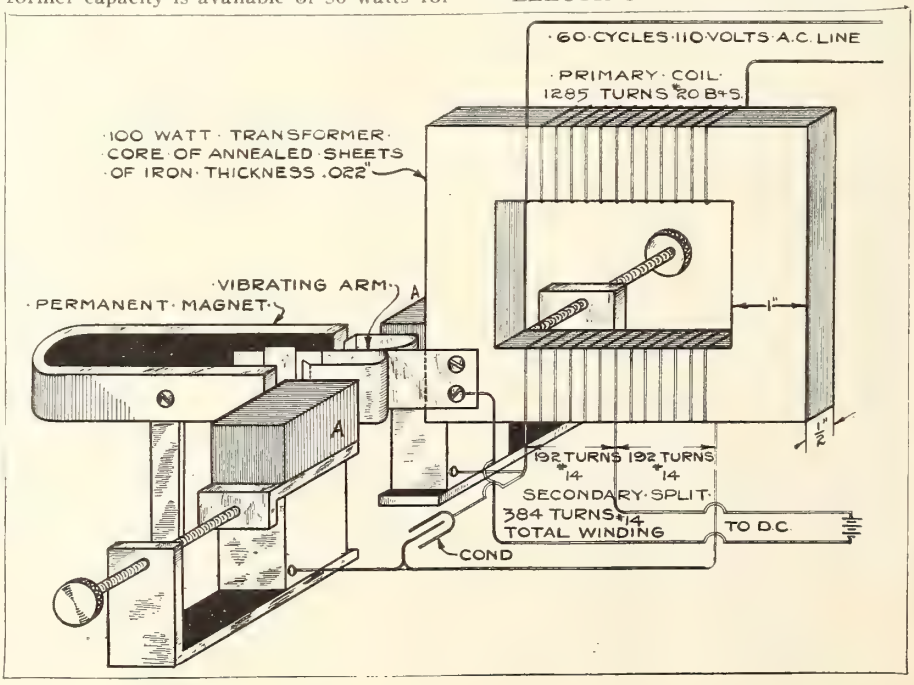
A Synchronous Vibrating Rectifier

The changing magnetic field set up by an alternating current in a static transformer is carried by a hardened steel spring, such as that in a clock, to the poles of a permanent magnet, causing the spring to vibrate. The changing magnetic polarity of the spring, due to the current in the transformer, makes the spring move from one pole of the permanent magnet to the other. By using this action, current delivered from a secondary coil may be directed in such a way as to give a pulsating direct current. Carbon contacts on the spring touch the carbon blocks A-A. A 1 mf. condenser makes the current flow more regular, and cuts down the arcing.

In the Present Article the Author Describes How to Build a Synchronous Vibrating Rectifier, Having Carbon Electrodes Which Will Not Burn Out, Due to Arcing. A Rectifier of This Type Will Work Very Satisfactorily, and Is Suitable for Charging a Storage Battery Such As 6 Volt Ignition Units From the 110 Volt A.C. Supply Circuit.

The dimensions given on the diagram are for a 100-watt transformer, although the core and windings can be designed for as high as 500 watts. Only one-half the transformer capacity is available or 50 watts for the design here described and illustrated.

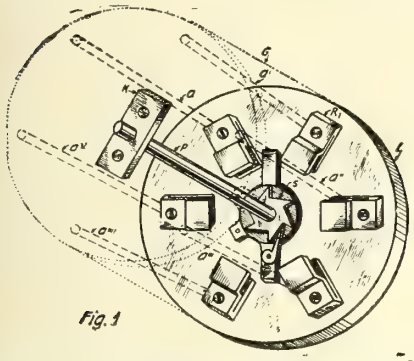
Contributed by an ELECTRICAL EXPERIMENTER.



Three-Color Electric Sign Control

By EARL BOTTEN

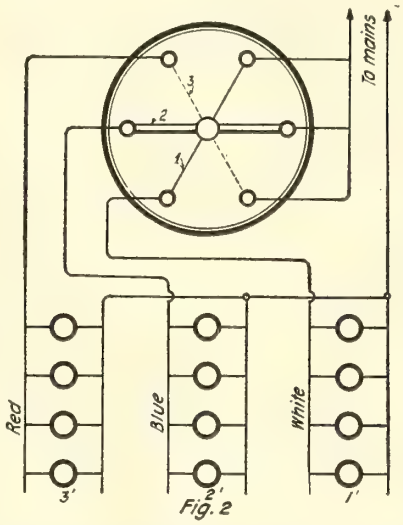
AN electric sign which will flash in different colors is sure to attract a great deal of attention. In this article a control for such a sign is described which



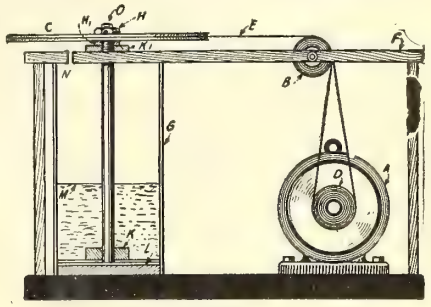
Detail Of Motor-driven Flasher Switch for Three Color Electric Sign.

is easy to make, and as it runs in oil, does away with all danger from short-circuits and sparking. No definite size is given for any of the parts, as they can vary in size according to the material which the maker is able to obtain, without injuring the control in any way.

A large wheel out of an old mantel clock was used. All of the spokes except two opposite each other were cut away, also the stubs of the spokes carrying the spring which holds the ratchet and pawl together were left, as indicated in Fig. 1. Six switch jaws are then set in a circle equal distance apart. They should be set so that the ends of the two spokes will slide easily thru the slots. The base to which these shoulders are fastened should be of hard rubber or fiber, and if bolts are used, the holes on the underside of the base should be deeply counter-sunk, so that the bolt heads will not come in contact with the receptacle (G). Two bearings (K & K¹) should be made of brass or copper, with holes just large enough to admit the shaft (P). The dotted lines (a to a⁵) indicate the wires running from the switch jaws to the lights. The method of connecting the wires to the lights is shown in Fig. 2. After the switch is in place in the receptacle, the receptacle is filled party full of



Circuit Diagram Of Red, White and Blue Lamps Connected to the Flasher Switch, Which Can Be Motor-driven Or Else Operated By a Spring-motor Or By Hand.



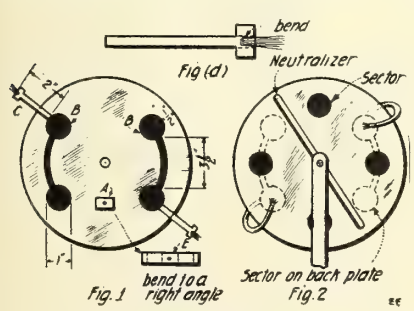
Sectional Side View of Motor-driven Electric Flasher Switch for Colored Lamps On Small Sign Or Decorative Feature, Such As a Tree, Fountain Or Floral Display.

oil, which should be heavy, such as Transil oil. As for running the switch, two methods are given: One shown in Fig. 3 is with a toy motor. A large thin wooden wheel (C) is fastened on the shaft, and held in place by means of the burrs (H H¹). A small pulley (D) is fastened to the shaft of the motor (A) and the belt (E) put on. Idler pulleys (B) are used to direct the belt between the two pulleys. The whole is then placed in a box (F). An air hole (N) should not be omitted. A few dry cells will suffice to run the motor, and the speed can be controlled by means of a small Rheostat. Contributed by "BIX."

Two Novel Suggestions

CHANGING A WIMSHURST MACHINE TO A TOEPLER-HOLTZ.

A Wimshurst machine can be remodeled to a Toepler-Holtz in a short time. I have an E. I. Co.'s static machine and I thought it would be handy to have it arranged so that I could use it as a Toepler-Holtz machine if I wanted to show how this type works. The first thing to do is to procure some plates. On mine I used seven-inch phonograph records. Glass plates can be used but they are difficult to handle. Assuming you have the two plates, drill holes in them large enough so that the bosses will just screw on. Then on one plate paste four round sectors. The sectors can be cut out of the sheet copper



The Author Shows In a Simple Manner How to Change a Wimshurst Static Machine to a Toepler-Holtz Type.

and should be about one inch in diameter. Fasten them on with shellac varnish. They should be put about one-half inch in from the edge of the plate. The next thing is the other plate. Copper sectors are cut as shown in the illustration, Fig. 1. At the projection C is a clamp to fasten tinsel brushes to. The tinsel is fastened on as shown at D the copper can be bent over and used to hold the tinsel. The sectors B are fastened on with shellac. Now drill a hole at A about the size of a battery bolt. The clamp E can be made from heavy copper or brass. It has a hole in it and fits over a battery bolt which can be put in the hole A.

The clamp is to hold the plate stationary as only one plate revolves on this machine. Bend the clamp and then put it over the standard on the machine. Then the movable plate is put in place and the axle is put in. Only one neutralizer will be needed and that one will be put on the movable plate. The projections C are bent so that the tinsel will rub lightly on the sectors of the movable plate. The sectors on the back of the stationary plate should have a piece of paper glued on each one with shellac to keep the electricity from escaping into the air. Now set the neutralizers to the position shown and turn the crank so that the plate will revolve as shown. You will have to turn it a minute before it will generate, but don't get rattled. If then it doesn't work the tinsel probably is not touching the sectors. See that it is and then it ought to work all right.

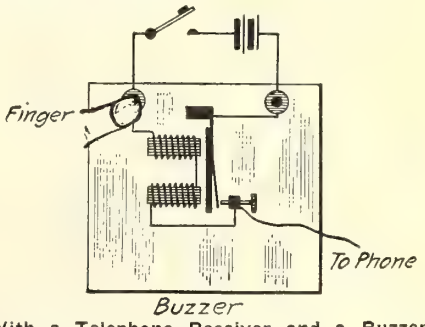
Contributed by CLYDE STEWART.

HEARING THE "JUICE" GO THRU YOU.

With a Tesla coil you can see the high frequency current jumping thru space to your hand—and yet you can't feel anything at all. You have probably "tasted" the current from a dry cell by placing one wire from it under your tongue and the other over it.

But—have you ever "heard" the current go thru you—not seen or felt it—but simply "heard" it? It is very simple. All you need is a buzzer and a thousand ohm (even a good 75 ohm phone will do) phone which all wireless "bugs" have; connect one wire from the phone to the contact pillar and grasp the other wire between the fingers of one hand while you hold one terminal of the buzzer with the other as shown.

Start the buzzer and you will hear the induction current passing thru the phone



With a Telephone Receiver and a Buzzer, Together With a Battery and Switch As Here Shown, You Can Actually "Hear" the Juice Passing Thru Your Body; If You Do Not Believe It, Try It!

via your arms. If three or four people hold hands so that they are all joined up in series you will still be able to "hear the juice" going thru them.

Contributed by K. McLEAN.

Electrical Machinist

By H. WINFIELD SECOR

NO. 9—GEARING AND OTHER DRIVES (Concluded)

THE friction drive shown at Fig. 2 was designed for use in a mechanical testing laboratory where various sizes and forms of automobile speedometers were built and tested. The speedometer, as is well known, at least in *most* types, has a needle, which registers the speed in miles per hour. These are tested in the laboratory by means of a flexible shaft, the same as used when installing the instrument on the car, and at the free end of this shaft, a small friction wheel, usually of fiber, is attacht. The tester then holds the speedometer with one hand, without its casing, and with the other hand he drives a small friction disc supplied to the small flexible shaft to the various speed steps of the multiple special cone pulley shown.

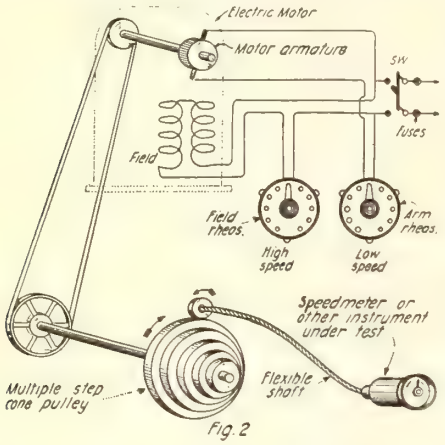


Fig. 2.—Variable Speed Testing Device, in Which Novel Electric Speed Control Features Are Involved.

This cone pulley was designed and calculated so that each step corresponded to a certain unit speed in miles per hour when used with a disc of certain diameter at the end of the shaft connecting to the speedometer.

A "check" speedometer was mounted on the table and rigidly secured to the rotating shaft driving the cone pulley, so that the speed of this shaft could be checked constantly, as the tester stood before it, by just glancing at the speedometer.

To enable the tester to correct the speed of the cone pulley and its shaft which were driven by an electric motor of the shunt type, as shown in the diagram at Fig. 2, two electric speed regulators were mounted on front of the testing table. One of these regulators lowered the speed, while the other raised the speed. The manner in which these were operated is this: To reduce the speed, the low-speed regulator comprised a circular rheostat wound with heavy resistance ribbon, so as to carry the current supplied to the armature of the motor, the motor having been rated at ¼ H.P., 110 volts, D.C. To raise the speed of the motor, the high-speed regulator comprises a field rheostat having small size ribbon windings which were suited to the low current passing thru the shunted field winding of the motor.

Thus, if the speed of the cone wheel ran low, the field rheostat or high-speed regulator was adjusted to increase the resistance in the field circuit, and thus weaken the field which sped up the motor proportionately, to the number of steps on the rheostat, including those in the circuit. If the speed of the cone wheel ran high, and had to be reduced, then the low-speed regulator was turned so as to increase the resistance in the armature circuit, which reduced the current supplied the armature and thus lower the speed of the motor. When the installation was first made, the belt driving from the motor to the cone shaft pulley was computed when the motor was operated on its rated speed in R.P.M. as stampt on the name plate, for the line voltage which it was wound for.

This arrangement thus enables the tester to compensate for any fluctuations in the line voltage which are bound to occur in most all instances.

CHAIN AND OTHER DRIVES.

Chain drives are used extensively in motor installations, even for fairly high speeds and large horse-power. Fig. 3 shows a typical chain drive. The motor in this case is mounted on the ceiling and drives a line shaft by means of a chain of a well-known make.

As will be evident, the chain drive has the advantage that the speed ratios are absolutely positive, and it is often more efficient and especially more noiseless than a directly coupled gear drive, particularly where high speeds are involved, of say, 1,000 R.P.M. and more.

Machine design books contain some data on the horse-power and size of the chain drives, but it is best to procure catalogs and data on these drives from the manufacturers of chain belts, several of which are building them regularly. Two well-known chain drives which are advertised in leading mechanical journals are the Morse and the Link-Belt.

To compute the relative speeds of two shafts such as motor and line shafts, as illustrated in Fig. 3, for a chain drive, the number of teeth on the two gears are figured in the same way as previously explained. The chain then performs the magic function of linking the two gears together, tooth for tooth.

Thus a ten to one ratio between the line shaft and the motor would mean 100 teeth on the gear wheel on the shaft and 10 teeth on the motor gear. The line shaft would then run at 1/10th the speed of the motor shaft. This is only cited for an example, and in practise the motor, if of medium size, would run somewhere in the neighborhood of 1,000 R.P.M., while the shaft would probably be operated at no more than 200 to 300 R.P.M.

Small motors such as 5 H.P. and the like have a speed of 1,750 R.P.M. very frequently, and for a line shaft of average speed, say 250 R.P.M., the speed ratio is one to seven; for a belt drive, the diameter of a shaft pulley should be seven times the diameter of the motor pulley, and for gear or chain drives the number of teeth on the large gear mounted on the shaft should be seven times the number of teeth on the pinion on the motor shaft.

It should be mentioned that one of the excellent features developt in the modern chain drive is the fact that the chain links have been so well developt in every fundamental, that they move along with their changing angle without any lost motion between the gear teeth, causing them to faithfully follow the contour of the teeth and thus they attain their pitch at two or more points with a certain heavy strain on the pulley and act in fact like a flexible gear or rack.

Chain drives should be well lubricated and a heavy lubricant for special drive pitches are available on the market, which should be applied to them frequently by the maintenance men.

For leather belt drives, there are several excellent dressings available on the market, which can be applied to the side facing the pulleys, and one of the old well-known dressings is "Neatsfoot Oil". A leather belt should not be overdressed, as this is just as bad as no dressing at all.

In emergency, molasses has been applied to belts if it slipt excessively, and also pulverized or crushed resin; but one of the iron-bound rules of the machinist is not to apply resin to ANY belt. The effect of the resin, as experience will show, disappears in a very short time, even in half an hour, and it leaves the surface of the belt in a bad condition, filled with hard, gummy lumps of resin, and making a muss of things in general so that some good liquid dressing would have to be applied for some time to get it in good shape again, if in fact, the resin has not burned the belt in spots, owing to its chemical effect. It is usually recommended in machinists' hand books to place the hair-side or rough side of leather belts against the pulley, but it is doubtful if this is advisable under any circumstances. The writer has seen hundreds of leather belt installations of all widths conceivable, and these were invariably placed with the smooth or dressed side of the belt to the pulley.

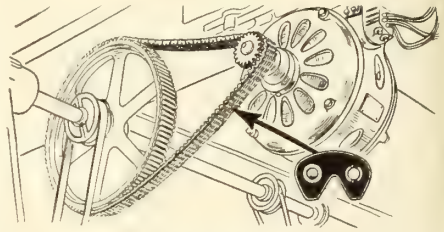


Fig. 3.—Chain Drive from Electric Motor to Line Shaft.

One reason why the smooth or dressed side of the belt should be placed to the pulley is this: The horse-power to be transmitted by a belt is tested and computed in machine designs by the number of square inches of belt surface passing over the pulley per minute. It will at once be seen that if the rough side of the belt is placed against the pulley that the friction caused by contact between the belt and pulley will only be one of a series of high spots, and thus when full horse-power is to be transmitted from such a belt or pulley, if designed on the regular basis and allowance for velocity, belt width, and horse-power, that the belt will simply not transmit the proper power without undue slipping. In belt drives, either rubber, leather or canvas, all of which are now in use extensively, a clever little wrinkle which is almost imperative in many instances, especially on high-speed drives, is to drill or punch a row of holes in the center of the belt, or two or three rows of holes on wider belts, along its entire length in order to allow the comprest air to escape from between the belt and the pulley and thus prevent undue slippage and waste of power.

The writer has seen another clever stunt and that is to drill one or more rows of small holes around the periferal surface around the pulley or pulleys.

Speaking of belts, there are quite a few varieties which we find here and there, among them spring belts, composed of a spiral spring with the ends linking together; flexible steel and wire core belts and rope belt drives, which are often used for very large horse-powers with high efficiency in connection with grooved pulleys.

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; Second Prize, $3.00; Third Prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

SECOND PRIZE, $3.00

HOW TO MAKE A "TATTOOING MACHINE."

By David T. Weinberg.

PROBABLY the majority of readers have at some time or other seen what is known as a "tattooing machine," but have wondered how one is made and operated. As this article pertains to the construction of such a machine, it can be simply explained as a buzzer permitting the armature of a considerable movement with a new, long and sharp sewing needle attacht to the extremity of the armature with a 3/16 or ¼-inch metal tube acting as a sleeve for the needle and also for containing the coloring fluid.

To begin with we require one small electro-magnet coil wound to a low resistance. This is set on a 3/16-inch thick wooden or better a fiber base.

Next procure a piece of cigar box wood of the same width and thickness and make a housing as shown in the diagram with a few small nails, thus forming a frame so that the armature and vibrator can be attached. Now in attaching the vibrator (one can be obtained from an old bell or at any electrical house), see that it will permit of a long jump, by placing it about ⅛ of an inch away from the magnet, then slot the end of the armature so that the needle will fit firmly into it, and solder carefully, first scraping the parts well.



A Simple Electrical "Tattooing" Machine Which Will Operate On One Or Two Cells Of Dry Battery. The Outline Of a Star Is Here Shown Being Tattooed On a Lady's Hand.

After completing it thus far, hunt up a 3/16 or ¼ inch copper or brass tube, the length being ¼-inch less than the length of the needle, and by tapping lightly and evenly around one end of the tube with a small hammer, taper it down as per the

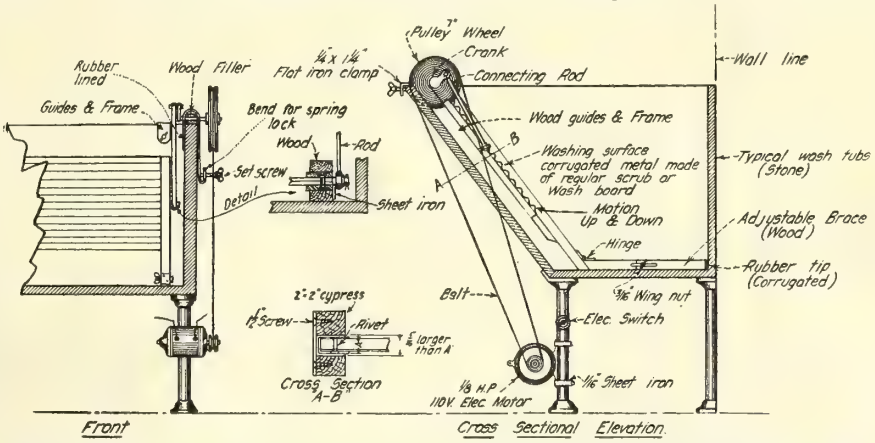
(*Continued on page* 347)

FIRST PRIZE, $5.00

HOME-MADE ELECTRIC WASHING MACHINE.

By P. P. Avery, M.E.

THIS idea is to facilitate home washing of clothes. Instead of the woman doing the rubbing, the board moves up and down and all she has to do is to keep the tubs filled with hot soap suds, water and soiled clothes to be washed and hold them against the moving washboard. Use a small ⅛ or 1/6 H.P. 110-volt motor and wood pulley, with a machine belt run to large 7" wood pulley which is clamped to one of the legs. Arrange a switch near at hand. Make a wood frame, as shown, and using an old scrub-board, bind its edges with a strip of heavy galvanized iron; on the one side make the driving pin fast, and make a connecting rod and crank from ⅛" flat iron, held in place with washers and cotter pins. The board moves freely in its guides as the soft water acts as a lubricant and the frame is held solidly in place by the top wing bolt clamps and by the extension "push-tight" braces. An ordinary lamp cord from wall fixture to switch and thence to motor will duplicate in system the use of the electric iron, and may be used for both.



A Good Home-made Electric Washing Machine, At Last! Instead Of Paying a King's Ransom for An Electric Washer You Can, With a Little Ingenuity and Patience, Construct One of Your Own. The Only Real Expense Is the Motor, and You Can Pick This Up Cheaply At Electrical "Second-hand" Dealers.

AUTHORS ATTENTION!!

We are desirous of publishing in this Department and also in our Constructor Department, the very best articles and ideas which we can obtain. To increase the incentive to authors to contribute suggestions and ideas to the ELECTRICAL EXPERIMENTER—(Science & Invention), we are pleased to offer a new schedule of prizes in this Department, with the present number. Instead of paying $3.00, $2.00 and $1.00 for the first, second and third prizes, we are offering with this number, prizes of $5.00, $3.00 and $2.00 for the first, second and third prizes, respectively.

If you have a good idea send it along! Read the directions for preparing articles at the head of this page, and whenever possible, have the text typewritten. 200 to 300 words are invariably sufficient. Describe the "details"—we will take care of the rest. Address all manuscripts to the Editor, ELECTRICAL EXPERIMENTER.

THIRD PRIZE, $2.00

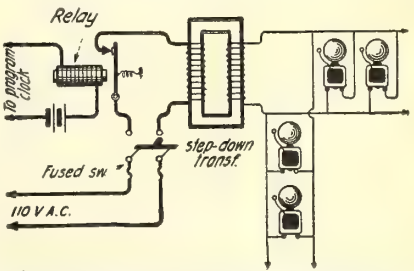
A PROGRAM CLOCK SYSTEM THAT WORKS

By J. C. Jensen.

EVERY factory, school or college should have a program clock and a system of electric gongs so that all may know the exact time for the performance of a given duty and work together on schedule time. A bell system operated by hand is subject to all the irregularities of a forgetful janitor. The elaborate electrical clock outfits used in some schools are very expensive and much of the time out of order.

It is not a difficult matter to change the striking system on the ordinary wall clock in such a way that it will trip on each five minute interval, the escapement rotating a *contact-maker* instead of striking the gong, for a three second interval. Several such devices are on the market for those who are not in a position to construct one.

The next problem is that of providing a positive and permanent source of power at minimum expense. The wiring diagram shown herewith solves this problem nicely for one cell of dry battery on the relay line will last for a year and the bell transformer is always on the job with plenty of power for the bells. Common bells work very well if resistances of 20 ohms or more are chosen for a 12 volt circuit, but transformer gongs give better results at little more expense. This circuit has the advantage of minimum danger from



A Clever Electric Program Clock System Operated With Step-down Transformer from 110 Volt A. C. Circuit, Which the Author Is Using In Actual Practise.

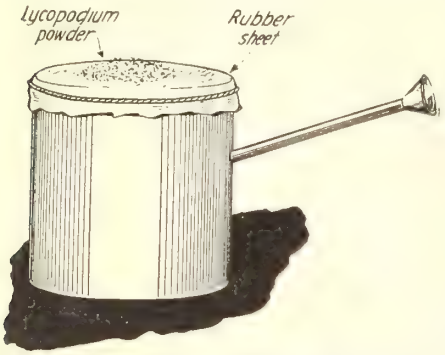
fire as the primary circuit is almost always open, and for the same reason the transformer losses are reduced to a negligible quantity. In fact, we have a system of 15 bells and the power cost certainly is not more than 5 cents per month. By placing switches in multiple with the relay lines to the clock, the same bells may be used for fire alarm purposes, switches being placed at convenient points.



HOME MADE EIDOPHONE.

All that is necessary is a clean tin about the size of a two-pound jam tin, also a piece of rubber sheeting, a small funnel, and an oblong piece of tin.

Take your tin and cut a round hole in the side, roll up the piece of tin and insert it in the hole; now solder the tube to the can and stick the funnel in as far as it will go. Take the thin piece of rubber sheeting, and stretch it tightly over the top of the can, and tie it.



Lycopodium Powder Resting Loosely on a Stretched Diafram, as Here Shown, Will Assume Innumerable Figures for the Changing Voice Tones Spoken into the Mouth-piece at the Right.

All is ready and all else you have to do is to obtain some fine powder such as lycopodium powder, dry salt, etc., and spread a thin layer of one of these materials over the sheeting. Now start to sing a single note, steadily and continuously into the funnel and the position of the powder changes and forms itself into a design. The designs thus formed are innumerable, as you can change the tone of voice or the powder as often as you wish.

Contributed by EXWYZED.

COLORED FIRES FOR ENTERTAINMENTS.

The following formulas for colored fires are reliable ones and are used by the large fireworks manufacturers. In compounding them, DON'T mix them with a mortar and pestle. They may be mixt on a large sheet of clean paper. Mix them *thoroly*. Don't pack them tightly in a small space; they are more or less *explosive*.

RED FIRE.

Strontium nitrat	40%
Sulfur	13%
Potassium chlorat	5%
Charcoal or lampblack	3%
Antimony sulfid	4%

CRIMSON FIRE.

Strontium nitrat	53%
Sulfur	22%
Potassium chlorat	20%
Charcoal or lampblack	5%

GREEN FIRE.

Barium nitrat	77%
Sulfur	13%
Potassium chlorat	5%
Charcoal or lampblack	3%
Metallic arsenic	2%

BLUE OR BENGAL FIRE.

Potassium nitrat	66%
Sulfur	22%
Tersulfid of antimony	12%

WHITE INDIAN FIRE.

Potassium nitrat	73%
Sulfur	20%
Sulfid of arsenic	7%

LILAC FIRE.

Potassium chlorat	49%
Sulfur	25%
Chalk	20%
Black oxid of copper	6%

PURPLE FIRE.

Potassium chlorat	43%
Potassium nitrat	22½%
Sulfur	22½%
Black oxid of mercury	10%
Black sulfid of mercury	2%

YELLOW FIRE.

Sodium nitrat	75%
Sulfur	19%
Charcoal or lampblack	6%

All the above percentages are taken by weight. They should be compiled accurately to give best results.

Contributed by JOHN BARRY.

CUTTING THE HIGH COST OF PARAFFIN WAX.

Paraffin wax is used in many manufacturing plants as a sealing compound, and as an insulating medium, also for waterproofing. The present price of paraffin wax is about ten cents per pound, and those using large quantities find this increased price cutting a hole into their profits.

Manufacturers of flashlight batteries use considerable paraffin wax in the construction of the cells as a sealing and insulating medium. Their cost can be cut considerable if they will take say one part paraffin wax and one part rosin. This gives a better insulating material, as well as a better sealing compound. Paper treated with a mixture of rosin one part and paraffin one part, makes an ideal insulation for placing between cells when they are made up in what is known as "battery sets." The same weight of wax when mixed with rosin will treat a greater quantity of paper than the wax alone; this is an additional saving.

The cost of rosin is about $7 per barrel of 280 pounds; this is 2½ cents per pound, and the paraffin wax is not less than 10 cents per pound. So if one pound of rosin is mixed with one pound of paraffin wax this cuts the cost from 10 cents per pound to 6¼ cents per pound, making a saving of 3¾ cents on every pound used. Most factories buy this wax in ton lots, and a saving of 3¾ cents per pound would be the small sum of $75.00 saved on every ton.

Contributed by WILLIAM HOPPIE

"MINIATURE LIGHTNING."

I wish to submit the following experiment which I believe would be of interest to the readers of the ELECTRICAL EXPERIMENTER.

Place a piece of phosphorus about the size of a pea in a glass one-half full of water. Next sprinkle a few crystals of chlorate of potash over the phosphorus. With a medicine dropper release a few drops of sulphuric acid C.P. into the glass. In a few seconds sparks will commence to fly from the phosphorus, and will be accompanied by a snapping and crackling noise which greatly resembles lightning.

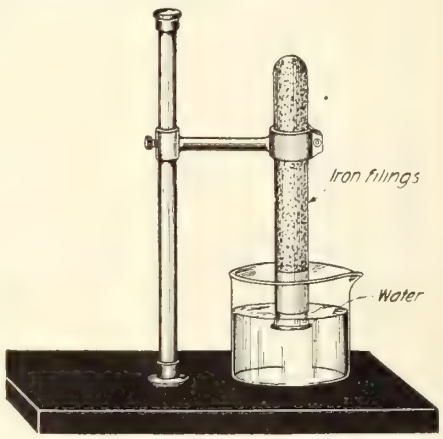
Contributed by MURRAY D. FAIR.

ILLUSTRATION OF OXIDATION BY AIR.

Wet the inside of a clean test-tube with water, and sprinkle a quantity of clean iron filings inside, so that they adhere to the wet glass. By means of a ring-stand, clamp the tube upside down, so that the mouth of the tube is slightly under the surface of some water in a beaker. (See illustration.)

Leave the apparatus in this position for about an hour. At the end of this time, it will be observed that the water has risen inside to about one-fifth the height of the tube.

Explanation: Air consists four-fifths of nitrogen and one-fifth of oxygen; the oxygen in the air imprisoned within the test-tube combines with the iron filings, forming iron oxid (iron rust). The water rises to take the place of the oxygen.



Interesting Experiment to Illustrate the Oxidation of Iron Filings by Air.

To prove the remaining gas is nitrogen, place the thumb over the mouth of the tube, and withdraw the tube from the water. Remove the thumb and apply a lighted match to the mouth of the tube; the nitrogen in the tube will cause the flame to go out.

Contributed by JOHN BARRY.

MAKING FLEXIBLE MIRRORS

Herewith I present directions for making mirrors (flexible) from tinfoil on celluloid.

Directions: Procure a piece of celluloid —an old photographic film, cleaned of its gelatin coating will do—and coat it as follows: Make a solution of ¼ teaspoonful of boiling water. Take a piece of tinfoil—not leadfoil—and rub a few drops of quicksilver on one side till it resembles a mirror. Wet the fingers in the prepared gelatin, size and rub it all over the surface of the celluloid, and lay the foil on, *quicksilver side down.*

Cover with a piece of newspaper. Hold it tight to prevent slipping, and burnish the foil down hard to the celluloid surface. This may be done with the end of a round paddle made of wood or similar hard surface.

When this has become dry a fine mirror will be the result. It may be twisted in almost any way so that it makes a very amusing device for distorting a person's face, making a stout person look tall and lanky, and making tall people look ridiculously squat and short.

Care should be taken not to bend the celluloid too sharply as the foil will wrinkle and the effect spoiled in consequence.

Contributed by WILLIAM J. WRIGHT.

Listening for Signals from Mars

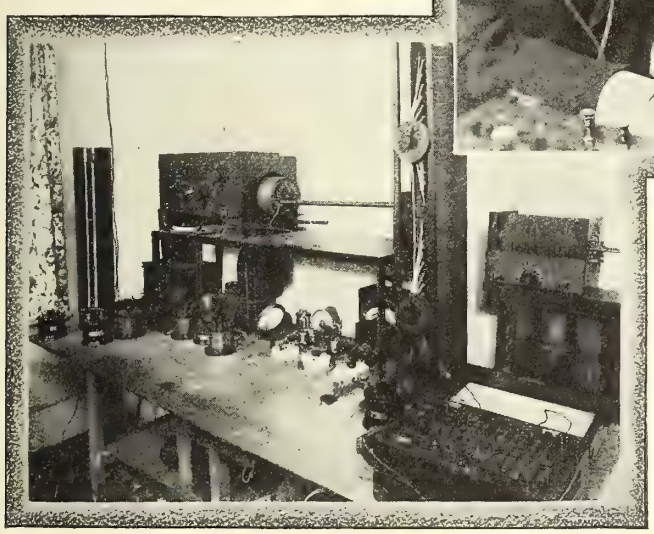
By DR. FREDERICK H. MILLENER

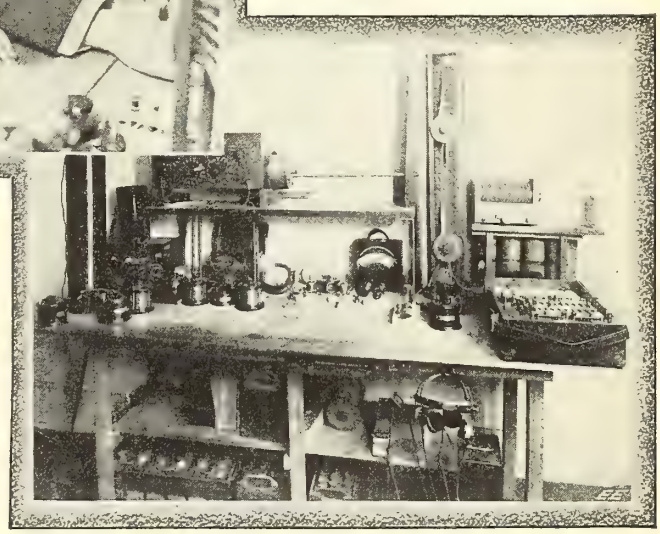
IN order to receive a signal from Mars or any other planet, we must first have some common language or method of signaling. If there are intelligent beings on these various planets endeavoring to signal the earth, it would have to be by some means common to them all. There are three such methods. First, light waves, visible and invisible, which would include the colors of the spectrum. Second, the regularity and precision with which planets move thru space. Third, mathematics, which would have to do with the above regularity.

Wireless telegraphy is undoubtedly tuned invisible light waves; that is, invisible to our eyes. Our scientists have been able by means of spectral analysis to tell us considerable about each one of the planets, and we have no reason to doubt that the inhabitants, if there be any on these other planets, have been able to tell considerable about the earth's spectrum. There is also no doubt that they must know at least as much if not more than we do of the regularity and precision of movement of the planets, stars, etc., and if they do, they must have a thoro knowledge of mathematics or what *we* call mathematics.

From time to time we have heard from the large Marconi stations that they have received signals at more or less regular intervals, the understanding of which was not clear. To a person so inclined there is nothing more interesting than an evening, where the surroundings are suitable for such work, to listen to the humming of the busy world in the ether. With proper apparatus almost any one of the large stations of Europe, North and South America and Hawaiian Islands can be heard, located and messages interpreted. This is doubly interesting if it is coupled with listening for signals from another world. Therefore, when Mars approached as near the earth as it would at this period we determined to listen in, and by building and acquiring certain apparatus secured as long an antenna and counterpoise as we could. As I stated, the question had been raised as to whether mysterious unrecognized signals emanating from an unknown source could possibly be the result of Martians endeavoring to communicate with the earth. Our experiments were conducted for the purpose of settling the question whether Mars was at this time endeavoring to signal the earth by the aid of what we know on earth as radio telegraphy, or by means of a tuned radiant energy.







Photos Show the "Mars" Listening-in Radio Station of Dr. Frederick Millener. Dr. Millener Appears at Left of Top Photo—the Gentleman at Right is Mr. Harvey L. Gamer, His Co-Worker. Both are Leaders in the Field of Radio Engineering.

DR. FREDERICK H. MILLENER, radio expert and the first man in the country to establish radio communication with a moving railroad train, during his famous experiments on the Union Pacific Railroad, needs perhaps no introduction to our radio readers.

During the last opposition of the planet Mars in the latter part of April, the entire world was breathlessly awaiting news from Dr. Millener's Omaha station whether the mysterious planet was actually trying to communicate with the earth. Scientists were agreed upon it that if anyone was able to detect these signals Dr. Millener's station certainly would be able to register them, due to his very fine instruments as well as the excessive wave length employed. For days the newspapers were full of Dr. Millener's work, and the world was awaiting news expectantly. That the result was negative is of course no fault of our scientists. If Mars had been sending radio signals such as we understand them, Dr. Millener's station would have received them. Our readers will be glad to read Dr. Millener's own account which has been written especially for the ELECTRICAL EXPERIMENTER.

—EDITOR.

THIRTY-FIVE MILES OF WIRE.

Our experiments were conducted from a station on a ranch sufficiently far from Omaha, so that local electrical disturbances would be entirely absent. A large part of the equipment was constructed especially for the purpose to which it was put by my co-worker, Harvey L. Gamer and myself, both of whom had been connected with the Union Pacific Railroad as experimental engineer and electrical engineer before the war; Mr. Gamer during the war. Part of it was apparatus that was used at Fort Omaha, Nebraska, to listen in and detect unlawful users of the ether during the war. It consisted of a large co-axial coupler, amplifiers, both radio and audio frequency, inductances and condensers. The antenna consisted of *approximately thirty-five miles of wire strung on telegraph poles, covering an area of about twenty-five square miles,* and the counterpoise somewhat larger. We were enabled to reduce the size of our antenna and counterpoise at will, thus permitting us to pick up the messages of almost any wavelength and accurately measure the same. Starting with the wavelength of an average commercial station we gradually lengthened our wavelength until that of New Brunswick and Annapolis were reached and past. Slowly increasing the wavelength until it

(*Continued on page* 317)

A War-Time Radio Detective

By PIERRE H. BOUCHERON

No. 3. Sleuthing a La Twentieth Century, or Trailing the Illegal Dot and Dash Slingers

FORTY years from now, when I am old and crabbed; when I no longer take pleasure in making home brew; when I shall have ceased experimenting with permanent electro-magnets on the electric light meter, and when my eyes shall have become dim and watery from close contact with sputtering arcs and X-ray machines to such a point that they will cease to appraise wondrous landscapes, art galleries, the language of the birds and flowers, beautiful women, near-beer and other works of nature and prohibition, I shall have my nurse-maid bring forth my diary and turning back to the experiences entitled "The part I played in the *Grate* War," shall have her read me to good cheer some of the many little comedies connected with my "radio-sleuthing" days.



. . . . "Mrs. S—— Lived Near Rochester, N. Y., in an Old Colonial House . . . She Led Me Into the Musty Old Parlor and Unfolded a Startling Recital of How She Had Received Radio Messages Direct from the 'Central Powers'—All Without Any Apparatus!"

Every time I swallow a false tooth, I shall want to be brought back to pleasant humor by insisting upon being read the passage about the nice old soul who once sent our bureau a 200-word *day telegram* to the effect that she had information of the greatest value to the Government of the United States, both from a scientific and military point of view, and that we make haste to visit her as soon as possible in order that she furnish us with all particulars. She did not forget, of course, to mention the fact that the matter was so startling and would prove so revolutionary that she could not even hint as to its nature in so open and public a method of communication as an ordinary telegram. The lady further stated that the case had to do with a totally *new system of radio telegraphy*, and for that reason no less than an expert in this science should be detailed on this important mission.

After this yarn has been read off to me, I shall contentedly sit back in my easy chair and perhaps take a few sips of weak tea, who knows? The story runs something like the following:

THE STRANGE RADIO TELEPATHIC SIGNALS.

Mrs. S—— lived near Rochester, N. Y., in an old house of the colonial days type. No sooner had an aged negro servant admitted me than the gloom and silence of the musty Revolutionary mansion began to weigh heavily on me in addition to the six-dollar raincoat on my back. I waited almost an hour when the lady finally made her appearance and greeted me with an air of dignity and low tones which seemed to spell mystery with a capital "M."

She led me to the old fashioned parlor and thereupon unfolded one of the most startling and fantastic recitals it has ever been my bad fortune to hear. *For the past two weeks she had received many messages direct from the Central Powers.* She explained that altho the messages were transmitted by means of radio-telegraphy thru the high-power stations at Berlin, Constantinople and other points, she had accidentally discovered a means of receiving them direct *without the use of an actual radio installation!* At this statement, I looked at her sharply, then began to look around for a quick exit to the nearest door. The odd part of it all was that the woman seemed perfectly rational and spoke in a well-informed and balanced manner, and no amount of questioning on my part failed to disclose the slightest trace of that well-known malady, *dementia americana.* To cap the strangeness of her story, she brought forth a number of sheets of paper containing all manner of messages written in several languages, evidently of an official character, judging from the various military and civilian titles.

I asked the lady just how she received these communications, at which she answered, "Why, by means of dots and dashes, of course. I have always been an expert operator, and there is no mistaking the manner in which the signals respond to my hearing."

For another whole hour I was forced to listen to many descriptions of just how the messages "came in," which were mostly at night, she said. The woman seemed so sincere that I began to have my own doubts. I remembered several instances in my operating days, when there had been times, when miles away from any radio apparatus, I *thought* I could hear familiar high frequency spark signals. Perhaps some radio men who read these pages may recall similar occurrences. Strange, but nevertheless true. So, as I say, I began to wonder whether the lady was not suffering from some exaggerated form of a similar delusion confined solely to the sense of hearing.

Finally, I gathered all the data offered me, made a few notes on the time and place of the strange *radio-telepathic* signals and fearing to be informed of more *startling and revolutionary* radio doings, I managed to make my exit with as much grace as I could command under the circumstances. Once out in the open country road, I breathed a sigh of relief, wiped the moisture from my almost "fevered brow," and started for the nearest house adjacent to the spooky Mrs. S—— in order to confirm certain thoughts.

Before I reached it, however, the rural mail carrier came jogging along in his buggy.

"Can you give me some character information on the lady living in that old homestead?" said I, pointing to the house in question.

"Sure," he promptly answered, "it's old Mrs. S——. She has been harmlessly but hopelessly mad for the past ten years. Her husband was a scientist of the old school, so she now imagines herself as carrying on his work, and she seems particularly cracked on subjects connected with mental telepathy."

"Thanks," I said, as I mentally resolved to prepare a long report to my superiors urgently recommending that in the future no attention be paid to the communications of informants unless accompanied by original certificates certifying to the sanity of the man or woman responsible for its dispatch.

STOCK "SIGNALS."

One day, while intensely interested in a lifelike description of some artistic subject within the pages of the "Follies Gazette," an urgent call reached us to immediately dispatch an expert signal man to a certain building in the downtown section of New York, where a telephone inspector was in the very act of listening to some authentic and quite audible "radio signals" having no business there.

Upon reaching the place, I found my telephone friend pottering and fuming over a large connection box on the main floor of the building. He was sure they were radio signals because he once had met a man who had told him all about it. As far as he was concerned, there certainly was *no room for doubt*, and accordingly, had telephoned his chief to come down and listen-in for himself.

Since this incident had occurred during one of the periods most pregnant with spy radio hysteria, these two gentlemen had lost no time in notifying official headquarters. With the aid of a telephone receiver I listened-in on an improvised circuit in the telephone box, to which ran many thousands of telephone wires. Sure enough, signals of a suspicious character were distinctly audible. They had a frequency of about sixty cycles, were quite loud, but hopelessly, pathetically and, as usual, *inevitably* unreadable. As I listened for a little while longer, the signals, which were composed mostly of series of long dashes with a few dots here and there, slowly began to assume the character of something I had once or twice heard, which sounded suspiciously like a certain instrument near the barroom of the Estor Hotel. You may remember, of course, that this well-known hostelry had, during the same year, been the scene of a suspected spy radio installation, not far from its immense roof. As the suspicion slowly began to impress itself on my mind, I asked one of the wire experts if there were any other lines besides telephone circuits within or near the connection box. He replied there was nothing

at all except a so-called "ticker" circuit.

"Ah!" I exclaimed, as the previous suspicion now became alive with possibilities, "that is just what I want; where is it?"

I thereupon made some sort of connection on the ticker circuit and was not surprised when I heard the sounds within the telephone receiver *absolutely identical* to those we had heard on the adjacent telephone wire. In other words, the signals were none other than those which had fooled us many times before, and I may say many times thereafter. In short, they originated from *stock ticker* circuits. In sections where these ticker wires were allowed to run close to telephone circuits inductive effects often resulted, whereby the familiar "da-da-di-da-da" of the news and stock tickers, you and I have frequently heard, were induced on adjacent telephone lines.

MYSTERIOUS STEEL TOWER IN THE CATSKILL MOUNTAINS.

Occasionally there would be cases which, during the process of investigation, would manage to get into the hands of newspapers. The result of course was that great notoriety would be given to instances which were nothing more or less than the overzealous activities of patriotic and well-meaning persons.

Such conditions would particularly be noticed after the press had given much space to one or two of these fiasco cases. A case of this nature was the following one, which took considerable time and expense to unravel. Three reports came in from three different sources reporting the one individual case.

A millionaire woolen manufacturer who, rumor intimated, had had his manufacturing plant confiscated by the Government, and which was now being operated by the office of the Alien Custodian had, previous to our entry into the war, been engaged in much German propaganda.

This gentleman was now living in a secluded and almost inaccessible spot somewhere in the Catskill Mountains. Here he had fortified himself by building a large and expensive mansion, surrounded by all the comforts characteristic of millionaires. The informants had heard from undoubtable sources that this German had constructed and was operating a *high-power radio outfit, capable of sending and receiving messages to and from Germany!* The report also said that he had a large steel tower, under the guise of a windmill, and that from this tower was stretched several lengths of wire to neighboring tall trees which acted as an antenna. A large generating plant had also recently been forwarded to this spot as well as many other electrical appliances.

One of the informants claimed that he had climbed a certain high spot near the German's place, called "Watch Hill," where he had *seen* the tower and wires very distinctly. It could also be noticed that a wire fence had been built around the estate and that large, ferocious dogs, assisted by evil-looking individuals, patroled this enclosure during the day and night in order to scare away possible intruders.

After reading these reports, the case certainly looked very promising and inferred possibilities of a great discovery. The only way to reach this place was by train which left New York at 2 a. m., and which reached a place called *Big Indian* at about 11 a. m. From this point it was necessary to board a stage (a Ford truck used by the local postmaster) and travel thru many winding roads for a distance of nearly thirty miles. I finally arrived at a spot within a short distance of the suspected estate, accompanied by a secret service man. We were prepared for a long siege and had the necessary equipment, such as revolvers, powerful field-glasses, and a small portable receiving outfit.

In order to allay suspicion as to our purpose, we explained to the stage driver that we were on a fishing trip and our paraphernalia consisted of supplies for a long ramble thru the mountain streams in search of trout. We reached the base of Watch Hill late in the afternoon and decided to start our investigation after midnight. We climbed the "Hill" and installed ourselves near the top, where we had an excellent view of the estate, as well as the steel tower. Upon closely scrutinizing the ground with our field-glasses, we saw the power house in question, separated from the mansion by a short distance, and what were evidently power lines leading to and from the house.

Articles In July "Radio News"

Radio Telephony on Aeroplanes.
By Major C. E. Prince.

Concerning Aerials.
By P. H. Boucheron.

The President's Special.
By Thomas W. Benson & Chas. S. Wolfe.

An Experimental Wave Tester for Receiving.
By Raymond Evans.

Radio in Germany.
By R. Wilhelm.

The Wavemeter and Its Importance in Radio Transmission.
By Yosé.

Musical Reception with Continuous Waves Without Local Oscillations.
By Dr. L. W. Austin.

We also observed that there were considerable lengths of wire attached to the steel tower, leading to distant trees, all seeming to be of standard length, as would be with a systematic attempt to secure a definite wave length, and the terminating ends also seemed to have large dark objects which closely resembled insulators. However, from the distance we were, we could not definitely establish whether or not these objects were actually insulators or merely twist-bolts.

At midnight we closely observed the place under investigation and noticed considerable activity, such as lights burning and persons walking to and from the power house, which in itself looked at least suspicious.

After this, we erected our portable receiving outfit and listened-in for the remainder of the night. However, nothing was heard which would preclude high-power transmission in the immediate vicinity. In fact, constant and careful observation for the following three days failed to furnish any conclusive evidence that our friend was engaged in anything more alarming than scientific farming and tree planting, aided by several gardeners and laborers.

We therefore decided to "swoop" down on the place and to make a thoro investigation of the power house and that suspicious-looking tower and wires.

The owner of the place was considerably annoyed when we explained our visit, and at first was going to have us thrown out, but when we explained to him the futility of doing this, he consented to allow us to go thru his place in order to demonstrate to us the absurdity of the reports that he was a German agent engaged in receiving and sending military information between Germany and the United States. He accordingly detailed his private secretary to accompany us in our search.

Alas for the vagaries of humans and the vividness of their imagination! What we had thought would mean the making of our fame while unraveling this mystery and discovering a den of German propaganda, proved only to be another story enough to give us a press notice of not more than two lines.

The tall steel tower was in reality a windmill and the wires separated from it were nothing more alarming than guy wires. The suspicious-looking objects at their termination were turn-buckles, designed to take up any sagging of the guy wire.

As for the power house, it was indeed genuine, but was used solely for the purpose of illuminating the house and surrounding barns as well as to furnish power to the many appliances necessary to a modern and up-to-date millionaire's estate.

Our German friend invited us to luncheon and he certainly exceeded himself to make us comfortable, including cigars, afternoon coffee and liqueurs. Under the genial influence of this meal, served to us by a butler in a gorgeous uniform, our host waxed genial and really was amused with the absurdity of his being *under suspicion.* He thought he knew who caused the report to be sent in. Probably a discharged employee, and he vowed he would investigate the matter himself in order to get at the bottom of it, to definitely prove to us that he was a true friend of the United States. He was a naturalized American citizen and had most of his money invested in Liberty Bonds. Not only that, but he had turned over his entire manufacturing plant to the Government for the manufacturing of khaki and incidentally had invented a new kind of cloth which was more serviceable, more economical and more efficient than any of the cloths used by the European countries.

Yes, critical reader, I fully realize that the Lightning Rod and the Underground Radio episodes promised last month are missing in the present issue. Be reasonable, as I have not yet received permission from the German War Office to publish them! In the next installment you will be rewarded with a few more choice exploits.

"We Reached the Base of 'Watch Hill' Late in the Afternoon . . . . . Where We Had an Excellent View of the Estate, as Well as the (Spy Radio?) Tower."





Left:—The Wireless Plant at "Knights of Columbus" School in New York City, Where Electricity, Acetylene Welding, Motor Mechanics and Other Vocational Trades Are Taught Free to the Demobilized Service Men. Right:—The Electrical Class of Ex-fighters in a K. of C. Vocational School Observing a Problem for Interior Wiring. This Course With "Radio-telegraphy" is One of the Most Popular in the Chain of Sixty Such Schools Operated Free for the Former Fighters.

Free Radio Course for Ex-Soldiers

By William M. Bolger

FIFTY thousand soldiers who served at home and abroad during the World War and were thrown back into civilian life to be classified among the "unskilled workers," of this nation of 100,000,000 souls have been taken in hand by one of the most unique educational systems ever launched in this country and are now well on their way ready to take their places in the factory, round-house, construction and various skilled trades.

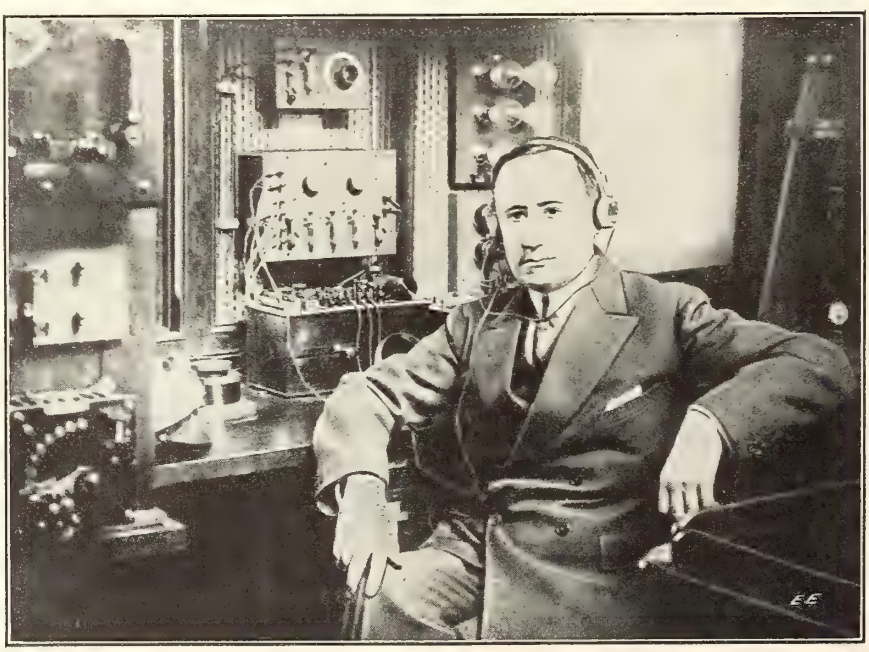
It happened not more than one year ago when the Knights of Columbus found the portals of peace about to be dropt on one of the most brutal wars the World ever stood up before. Every patriot in this country had done their share. Those who could not go gave unstintingly of their funds so that the soldiers, sailors and marines overseas might have some proper attention through the many war relief agencies which had sprung up with the clash of arms. Foremost in this field came the Knights of Columbus with their cheery slogan of "Everybody welcome; Everything Free." They gave millions of dollars worth of creature comforts to the men and at the end found a balance of seven million dollars on their books which remained to be spent.

From this fund and thru the formation of a committee of educational experts from all sections of the country, the idea of the supplementary Vocational and Elementary Evening Schools was conceived and put into practical operation. A chain of sixty schools from the Canadian border to the Rio Grande and across to the Pacific are now functioning at top speed. Any service man or woman simply presenting a discharge certificate showing the applicant has been "in the service" is all that is necessary for the admission of a pupil. The schools are in session five evenings each week and the study periods are divided between 7:30 and 9:30 each evening. No religious or racial lines are drawn. They are operating schools for the negro soldiers apart from those for the Southern boys. In their vocational schools they have given great attention to the studies of advanced motor mechanics, electricity and radio-telegraphy, because many of the ex-service men and women display enthusiastic interest in these subjects. The attendance of the students averaged up in these courses at the many schools shows very little sign of declining. William J. McGinley, the Supreme Secretary of the K. of C., is at present completing a tour of certain schools for the purpose of making a survey that will allow for intelligent development this coming Fall, when more schools will be opened and new studies brought in.

One of the attractions of the school system is that all pupils are allowed to pick any particular course in which they are interested. And the other attraction provides that any student upon completing the study may choose a new one free.

Marconi--The Master Radio Experimenter

Signor Guglielmo Marconi, the famous inventor of applied Radio-telegraphy, is still as enthusiastic as ever, when he sits among his instruments and he truly may be called, the "master radio experimenter." Signor Marconi, unlike many inventors, has had a very fine education in the various branches of science, pertaining to the subjects in which he is interested, and holds the degrees of D. Sc., and a number of other high scientific honors bestowed upon him by various universities thruout the world. The inventor of applied wireless telegraphy is seen in the accompanying photo, on board his palatial ocean-going yacht, and recent news reports have intimated that he intended sailing out on the ocean so as to be as far as possible from all earthly radio stations, in order to make further careful tests of the mysterious Martian (?) signals.



The Accompanying Photograph Shows Signor Guglielmo Marconi Seated in His Radio Laboratory on Board the Palatial Marconi Ocean-going Yacht. Despite His Advancing Years, Signor Marconi Is Just as Enthusiastic an Experimenter as in His Younger Student Days, When He Raised the First Elevated Antenna Wire on His Father's Farm, and Discovered That the Hertzian Waves Would Carry Signals a Mile and More, Instead of Just a Few Feet, the Distance Covered by Lodge and Other Previous Experimenters

Three Types of Amateur Spark Gaps

By PIERRE H. BOUCHERON

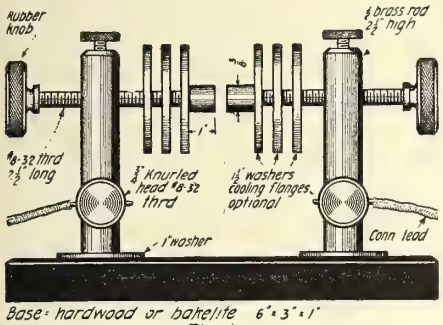
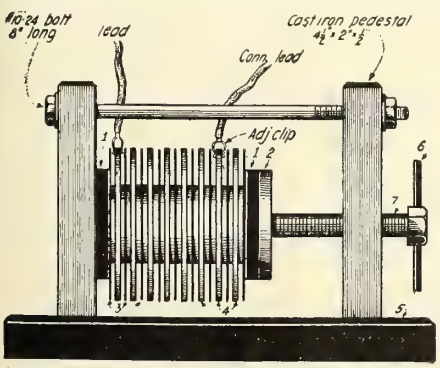


Fig. 1

Plain Fixed Spark Gap, Fitted With Cooling Flanges or Vanes.

WE shall begin by refreshing the memories of some radio beginners. The spark gap may be likened to a trigger allowing high voltages to pass thru at a certain time. In other words, altho there is an actual air space across the electrodes of the gap, it forms and is always a part of the high frequency oscillations produced in the primary circuit of a transmitter. This air gap is broken down only at such time as the transmitting condenser has become fully charged by the high voltage supply from the spark coil or transformer. Thus *when once broken down* it readily allows the condenser to discharge itself. As soon as the condenser has become fully discharged, the gap opens once more and is given a chance to cool off slightly before the next condenser discharge takes place. Therefore, the gap is a conductor during a fraction of a second and is a non-conductor during the next time interval. If this were not so, the condenser would not be able to charge itself again and an *oscillatory circuit could not be maintained.* The rapid restoring of the gap to this non-conducting state is, therefore, called the *quenching action,* and for that reason all gaps, no matter what type, quench to a more or less perfect degree. An arrangement which performs this task very effectively, and which has come into general use with spark transmitters, is the so-called quenched gap. It was given this name because of its ability to perform the quenching action with remarkable rapidity and efficiency.

We will now describe three forms of gaps each having its own particular use and adaptability; in other words, the plain two-electrode spark gap, the non-synchronous rotary spark gap and the quenched spark gap.



1- Bakelite end pieces. 2- Metal end piece. 3- Insulating gaskets. 4- Plates. 5- Base 10"x6"x2" 6- Handle. 7- ⅜-32 pressure bolt

Fig. 3

The Genuine Quenched Spark Gap—Each Gap Airtight and Mica Insulated. Open Gaps Only Partially Quench.

THE PLAIN SPARK GAP.

This gap on account of its simplicity may be readily constructed by the average experimenter and does not require much material. It is suitable for spark coil transmitters and may also be used with small transformers up to one-half K. W.

Fig. 1 shows the general construction details of such a spark gap. The base may consist of a piece of hard rubber, marble, bakelite or hard, well-seasoned wood. In this case it is 6 inches long, 3 inches wide and 1 inch thick. The two uprights can be made from half-inch brass rods each 2½ inches high. One-half inch from each top holes are drilled and tapt with an 8/32 thread so that tapt rods may be employed as electrode adjusters. The electrodes proper may be secured by cutting two small lengths of battery zincs and also tapping them with an 8/32 thread. The cooling fins or flange shown in the figure may be employed, altho they are not absolutely necessary. They have the desirable effect, however, of rapidly dissipating the heat generated at the spark points and therefore keeping the gap comparatively cool, *thereby helping the quenching effect.* These fins may be in the form of several one-and-a-half or two-inch brass or copper washers, also tapt, so that they may be adjusted equi-distant from the zinc electrodes as shown. By means of the adjusting knobs the gap distance may be adjusted almost minutely, thus insuring proper sparking distance under any given condition.

The noise from an open spark gap is sometimes very annoying, particularly to the less enthusiastic members of one's family. An effective *silencer* may therefore be easily made by securing a short piece of glass tubing one-half inch in diameter or more of the glass gage type, having wooden or rubber ends fitted to it just large enough to admit the gap electrodes, thus completely enclosing the spark gap.

THE NON-SYNCHRONOUS ROTARY GAP.

This type of spark gap is the one mostly used by the up-to-date amateur as it has the advantage of raising the natural pitch of ordinary sparks, the never-ending desire of the real enthusiast being to have as high and clear a note as possible. Another advantage of the rotary gap is that on account of its high speed and fanning action it is singularly free from arcing. Still another desirable qualification is that the emitted spark note may be changed at will by varying the speed of the motor with an appropriate rheostat. There are many types of rotary gaps in use at the present time, but their fundamental principle is practically the same; that is to say on the shaft of an electric motor is arranged a metal disc having a series of projecting points which revolve between two stationary electrodes, one on each side of the wheel and where the spark jumps across these. The note is therefore dependent upon the number of times the spark is interrupted by the revolving wheel.

In Fig. 2 we have a type of rotary gap which has been found very efficient for low power amateur use, particularly for the employment of short wavelengths. For as will be seen from the illustration, it is not necessary for the high frequency oscillations to travel thru long metal discs, arms or other parts of the gap structure, and in some cases a direct saving of over ten meters is effected.

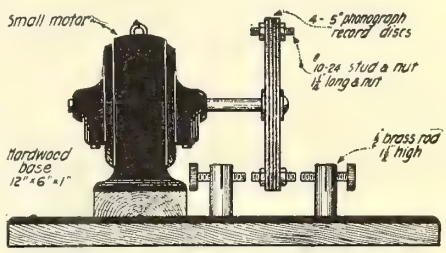


Fig. 2

An Effective Rotary Spark Gap, Having the Shortest Possible Path Thru the Gap Members.

A bakelite or marble base may be employed in this instance, having the dimensions of, let us say, 12 inches long, 6 inches wide and ½ inch thick. A small fan motor may be employed, preferably one of about 1/16th horsepower which will give about 6,000 R.P.M., using either A. C. or D. C. according to the power available. Battery motors may also be employed, but where regular A. C. or D. C. is available, 110 volt motors are preferable. On the end of the motor shaft is mounted a four or five-inch composition disc. This may be either bakelite or two small phonograph discs may be used jointly with equally good results. In drilling the latter, however, great care must be taken not to split or crack them. Twelve holes are drilled near the edge of the discs *an equal distance apart* and thru these are fastened twelve 1½-inch brass screws of the 10/24 variety or larger, after having first cut off or clipt each head. Nuts are fastened on each side and tightened securely making the two discs a compact unit. It is, of course, essential that all protruding ends of the screws be exactly of the same length. If they are found to be of unequal length, they should be carefully filed down so that they will pass by the stationary electrodes arranged on each side of the disc in precise and equi-distant order. After the gap has been completed, the sparking distance is regulated by means of the adjustment screw on each one of the electrode standards. By following the general plan laid out in Fig. 2, the experimenter will obtain a fair idea of the essential parts and their arrangement so that further construction data is not necessary.

THE QUENCHED GAP.

The quenched gap is in reality a series of very small gaps, enclosed in such a man-

(*Continued on page* 334)

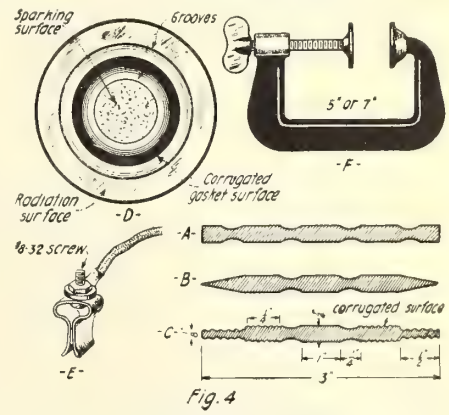
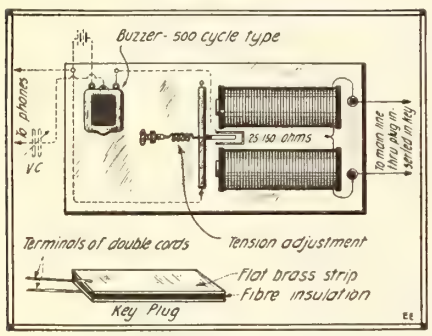


Fig. 4

Hints and Construction Details on the Quenched Spark Gap.

USING MORSE RELAY FOR CODE PRACTICE.

Here is a way for the "bugs" who are employed in or have access to the main circuits of a telegraph office, to keep up their wireless practise, or an excellent way in which to learn to read signals wirelessly. The following involves the application of a Morse relay, and is nothing more than a simple relay system, from sounder to 'phones.



A Scheme for Using a Standard Morse Telegraph Relay for Telegraph Code Practise. The Relay Operates a Hy-tone Buzzer and Receives Its Current Impulses from Any Telegraph Line, by Means of the Special Plug Inserted in the Key.

As the diagram shows, the coils of the relay (which may be of varying resistance, from 25 to 150 ohms, altho about 75 is best), are connected in series with the main line thru a jack plug inserted in the key. This plug is the same as used on the Vibroplex or other types of sending machines in telegraph service, or may be easily made as per the diagram.

A 500 cycle note buzzer is connected in series with a dry cell and thru the make and break contacts of the relay. Your wireless 'phones are connected one terminal to the third or middle post of the buzzer, the other terminal to one side of the battery thru a variable condenser. The variable is for tuning the strength of the signals desired.

It will readily be seen that any signals coming from the main line will pass thru the coils of the relay and actuate the armature, which in turn opens and closes the buzzer circuit, reproducing the dots and dashes in the phones wirelessly. The buzzer, and the condenser (if removed from the case) can be neatly mounted upon the base of the relay.

Contributed by PENUEL E. BALLARD.

HAVE YOU A "WIRELESS" SCRAP-BOOK?

Here is a suggestion which will be valuable to experimenters: For the last four years I have spent spare moments in making a "Wireless Scrap-book." To date it contains over 800 pictures, hook-ups, tables and articles of interest not only on wireless, but nearly everything in the electrical, mechanical and chemical line. Proper grouping of the subjects will show the advance in these fields, and the value of such a book would be difficult to estimate.

The wireless scrap-book idea is one which can be followed by several different ways. Some people simply buy a cheap copy book or obtain an old account book, etc., and proceed to paste in wireless pictures, which they happen to see in magazines, newspapers, catalogs, etc., but the real use of such a book will be found only when it is properly indexed.

Contributed by
ALBERT LEE WOODY.

ANTENNA, RADIATION AND GROUND RESISTANCE.

The antenna had a capacity of .00126 mf; inductance of 43 mh, and a fundamental wave-length of 440 meters.

Wave-Length.	Antenna Resistance.	Radiation Resistance.	Ground Resistance.
400	26.0	14.0	6.5
500	19.0	9.0	7.5
600	16.0	6.7	9.0
700	14.9	4.9	10.1
800	15.0	3.5	12.0
900	15.8	3.0	13.5
1000	16.9	2.5	14.8
1100	18.0	2.0	16.0
1200	19.0	1.8	17.5
1300	20.2	1.7	19.0
1400	21.5	1.6	20.2
1500	22.5	1.5	21.9
1600	24.0	1.4	23.0
1700	25.5	1.3	24.6
1800	27.0	1.2	26.0
1900	28.4	1.1	27.8
2000	30.0	1.0	28.7

In the data presented below it is shown that while the ground resistance increases gradually for each increase in wave-length, the radiation and antenna resistance drop, until around 700 meters the antenna resistance begins to increase again, setting the same pace as the ground resistance for the remainder of the test. The radiation resistance decreases gradually until reaching about 1100 meters, where it decreases more slowly and at a more uniform rate. Between 600 and 700 meters seems to be the logical working point for this antenna under measurement. This data is from actual laboratory tests made by the U. S. Navy.

Contributed by E. T. JONES.

HOW FAR AWAY IS THAT CALL?

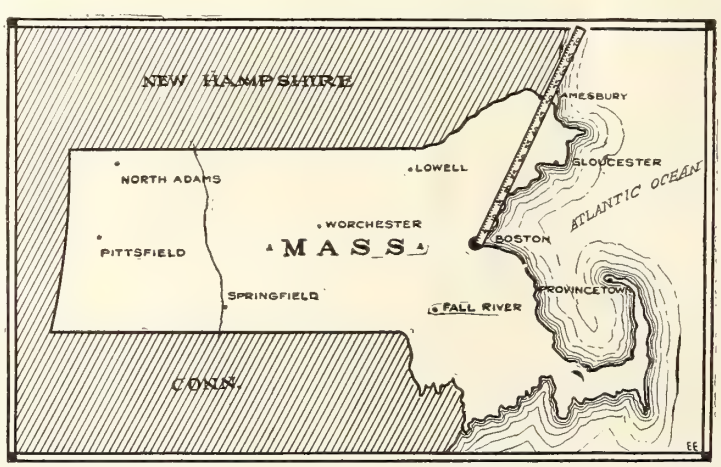
I had always wondered how far away this or that station was until this little device was put up in my station.

A man of the state was tackt on the wall and a ruler or scale made which had marked off on it the number of miles according to the scale given on the map. A thumb tack was put thru the "O" mile point and this tack also was stuck on the point on the map which represented the home town. When this rule was swung around, the distance to any of the towns was shown when the town point came flush with the edge of the ruler.

Maps may be secured from the government at Washington, of your county, state, section or of the entire country. The charge is nominal.

An improvement would consist in making the scale of transparent celluloid, scratching or engraving the figures and division marks into the surface so that the ink used will be held firmly and not easily rubbed off.

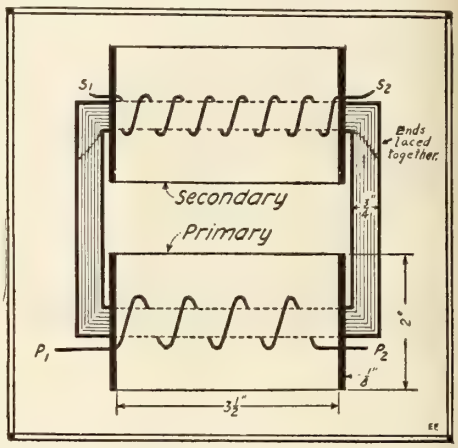
Contributed by "BIX"



Here Is a Nifty Way to Quickly Determine the Distance Between Your Home Town or City and Any Wireless Station You May Hear. A Piece of Paper Is Laid Off with a Scale of Miles Corresponding to the Map Scale Used. This Strip of Paper Can Then Be Anchored with a Pin or Thumb-Tack to Your Home-Town Spot on the Map and When Swung Around the Mileage to the Various Towns Can Be Read Off.

TRANSFORMER USING SPARK COIL PARTS.

A 110-volt, 60-cycle transformer from parts found around the average experimenters' work shop can be built at practically no cost. It will give good results when used for Radio Work or in connection with



Details Are Here Given for Constructing an Efficient Closed-Core Transformer, Using Parts from Old Spark Coils.

High Frequency experimenting, etc. A secondary coil from an old type Atwater-Kent Ignition Coil (or any large secondary) is used as a transformer secondary. Obtain enough soft iron wire, No. 18 or 19, to make a core ¾ of an inch in diameter and 11½ inches long. Three and one-half inches in the center of this core is to be used for a primary winding. The core should be well insulated for this length.

Make two fiber end plates one-eighth of an inch thick by two inches square with ¾-inch hole in center, slip these over core 3½ inches apart. Wind this space full of No. 20 magnet wire and bring out leads.

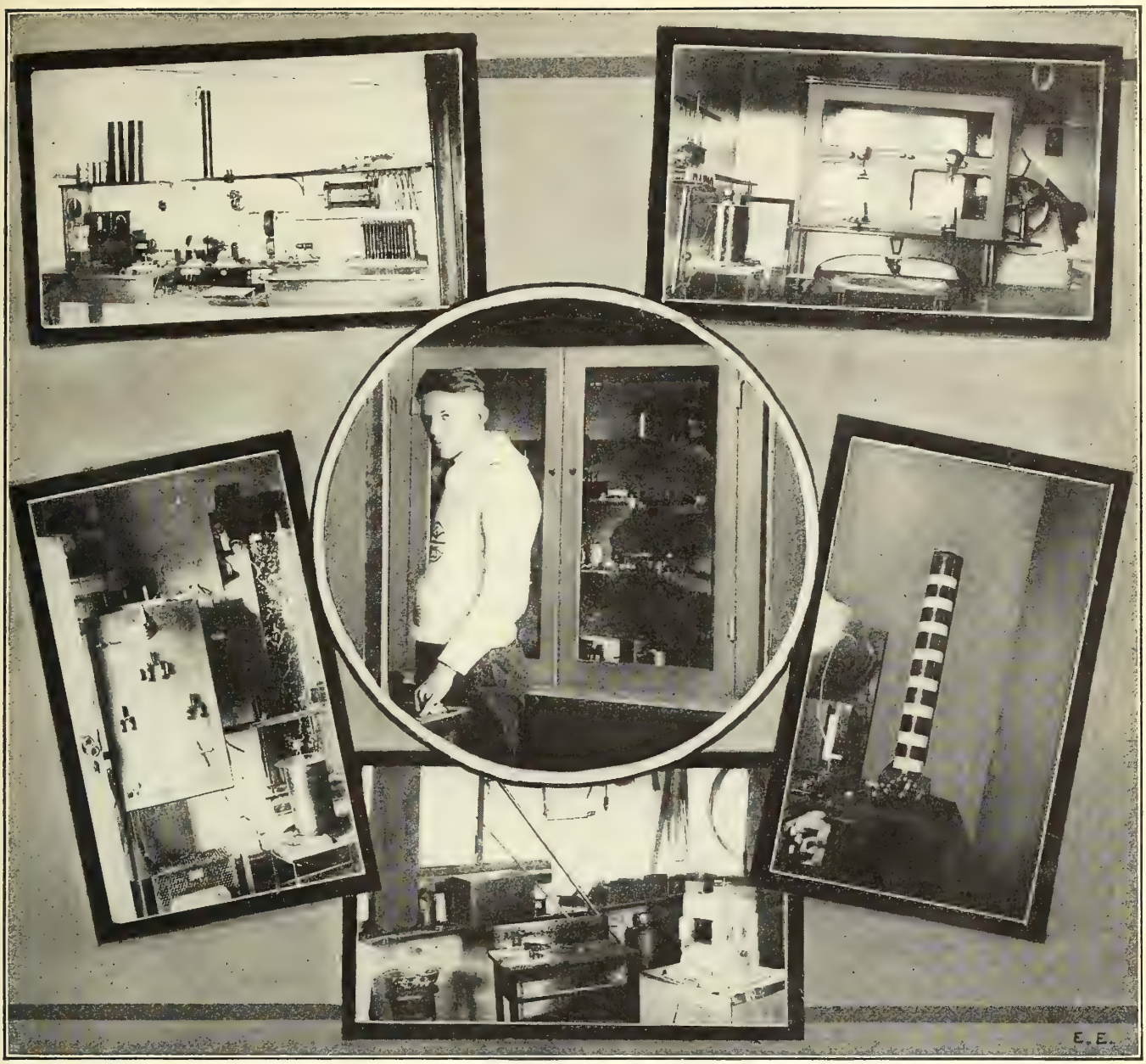
The wire and insulation are removed from the old core which is then placed in the secondary, the remaining space is filled with soft iron wire, the core being well insulated from the secondary winding.

Contributed by E. W. LETPER.

A NEW TELEGRAPH CODE

This code can be used to convey messages to and from any distance either over the telegraph wires and operated by keyboards, or they can be flasht by light, bells, whistles or rappings and from the letter E to Z there is a slight pause between each dot. There are no dashes. Those beyond the letter Z to No. 1 are straight dots, as indicated. Then the No. 1 to 9 and 0, the dots are made with a slight pause between the first and second dots, etc. Copyrighted, 1915, by Alfred A. Wright:

	ALL DOTS		NO DASHES	
A	1.		P	3. 4.
B	2.		Q	4. 1.
C	3.		R	4. 2.
D	4.		S	4. 3.
E	1.	1.	T	4. 4.
F	1.	2.	U	5. 1.
G	1.	3.	V	5. 2.
H	1.	4.	W	5. 3.
I	2.	1.	X	5. 4.
J	2.	2.	Y	6. 1.
K	2.	3.	Z	6. 2.
L	2.	4.	Period.	5.
M	3.	1.	Comma.	6.
			Question Point...	7.
N	3.	2.	Dash...	8.
O	3.	3.		
No.			No.	
1	1.	5.	6	2. 5.
2	1.	6.	7	2. 6.
3	1.	7.	8	2. 7.
4	1.	8.	9	2. 8.
5	1.	9.	0	2. 9.



The Accompanying Photographs Show Some of the Excellent Features of Mr. Everett Leo Deeter's Home Laboratory. Mr. Deeter has Built Practically All of His Apparatus, Which Includes Some Real Ambitious Electrical Apparatus. Among Other Things, There Is a Battleship Controlled by Wireless, a Large Electric Furnace, Long-Wave Tuning Apparatus, and High-Frequency Coils, Etc.

Special Laboratory Contest

Prize Winner--EVERETT LEO DEETER

THE accompanying photos are views of my Electrical Laboratory, which is the accomplishment of "odd moments" found in the past two years. My wireless set is all home-made except for the Electro loose-coupler and the Murdock 'phones. The sending outfit is composed of ½ K. W. closed core transformer, glass plate condenser, two-winding oscillation transformers of my own design, large quenched gap, and also a small one.

The receiving set consists of an Electro loose-coupler of 2,500 meters wave length, cabinet loose-coupler used for long wave lengths, and three undampt wave loading coils. I have two variable condensers, and three detectors, with detector and an Audiotron bulb detector, which can be used as an amplifier for the mineral detectors. A ten-foot gas pipe driven in damp ground makes up the ground, and the aerial consists of three No. 8 copper wires, spaced on eight-foot spreaders, 100 feet long, and supported at one end by a 65-foot iron pipe mast, and at the other end by wooden pole, mounted on top of the laboratory, reaching a height of 45 feet. My antenna switch is a bridge type recently described in the *Radio Amateur News*.

The switchboard contains switches for operating various lights and circuits in the "Lab." The rheostat underneath panel, is used in connection with the large electric furnace shown in another photo. The high-frequency Oudin coil is capable of producing a heavy eight-inch spark when used with the ½ K. W. transformer and condenser. I operate several models by wireless, including a miniature battleship and a small electric car.

The large cabinet type Cabot-Holtz static machine is a 30-inch spark generator, with which many interesting experiments can be carried out. The views only show one room of my "Lab," there being another in which there can be found the usual tools, "junk," etc.

I have been a reader of the ELECTRICAL EXPERIMENTER for several years, and it was thru this splendid magazine that I received my start in my electrical career, and which said career I am preparing to follow. I am a Senior in the High School, and will enter college next year, to take a course in electrical engineering.

SPECIAL LABORATORY PRIZE CONTEST.

As announced some months ago, we stated that for special experimental laboratory photos and descriptions an extra inducement or special prize would be offered. This month, we have pleasure in presenting an exceptionally fine experimental laboratory group, that of Mr. Everett Leo Deeter. We hope to receive more of these complete laboratory write-ups every month, and shall offer a cash prize of $10.00 for the best description, accompanied by photos, submitted.

Send photos and descriptions to Editor of "Special Laboratory Prize Contest."

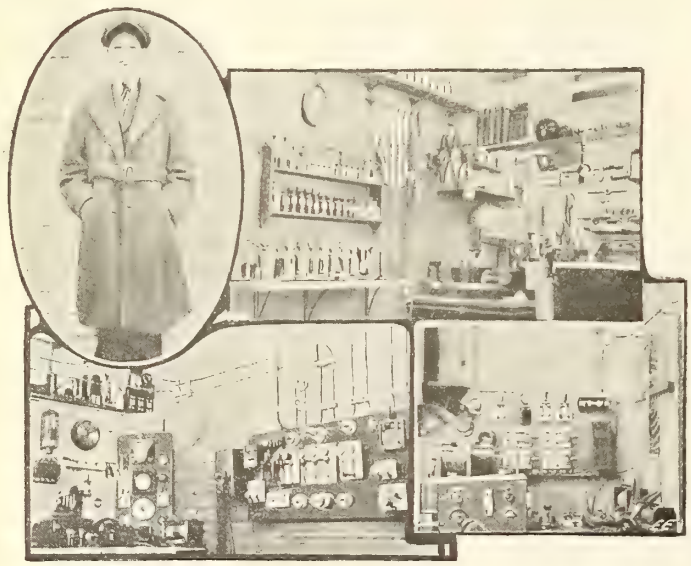
WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER—

W. ROBERT DRESSER



HEREWITH I present several photographs of my laboratory and radio set. The electrical corner of my "Lab." contains two switchboards,—the large one at the right giving any voltage up to 110 by use of the step-down transformer and water rheostat. The lefthand switchboard gives 0-15 volts direct current. This board also contains my test meters and storage battery control. Practically every experiment may be conducted in this corner of the room, and it is here that I have constructed most of my apparatus.

My electrical equipment also contains several electric motors, spark coils, generators, Geissler tubes, high frequency coils, a gasoline and a steam engine. At present, I have under construction a small Tungar rectifier, described in a recent issue of the ELECTRICAL EXPERIMENTER.

For the purpose of surprising uninvited visitors who are willing to risk their lives by entering my laboratory, I employ an old automobile spark coil which has no vibrator, but which runs on the 60 cycle current.

Inasmuch as I have only been interested in chemistry for a short time, I have not as yet a very large variety of chemicals in my possession, but even with the small outfit I have, I am able to carry on a great number of experiments.

To aid me in experimental construction work, I have a bench lathe and a scroll saw, also a fairly large number of tools.

As for reading matter, I have on file the ELECTRICAL EXPERIMENTER, *Radio Amateur News* and many other leading radio and electrical magazines. My book department also contains: Hawkins' Electrical Guides, a set of the American School of Correspondence's Text Books, Volumes 1, 2, 3 of *Everyday Engineering* and several other books on radio and electricity.

In my wireless set, I utilize an Audion detector and also a Crystaloi. My set also comprises a large and a small tuning coil, a loose-coupler, two pairs of "Electro" phones and Tresco variables, a galena and a silicon detector, and a Radiotone test buzzer.

My sending set is a combined set using either a two-inch coil or a quarter-inch spark coil. The helix and condenser are of my own make. My main aerial is made of four wires, 100 feet long and I also have a four foot square loop aerial. I can utilize either aerial, merely by pressing one of the switches seen on the switchboard at the rear.

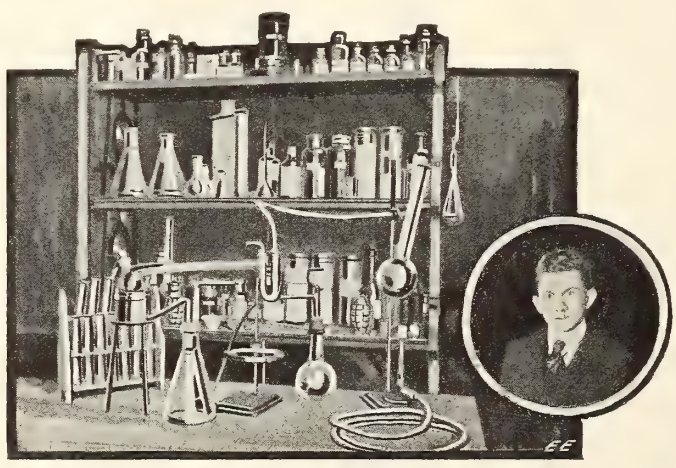
I hope to finish the long wave loader which I am now busily engaged in building, and then I shall endeavor to do much better work. My official call is 1-V.T.—W. Robert Dresser, 283 Main Street, Calais, Maine.

HONORABLE MENTION—H. DUSHER

$2.00 PRIZE

THE accompanying photo is one of my chemical laboratory which consists of over 150 chemicals and about as many solutions. My glassware consists of Erlenmeyer and Florence flasks, beakers, graduates, retorts, evaporating dishes, etc. I also own about 75 scientific books, and have on hand at all times a few of the latest copies of the ELECTRICAL EXPERIMENTER, *Popular Science*, etc. I also have several books on the art of fingerprinting, which I have spent considerable time in studying.

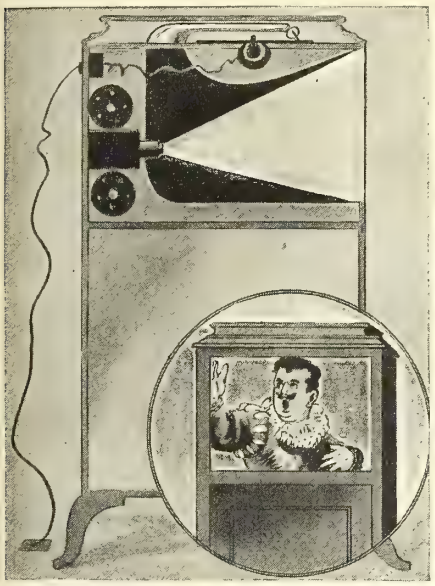
I have my stock of chemicals carefully arranged, and the bottles well labeled, so that no mistake can be made in mixing chemicals, certain of which are liable to cause an explosion or other serious trouble. I have a neat test-tube rack in which a series of test-tubes could be placed while making certain tests, and also the rack serves as a first class support for them when they are not in use. I also have a Bunsen gas burner together with an iron ring stand and tripod for supporting a retort or condenser.—H. Dusher, 364 East 123rd Street, New York City.



What To Invent

By JAY G. HOBSON

SOME day every talking machine will be known as "Phono-Movies" because a needed invention of this kind will enable the public to both *see* and *hear* their favorite opera, artist, band or orchestra in their own home by a simple electrical arrangement between the phonograph and the motion picture; possibly an arrangement similar to the one illustrated in the form of an electric harmonizer that will *simultaneously* reproduce the voice and picture of the artist singing. This will become practical when the inventor succeeds in obtaining the required co-operation between vibration that gives tone from the record and light or sight that produces motion pictures.



Why Not Motion Pictures With Our Phonograph Music? Some One's Going to Make a Fortune Out of Such an Invention.

It is true many attempts have been made to combine the motion picture machine and the phonograph but so far it has failed to work properly. In the recent past a youthful inventor perfected a machine to send pictures of people over the telegraph wire, and it seems to me a readjustment of this principle applied to the motion picture and the phonograph may prove to be successful in perfecting "Phono-Movies" for the home. A world market is waiting for this great instrument, and it is well worth an inventor's time and efforts to accomplish the task of successfully combining the two instruments.

SAW-DUST PAVING BLOCKS.

By the test of time, paving contractors know that wood blocks dipt in oil or creosote make the best and noiseless paving material obtainable. But at present these wooden bricks are sawed from sound timber which means large waste of valuable lumber that could be used for building purposes. All sawmills, woodworking plants and factories using lumber have an abundance of sawdust that is piled onto a dump to rot, blow away or be burned later if necessary. This is a useless waste of a valuable by-product that can be manufactured into compact form and that will be in immense demand for paving streets, etc. I believe a mixture of sawdust, asphalt or oil comprest in a powerful hydraulic machine fitted with dies or moulds for making wooden paving blocks would turn out a product that would be entirely satisfactory for use as street material. No doubt one similar to that shown in the sketch could be constructed to do the work properly.

ALL-STAR TOOTHBRUSH.

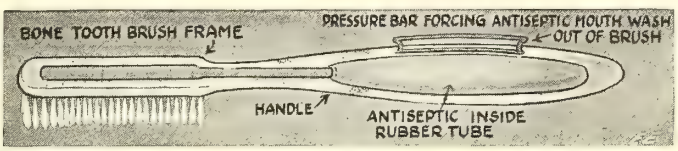
The Patent Office, from time to time, has allowed several patents on the toothbrush in different forms, such as the rotary kind, folding, removable bristles, etc., but so far as I am able to ascertain no one has as yet brought out a combination toothbrush and antiseptic mouth wash retainer.

The public have been so well educated on antiseptics for the mouth and tooth paste or powder for the teeth that ninety per cent of us use both. It seems unnecessary to have two packages or containers for the preparations, so the idea occurred to me that a *fountain toothbrush* would be a good improvement. The user could either carry the antiseptic liquid in the brush or use the fountain construction for water when washing the teeth.

In operation the handle of the brush is gript tightly which pushes pressure bar inward onto rubber tube and this pressure forces the antiseptic or water out thru the bristles onto the teeth which supplies a fresh quantity for each wash, instead of dipping the brush into a glass of water and using the same water or preparation over again as many of us are wont to do. As can be plainly seen this idea would be far more sanitary than the present method employed.

"AUTOMATIC MEMORY" FOR CONDUCTORS.

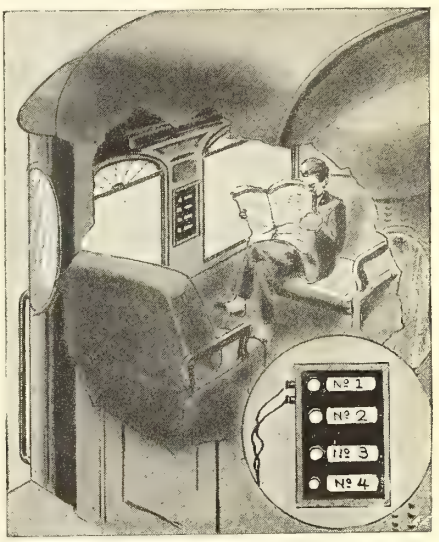
Did you ever stop to consider what a wonderful memory railroad conductors must have to remember the faces of their passengers, whether or not they have paid their fare, where they wish to get off and the numerous other things a conductor must *not* forget, to be 100 per cent efficient?



Wouldn't You Like a Tooth-brush Like This One?—Squeeze the Handle and—Presto! You Have the Mouth-wash Post-Instanter.

The truth of the matter is conductors do forget, pass by many a passenger's fare, carry passengers beyond their destinations, et cetera, because it is practically impossible for one mind to retain every detail when traffic conditions happen to be heavy.

The system now in use for assisting the conductor's memory is a small cardboard marker which he punches and sticks in your hat or onto the window blind to remind him of the station you want to get off. But frequently this piece of unsightly paper blows out the window, which confuses the conductor or else he forgets it, and you parade uptown with it showing like a headlight on the front of your hat.



And the Railroad Conductor—Why Not Invent a Simple Indicator to Jog His Memory as to Where Each Passenger Is to Get Off?

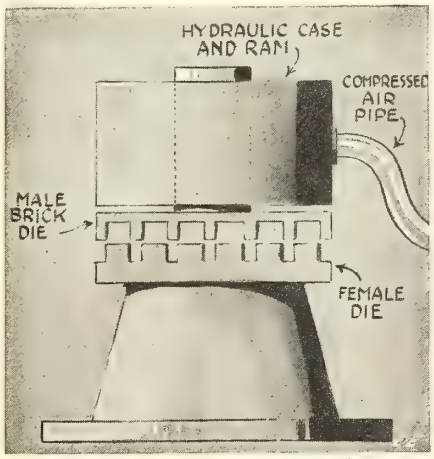
Most all trains are now electric lighted which brings to mind a possible device for marking the passengers of each seat. A small box-like construction with press buttons for operating it and at least four openings as shown for placing the numbers for the occupants of each seat, or the two seats thrown together for accommodating four people.

As the conductor collects the tickets, he presses the button that will set, by electricity, the number of the station the particular passenger wishes to get off. A small light, inside the box, enables him to read the numbers from the aisle as he passes, which will keep him posted on the destination of each person and will greatly relieve his memory which must work overtime because of the inefficient system now in use.

Once the push button was deprest and the number desired set, passengers could not change it because of a lock arrangement enclosed that held the number permanent until the conductor prest his key into the lock which would release the button, the numbers and shut off the light.

There is no question at all but the railroads would gladly adopt a system of this kind, and it is needless to say the inventor would reap a handsome reward for his improvement if it could be built cheap and simple.

This is indeed, a much needed device, and its utilization would tend to save time and trouble for both the conductors and passengers, and would also undoubtedly eliminate many unnecessary misunderstandings as to the distance the passenger is entitled to travel. Any person would prefer to travel on a railroad upon which the conductors were not compelled to annoy the passengers at each station for the purpose of punching their tickets, and it is evident it would be to great advantage for the traction companies.



Ever Think of the Thousands of Tons of Saw-dust Going to Waste Annually? Compress It Into Briquettes and Pave the Streets With Saw-dust! Sounds Foolish? But We're Coming to It.

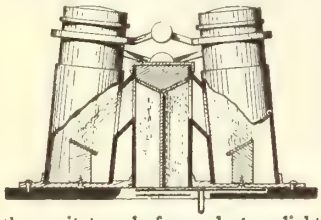
(Copyright 1920 by the Author)

LATEST PATENTS

Cinematographic Stereoscope.

(No. 1,334,480, issued to Harry R. Zimmer.)

This scheme is the very latest for production of stereoscopic movies and uses two telescopic tubes fitted with regular stereoscopic lenses as its basic principle. Light is transmitted thru the lens onto a reflector

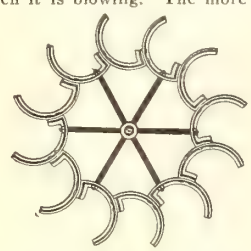


thence it travels forward at a slight angle and is again reflected inward, having effect upon the film. The other lens adjusted to it presents another view of the object, but due to the difference of refraction between the lenses, the two images upon the film will be slightly different. The rotary shutter revolves in the interval between the lenses and camera proper, shown in our illustration with the shaft extending.

Horizontal Windmill.

(No. 1,334,882, issued to John F. Boettner.)

A form of wheel with radially disposed plates mounted on the spokes and connected to each other in circular series. The plates are shaped so that the wind will strike them regardless of the direction in which it is blowing. The more spe-

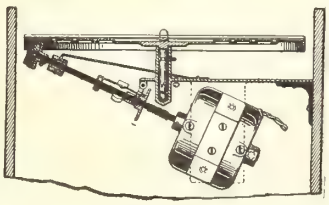


cific object of the invention is to apply a method for maintaining the circular series of plates by pressing those plates compactly, simply and efficiently, at a low cost. The plates themselves are reënforced circularly by angle irons, which make for ruggedness and lightness.

Phonograph Driving Machine.

(No. 1,335,809, issued to Dexter W. Allis.)

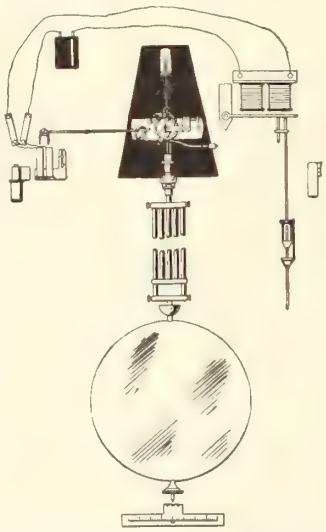
An exceptionally clever and novel scheme is the subject of this recent patent. The phonographic table itself does not have the delicate bearing mechanisms which have been so essential in the past, but a single ball is used as our illustration shows. To this turn-table directly coupled thru friction is a motor driven by the regular house current. The shaft leading from the motor to the friction disc at its end has a universal joint upon it which is, nevertheless, so adjusted that the motor could run considerably faster than the shaft itself. A fly-ball governor maintains the even speed. Art gum is used as a friction wheel, giving a positive non-slipping drive, at all times resilient and absolutely noiseless, differing greatly in this respect from rubber and fiber.



Electric Clock.

(No. 1,335,147, issued to Poul Peter Anderson.)

An exceptionally clever scheme whereby a master clock is caused to keep its pendulum oscillating by a rather odd feature. The method employed is as follows. As the pendulum swings from side to side, it engages with a ratchet wheel. This ratchet wheel is actuated by a ratchet on the pendulum and turns slowly, one notch with each oscillation. A trip is fastened to this wheel which automatically closes a circuit thru a lever arm momentarily, by introducing a metallic connecter between two containers of mercury. Automatically, a circuit

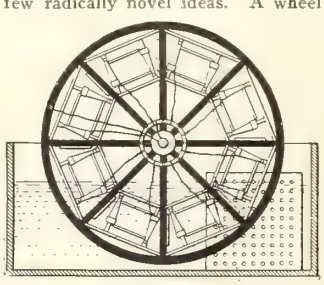


is closed to a magnet which lifts up a hammer-like device not shown in our demonstration, but as stated before, the circuit is of very short duration, and is again quickly broken whereupon this hammer device is released allowing it to strike an arm carried by the pendulum; the effect of which blow causes the oscillation to be continued.

Electrolytic Apparatus.

(No. 1,335,175, issued to Matthew M. Merritt.)

This is a very clever improvement in electrolytic apparatus and methods, and seems to embody a few radically novel ideas. A wheel

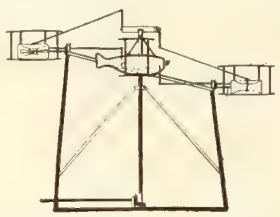


in which the members to be plated are fixt, is rotated between two anodes, preferably scraps of copper when copper plating is being performed. The cathodes themselves are connected to the hub of the wheel, i. e., the articles to be plated. Also a metallic rim around the wheel known as a "thief" is connected to the same hub. The effect being to take up the excess of copper which would formally tend to deposit on the outer portion of the cathodes. Another novel feature is the *plow*, a block of wood extending from each side of the wheel shakes. When the wheel is rotated the liquid is agitated enough to give an even coating. Each item is in the solution two seconds and out of the solution four seconds; which proportion has been found to be very satisfactory.

Amusement Apparatus.

(No. 1,337,820, issued to James H. Butcher.)

This amusement apparatus embodies general principles of opera-



tion and movement of merry-go-rounds and allows a wide range of modification in the plan and general form of the track or similar guiding means so as to produce variety, necessary and desirable to the public. There is employed an elliptical form of track on an inclined plane. The airplanes are so arranged by means of lever system as to keep them on an even plane. A propeller at the front is rotated by the means of gearing thru the wheel resting upon the track.

Intensifier for Spark-Plugs.

(No. 1,335,940, issued to J. A. De-Viioiss and H. L. Miller.)

This invention relates to intensifiers for spark-plugs for internal combustion engines. It is simply an auxiliary gap which can be placed on the top of the spark-plug and can be held in that position where it is not subject to vibration when

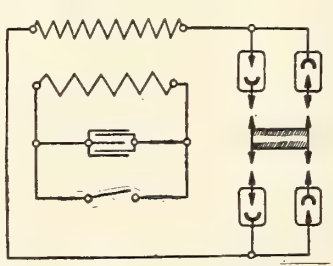


the engine is in operation. It has an adjustable screw at the top by means of which the gap can readily be lengthened. This gap is between the spark-plug screw top and the movable electrode. A window on each side permits of vision and a mica shield prevents oil and other dirt from accumulating between the gaps.

Ignition Apparatus.

(No. 1,335,933, issued to Jacques Bohli.)

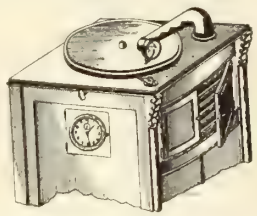
This planned device is for the distribution of high voltage current for ignition apparatus, for internal combustion engines; and has for a two-cylinder motor, two rectifying devices. The inventor claims that the current used in motor ignition is invariably of the alternating type; it is allowed to pass thru one rectifier and current in the opposite direction thru the other rectifier due to the actions of said rectifiers, producing in this way intermittent ignitions. Ignitions in four-cylinder engines are effected by an arrangement which may be employed as shown in the accompanying diagram. The rectifier tubes will be readily noted in the drawing, having a pointed arrow on one side and a cup shape disc on the other.



Time Control for Phonographs.

(No. 1,337,759, issued to August C. Dittrich.)

In the last issue we described a time control for phonographs. Mr. Dittrich has secured a patent on the device then described and also on the one here described. A clock mechanism is fitted like a door into the cabinet in such a manner that the simple shutting of the door when properly arranged will set the apparatus. A record is placed upon the machine and it is then ready to "wake you on the morrow." Instead of being rudely awakened by an ordinary terrifying alarm, your favorite musical selection will awaken you. All that is necessary is a separate catch and a detent trip which, when set, holds the starting mechanism inoperative. This spring is released by the clock, and that in turn releases the catch and allows the turn-table of the phonograph to revolve. It can be instantly detached and the hand control used if that method is desired for playing ordinarily. An-

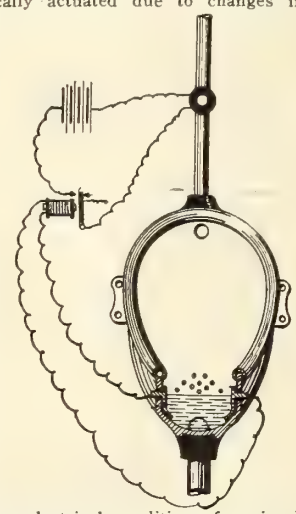


other type is made so that it can be attached directly to any phonograph and no change in the latter case is necessary; the apparatus being self-contained in the clock mechanism, and simply set upon the machine.

Automatic Actuation of Mechanisms.

(No. 1,335,380, issued to Edgar E. Littlefield.)

This is a rather clever invention whereby mechanisms are automatically actuated due to changes in



the electrical condition of a circuit caused by varying the character or condition of a bath which forms a link in said circuit. It has been found that the difference in electric condition caused by slight changes in the electrolyte either of chemical or thermal character, may be used to operate a relay and hence the scheme has been applied to closets, etc., which flush automatically due to the thermal or chemical changes when any body waste is added thereto. It consists of two electrodes placed in the closet and insulated from each other. These are connected to a relay, with a battery in series, which relay in turn is connected to any other mechanism for flushing purposes, etc.

Scientific Humor

And Exploded with Wrath!—FRESHMAN—"I broke two beakers in yesterday's laboratory experiment."

SOPH.—"What did the professor say?"

FRESHMAN—"He made a *retort.*"—*Edward J. Norwood.*

Yes, With the Gas-Meter Off!

There is meter in poetry,
There is meter in tone;
But the best meter of all
Is to meter alone!

—*Edward Lippert.*

Safety First.—AUTO SALESMAN (demonstrating new car to a lady)—"You had better not touch that spark-plug. It will shock you."



LADY—"Then I guess you had better put shock-absorbers on my car!"—*Dulaney M. Gregory.*

Soft Water Must Be Fog!—PROF. WATT T. ELL—"The class in chemistry will now come to attention. What is the formula for gasoline?"

DUMAS ENNITHINGG (star pupil)—"H O N C—H O N C."

PROFESSOR—"Very good, now the formula for sea water?"

PUPIL—"*C* H_2 O, is that right, teacher?"

PROFESSOR—"We'll let it go at that. What is hard water?"

PUPIL—"It's ice, sir."—*J. H. Schalek.*

With a Lightning Arrester!—"I want a man to figure out how much electricity it is going to take, to run my mill."

"One of those lightning calculators, I suppose."—*Barney Kellam.*

Telegraphy Explained.—"Pap," said a colored youth, "Ah'd like you-all to expatiate on de way dat de telegraph works."

"Dat's easy 'nuf, Rastus," said the old man. "Hit am like dis: Ef dere was a dawg big 'nuf so his head could be in Bosting an' his tail in New Yo'k, den ef you tromp on his tail in New Yo'k he'd bark in Bosting. Understan', Rastus?"



"Yessah! But how am de wireless telegraph?"

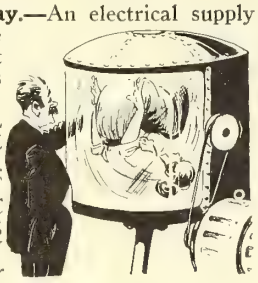
For a moment the old man was stumped. Then he answered easily: "Jess prezactly de same, Rastus, wid de exception dat de dawg am 'maginary."—*Everett Cookson.*

And in Winter We're *Short* of Coal.—TEACHER—"By accurate experiments, we have come to the conclusion that *heat* expands a substance, while *cold* contracts it. In other words, *heat* makes a substance *longer;* cold makes it *shorter.* Now, who will give me a definite example of this?"

STUDENT—"Here is one. In summer it is *hot* and the days are *longer.* In *winter,* when it is *cold,* the days are *shorter.*—*Nathan Silverman.*

FIRST PRIZE $3.00

The Easier Way.—An electrical supply merchant hung the following sign out in front of his shop:



"DON'T KILL YOUR WIFE WITH WORK. LET ONE OF OUR ELECTRIC DISHWASHERS DO THE DIRTY WORK." — *Oscar DuPre.*

That's What Makes 'Em Afraid?—There is no reason why people should not take more to flying because when they are in the air their fears are groundless.—*Earl H. Barton.*

AS our readers will note our new department keeps on improving. Quite a few jokes have been hatched out successfully this month and are crowing lustily—until somebody writes us a sassy letter, telling us that his grandfather related the joke to him years ago. Of course, we cannot know every joke that ever was fostered upon a suffering humanity,—we aren't that old—and what looks new to us might belong to the pliocene age. Nevertheless, we believe you will like the present efforts of our jokesmiths at one dollar a crow.

One of the latest developments is that readers keep on sending us scientific jokes which have appeared in Volume No. 1, ELECTRICAL EXPERIMENTER, *and expect to be paid for them. We are not quite convinced that they are sending these jokes in as real jokes or whether they intend to play a joke on us with those jokes. In either event it would be a poor joke. In the meanwhile, we are paying* $3.00 *as a first prize for the best, strictly fresh laid joke and* $1.00 *for each medium-boiled one.*

Why Not Print 'Em on Fly Paper?—"Don't you think that we should have a more elastic currency?" askt the old fogey.

"It's elastic enough," replied the grumbler. "Why don't they make it more adhesive?"—*Leo Hansen.*

A New Use for Fifi.—A lady who kept a little curly poodle lost her pet, and called on the police to find it. The next day one of the force came around with the dog, very wet and dirty. The lady was overjoyed, and asked a number of silly question—among others:



"Where did you find my sweet, dear little darling?"

"Why, ma'am," said the officer, "a fellow had him tied to a pole and was washing windows with him!"—*Charles Dill.*

Current Topics.—FIRST ELECTRICAL ENGINEER—"Wire you insulate?"

SECOND ELECTRICAL ENGINEER—"Couldn't get ohm sooner."

FIRST E. E.—"Watt?"

SECOND E. E.—"I was out sparking in the park."

FIRST E. E.—"I can guess switch girl, Mazda?"

SECOND E. E.—"See here, fuse get personal I'll socket to you!"—*Edwin S. Warner.*

Did the Mosquitos Give Honey?—CRANK—"What's in those cages, Hank?"

HANK—"I'm trying the Luther Burbank stuff on insects. You know that wizard crost two spiny cactuses and produced a *spineless* cactus. I'm trying to cross a bee which stings from one end, with a mosquito which uses the other end."



Two weeks later Crank met Hank. "Well, Hank, how did you make out?"

Hank, swathed in bandages, mumbled: "Rotten. I produced bees which sting at *both ends.*"—*J. H. Kraus.*

The Messenger Got "Shoed!"—"Here, lad, take these papers up to the blacksmith."

"Do you want them forged?"

"No, just filed."—*H. Howey.*

Too "Deep" for Grandpa.—"Grandpa, have you heard of this new underground wireless?"

"No, son; what is it? A new method for communicating with the dead?"—*D. Kantro.*

We Just *Had* to Accept This One!—JACK—"Why do you always sign your name William Johnson E.E.?"

WILL—"Because I have earned that degree."

JACK—"Oh! Then you are an Electrical Engineer?"

WILL—"Oh! No! I am an Electrical Experimenter."—*Edward L. Friedman.*

An Ingersoll Might!—"Did your watch stop when it dropt on the floor?" askt the man of his friend.



"Sure," was the answer. "Did you think it would go thru it?"—*C. S. Harvey.*

Hope He Don't "Short-Circuit!"—HE—"Here comes a friend of mine. He's a human dynamo."

SHE—"Really?"

HE—"Yes, everything he has on is charged."—*J. O. Campbell.*

Unless It Hits Your Barn.—TEACHER—"What is the difference between electricity and lightning?"

WILLIE—"You don't have to pay for lightning."—*Wade D. Annis.*

She Must Be to the Point!—WAG—"What makes the best contact points?"

TAG—"My girl's lips, of course!"—*M. M. Wrenn.*



THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

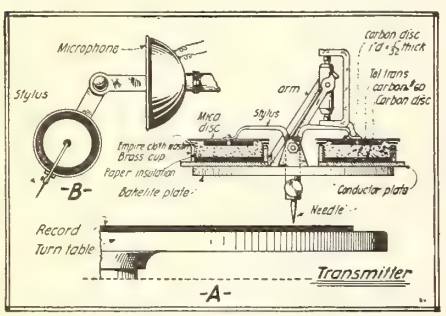
PHONOGRAPHIC TELEPHONE TROUBLES.

(1051) E. A. Papini, Philadelphia, Pa., writes this department:

Q. 1. In the enclosed sketch is shown an arrangement for loud-speaking telephones with which I have been experimenting with, but with poor success. Evidently something must be wrong. The transmitter is, perhaps, not proportioned properly, but when connected to a common telephone receiver the degree of loudness or volume is fair, but there is present considerable extraneous noise. When it is connected to the receiver shown in diagram, the result is very poor, resulting in the degree of loudness being weakened and also the extraneous noise is increased; perhaps the design shown is wrong or again the elements involved may be out of proportion. Kindly advise if you can give a better way to design and proportion these parts.

A. 1. We have studied your diagrams and circuit for the phonographic telephone arrangement carefully, and tho they would, off hand, appear to be quite workable, our experience with apparatus of a similar nature, as well as the study of telephone matters in general and especially some recent developments in this direction, tend to make us think otherwise. In the first place, the editor of this column does not believe in a phonograph transmitter or microphone in which the needle or stylus arm is mechanical or rigidly connected to the movable electrode or electrodes of the microphones, as shown in your sketch, altho many devices of this type have proven more or less successful.

One of the best ways to convert phonographic music into telephonic current waves would seem to be that followed by the Magnavox designers, and this method is shown in the diagram at "B." Here a special tone-arm is used, and the diafram



Illustrating the Querist's Idea for a Double-acting Microphone to Be Actuated By the Stylus of a Phonograph; and At B, the Method of Mounting the Microphone Directly In the Tone Arm As Suggested By the Magnavox Design of Phonographic Telephone

of the phonographic reproducer is not tampered with or loaded down with extra weights or levers for actuating microphones, but is left free to vibrate at its own frequency or imprest frequency. This seems very good practise, as it is not well to tamper or put an extra load on the diafram of a phonograph sound box, for the reason that the designers of such machines today have ascertained to a very fine degree just the right proportions for this mechanism. You might also study Mr. Gernsback's

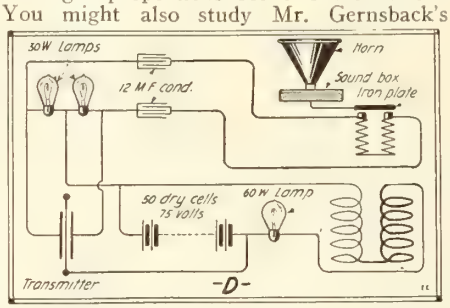


Diagram Used By the Querist In Connection With His Loud-talking Telephone Transmitter Shown At A, and the Reproducer Shown At C, and Which Has Not Given Him the Results He Originally Anticipated. The Faults Of This Arrangement Are Here Gone Into.

WANTED!!!

"ODD PHOTOS" AT $1.00 EACH

Here's what we want! What have you got?

ELECTRICAL PHOTOS—
New photos of Lightning; new and unusual Electrical Apparatus and Machinery; Electric Signs; Electric Autos; Electric Clocks.

SCIENTIFIC PHOTOS—
New Scientific Apparatus; Results; Effects; Motion Pictures; Stunts.

OPTICAL PHOTOS—
Peculiar stunts obtained with various lens arrangements; odd film effects caused by unusual conditions; novel micro-photographic subjects.

ASTRONOMICAL PHOTOS—
New eclipse photos; star and moon effects caught by the camera; comets; shooting stars; progressive moon studies.

FREAK PHOTOS—
Odd double and triple exposure effects; novel and striking effects due to unusual exposures.

MECHANICAL PHOTOS—
Electrical and Mechanical apparatus of unusual news interest.

RADIO PHOTOS—
New stations, both commercial, government, and private. Owners of private or amateur stations will find a special contest for these photos on another page of this issue. And don't send us plate or film "negatives"; send unmounted or mounted "prints" preferably a light and dark one. Enclose stamps if photos are to be returned.

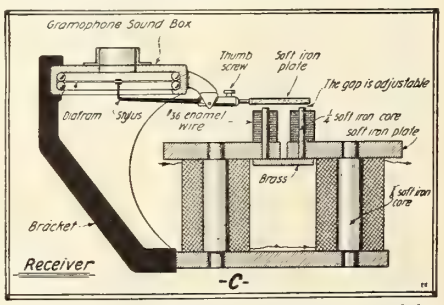
Address photos to—Editor "Odd Photos", Electrical Experimenter, 233 Fulton Street, New York City.

Physiophone in our April, 1920, issue. He developt a simple and efficient phonograph microphone, which works remarkably well. Referring to Fig. "B" again, we see that the sound as reproduced by the sound-box travels up thru the tone arm for a distance of about four to five inches, when it impinges against the diafram of a microphone of standard pattern, which forms an integral part of the tone-arm.

It would seem to us that, with the arrangement shown at "B," that more powerful effects could be obtained with regard to the transfer of sound to the microphone, but where the sound is desired to be picked up by the microphone in a fully resonant form it is usually the best practise to place one or more microphones in the wooden horn or amplifier chamber of the phonograph. This is so, for the reason that only when the music has reached the outer end of the amplifying chamber has it fully expanded in all of the harmonics of the notes. Therefore, the music in figure "B" would seem to be more strained and forced, altho perhaps more powerful, but in the end very "hard", so to speak, compared to the case where the microphones are placed in the amplifying chamber.

With regard to the receiver you show at Fig. "C", we do not care very much for this design, and we can truthfully say from our experience in the matter and the experience of other investigators, with which we are familiar, that many thousands of dollars have been expended and also many years of research on the telephone receiver as we know it today, and it is a very peculiar fact that not a single different type of receiver, out of the thousands of types that have been developt, has ever been adopted or recognized by the telephone world that has not embodied the general basic principles laid down by Prof. Bell.

In the loud-talking receivers as well as



Form of Loud-talking Telephone Comprising a Phonograph Sound-Box Rigged Up to Be Operated By a Pair Of Electro-magnets In the Manner Apparent. The Merits and Demerits of This Interesting Scheme Are Here Discust.

in telephone receivers of different makes, all of which practically embody the same principle, the main feature is the circular *iron diafram.* There are not more than three or four telephonic receivers on the market which do not use a diafram, and

(*Continued on page* 308)

Are Your Top and Side Curtains Gray, Dusty and Leaky?

HERE'S a preparation with which you, yourself can easily and quickly make them look like new. Johnson's Black-Lac gives perfect satisfaction on any kind of a top—leather, imitation leather or mohair. One coat imparts a rich black surface just like new.

Johnson's Black-Lac is easy to apply—dries in fifteen minutes—does not rub off on the hands or clothing—is permanent, waterproof and inexpensive.

JOHNSON'S BLACK-LAC

The Perfect Top Dressing

Do not hesitate to use Johnson's Black-Lac on the finest leather—it acts as a preservative and renders the leather soft and flexible. It requires no experience to apply Johnson's Black-Lac—all you need is a brush and an hour's time.

Keep Your Car Young

Start today to reduce the depreciation of your automobile with JOHNSON'S CAR SAVERS. There's a JOHNSON CAR SAVER for every purpose.

Johnson's Valve Grinding Compound
Johnson's Carbon Remover
Johnson's Radiator Cement
Johnson's Auto-Lak
Johnson's Stop Squeak-Oil
Johnson's Prepared Wax
Johnson's Cleaner
Johnson's Hastee Patch

Write for our booklet on Keeping Cars Young—it's free.

S. C. JOHNSON & SON, Racine, Wis.

DEPT. EE7



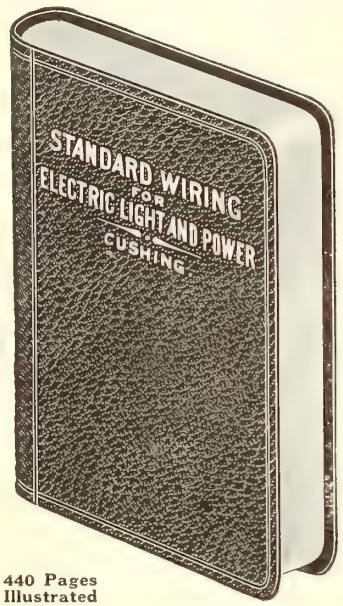
LEARN TO BE A

WIREMAN

AND EARN

$75 a Week

This year's Edition will make you an Expert



440 Pages
Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. Electrical Units and their Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve your wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges.
Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.
12 W. 40th Street New York

"The Oracle"

(*Continued from page* 306)

they are so expensive and complicated that it is seldom that they are employed, excepting for very special requirements.

The Magnavox, most powerful telephonic loud talker ever produced, the voice of which has been hurled thru the air for a distance of over a mile, employs a thin circular diafram and not a heavy armature of the general arrangement you show. The trouble with your arrangement is primarily that it has too much inertia usually, and it cannot follow the rapid fluctuations of telephonic speech or currents, the average frequency of which is 800 cycles per second. The Magnavox loud-talker has a large diafram in the center of which a small, light weight, air core magnet coil is secured. This coil moves at right angles thru a gap between the pole-pieces of a powerful electromagnet. The talking current is past thru the coil mounted on the diafram.

We would suggest in general that you will get much better results so far as the receiving end of your circuit is concerned, unless you build a very large elaborate and extremely well designed mechanism, by using a diafram with suitable electro-magnets to operate it, instead of the arrangement shown at Fig. "C". We hope to publish more details of the Magnavox system in an early issue. In the November, 1919, issue considerable data was presented with a cross-sectional view of the Magnavox loud-talker.

Home Electrics

By G. L. HOADLEY, M.E.

(*Continued from page* 274)

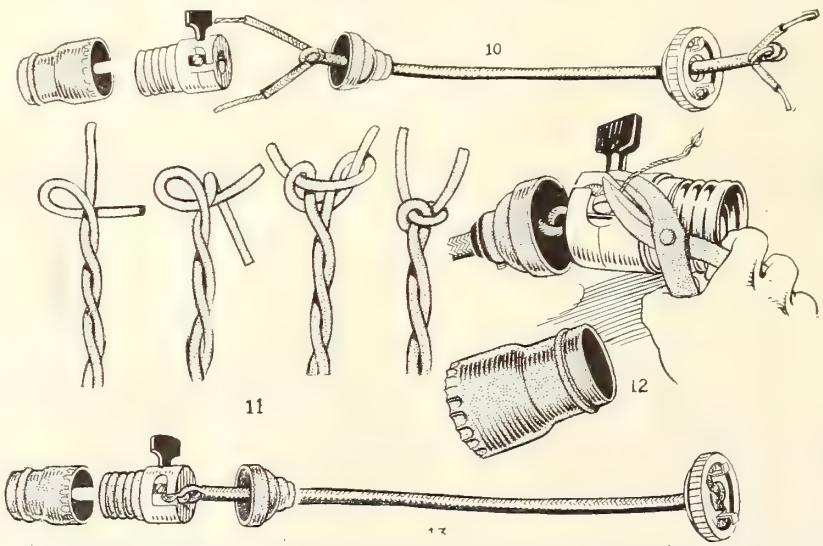
socket shells. Fig. 4 shows the Interchangeable socket, which will snap together and hold securely in any position without turning. Fig. 5 will snap together and hold in twenty different positions. It is known as the Multipo type and is quite generally used.

A portable lamp guard with a reflector as shown in Fig. 6 is desirable but not a necessity. The difference between ordinary lamp cord and re-enforced flexible cord is clearly shown in Fig. 7 and Fig. 8. The New Code lamp cord Type C has a 3/64-inch rubber insulation placed over a tight close wind of cotton and over all is the usual cotton outer braid. The re-enforced flexible cord Type PO has an additional rubber jacket which in turn has a hard glazed-cotton braid covering it.

To connect up the extension cord at the socket end, take a sharp knife and "skin" the wire as one would sharpen a lead pencil. See method B, Fig. 9. If method A is used, the wire is apt to be nicked and will be easily broken afterward. Bare the wire for about 2 inches, scrape the exposed strands with the back of a knife till they are bright, and then twist them together. The outer braid and the adjoining rubber jacket should be cut away a sufficient distance to enable the two rubber-covered separated inside wires to reach each connection on the lamp socket, but the braided and rounded cord should be left intact where it passes thru the cap. The socket cap should then be slipt back over the cord to the position shown in Fig. 10. Fixture sockets have a threaded hole at the smaller end with a set screw at the side to fasten the socket on the metal fixture. Such sockets should have the set screw loosened and a rubber bushing screwed into the smaller end of the socket to prevent chafing the flexible cord.

Next, tie a knot with the two insulated cords as in Fig. 11 to take the strain off the screw connections when the cord gets pulled or jerked as it will in actual service. Care should be taken to see that the insulation on the separated wires is intact where the knot is made or the bare wires would be in contact and trouble result. The knot itself is not difficult to tie if it is started right. Remember to place the first fold *behind* the straight wire; the rest of the operation is easy and clearly shown in Fig. 11 which illustrates the tying of the Underwriters' Knot.

Next, loosen the two screws in the socket base and bend each bared copper wire *once* around the screw in the direction in which the screw *tightens*. Draw the wire up tight under the screw as shown in Fig. 12. The spare ends will give the fingers a hold and assist in getting the wires tight under the screws. Now tighten the screws and cut off the spare ends as shown in Fig. 13. Now slip the socket shell and cap back over the socket base and snap them together, thus completing the operation.



10. Extension Lamp Cord Ready to Assemble. 11. Four Stages of Tying the Underwriter's Knot in Lamp Cord, to Take the Strain from the Connections. 12. Clipping Off the Projecting Wire on a Socket Connection. 13. The Connected Extension Cord, All Joints Tightened Up and Ready to Assemble the Socket. The Porcelain Rosette Twists Into Place On Its Base.

Radio and Electrical Experimenters

We offer you a partial list of our products of A-1 experimental apparatus. Here you can buy anything you need. If it is not quoted below, send for it and we will do our best to fill your order. All inquirers promptly answered. Note the wonderful goods we offer at rock bottom prices.



Transmitters

With Arm $2.00
With Arm and Button 2.50
With Button only... 2.00



Receivers

Watchcase, 75 Ohm. $1.25
5 Ohm. 1.50
Single Headband ... 1.00



Condensers

½ to 2 mf..... .60c



Key Switchboard

20 Springs $1.25



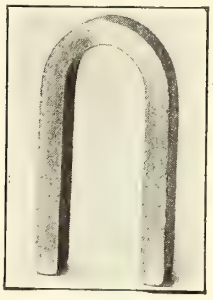
Ringers

1000 Ohm $1.25



Receivers

Telephone...$1.00, $1.25



Magnet

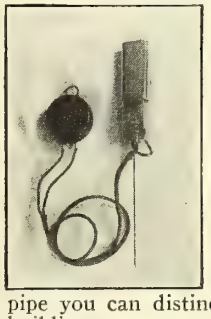
3¼ x 5", lift about one pound, weight two pounds, price.....35c



Induction Coil

Primary 1 Ohm, Secondary 55 Ohm, each 75c

Mechanical Stethoscope

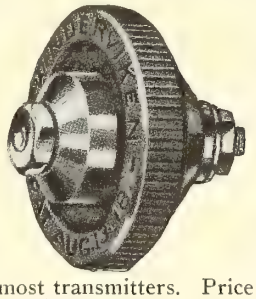


The latest mechanical achievement, a boon for Engineers, Mechanics, Experimenters, Automobile Mechanics, Etc. Immediate detection of all knocks or defections in running machinery of every description is made possible with the use of this instrument.

Sensitive as a detectiphone; picks up the sound of your watch. By placing point of rod on steam-pipe you can distinctly hear words spoken thruout the building.

Price $5.00 without battery. Money Order, Check, or registered currency only.

Skinderviken Transmitter Button



This famous button made in several styles for experimenters and wireless men. Supersensitive style for detectiphone work. Sends piano, violin, and victrola music thruout the house.

Common battery style for Wireless telephone and amplifier use. Capable of passing a greater amperage than most transmitters. Price with complete instructions for use $1.00.

When ordering be sure to remit enough for postage. Any excess will be refunded. All apparatus is guaranteed to be of high-grade commercial type. Write name and address plain. All orders filled the day they arrive.

J. SKINDERVIKEN

Inventor and Sole Manufacturer

414 BROADWAY NEW YORK

----------MAIL THIS COUPON----------

J. SKINDERVIKEN, 414 Broadway, New York

I enclose $..... for which please send me the following:

.....

.....

.....

Signed .....Address .....



BURN LESS COAL

With an improved, all-cast pipeless furnace you can cut your coal bills in two. This efficient, basement installed heating plant heats and ventilates the entire home. It burns any grade of coal more economically than a stove. It needs no expensive piping or other equipment. Anyone can install it in a day. They are described at our wholesale prices in our Handy Man Book. Send for it.

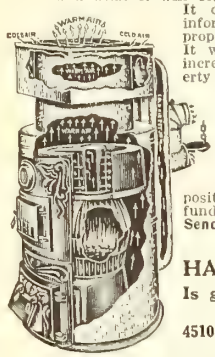


Do Your Own Plumbing and Heating by the Cut-to-Fit Method.

By our new plan anyone can install a complete plumbing or heating plant in his own home. Send us a rough sketch with measurements. Our Engineers will draw your plans, furnish information and see that the supplies you order come CUT-TO-FIT your needs. No waste of time, labor or unused material. Only a few simple tools necessary. **Send for**

The Handy Man Book

It will show you how. It will tell you just what to order and what it will cost at our wholesale prices. It contains plans and useful information for every builder, property owner or contractor. It will convince you. It will increase the value of your property 50%. You can do the work yourself.



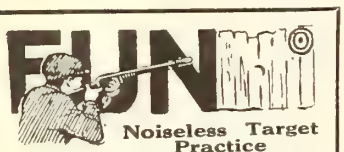
We have spared no effort or expense in the preparation of this valuable book. To keep from sending it broadcast to uninterested persons we request a temporary deposit of 25c which will be refunded with your first order. **Send for it Today.**

The Service of

HARDIN-LAVIN CO.

Is guaranteed by 40 years' business at

4510-20J Cottage Grove Avenue
CHICAGO



Noiseless Target Practice

More sport out of shooting than you ever imagined was in it, and **no disturbance,** when you use a

MAXIM SILENCER

Price, .22 cal., $7.00. Send 6c in stamps for catalog and booklet of humorous stories of noiseless shooting.

THE MAXIM SILENCER CO.
89 Homestead Ave., Hartford Conn.

LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries—thousands needed today. We give you personal and thorough training—practical, technical courses 3 months to 2 years under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. **Not a trade school.** Training is condensed—if your time is limited, come to the **Finlay Engineering College**—only one of its kind in the West. Day and night sessions—enroll anytime. Write for **FREE** catalog, a post card will do.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.



Cleartone Phonographs
$4.00 to $200.00 Retail

Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B East 12th Street, N. Y.

Do We "See" Electrically?

By H. WINFIELD SECOR

(*Continued from page* 264)

such a position as to affect the sight portion of the brain, then the function of sight would also be affected. The more one thinks about it, the more certain it seems that the

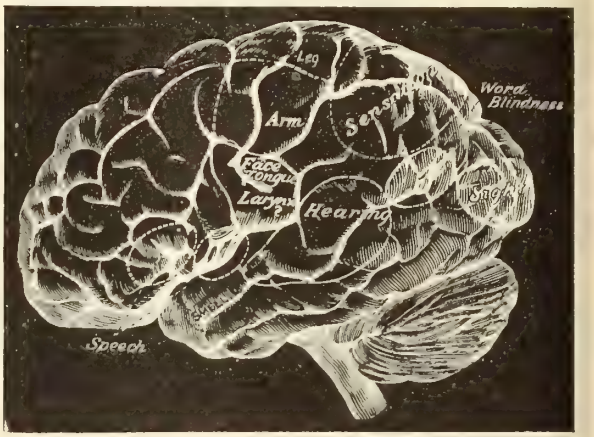


Fig. 2. The Cortical Brain Centers of the Various Functions. These Have Been Determined by the Fact That the Brain Cells in These Regions Sometimes Die, Due to an Injury, Paralyzing Speech or Sight, Et Cetera; or a Lesion in the Brain Produces Paralysis Externally.

whole action of sight is very much akin to that of the "telephot"—the man-made electrical eye, upon which many scientific investigators are now working, and which has been partially successful, so far as it has been developed.

As is well known, selenium or light-sensitive cells are used in this apparatus, and as the varying degrees of light and shade impinge on a series of these cells, a large number of which are sometimes arranged in a compact bank, the individual cells lower their electrical resistance in accordance with the amount of light thrown upon them. Conjointly, the various circuits to which they are connected have their currents altered correspondingly. The relays or other apparatus at the receiving end of the circuit respond in accordance with the various light images thrown on the respective cells at the transmitting end, and with suitable current responsive and light-reproducing apparatus at the *receptor*—we have once more the picture seen at the transmitting end thrown up before us.

It is the old, old story of nature's great simplicity. Man finds it very hard to imitate nature and there are some things in which nature has outdistanced him forever. The 20th century has seen greater and more epochal advances in science than all of the centuries that went before, but as yet no one has succeeded in reproducing the action of sight or "television" over an electric wire in a satisfactory manner—nor anything like it!

Some of the inventors working on television have used several hundred light-sensitive cells or even a thousand or so, but it is readily seen that no very perfect picture or likeness could be transmitted over a wire in this manner when a single human eye and its attached optical nerve and brain center involve the use of somewhat

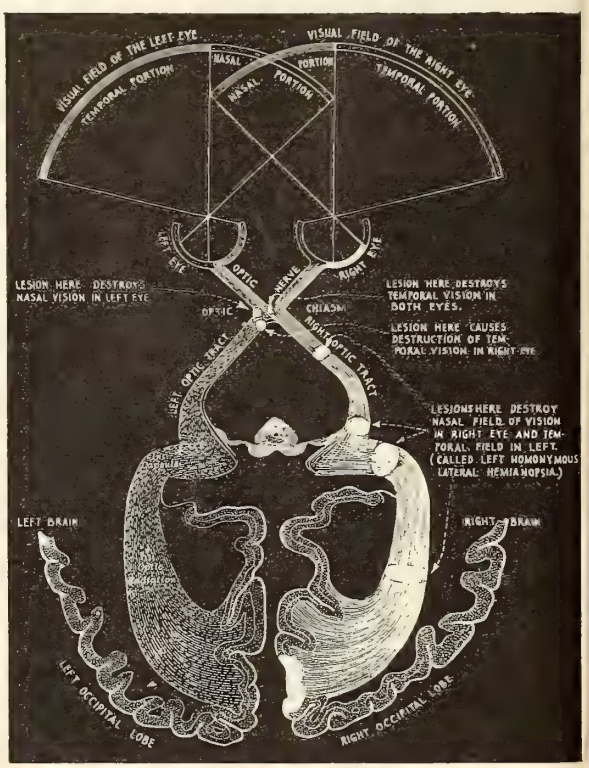


Fig. 3. A Remarkable Diagram Showing in Detail the Visual Fields of Both Eyes, and the Portion of the Retina Each Field Affects. The Location of Lesions and Their Effect Upon the Sight Is Clearly Shown. This Lesion Could Be a Blood Clot, Abscess, or Any Other Injury Which Would Destroy the Nerve Fibres in the Area Indicated.

over 2,000,000 light-sensitive elements!

Possibly, if we should build an electrical apparatus as elaborate as this, we could reproduce a very perfect image. But where is the genius who is going to build an optical or light-sensitive cell the size of the human eyeball or about one inch in diameter (the average diameter of the human eyeball) where, in the space of less than two square inches, there are encompast 2,000,000 light-sensitive cells? And to make television a perfected idea, it would seem that we should have an apparatus almost as small as this and nearly as sensitive with regard to the subdivision of the light image. The rod and cone layer covers about six-tenths of the inner surface of the eyeball.

The electrical theory of ocular vision in humans, as well as in animals, has been arrived at in several different ways. It may be thought that this is merely a hypothetical supposition, but such is not the case. This theory of ocular vision has occupied the writer's mind for a long time and it has been very difficult to procure much aid on the subject, as but a trifling amount of matter has appeared on the subject, owing principally to the fact that the function of sight is so involved and extremely delicate that it has, up until the present time, been almost impossible to determine just how we do *see*.

A medical friend of the writer's recently gave him a little data which only tended to more greatly strengthen the electrical

(*Continued on page* 313)



Man alive—Listen!

You can smoke Camels till the cows come home without tiring your taste!

CAMELS bring to you every joy you ever looked for in a cigarette! They are so new to your taste, so delightful in their mellow mildness and flavor, and so refreshing, you will marvel that so much enjoyment could be put into a cigarette!

To the most fastidious smoker, *Camels are a revelation!*

Camels quality is as unusual as Camels expert blend of choice Turkish and choice Domestic tobaccos which *you will prefer to either kind of tobacco smoked straight!* No matter how liberally you smoke, Camels never will tire your taste!

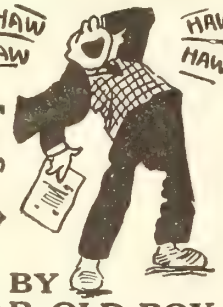
You will marvel at Camels smooth "body". And, your delight will also be keen when you realize Camels leave no unpleasant cigaretty aftertaste nor unpleasant cigaretty odor! For your own personal proof, compare Camels with any cigarette in the world at any price.

Camel
CIGARETTES

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes for 20 cents; or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.

R. J. REYNOLDS TOBACCO CO. Winston-Salem, N. C.

BE AN ARTIST



DRAWN BY 14-YEAR-OLD BOY

The above cartoon was drawn by Master Bob Brennan of the Washington School of Art. Bob writes that he is selling his work and that he is cartoonist on a small paper in Evansville, Ind. He is but one of our many students and graduates who are making money as cartoonists, illustrators and designers.

Learn By Mail at Home!

By our new method of teaching drawing by mail you can learn in your own home, in a short time. Get into this fascinating work yourself and earn $50 to $100 or more per week! The study is fascinating. Only a few minutes a day! Have your own studio or secure high-salaried position. Or work in spare time. Many students earn while they are learning.

FREE! BOOK AND ARTISTS' OUTFIT! WRITE TODAY

A complete outfit *free* to all students. Includes everything required to produce hundreds of dollars' worth of pictures. Write today. Special terms to a limited number of new students. Mail postal or letter for beautiful Booklet, "How to Become an Artist," filled with drawings and full particulars of our extraordinary offer. Do it now—Before you forget.

WASHINGTON SCHOOL OF ART, Inc.
1516 H Street, N. W. Washington, D. C.

DIAMONDS ON CREDIT WATCHES

WE WILL SEND YOU ANY DIAMOND, WATCH, JEWELRY, SHOWN IN OUR CATALOG FOR *FREE EXAMINATION*



There are 128 illustrated pages of Diamond Rings, Diamond La Vallieres, Diamond Ear Screws, Diamond Scarf Pins, Diamond Studs, Watches, Wrist Watches; also our wonderfully showy assembled Solitaire Diamond Clusters. Our Catalog shows all the standard world renowned Watches—solid gold and gold filled cases. Splendid bargains in 25 year guaranteed watches on credit terms as low as $2.50 a month. We Accept Liberty Bonds

We are offering wonderful values in these and all other Diamond Rings, at $50, $75, $85, $100, $150 and up. Every article in our Catalog is priced unusually low. Whatever you select will be sent prepaid by us. If satisfied, pay one-fifth of purchase price and keep it, balance divided into eight equal amounts, payable monthly.

LOFTIS BROS. & CO.
THE NATIONAL CREDIT JEWELERS
Dept. B-22 108 N. State St., Chicago, Ill.
Stores in Leading Cities

Handwriting Tells You Secrets

Strengthen your character! Develop your personality! Be successful! Find out what holds you back! Know your faults, your virtues, your strength, your weakness! Know what to cultivate within yourself and what to fight so that you may make the most of yourself. By Graphology we can tell you these, and help you to know yourself.

Know your friends! Know whom to trust and whom not to trust! Is a certain friend—sincere, trustworthy, energetic, kind, generous, or lazy, fickle, deceitful, irritable? Send us sample of their handwriting and find out. Avoid unhappiness by knowing the truth now instead of later!

Send us a dollar and specimen of handwriting for informative analysis. (Critical-Analysis $5.00.) Our expert Graphologists will analyze it carefully so that in business, in love, in everyday friendships, you cannot go wrong. Dollar back if you are not satisfied. Unusual offer for limited time only.

Don't walk in the dark! Don't wait! Send today!

Robert R. Ross, 110 W. 40th St., New York

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(*Continued from page* 281)

stars in the system are flowing to and fro along the spiral arms in obedience to the dynamical laws of the system.

It is believed, moreover, that this system of stars may be surrounded by dark absorbing matter, such as appears in photographs of spiral nebulæ, which shuts off from our view external systems lying near the plane of the Milky Way.

On the assumption that the system of stars to which our sun belongs is a vast spiral nebulæ formation an attempt has been made to find its motion onward thru a still greater universe, that occupied by the spiral nebulæ, and a motion thru space of 375 *miles per second* has been deduced from rather limited data. This may be considered the first attempt to find the motion of our sidereal universe as a unit with reference to external universes, the spiral nebulæ.

We have come far in the past three hundred years from the conception of an immovable earth at the center of the universe to such an awe-inspiring conception as is now seriously entertained by the astronomers of today and which is based upon convincing observational evidence of the actual motions of the stars and spiral nebulæ obtained by means of the spectroscope.

Whatever may be discovered in the future in regard to the form and extent of the universe the idea of a fixt and immovable center either within the solar system or among the stars beyond has gone from the minds of men at last.

Not more than a generation ago a survival of the old idea of a fixt center was seen in the theory that Alcyone, in the Pleiades was a "central sun" about which all the stars revolved, but it is now known that the Pleiades form a moving star cluster. Alcyone is therefore drifting slowly onward thru the universe and the idea of a fixt and immovable center to which man may anchor his ideas is drifting away also. There may be local centers of systems, such, for instance, as the sun occupies in the solar system or some group of stars may occupy in the stellar system to which our sun belongs, yet *as a whole* these systems move on and their centers with them. There is no evidence today that any fixt and immovable point exists in the heavens.

No celestial object has been found to be without the attribute of *motion,* not only motion *onward* thru the universe, but also *rotational* motion about an axis of the body. The planets rotate on their axes as well as revolve about the sun, and the sun also turns on its axis as it moves onward thru space. This rotational motion is also found in the nebulæ and star clusters as well as in the stars and planets. No object in the heavens is known to be without it. Even the slowly drifting Orion nebula possesses a rapid internal velocity of rotation. There is no such thing as a body absolutely at rest in the universe.

TABLE I.

Showing the number and relative size, velocity and distribution of the various types of celestial objects.

Object	Number	Diameter	Velocities miles per sec	Distribution
1. Solar System				
a. Planets	Eight	3,000 to 88,000 mi.	3 to 35 miles per sec.	Revolving in orbits about sun.
b. Sun		864,000 mi.	12½ mi.	Traveling thru galactic systems of stars (Milky Way).
2. Stars				
a. Helium (bluish)			8 mi.	
b. Hydrogen (white)	Approx. 2,000,000,000 (Two thousand million)	500,000 to 1,000,000 mi. on the average	14 mi.	All types of stars are more or less crowded toward plane of Milky Way in lens shaped formation. (Milky Way possibly a spiral nebula.)
c. Solar (yellow)			18-19 mi.	
d. Type M (red)	Including all types		21 mi.	
3. Nebulae				
a. Diffuse or Gaseous	Numerous	Very extensive, many light years.	Very low	In or close to Milky Way.
b. Spiral	Approx. 700,000 (Seven hundred thousand)	Size and distance doubtful but very great.	Average 480 mi.	Far external to Milky Way and numerous near its poles.
c. Planetary	One hundred and fifty (150)	Several times that of the solar system on the average.	Average 48 mi.	In or close to Milky Way.
4. Globular Star Clusters	Not over one hundred known	Many light years.	Very high	External to Milky Way and spherically distributed about it.
5. Magellanic Clouds	Two (Greater and Lesser)	" " "	Very high	Far beyond Milky Way. Possibly near by spiral nebulae.

Electricity from Water Power

By H. WINFIELD SECOR

(*Continued from page* 285)

proper dimensions of the buckets, the width of the wheel, etc.

Generally speaking, the head or drop of the water is most always known first, owing to natural conditions available. For a water-wheel the diameter of the wheel is generally found by subtracting two feet from the head, exprest in feet; while the width of the water-wheel will depend on several factors, which are the speed at which the wheel is to rotate, the amount of water to be carried over the wheel per minute, the shape and number of buckets, and also on the depth of the buckets.

The horsepower of an overshot water-wheel is calculated as follows: The head in feet, multiplied by the weight of water in pounds falling over the wheel per minute, divided by 33,000 times .7. The tables appended at the end of this article give a great deal of information on small water turbines which are available on the market, and if those interested will address the writer enclosing a stamped, self-addrest envelope, the names of companies manufacturing both small and large high efficiency turbine wheels, as well as the latest pattern steel water-wheels will be furnished gratis.

Do We "See" Electrically?

(*Continued from page* 310)

theory here presented. This data, in brief, was as follows, viz.: that in making tests on the action of light on the rod and cone layer of the eye, and also in attempting to make measurements of the velocity of transmission of the optic nerve impulses, that there are only two theories apparently open as to how the light images passing thru the lens and, falling on the retina, could produce their well-known effects on the cells of vision in the brain. Either the action is electrical or of the nature of a photo-electric effect; or otherwise it is considered that it is of a chemical nature,—*which* it is, however, is the moot question that remains as yet unanswered.

The 2,000,000-odd fibers composing the optic nerve and over which the light impulses, either electrical or chemical, but presumably and apparently *electrical,* are transmitted are of very small size—far smaller than one would imagine at first. These fibers, corresponding to minute electric wires, so far as we can now see, are only visible under the most powerful microscopes, such as those used by physicians and physiological investigators.

It has furthermore recently been pointed out by a European investigator that the nerves and nerve fibers are indeed like many electric wires, for several reasons,—principally because it has been found that these parts of the human body are covered thruout with a fatty insulating covering, and as this authority has suggested, it would seem to show that this insulated covering on the nerves and other component parts actually serve to preserve the electric potential and natural charge of the body; and in certain diseases that these break down, causing the electric charge of the body to become markedly lowered.

As this investigator states further: "Anything which causes a break in the insulated covering of the body or its component parts, such as a cut or wound, or even damp feet or clothes, causes leakage of electricity from the body, with consequent impairment of the vitality; and anything that will stop this leakage, repairs the lost vitality and heals the wound. A diver rubs himself over with oil for this purpose; likewise *trench-foot* or *frost-bite,* to which the soldiers in the trenches were subject, were readily prevented by massaging the feet daily with oil. Again, the application of pure paraffin wax to a wound or cut completely stops this electric leakage and heals it."

Compressed Air for the Sick

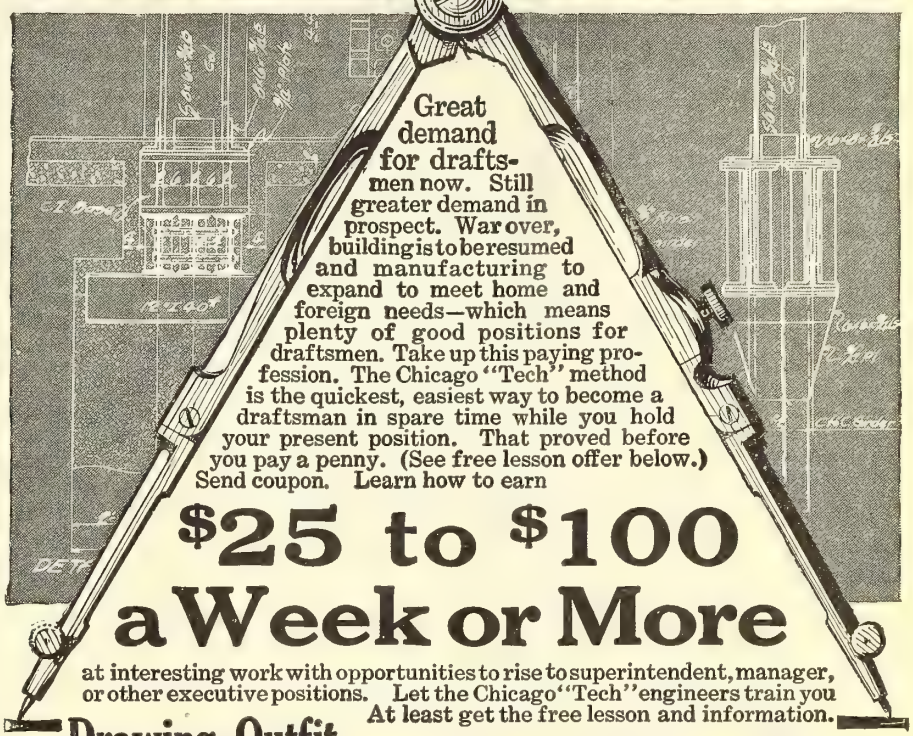
By GEORGE WALL

(*Continued from page* 251)

One will note the very ingenious scheme for dividing off the respective patients, which is made possible by designing each compartment complete, by itself; that is to say, each patient lies in a separate steel compartment in which the air pressure could be raised to any pressure desired, and maintained at that point for several hours or more, as required for the particular ailment under treatment.

On the outer wall of the compartment door in each case, there is provided an air pressure gage which indicates the pressure within the compartment in pounds and fractions of a pound, at all times. The orderlies who administrate the treatment, can pass along the central aisle between the two rows of compartments and keep a constant

Make a Bigger Income Learn Draftsmanship

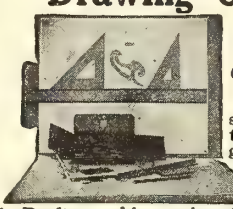


Great demand for draftsmen now. Still greater demand in prospect. War over, building is to be resumed and manufacturing to expand to meet home and foreign needs—which means plenty of good positions for draftsmen. Take up this paying profession. The Chicago "Tech" method is the quickest, easiest way to become a draftsman in spare time while you hold your present position. That proved before you pay a penny. (See free lesson offer below.) Send coupon. Learn how to earn

$25 to $100 a Week or More

at interesting work with opportunities to rise to superintendent, manager, or other executive positions. Let the Chicago "Tech" engineers train you At least get the free lesson and information.

Drawing Outfit



(*No Extra Charge*)

Every student of the Chicago "Tech" Home Study Course in Draftsmanship receives this drawing outfit—set of instruments in case, drawing board, T square, triangles, scale, curve, drawing paper, pencils, etc., or a cash credit in case he already has an outfit. You use them while learning,—then take them right into your practical work.

NOTE: Enrolled with Chicago "Tech" you have the personal direction of practical engineers, builders and architects who teach you the methods they use in their own work. No useless theories, no time wasted. You are prepared to stand beside old, experienced men. Big advantage to learn from a staff like this—every man a specialist.

Come To the College or TRAIN at HOME

Wherever you are you can have this Chicago "Tech" training. Complete instruction by mail. Exercises, lessons, personal direction of our experts right in your own home if you cannot come to the college for a resident course. Send the coupon and get the facts.

Auto and Gas Engine Course

All about automobile mechanism—its construction, operation and REPAIR—taught by mail. You train directly under the Chicago "Tech" automobile experts. Splendid opportunities open now.

Learn All This in Spare Time

All about the Principles of the Automobile.
All about Gasoline Engines.
All about Power Plants and Transmissions.
All about Carburetors and Fuel Supply Systems.
All about Lubrication and Cooling.
All about Batteries.
All about Magneto Ignition.
All about Starting and Lighting Systems.

Know How To Fix Troubles

Most complete instruction in auto repair work. Equips you for high pay or to start a business. Big demand for trained repair men.

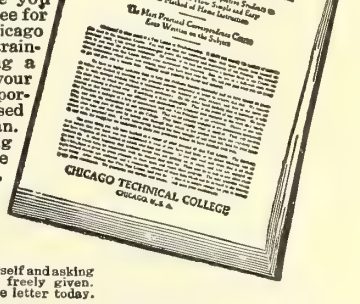
Write Send the coupon and get catalog and all information now.

Easy Payments

The fees for Chicago "Tech" courses are very moderate—and you can pay on easy terms. And also—you can obtain in a few months what it would take several years to acquire by ordinary methods. You can get an early start. You are soon ready to take a paying position and to quickly get back the cost of your course.

FREE TEST LESSON

Other institutions ask you to pay first—and then to find out later how well qualified you are for this profession. We send the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything. And see for yourself just what Chicago "Tech" offers you in training which will bring a ready market for your services and open opportunities which are closed to the untrained man. The coupon will bring all the facts about the course, the small fee, and the easy terms.



Mark with X the branch you are interested in—or if in doubt about which course to take, write a letter stating facts about yourself and asking our advice which will be freely given. Mail either the coupon or the letter today.

CHICAGO TECHNICAL COLLEGE
745 Chicago, "Tech" Bldg., Chicago, Ill.

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below:

[ ] Draftsmanship
[ ] Automobiles
[ ] Gas Engines
[ ] Aeroplanes
[ ] Designing
[ ] Contracting—Buildings
[ ] Plan Reading—Buildings
[ ] Plan Reading—Machinery
[ ] Estimating—Buildings
[ ] Surveying
[ ] Plumbing—Estimating, etc.
[ ] Steam Engineering

Name .....

Address .....

Post Office..... State.....

Free Trial lesson included when inquiry is for Draftsmanship or Plan Reading.



INSTALL THE
ALSOP-ALL-SPARK

on your car and get the increased power that results from a big, hot, fat spark.
It eliminates the cost of new plugs, by causing old, cracked, carbonized and oil-soaked plugs to give powerful sparks, which retards carbon, saves gas, develops greater power, and insures continued driving without misfires.
The "Alsop-All-Spark" is simple—merely attach the handsome control dial to your dashboard and attach the wires to the spark plugs. The "Alsop-All-Spark" is safe—it has no dangerous, exposed spark gaps to set your car afire. The "Alsop-All-Spark" is sure—it will not make your car hard to start; and assures continuous running without misfires.



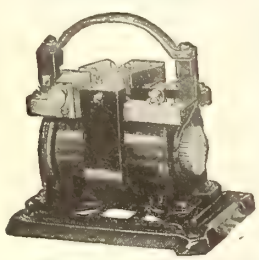
Send $7.50 for 4-cylinder type device—money-back guarantee.

Live Dealers, Agents, Salesmen Wanted

ALL-SPARK IGNITION CO., Inc., 13-X Water Street, New York City

CHARGE YOUR OWN BATTERY AT HOME FOR 10c.

F-F Battery Boosters have been in service for over 5 years and their rapidly growing popularity is a reliable measure of their ability to perform the service for which they are intended.
Our increased factory space is buzzing steadily so we can take care of your requirements.



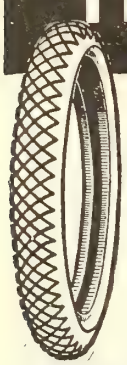
F-F BATTERY BOOSTER or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current.

Bantam type 6-6 amp. 6 v. battery..$15
Type 16-8 amp. 6 v. battery.... 24
Type 166-12 amp. 6 v. battery.... 32
Bantam type 12-5 amp. 12 v. battery..$20
Type 112-6 amp. 12 v. battery.. 24
Type 1612-7 amp. 12 v. battery.. 32
Type 1626-12 or 7 amperes in combination for both 6 and 12 volt batteries.. 48

Shipping weight complete with **Ammeter** and **Battery Clips.** 11 to 15 pounds.
All outfits do the same work except as to time to complete a charge.
Include postage and insurance with remittance for parcel post shipment.
Ask for bulletin **No. 12** describing these and other F-F charging apparatus of larger capacities and of other voltages and cycles; also Boosters that operate on Farm Lighting Plants and Direct Current.
Write for Bulletin No. 12

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

TIRE PRICES CUT
FROM OUR FACTORY TO YOU



6000 MILES GUARANTEE

National GOOD-WEAR Double-Tread Reconstructed Tires represent quality, value, service and satisfaction, and are guaranteed for 6,000 miles. Our tires do away with tire trouble. The fact that we have over 30,000 satisfied customers speaks well for the wearing qualities and enduring powers of National GOOD-WEAR Tires and Tubes.

Reliner FREE with Every Tire. Tubes Are Guaranteed Fresh Stock.

Size	Tires	Tubes	Size	Tires	Tubes	Size	Tires	Tubes
30x3	$5.50	$1.60	32x4	$8.25	$2.40	36x4½	$11.50	$3.40
30x3½	6.50	1.75	33x4	8.50	2.50	35x5	12.50	3.50
31x3½	6.75	1.85	34x4	8.75	2.60	36x5	12.75	3.65
32x3½	7.00	2.00	34x4½	10.00	3.00	37x5	12.75	3.75
31x4	8.00	2.25	35x4½	11.00	3.15			

Send $2 deposit for each tire and $1 for each tube ordered, balance C. O. D. Tires shipped subject to your examination. State whether S. S., C. L. (Q. D.) plain or N. S. is desired. All same price.

NATIONAL GOOD-WEAR TIRE CO., 1113 Washington Blvd. Dept. 541 CHICAGO

10¢ OR 25¢ Anti-Kamnia
AK FOR HEADACHE, NEURALGIA, INFLUENZA AND ALL PAIN
Ask For A-K Tabs TABLETS

MODEL AIRPLANE SUPPLIES



Build and fly Model Airplanes

Send 5¢ for catalog of complete and knocked-down scale models of new machines, parts, fittings, and supplies.

Wading River Mfg. Co. 672 Broadway, Brooklyn, N.Y.

watch or check upon the instruments attached to each berth.

Two tiers of steel berths are shown in the illustration herewith, which gives a very considerable capacity; a steel tube 12 feet in diameter by 100 feet in length is capable of caring for 125 patients.

As will be seen, the steel chamber is divided off so as to contain at the entrance end a consultation and diagnostic room containing lung testing meters, etc., for the purpose of ascertaining the strength of the patient's lungs, etc., so that too great an air pressure will not be administered. Of course, all the regular diagnostic points are carefully watched, such as the blood pressure, pulse, etc., before the patient has a prescription given for the treatment by comprest air.

Arrangement of the machinery for maintaining the air pressure and also an adequate supply of fresh air for all times, is also quite ingenious, but withal very simple. Generally explained, there are two distinct systems of pipe and ventilation involved—one, for compressing the air and distributing it by means of suitable pipe lines and nozzle banks on each compartment, with suitable pressure regulating valves fitted at the exterior of the compartment, and secondly, a system of ventilation by means of automatic valves, whereby the foul air is released to the atmosphere as the pressure rises within the compartment.

In this manner, a practically continuous stream of fresh air under pressure is applied the patient. The air compressor is driven by an electric motor fitted with suitable regulating devices, so as to maintain the speed at a very constant value, which in turn insures a supply of comprest air at constant pressure.

Among other novelties in this comprest air sanitarium, we find pneumatic mattresses and pillows which can be inflated with comprest air, and then capt the same as automobile tires, these mattresses giving the utmost of comfort. Also, there is an air pressure testing cabinet made of glass, in which the patient can be placed and watched closely by the diagnostic physician, while the air pressure is steadily increased within the cabinet.

Moreover, the sleeping compartments are provided with telephones, so that in the event that the patient may become ill or faint, he can signal this fact to the attendants and, thanks to the telephone, they can carry on ordinary conversation without having to have doors open, which would cause a break in the treatment owing to the release of the air pressure.

The record of each patient is kept on a card secured in a suitable holder on each compartment door, and, besides this, there is a small glass window thru which the attendant can keep an eye on the patient.

AMERICAN LAMPS DISPLACE GERMAN.

Before the war in 1914 the whole of the lamp trade of Brazil was in the hands of the German "Osram" company, the lamps of which up to 50-candle power were sold by the retailers at about 29 cents to 30 cents. The Dutch "Phillips" lamp also had a certain sale, but not to be compared with that of the German product.

Since the beginning of the war American lamps have largely held this field, but, according to a report by John M. Glen of the British Electrical and Allied Manufacturers' Association, the American lamps have not proved so serviceable as the German lamps.

It is impossible to state the number of lamps imported annually into Brazil, but the author of the report was of the opinion that, considering the population, it is enormous, as may be judged from the number of hydroelectric plants thruout the country for lighting even the smallest towns and cities.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page 283*)

peroxid and powdered charcoal. Place the mixture in a dry test tube clampt to a ringstand or other support and set behind a glass screen. Allow one drop of water to fall upon the mixture from the end of a long glass tube.

Potassium Chlorat and Red Phosphorus: To a pinch of finely powdered potassium chlorat add one-third that amount of red phosphorus and place in a previously folded paper, being careful to exert no pressure on the mixture. Place it on an anvil or brick and strike it with a hammer held in the gloved hand.

A Brilliant Display of Green Fire: For an evening display of fireworks the following is excellent: Scoop out a small hollow in a stick of willow charcoal. Then heat the charcoal to glowing in the flame of an alcohol lamp or a Bunsen burner. Immediately throw on a few crystals of barium chlorat and a very vigorous combustion accompanied by green light will take place.

Explosion of Chlorin and Hydrogen: In carrying out this experiment two precautions must be observed. The poisonous chlorin gas must not be breathed and the greatest care should be taken to keep the mixture of gases away from direct sunlight or very strong light of any sort, for under the influence of light they combine with explosive violence.

To generate the chlorin arrange apparatus as shown in Fig. 7. In the flask place two teaspoonfuls of manganese dioxid and then, having the apparatus in a good draft, pour thru the thistle tube concentrated hydrochloric acid until the manganese dioxid is well covered. Heat the mixture very *gently* and chlorin gas will quickly fill the cylinder. When full cover the cylinder with a glass plate and set it aside. Also remove your alcohol flame or Bunsen burner.

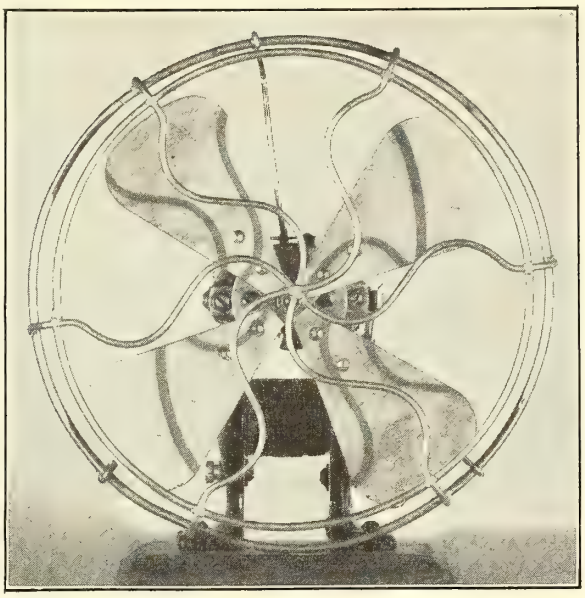
To generate hydrogen use granular zinc and dilute sulfuric acid (one part of acid to six parts of water, always pouring *acid into water*). Place the zinc in a generator as shown in Fig. 2 and pour the acid thru the thistle tube. Allow the action to continue for a few moments to free the generator of air, and then collect a cylinder of the gas over water in the usual way. Remove the cylinder by placing a glass plate beneath it while still in the water and invert it on your table.

Now invert the cylinder of chlorin over the hydrogen cylinder, bring them mouth to mouth, remove the plates and mix the gases by shaking. On removing the plates and applying a flame the mixture explodes with a loud report.

Combustion of Turpentine and Chlorin: Fill a wide mouth bottle with chlorin gas as described above. In a test tube gently warm a few cubic centimeters of turpentine and pour them over a large piece of filter or blotting paper. Then quickly thrust the paper into the bottle of chlorin. Spontaneous combustion will at once occur.

Explosion of Oxygen and Carbon Disulfid Vapor: Fill a very stout walled bottle with oxygen, generating it by heating a mixture of potassium chlorat and manganese dioxid and collecting the gas over water as shown in Fig. 7. Remove the bottle covering it with a glass plate and pour into it 2 c.c. of carbon disulfid. Shake the bottle and contents vigorously. Remove the glass plate and substitute for it a cardboard with a small hole in the center. Upon applying a match to the opening a sharp explosion is obtained. Unless the bottle is a strong one, wrap it in a towel.

The GREATEST FAN OFFER EVER MADE



Knapp 6" Battery Fan $4.50

Runs on 4-6 Volt Dry Cells or Storage Battery

A good, durable fan that gives a splendid refreshing breeze. Complete with switch, motor pulley and guard. Rigid, sturdy, dependable. Regular "Knapp" high standard of construction throughout.

Everybody Needs a Fan Hundreds of Uses for This Model

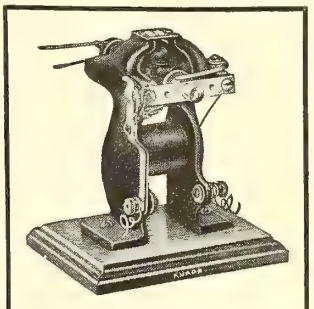
In the sick room to keep the air pure and fresh, for camp use to keep mosquitoes away, in the laboratory, for drying photographic plates, in the home, in the nursery to keep baby cool and comfortable —everywhere, everybody needs a good fan.

Here is your opportunity to get one that you can use even if your house isn't wired for electricity. *And at a price you can't duplicate anywhere.* The ordinary 6" fan cannot be bought for less than $8 to $10.

A Real Practical Motor for Many Other Purposes

This fan is equipped with our regular type B.B. Motor. Any time you need a powerful little motor for other uses you can take the fan off by removing three screws.

The motor has a six pole armature, 1⅜" in diameter, laminated. Also has starting switch and pulley for driving models, and all sorts of experimental work.



This offer is made for this month only. This ad will not appear again. Take advantage of it quickly. Order today. Send parcel post charges for 4 lbs. with your remittance and your fan will come by return mail.

Knapp Motors, Electrical Toys and Specialties Are Best

Knapp Goods have stood the test for 29 years. No detail in construction has been spared to make them the best that money can buy. The complete Knapp line includes Toy and Power Motors, Generators and Dynamos. Specialties and Novelties that amuse and instruct. A larger fan: 8" for 6 volts, 32 volts, 110 volts; Rheostats, etc. And Knapp prices are always lowest. Always insist on Knapp Goods.

DESCRIPTIVE CIRCULAR and CATALOG of celebrated KNAPP MOTORS and Electrical Specialties FREE on request.

Knapp Electric & Novelty Co., 523 WEST 51st STREET NEW YORK CIT

—ATTENTION—
MOTORISTS and DEALERS!!!
TIRES, TIRES, TIRES Galore

at exceptionally low prices, considering the very high quality of our merchandise. Are you skeptical, just try us ONCE.

Slightly Used and Factory Repaired Tires

	Used Tires	NEW TUBES
30x3	$4.50	$1.95
30x3½	5.50	2.30
31x3½	5.95	2.40
32x3½	6.25	2.40
34x3½	6.95	2.60
31x4	7.20	2.70
32x4	7.95	2.80
33x4	8.85	2.90
34x4	9.00	2.90
36x4	10.00	3.00
34x4½	9.30	3.15
35x4½	9.60	3.25
36x4½	9.95	3.40
37x4½	12.25	3.50
35x5	11.00	3.75
36x5	11.50	3.85
37x5	12.00	3.95

Of course, owing to the low prices quoted, these tires are not guaranteed for any definite number of miles, but should it happen that you do not receive service in proportion to the price paid, we will make reasonable adjustments if tires are returned to us prepaid. Is this not fair enough?

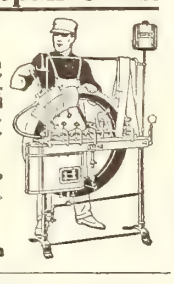
Send $1.00 deposit for each tire ordered. Tires will be sent promptly C. O. D. with privilege of examination.

LINCOLN TIRE & SUPPLY CO.
1429 S. Michigan Ave.
Dept. 64 CHICAGO, ILL.

AN EASY WAY TO MAKE MONEY Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method
Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2206 Fourth St. Waupun, Wisconsin



SLIGHTLY USED STANDARD MAKE TIRES

Size	Price	Size	Price
30x3	$5.00	33x4½ (Cords)	$16.00
30x3½	6.50	34x4½	12.75
32x3½	8.00	35x4½	13.75
31x4	8.75	36x4½	14.50
32x4	9.50	37x4½ (Cords)	25.00
33x4	10.50	35x5	14.75
34x4	11.75	36x5	15.00
32x4½ (Cords)	15.00	37x5	15.50

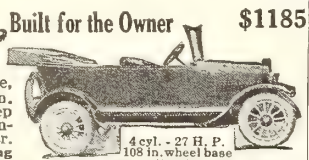
Special Brand New Tubes, Guaranteed.
Three sizes only.

Size	Price
30x3	$1.75
30x3½	2.00
31x4	2.35

Order now. Shipment made the same day. $1 deposit required with each tire ordered. Balance C. O. D., subject to your examination. Specify whether you desire to have clincher or straight side tire. Special cash discount of 5 per cent. if full amount accompanies order.

G. & H. TIRE & VULCANIZING CO.
2559 S. State St., Chicago, Ill.

The Seneca MOTOR CAR **Built for the Owner** **$1185**



Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. **Comfortable E-Z riding**

Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. **Write or Wire NOW.**

THE SENECA MOTORCAR CO., 17 Seneca Factory, FOSTORIA, OHIO



Printing Cheap
Cards, circulars, labels, book, paper. Press $10. Larger $30 Job press $120. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE, cards, etc. **THE PRESS CO., D-47, Meriden, Conn.**

The Tesla Gasoline Turbine

By JOSEPH H. KRAUS

(*Continued from page 277*)

operation as an internal combustion motor.

The upper part of the turbine casing has bolted to it, a separate casting, the central cavity of which forms the combustion chamber. To prevent injury thru excessive heating a cooling jacket may be used, or else water injected, and when these means are objectionable recourse may be had to air cooling, this all the more readily as very high temperatures are practicable. The top of the casting is closed by a plate with a spark-plug inserted and in its sides are screwed two of the new Tesla *valvular conduits* communicating with the central chamber. One of these is, normally, open to the atmosphere while the other connects to a source of fuel supply.

The bottom of the combustion chamber terminates in a suitable nozzle which consists of separate member of heat-resisting material. To regulate the influx of the explosion constituents and secure the proper mixture the air and gas conduits are equipt, respectively, with regulating valves. The exhaust openings of the rotor should be in communication with a ventilator, preferably carried on the same shaft and of any suitable construction. Its use, however, while advantageous, is not indispensable, the suction produced by the turbine rotor itself being, in some cases at least, sufficient to insure proper working.

But a few words will be needed to make clear the mode of operation. The air valve being open and sparking establisht across the gap, the gas is turned on slowly until the mixture in the explosion chamber reaches the critical state and is ignited. Both the conduits behaving with respect to efflux, as closed valves, the products of combustion rush out thru the nozzle acquiring still greater velocity by expansion and, imparting their momentum to the rotor, start it from rest. Upon the subsidence of the explosion the pressure in the chamber sinks below the atmospheric, owing to the pumping action of the rotor or ventilator and new air and gas are permitted to enter, cleaning the cavity and channels and making up a fresh mixture which is detonated as before, and so on; the successive impulses of the working fluid producing an almost continuous rotary effort. After a short lapse of time, the chamber becomes heated to such a degree that the ignition device may be shut off without disturbing the establisht régime.

The turbine thus shown presents the advantages of extreme simplicity, cheapness and reliability, there being no compressor, buckets or troublesome valve mechanism. It also permits, with the addition of certain well-known accessories, the use of any kind of fuel and thus meets the pressing necessity of a self-contained, powerful, light and compact internal combustion motor for general work. When the attainment of the highest efficiency is the chief object, as in machines of large size, the explosive constituents will be supplied under high pressure and provision made for maintaining a vacuum at the exhaust. Such arrangements are quite familiar and an enlargement on this subject is deemed unnecessary.

In speaking about the rapidity of explosions, Dr. Tesla says, "I have been able to speed up the rate of such explosions until the sound of exploding gases produced a musical note. The device is by far the simplest I have ever seen and I consider myself indeed fortunate in perfecting it at this time. I have also used this valvular conduit to great effect in rarifaction of air or the compression of gases when operated by my oscillator."



HANDY VEST POCKET BLOW TORCH **$1**

Clean, Compact, Neat, Efficient. Gives Instant Intensive Heat and Sootless Flame. Inexpensive to operate. Anyone can operate it. Useful for ELECTRICIANS, MECHANICS, AUTOMOBILISTS, HOME TINKERING. Add 25c and we will include bar of guaranteed ALUMINUM SOLDER for mending aluminum ware at home yourself.

Torch .....$1.00 Postpaid
Torch and Solder.... 1.25 Postpaid

REO SPECIALTY CO.
6381 Woodbine Avenue
Philadelphia, Pa.

ALL MOVING PICTURE MACHINE AND WIRELESS OPERATORS USE

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR

25c PER TUBE



TORCH $1.25

A PASTE THAT TURNS INTO METAL WHEN HEATED

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. 9
129 Sussex Ave., Newark, N. J.

COMBINATION SET Tube and Torch Complete **$1.50**

You Can Save $50.00



$8.93 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.



ONE PIECE

On market 5 years. 1,000,000 a month. Beware imitations. "NO-LEAK-O" Patented.

NO-LEAK-O PISTON RING CO., BALTIMORE, MD.

Tire Agent



We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. **Guarantee Bond for 8000 Miles.** (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.
901 Oak St. Kansas City, Mo.

Learn Autos and Tractors



Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O.

DENINGER WILL SAVE $40

BIG MONEY SAVINGS FOR YOU

Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.



Send for catalog

Deninger Cycle Co., Rochester, N.Y.

YOU 25 TO 50 DOLLARS

The ROGERS
Violet Ray, High Frequency Generator

Does not burn out. No sparking—therefore all shocks are eliminated. An ideal outfit, fully guaranteed as to material and workmanship.

PRICE COMPLETE With One Surface Applicator **$25.00**

Send for free descriptive Booklet

The Rogers Electric Laboratories Co.
Dept. B, 2056 E. 4th St., Cleveland, Ohio

Listening for Signals from Mars

By DR. FREDERICK H. MILLENER

(*Continued from page 295*)

was longer than any known station on earth we added more antenna and counterpoise until all our wire was in. Then carefully searching backward and forward, rearranging the various parts of our instruments, carefully tuning all the time, we searched for the signals which we hoped to hear.

NOT DISAPPOINTED

Had Mars been endeavoring to communicate with the earth, provided her signals were heavy enough to carry this far, our instruments would have picked up the waves which were going thru interstellar space, had these waves been of a similar nature, to the wireless waves generated on this earth, and as we understand them. As a result of this experiment it was evident to us that Mars was not sending wireless signals during the time that the planet was nearest the earth. We are not disappointed at the result. We did not undertake the experiment to prove that wireless signals were being sent from Mars, *but simply to discover if such signals were being sent.* We would have liked to accomplish the unusual and to have reported to the world the reception of signals from another planet. We realize that there is no good reason why some time in the future interplanetary communication should not be accomplished, provided there are intelligent beings on the other planets.

It is my conviction that at the present time we cannot receive signals from any planet. However, such communication might be possible with apparatus and methods which the future is bound to develop. This is not a failure, however, in not receiving these messages, but rather a negative result. In addition to the large antennae the apparatus was extremely sensitive, so sensitive in fact that when we disconnected the antenna and merely used a small portion of the counterpoise we had no difficulty in receiving the eastern stations such as Annapolis, New Brunswick, New Jersey, and Mexico City, Mexico. Just approaching your body to the coil would dampen out the signals.

The early part of the first evening that we listened in for these signals we were troubled with heavy static, so it was impossible to hear anything except stations in South America and United States. After two o'clock in the morning the static disappeared, the sky cleared and you could see Mars rolling her way thru space. It was after this time that we worked the hardest. When the wireless was stretched to its fullest extent, listening for interplanetary communication, we heard nothing that by any stretch of the imagination could be construed as a message from Mars. I believe that if any station on earth could have picked up any such message, ours could have done so. However, it is probably well for our reputations that we heard nothing, because if we had heard some signals we would have been promptly relegated to the Ananias class, no matter what evidence we would have had as proof of our statements. As it is, our mail has been full of rebukes, insisting that it was almost blasphemous for us to attempt such work.

Mars will be 35,000,000 miles from the earth about 1926. Mars is now on its way away from the earth and the greatest distance which it will reach will probably be 200,000,000 miles.

CORRECTION NOTICE.

An apparent oversight in the article "Wind And Rain to Order" in the June issue, failed to credit the photos to Universal Film Co.

LEARN DRAFTING

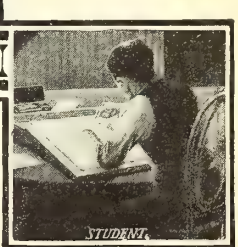
At Home—In Spare Time
as you would in actual practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed, by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher, especially qualifies him to give you the training you need to become a successful Draftsman.









Become a Specialist

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.

Draftsmen are needed in greater numbers, and receive better salaries than ever before.

Draftsmen Get $35 to $100 a Week

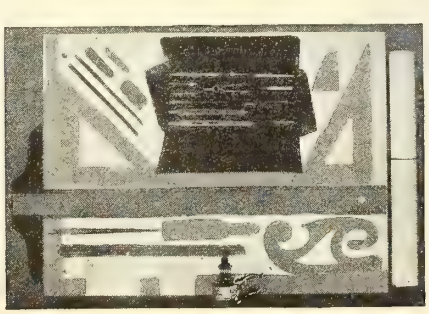
Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field paying as high as $50,000 a year.

How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions now open. Here is what "Columbia" training is doing for some of our graduates: Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.

This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



Big Concerns Employ "Columbia" Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them.

Send This Coupon Today

Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write today to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1145 14th, & T Sts., N. W., Washington, D. C.

COLUMBIA SCHOOL OF DRAFTING,
Roy C. Claflin, President
Dept. 1145 14th & T Sts., N. W.
Washington, D. C.

I am interested in your practical training in Mechanical Drafting. Please send me Free, your illustrated book of particulars, testimonials, terms, etc. I am also interested in the special post-graduate course checked below:

(Mechanical Drafting, or Machine Drafting is the foundation course and is complete in itself.)

Architectural Drafting...	Ship Drafting .....
Automobile Drafting.....	Statistical Drafting .....
Electrical Drafting	Radio Drafting .....
Aeroplane Drafting	Automotive Drafting ....
Special Machinery Drafting	Hydrographic Drafting...
Sheet Metal Drafting....	Machine Design .....
Structural Drafting	Tool Design .....
Highway Drafting	Shop Mathematics .....
Patent Drafting	Builders' Course .....
Topographical Drafting..	

Name.....

Address.....

City..... State.....



The laborer is worthy of his hire

All service is worthy of its hire and good service cannot be continuously obtained unless adequately rewarded.

From the beginning of telephone history the American public has received the best telephone service of any country in the world. In proportion to the service rendered the people have paid less for this telephone service than any other country in the world.

The reason why the American people have received the highest type of telephone service at the least proportionate cost is because the Bell System has been operated on a scientifically economic basis.

Every device which inventive skill, engineering ability, labor and time saving talent has been able to create; every efficiency known to buying, operation, executive control and financial conduct has been employed.

Public service companies feel the high cost of living as well as individuals. Pay them enough to make possible their giving good service. There is no permanent saving in poorly paid service.

In this land of opportunity none of us is willing to jeopardize his success or happiness by stinting the payment necessary to secure the most helpful and efficient service.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

ANNOUNCEMENT—BINDING POSTS FREE!

To care for our business in the eastern section of the country we are opening a branch at 20 N. Ninth St., Philadelphia, Pa. We are placing a complete stock of radio equipment in this office and will be ready to care for the local and mail order trade with even more dispatch than formerly.

As a special introductory offer with each order of $5.00 or over bearing the postmark of any date in July we shall give one dozen of binding posts free of charge. These binding posts ordinarily sell for 6c each and are one of our best values.

Our 64 page catalogue is now on sale at 15c which amount will be deducted on your first order for $1.50 or more.

ELECTRICAL SPECIALTY CO., Dept. E 48-50 SO. FRONT STREET COLUMBUS, OHIO

How and Why of Radio Apparatus, by H. W. Secor. A book every Radio Operator should have (full description on page 248)—$1.75. Experimenter Publishing Co., 233 Fulton Street, New York City.

My Message to Mars

By CLEMENT FEZANDIÉ

(*Continued from page 267*)

When Marty thoroly understood our numbers, I taught him a new word: "w-h-a-t." Thus, 2 + 3 = what? 5 + 7 = what? I would pause awhile after each question and then give the answers, and in this way taught him the very important word that signifies that a question is asked. This, and the word "equals" proved invaluable.

Next I taught him to repeat a message. I would begin a problem and then suddenly interrupt myself with a series of quick dots, and then I would start the message over again. Afterwards I interrupted his messages in a like manner until he learned that this sign meant "repeat." By this time, it was nearly bedtime.

"I'm going to ring off, now, Chuck," said I, "I'll just tell Mars to shut off the juice and call me up again at six o'clock tomorrow morning."

Chuck looked at me with a grin on his not over-handsome features.

"Yaw," he said with a wink, "I guess not."

"I'm not such a fool as I look, Budd. I know Mars' time is entirely different from ours."

"That's time enough, but I'm sure I can make Marty understand I want him to call me up at six o'clock."

"If you do, here's a ten dollar bill I had some trouble in borrowing, but I got it from a fellow who didn't know me. It's yours if you succeed."

"Well, you just *listen,* and you will see," I replied.

Had I known then the awful scrape I was destined to get into by my correspondence with the Martian, I should have hesitated. But with the recklessness of youth, I proceeded to put my scheme into execution.

It was a hard proposition I had undertaken, but I had thought of a method for making Mars understand our divisions of time. I began by sending out my regular call of three dashes repeated ten times. Mars already understood this to be a signal for attention. I waited exactly five seconds after making the call, and then wrote the figure "one" followed by two dots.

Five seconds later I sent the figure "two" followed by two dots, and so I continued, every five seconds giving the next numerals, always followed by two dots. Mars carefully repeated the message back to me, but evidently did not understand it. Then I tried a new trick. I gave the call again, waited ten seconds and gave the number "two" followed by two dashes. Then I waited 25 seconds and gave the number "five" with two dashes, then waited 35 seconds and sent the number "seven" with two dashes. I was about to continue, but Marty signalled me to stop and gave the call, and after a wait of fifteen seconds, he signalled the number "3," followed by two dots, and after five seconds more, the number "1" with two dots.

"He understands me, Chuck," I cried triumphantly. "He understands that two dots stand for an interval of five seconds. In other words, I have taught him to understand our time."

The rest was easy. After practising this at various intervals of time, I taught him to understand that I would leave the instrument and call him up again at the expiration of 40 seconds, 60 seconds, etc. After that, it was a simple matter to tell him to call me up at six o'clock the fol-

lowing morning. It was now midnight, so I told him "call: $72 \times 60 \times 5$ seconds."

I only waited to hear Mars repeat the message, then I gave a farewell rat-tat-tat on the instrument and hied me to a much needed rest. The next morning, I was at my instrument again, and sharp at six o'clock I heard Mars calling me. He was exact to the very second!

Chuck, who was with me, reluctantly pulled his ten dollar bill from his pocket and handed it over to me in payment of his bet. But as he borrowed twenty-five dollars from me that same afternoon, I didn't make much by the transaction.

This second day, I began by teaching my Martian friend the words "yes" and "no." To do this I again employed simple examples in addition and multiplication, making use of the question mark I had already taught. I wired: $2 + 3 = 5$? And after a pause sent a word-sign for "yes." Then $2 + 3 = 8$? And then sent the word sign for "no." After a dozen such messages Mars undertsood "yes" and "no," tho it was only later I taught him the distinction between these and "correct" and "incorrect."

Then I started teaching him squares and cubes and circles, lines, surfaces and areas. Marty was now familiar with numbers, so I merely wired: 3 square $= 9$, 4 square $= 16$, 5 square $= 25$ etc., and soon had Marty calling back 9 square $= 9 \times 9 = 81$, showing that he had learned the new word "square." The word cube and sphere were even easier. For fractions I used the form $1 \div 2$ for one-half, $3 \div 4$ for three-quarters, etc. So that π or 3.1416 by our system became $3 + 1416 \div 10{,}000$.

Circle 3 boundary $= 2 \times 3 \times (3 + 1416 \div 10{,}000)$.

Circle 4 boundary $= 2 \times 4 \times (3 + 1416 \div 10{,}000)$.

Then, Circle 3 area $= 3$ square $\times (3 + 1416 \div 10{,}000)$.

Circle 4 area $= 4$ square $\times (3 + 1416 \div 10{,}000)$.

Circle 3 volume $= 3$ cube $\times 4 \div 3 \times (3 + 1416 \div 10{,}000)$.

Circle 4 volume $= 4$ cube $\times 4 \div 3 \times (3 + 1416 \div 10{,}000)$.

It took an hour for him to understand that I was sending him the circumference and area of circles of radius 3 to 4 and the volume of a sphere of the same radius. I may state here that I did not use the number 3.1416 for π, but its Martian equivalent in the duodecimal system, namely 1.6220, which must have been as familiar to him as 3.1416 is to us, and thus suggested a circle at first sight, as the latter would to us.

The parenthesis or brace used above I had taught by simple examples in arithmetic and algebra. Thus after 3 square $= 9$ and 4 square $= 16$, I wired brace $3 + 4$ brace square $= 7$ square $= 49$, using the word brace before and after the numbers to indicate a parenthesis. Repetition of this process with other numbers soon taught my Martian friend that two braces indicated the coupling together of the numbers between. Then $(a + b)$ square $=$ a square $+ 2 \times a \times b +$ b square, and $(a + b) \times (a - b) =$ a square $-$ b square, taught him the use of "a" and "b" to represent any numbers. For "X" I used the word "what," which I have already explained that we used as a question mark.

Well, I shall not weary you with the details of our progress. A single example will suffice to show you the method I followed, and what roundabout ways were often required to teach my Martian friend the simplest things.

I will take the case of our weights and measures, which I had some trouble in making Marty understand. As a preliminary, I wired a few phrases like the following: $(3 \times 1$ foot$) \times (3 \times 1$ foot$) =$

An Ancient Greek Athlete



Reproduced from STRENGTH.

OUR ancient histories tell us the story of Milo, who was the most famous athlete of Greece many centuries ago. As a lad Milo was very frail and weak, and craved the strength and development of other lads of his age.

One day as Milo was taking his father's cattle to pasture, a very young calf attracted his attention. His ever present desire for strength prompted him to test his powers. He caught the young beast, braced his shoulders beneath its belly, holding the legs with his arms,—and lifted. He barely raised the animal from the ground, but was secretly pleased with his performance and tried it again. The next day he did the same thing, and so on for many days.

Finally Milo noticed that the calf had grown to a fair size, but he could now lift it easier than on the first day. He also noticed that he was becoming bigger and stronger, and could out-do his playmates at any of their games. The calf grew to be a huge bull, and Milo was still able to raise it from the ground. The weakling had become a famous athlete.

Milo, the Greek youth, was the originator of the progressive system of exercise. He started within his limits, and grew with the calf. He acquired supreme strength and a marvelous physique. He made his efforts count—what about yours?

Make Your Efforts Count!

Perhaps you too are envying the health and strength of some of your acquaintances. It was only by chance that the Milo of ancient days hit upon the method which made him the most famous athlete of his time. It is no longer necessary for you to merely long for health and strength, or to trust to luck for its achievement. Our scientific methods have placed health and strength within the reach of every normal man and boy, through the Milo system of progressive bar-bell exercises.

You should be vitally interested in good health and the best method of obtaining it. Perhaps you are **apparently** in good health, but you can not have **real** health with all its advantages unless you possess a strong body. Health and strength go together. You have no doubt heard a man say, "I don't want to be rich, I only want enough to live comfortably." The same man would probably say, "I don't want to be strong, I only want to be healthy." Show this man how to make a million and watch him become rich. Show him how to become strong and watch his development. We can make you both healthy and strong. We guarantee results. SEND FOR

Our illustrated Catalog and Folder No. 18, describing our system of exercising.

BOTH FREE

STRENGTH

The readers of STRENGTH were so well pleased with the May issue that we are receiving hundreds of letters of appreciation every day. Here are just a few of them:

"I received my copy of STRENGTH yesterday, and was very much pleased with it. It is becoming a better magazine with each issue."

"I received the May issue of STRENGTH and was well pleased with it. If the subscription price of the magazine does go up, it will make no difference to me for I could hardly get along without it."

"Congratulations on the May issue. STRENGTH has been valuable to me in developing what every man covets—perfect health and a strong, symmetrical body. I would like to see a copy of STRENGTH in the hands of every man in the United States."

"A friend has just given me a copy of STRENGTH, and I wish to express my appreciation of STRENGTH as a real help to any man who feels that his physical condition is not just what it should be. May STRENGTH continue to grow."

And hundreds more like them! Why be weak and sickly when perfect health is within your reach?

Don't imagine that your case is different, and that you can not better your physical condition. Good health is within the reach of every normal man and boy. Did you ever hear of anyone who was born with a good education? Education is something that must be acquired, and so is good health. STRENGTH will show you how to acquire good health—how to possess the vigor of body and mind which is absolutely necessary in every walk of life. The July number is now ready. Send in your subscription TO-DAY.

The Milo Bar Bell Co.

Physical Culture specialists and largest manufacturers and distributors of bar-bells, dumbbells and kettle bells in the World.

Dept. 7

Diamond & Third Streets

Philadelphia, Penna.

Subscription Blank

Date.....

MILO BAR BELL CO.
Diamond & Third Sts.
Dept. 7, Philadelphia, Pa.

I herewith enclose one dollar ($1.00) in payment for one year's subscription to "STRENGTH." ($1.25 Canada and $1.50 foreign countries.)

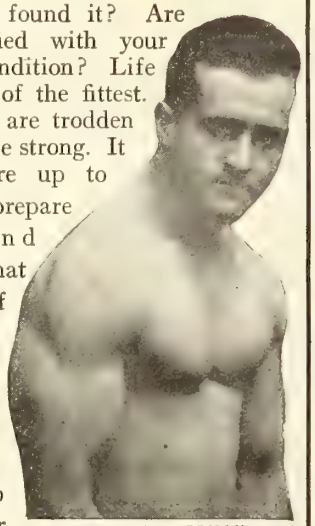
Name.....

Street Address.....

City or Town.....State.....

The Road to Strength

Have you found it? Are you satisfied with your present condition? Life is a fight of the fittest. The weak are trodden down by the strong. It is therefore up to you to prepare yourself and build up that body of yours for the fight. Enter the conflict and be a success. No one cares for the failure.



EARLE LIEDERMAN
The Acme of Physical Perfection

Be a Man of Strength and Power

What I have already done for thousands of others I can do for you. I will broaden your shoulders, deepen your chest (increasing your lung power), enlarge your arms and strengthen every muscle of your body. I will fill you with vim and pep so that you will be admired for your perfect physique and dominance of strength.

Send for MY NEW BOOK

"Muscular Development"

It tells the secret. Handsomely illustrated with 25 full page photographs of myself and some of the world's best athletes whom I have trained. This valuable book and my special offer will be sent on receipt of 10c, stamps or coin, to cover cost of wrapping and mailing. Don't delay! Send for it now, while it is on your mind.

EARLE E. LIEDERMAN

Dept. 216 203 Broadway New York

Every Electrician Needs This Book

Motion Picture Theatres are being built, those now running need new electrical installations, repairs, re-wiring.

Any Electrician who understands the special requirements of Motion Picture Electricity can add materially to his income from Picture Theatre work.

Motion Picture Electricity

By J. H. Hallberg

$2.50 POSTPAID

is a 280 page book, fully illustrated, that contains complete information in the specialized field of Motion Picture Theatre wiring, illumination, machine and equipment installation. The reference tables on wire sizes and capacity, weights and measures, heat units, etc., are worth the price of the book.

You cannot afford to let the dollars slip past you to your competitor. Reach out and grab them for yourself by ordering a copy of Motion Picture Electricity TODAY.

The Chalmers Publishing Co.

Suite 604

516 Fifth Ave., New York

Save Your Feet

From That Tired, Aching, Broken-Down Feeling.

Jung's Arch Brace, just out, is an elastic, light, comfortable, economical and corrective brace. Relieves tired and aching feet instantly. Corrects fallen arches and foot-strain. Strengthens and supports muscles. No ungainly humps. No leather pads. No metal plates. Made of specially prepared "Superlastik". Recommended by physicians. Guaranteed. Price $1.00 per pair. Money back if not satisfied. Order today. Booklet free. Ask your shoe dealer or druggist.



Geo. H. Jung Co. 3970 Jung Bldg. Cincinnati, O

STUDY HUMAN NATURE

MAKE PEOPLE LIKE YOU

Get along better, make more money, develop a winning personality, learn to know people as they are. Send 5 cents (stamps) for "PERSONAL POWER," a little book that points the way. Address

PROGRESS LEAGUE, 313 UNION SQ., NEW YORK.

9 × 1 foot × 1 foot = 9 × 1 foot square. He soon understood that the word "foot" stood for some linear measure and "foot square" for the same unit of surface. But of course he could not tell whether a foot meant one inch or one mile. To teach this, some object of comparison was necessary, and for this I was obliged to have recourse to astronomy. I first planned to teach him about the planets, but had to give this up as too complex. A much simpler method was to confine myself to the Sun, the Earth and Mars. That my correspondent lived on Mars I was now certain as I had succeeded in locating the exact direction from which his wireless impulses came.

I began by teaching Marty the word "noon." For this purpose I had an astronomer friend make me out a table of the time by our clocks when it would be noon at Mars each day of the year and also the time of the rising and setting of the Sun on Mars.*

Then for several days running whenever I stopt wirelessing I calculated how many seconds would elapse before his noon-time and notified him I would call up then. He could not fail to perceive the fact that my messages always arrived sharp at noon. That he did so and that the Martians understood something of astronomy was evident when in return he called me up for the next week sharp at noon-time by our time, —that is to say when the sun was on the meridian here. The word "noon" was then easy to add to our vocabulary. "Call noon = call 23 hours" did the work, for by this time I no longer counted by seconds but had taught him that 60 seconds = 1 minute, etc.

When he thoroly understood Noon as the time when the sun was on the Meridian at Mars, I taught him Earth Noon = Noon + 83 minutes since our noon was then 83 minutes later than his. He thus learned the word "Earth." Then by comparing Earth Noon and Mars Noon, I taught him the word Mars. To teach him the word "sun" was then comparatively easy. Noon + 6 hours = Sun stop. Sun stop + 12 hours = Sun begin. Sun begin + 6 hours = Sun noon. For "stop" and "begin" I used the signs we used for beginning and stopping our messages. Mars readily understood and wirelest back the time of sunrise and sunset on our earth.

All this preliminary work being accomplisht, I could now teach Mars what a mile was. I merely radioed him the volume of the Sun, the Earth and Mars in cubic miles and their surface in square miles; he then knew the exact length of one of our miles, so when I informed him that 5280 feet = 1 mile, and 12 inches make one foot, he understood our linear dimensions.

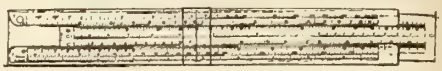
For weight I wired how many times one Earth made one Sun, and how many times one Mars made one sun. When he understood this I taught him the word "weight" by repeating the above, inserting the word "weight." Then I wired how many pounds the earth weighed and how many Mars weighed and so taught him what a pound was, which opened the way to teaching him all our weights.

Here I was indiscreet enough to stop to ask him how old he was and how much he weighed and learned to my surprise that he was 153 (terrestrial) years old and weighed one thousand pounds (earth weight)!

My next achievement was to teach him our elements. I sent him a complete table of the elements arranged in order of their atomic weights with their symbols and weights (atomic weight) and was delighted when he sent back a much more complete table with many elements we have not yet

* *Just a trifling slip of the author: It is "noon" every second, all day long, somewhere on Mars, just as it is on Earth*—EDITOR.

RICHARDSON'S POLYPHASE SLIDE RULE



has the regular A, B, C, and D Scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case with 100 page Instruction Book $2.00.

An ideal Slide Rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10. each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO. NILES, MICH.

REBUILT ELECTRIC MOTORS

General Electric
Westinghouse
Crocker-Wheeler
Emerson
Century
Wagner
etc.



All Motors Guaranteed For One Year

Motors bought, exchanged and repaired

ELECTRICAL SUPPLIES

Wholesale Prices

Sockets, wire, tape, loom, fuses, switches, cut outs, etc.

New illustrated catalogue free. Satisfaction guaranteed or money refunded.

HYRE ELECTRIC CO.

631 S. Dearborn St. Chicago, Ill.



Phonograph Owners, Attention—The **Ear-O-Phone** when placed over the ear, **collects** a musical tone and brings it to the ear in an **intensified** form, **clarifying** it so that it sounds more **natural** with increased **volume.** You get a strong **overtone** too. Only 3 by 2 inches in size. (State for which ear it is intended.) Made in **Oak, Walnut** and **Mahogany,** price $3.50 postpaid. Send **P. O.** or Exp. money order. Address

THE EAR-O-PHONE

1413 North Broadway

Los Angeles, Calif.

RAISE RABBITS



Make $60 a year profit from one pair. Thousands are doing it right now. It's easy, pleasant, profitable work and we help you get started.

Write today for circular.

PIGEON SUPPLY HOUSE. Box 251, Hanover, Pa

"Pigeons-Poultry-Pet Stock"

FOR SALE

12,000 lbs., No. 22 B. & S. Annunciator wire insulated with 2 layers of cotton in lengths of 25, 35 and 50 feet, suitable for wiring Bells, Wireless, and Land wire Telegraph, etc.

PRICE—35 cts. per pound postpaid.

SPECIAL PRICE quoted in large quantities.

STANDARD EQUIPMENT & TOOL WORKS,

307 St. James Street, Montreal, Canada.

Small Steam Engines and Boilers



Gas and Gasoline Engines, ⅛ H. P. up; Tanks, Pumps, Gears, Model Maker's Supplies. Get our Big Catalogue sent postpaid for 15c (coin preferred) or stamps. Refunded first order. 192 Pages —over 200 Illustrations.

MODERN ENGINE & SUPPLY CO. 346 Monadnock Block, CHICAGO.

YOUR FUTURE

depends upon the use you make of present opportunities. Write now for literature explaining our day and evening courses in Chiropractic, the greatest science of the age. Hurry for prices advance soon. New classes forming now.

The New York College of Chiropractic

1416 Broadway, New York City

MAKE YOUR BICYCLE A MOTOR CYCLE



by using a Steffey Motor Attachment. SIMPLE—RELIABLE — ECONOMICAL. In use over 20 years. Fits either double-bar or diamond frame. Send stamp for circulars.

STEFFEY MFG. CO.

Dept. E, 5025 Brown Street, Philadelphia, Pa.



158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. Only 10

Finest Approval Sheets 50% to 60%. AGENTS WANTED. Big 72-p. Lists *Free.* **We Buy Stamps.** Established 25 yrs.

Hussman Stamp Co., Dept. 67, St. Louis, Mo.

discovered. For these he had given Martian names. Then I sent him chemical compounds and formulas. For instance $H_2 SO_4$ would be wired as 2H + S + 4O.

In return Mars sent me many chemical formulas for compounds we have as yet no knowledge of here. I have taken careful note of them and expect to make my fortune by working them out as soon as I have time. My last trouble came in teaching Marty our alphabet. He now had a large vocabulary of English words, so I changed the symbols for these by sending for arbitrary words such as "Sun," "Mars," etc., its equivalent in letters in the Continental code. The use of the equal sign rendered this change easy. Then I separated each word into its component letters, sent several words in succession that had the same letter in them, and finally sent the whole alphabet in order a number of times.

It was some job, let me tell you, worse than to teach a deaf-mute how to write, but I finally succeeded. After that, everything was comparatively plain sailing, for I spelled out simple sentences containing the words he knew and adding one new word occasionally whose sense could be seen from the content. He learned, just as a child learns.

Finally, after several months, I could make him understand almost anything, even music which I wired by sending the number of vibrations per second for each note.

And then came the surprise of my life, for on making some inquiries in regard to the people on Mars, what was my astonishment when the operator on the other end informed me that she was a *woman!*

Here I had been for months intimately corresponding with a lady, and without any other chaperone than poor simple-minded Chuck! Lack of space forbids my telling you all I learned about the Martians, their history, customs, habitations, etc. Besides, it is all so wonderful, I fear my readers would disbelieve me and this would tend to throw doubt on the rest of my narrative.

On learning that my fair correspondent on Mars was a lady, I became desirous of seeing her likeness, so resolved to teach her our newspaper method of telegraphing pictures by the use of two co-ordinates for the main points in the outlines of the drawing to be transmitted. I began with simple geometrical forms, beginning with the semi-circle (half-circle) with which she was already familiar. I had by this time taught her the words, "line," "join" and "point," "diameter" and "perpendicular."

I first told her to draw a line five inches long. I then telephoned her to draw perpendiculars one inch, two inches, three inches, etc., from the beginning of the line and mark off points at the proper distances on these diameters and then join these points with a line. This line would evidently be a semi-circle. I then sent her the outline of squares, triangles, ellipses, spirals, etc., in the same way, thus not only opening up the entire study of analytics and calculus, but also enabling me to send and receive drawings of any objects desired.

I hoped by this method to secure not only a photograph of "Miss Mars," but also pictures of many other objects on Mars which I should have been most happy to send you for the benefit of your readers, had it not been for a startling event that came like a thunderbolt out of a clear sky and put a stop to all further communication with Mars.

Yesterday I wired to my Marchioness—excuse me, my Martianess as usual—and after some preliminary talk I was dumbfounded when she sent me the following message:

"Bud, will you marry me?"

I was so flabbergasted I couldn't stop to calculate how it happened that Leap Year

LEARN WIRELESS AT HOME

The Demand for Wireless Operators Far Exceeds the Supply

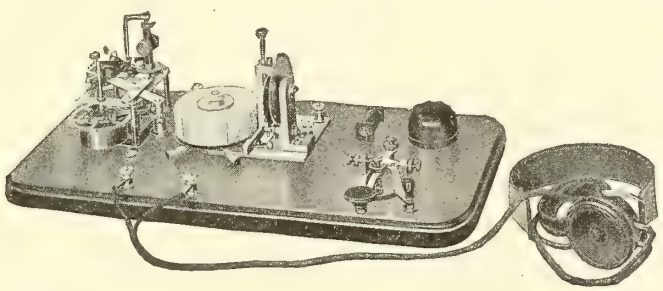
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, Chief Radio Inspector, Bureau of Navigation, N. Y. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way, will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free,* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do,* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* **This set is not loaned, but *given* to all students completing the Course.**

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph,* place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—*but do it today.*

NEW YORK WIRELESS INSTITUTE
Dept. 12, 258 Broadway
New York City

New York Wireless Institute
Dept. 12, 258 B'way, N. Y. City

Send me free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your *Free Instrument Offer.*

Name .....

Address .....

City or Town.....State.....

occurred on Mars at the same time as on the Earth, and I was so flurried that I answered "Yes" before I knew what I was doing. Then I rang off.....

Now, I don't know what to do. I am in an awful fix. Here I am pledged to a Martian girl 153 years old and weighing one thousand pounds. I haven't the faintest idea what she looks like. I may be engaged to a spider or a snake or something a hundred times worse, and I fear that any day she may drop down from heaven (?) and claim the fulfillment of my promise.

What can I do? If any of your readers can help me out of this muddle I shall be truly grateful.

(Down to the last few paragraphs we took Mr. Fezandié quite serious—the stuff read pretty smooth and logical. But right here we scratch our editorial heads and begin to wonder, wonder..... As a matter of fact we think he's been spoofing us (as our English friends say), or in plain American we have an idea he's trying to kid us. Of course, we won't stand for that, so we are sending his story right back to him!—EDITOR.)

Care of the Lead Plate Storage Battery

By JESSE J. HIPPLE

(Continued from page 286)

should be taken from the point that the hydrometer scales meet the lowest point of the convex surface of the confined liquid. (Fig. 2.) Most hydrometers are calibrated for a temperature of 70° Fahrenheit, and for extremely accurate readings the temperature should be taken into consideration and compensated for. This, however, is not necessary for ordinary work. The voltmeter is also a source of unfailing information as to the true condition of a battery and should be used in conjunction with the hydrometer. A battery is ready for recharging when the individual cells register a voltage of 1.75. Storage batteries should be watched constantly and some sort of a chart should be devised so that any radical change in performance can be noted and the trouble found before it ruins the entire set. **Vigilance is the price of service.**

DISEASES OF BATTERIES.

Battery diseases may be divided into three general classifications: (1) Sulfation, (2) Contamination, and (3) Loss of capacity.

Sulfation: Sulfation is caused by discharging a battery too low. A cell should never go below 1.75 volts. To correct sulfation, a battery that has been heavily sulfated should first be given a quick, heavy charge to loosen the sulfate and then the jar cleaned out and the battery discharged. After this the battery should be given a long, light charge until the hydrometer is up to the point required. Never allow a battery to stand discharged.

Contamination: There are many sources of contamination but the principal ones are (1) Iron, (2) Sea water, (3) Copper and (4) Mercury. All the above sources may be guarded against by cleanliness.

Loss of Capacity: Loss of capacity may be caused by overcharging, gasing, standing idle, contamination, short-circuits and many other things. The principal cause of short-circuits is wet battery tops, i. e., wet with acid, possibly from spray produced while charging.

LEARN DRAFTING
From Recognized Experts

Here's a big-pay profession in pressing need of more trained men. Mechanical and Electrical Draftsmen who have been properly trained, command high salaries everywhere and their services are always in demand. Come to School of Engineering of Milwaukee to learn this fascinating work. Learn by actual practice in big sun-lit drafting rooms under supervision of recognized experts. You work from actual models the same as you must do in industrial work. When out of school you can do practical work and assure yourself a brilliant future.

Earn While You Learn

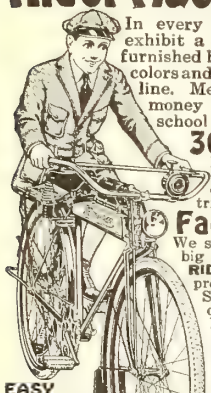
In six months to one year you can master this fascinating work. On the one-year plan, you can earn your way by devoting part time to a well-paying position we secure for you. Low tuition fee; dormitory and other special privileges.

Catalog Free

Write to-day for big illustrated book on drafting—telling all about the great opportunities in this field. Describes also this great school—America's greatest institution of electrical education. Explains our Earn While You Learn Plan. Send postal card or letter now.

School of Engineering of Milwaukee
Dept. B-17—373 Broadway
Milwaukee, Wisconsin

Rider Agents Wanted



In every neighborhood to ride and exhibit a sample RANGER bicycle furnished by us. Choice of **44 styles**, colors and sizes in the famous **Ranger** line. Mead Rider Agents make big money in spare time hours—after school or work.

30 Days Free Trial
Is allowed on every RANGER bicycle. We **prepay** freight charges. If not pleased the trial costs you nothing.

Factory-To-Rider
We sell bicycles made in our own big factories **DIRECT TO THE RIDER**—giving you a **superior** product at greatly reduced cost. Save time, money and trouble by dealing **direct** with our great Factory organization. Satisfaction in every detail guaranteed or money promptly refunded.

EASY Payments
Nine months to pay if desired — at a small advance over our special cash prices.

TIRES Lamps, Wheels, parts and supplies at half usual prices are also fully described and illustrated in the big **free** Ranger Catalog. **SEND NO MONEY,** but write us **today** for factory prices, liberal terms and if desired Rider Agents Plan.

MEAD CYCLE COMPANY
Dept. R.A.-107 Chicago

FREE TO PHOTOPLAY WRITERS

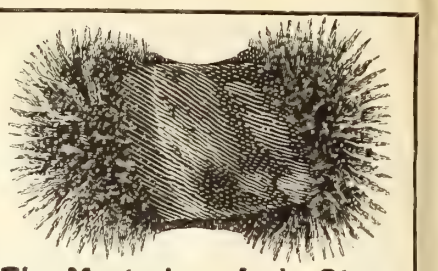
A wonderful book, illustrated with 100 potographs, of stars, directors, producers, scenes in the filming, studio interiors and exteriors. Literally takes you on tour of the great Motion Picture Studios.

It tells how Adrian Johnson, author of 300 produced photoplays by formulating a simple, practical, followable system of screen writing, has brought this fascinating profitable profession to your very door.

It is a system for persons of average intelligence. You need not be a "genius" to master it.

Send no money. Get this beautiful souvenir book today, for the asking.

The Adrian Johnson Photoplay System
111 American Theatre Building, New York, N. Y.



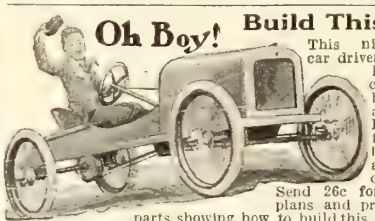
The Mysterious Lode Stone

Have you a cabinet of minerals? Are you interested in scientific or wireless experiments? In aviation — in the magneto, and its magnets? Would you like to solve the unsolved problem of perpetual motion? Would you like to make a Viking compass out of a Lode stone? Do you think you can find an insulation for its magnetism? (so far unfound).

Get a Lodestone!

The writer has a few very powerful imported stones for sale—prices ranging from $1 to $5 according to size, shape, beauty and power. Write today.

Eugene S. Todd
113 FULTON STREET NEW YORK



Oh Boy! Build This Car.

This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 26c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO., 156 Sypher Bldg., Toledo, Ohio

Fun, Magic and Mystery!

56 Feats in Magic, 250 New Jokes, 21 Puzzles, 1 Fortune Telling Tablet, 52 Money-Making Secrets, 15 Card Tricks, 71 Toasts, 58 Verses in Comic Poetry, 10 Funny Readings, 41 Epitaphs, and 11 Parlor Pastimes. You get all the above-mentioned and our big illustrated Catalog of 125 Magic Tricks for only 10 cents. Write today.

DETROIT TRICK & NOVELTY CO.
454-456 Dix Avenue Detroit, Mich.

SELENIUM CELLS

Made by entirely new process. Highly sensitive and quick-acting. Suitable for all experiments. From $5 up.

Write for Catalog

Selenium Laboratories
Good Ground, Long Island, N. Y.

Become an Electrical Expert

Let a consulting engineer train you. You can earn

$65 to $125 a week

My Home Study Course is considered one of the best practical courses of its kind. Write

H. K. BLATCHLEY, Consulting Engineer
Box 1477 New Haven, Conn.

Learn to Dance!



You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful **Peak System of Mail Instruction.**

New Diagram Method. Easily learned; no music needed: thousands taught successfully.

Write for Special Terms. Send *today* for FREE information and surprisingly low offer.

WILLIAM CHANDLER PEAK, M. B.
Room 249, 621 Crescent Place — Chicago, Ill.

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S., 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER OVERLAND, MO.

BATTERY TROUBLES AND REMEDIES.

When the level of the electrolyte in one cell chronically lowers faster than the others, look for a cracked or leaking jar. When found, cut the cell out of the battery and substitute new one, using the old plates and electrolyte.

When one cell tends to discharge faster than the others (shown by voltmeter or hydrometer readings), it should be cut out and examined for both external and internal short-circuits.

External short-circuits are caused by acid wet tops and internal short-circuits may be caused by an *accumulation of sulfate in the bottom of the jar* (see Fig. 4-A), punctured separators, fallen plates or contamination. It is obvious what should be done should any of the above conditions exist.

If a battery will not deliver current and the individual cells show up well in voltage and gravity, the lugs and connectors should be examined for a break. If one is found it may be easily mended by burning on a new part with a small alcohol torch and a blow pipe.

If a battery takes a full charge but does not hold it, look over it for short circuits or sulfation. A remedy for both these conditions has been given in the earlier part of this article.

The above will also apply to batteries that will not take a charge. That is, it is caused by either short-circuiting or a broken connection.

CHARGING

When a new battery is assembled it is given a full charge and then discharged. It is then charged again up to its full capacity and put into service. To charge after that, the following rules should be followed. First be sure that the *positive terminal of the charging circuit connects with the positive pole of the battery* and that the negative pole of the battery connects with the negative terminal of the charging circuit. The polarity of a circuit may be found by holding the two wires in salt water. The wire on which the most bubbles collect is the negative terminal. Remove the filler plugs and the battery cover. Most batteries contain the charging voltage and rate on the name plate. This should be followed closely in most cases. For general practise, however, the following is a safe rule: For a six-volt, 60 A. H. battery, the charge should start at about 7 or 8 volts and 15 amperes. This charge should continue until the batteries begin to "boil," or in other words until the gas generated comes off in fairly large quantities. When this stage is reached the amperage should be cut down to about 5 amps and the charging allowed to continue until the cells begin to gas again. Record should be kept every hour of the gravity and temperature during the charge so that when the battery registers full density and voltage, the charge may be continued for another hour and stopped. The cells should be guarded from overheating and when the temperature rises to 125° Fahr., the charging rate should be reduced or the charge stopt until the temperature reduces. A convenient way to charge is to give a battery an hour's charge at about twenty amps and then allow the charge to continue at five amps until finished. This is more convenient, but it takes a longer time and is not as efficient as that method where all stages are carefully watched. **Keep an open flame away from a charging battery because the gases generated include Hydrogen and Oxygen in their most explosive proportions.**

When transferring a charged set of plates from one jar to another they should be placed in a jar of distilled water until their new jar is ready for their reception. In no case allow them to be exposed to the air for any length of time.



It takes but a moment—to mark the career of your choice, sign your name, clip out and mail.

Yet that simple act has started more than two million men and women toward success.

In city, town and country all over the world men are living contented lives in happy, prosperous homes—because they clipped this coupon.

In every line of business and industry, in shops, stores, offices, factories, in mines and on railroads, men are holding important positions and receiving splendid salaries—because they clipped this coupon.

Clerks have become sales, advertising and business managers, mechanics have become foremen, superintendents and engineers, carpenters have become architects and contractors, men and boys have risen from nothing at all to places of responsibility—because they clipped this coupon.

You have seen it in almost every magazine you have looked at for years. And while you have been passing it by more than ten thousand men and women each month have been making it the first stepping stone to real success in life.

Will you still turn away from opportunity? Can you still go on, putting in your days at the same grind, getting the same pay envelope with the same insufficient sum, trying to keep up the constant fight against a soaring cost of living, when such a little thing can be the means of changing your whole life?

You *can* have the position you want in the work you like best, a salary that will give you and your family the home, the comforts, the little luxuries you would like them to have. No matter what your age, your occupation, your education, or your means—you can do it!

All we ask is the chance to prove it. That's fair, isn't it? Then mark and mail this coupon. There's no obligation and not a penny of cost. It's a little thing that takes but a moment, but it's the most important thing you can do today. Do it now!

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6240, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

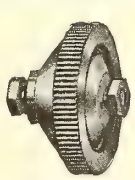
☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Car Running	☐ Outdoor Sign Painter
☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ BOOKKEEPER
☐ Mechanical Draftsman	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Ship Draftsman	☐ Traffic Management
☐ Machine Shop Practice	☐ Commercial Law
☐ Gas Engineer	☐ GOOD ENGLISH
☐ CIVIL ENGINEER	☐ Common School Subjects
☐ Surveying and Mapping	☐ CIVIL SERVICE
☐ MINE FOREM'N OR ENG'R	☐ Railway Mail Clerk
☐ ARCHITECT	☐ STATIONARY ENGINEER
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____



PIN $1 to this coupon

Write your name and address plainly, mail us both, and by return mail you will receive your

SKINDERVIKEN

Transmitter Button

Electro Importing Co., 231 Fulton St., New York.

Gentlemen:—Enclosed please find One Dollar. Ship *at once* one Skinderviken Transmitter Button to

Name .....

Address .....



"You'll Have to Have An *Auto-Wheel* to Keep Up."

It's the coaster wagon that real fellows have. Genuine Roller-Bearings make the ride smoother. The **Auto-Wheel** glides up to the finish line—leading all the others. Has steel tires and axles and a low racing body. **Auto-Wheel** wagons are well built. Not just rattle-traps, but high-grade, substantial, heavy-duty wagons. Carry 1,000 pounds. Material carefully selected, put together right.



Two Models—Take Your Pick.

Auto-Wheel Coaster—the old standard and stand-by. Just as good for coasting as for hauling.



Auto-Wheel Convertible Roadster is the newest thing in wagons. Sides can fold up or down (on durable pivots.) If you want a roadster just swing sides up. For errand wagon fold sides down to form box-wagon.



***Auto-Wheel* Owners Are Club Members.**

Write for details. Send names of three coaster dealers, mentioning which ones carry the **Auto-Wheel**. We'll put you on the mailing list of **Auto-Wheel** "*Spokesman*" Tells about our big PRIZE CONTESTS.

The Buffalo Sled Co.,
163 Schenck St., N. Tonawanda, N.Y
In Canada: Preston, Ont.

Electrical Engineering men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete

In One Year



Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 28th year opens Sept. 29, 1920
BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.



Send for a Complete Catalog of
MASONIC BOOKS
Jewelry and Goods
REDDING & CO.
Publishers and Manufacturers
Dept. 5 200 Fifth Avenue, N. Y.

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to quality. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.
AMERICAN SCHOOL OF AVIATION
DEPT 774B. 431 So. Dearborn St., CHICAGO



PIGEONS PAY

They build their own nests and work for you 11 months in the year. A few good pair of pigeons now will bring you a good sized, profitable squab farm next season.
Write today for circular.
PIGEON SUPPLY HOUSE. P.O. Box 251. Hanover. Pa.

"The Ellis Music Master Reproducer"
made for all phonographs. Pleases the most exacting music lover. Eliminates twang. Perfect harmony of accompaniments, individuality of artists, voices and instruments reproduced from records in life like reanimation. It sells on its merits. Send 10c for booklets E, "Hints to Music Lovers" and "Music Masters." Agents wanted
J. H. ELLIS, P. O. Box 882, Milwaukee, Wisconsin

An Efficient Primary Battery

By W. S. STANDIFORD

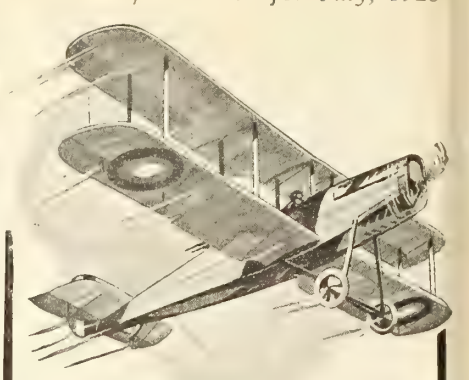
(*Continued from page 289*)

the binding post on the cover; bore a hole alongside of it to fit the copper wire, scrape the insulation off end of wire and twist the latter around the tang of the binding post, screwing the base of the latter down on it tightly. Allow enough insulation to remain on the wire after it passes through the board so as to extend to 2 inches below the top of the porous cup. Remove the rest of insulation from wire and brighten the latter with emery cloth. Coil the wire around the porous cup, but keep it closely touching the inside surface of glass jar, and as far away as possible from the side of the porous cup. If desired, the wire (with its insulation left on except the part under the binding post) can be extended straight down to the bottom of the jar, the end to have the insulation scraped off, brightened with emery cloth and twisted in a single loop around the porous cup, it being away from the latter's side, as previously described. Either method of wire arrangement is good. On the bottom of the coke spread a layer of copper sulfate crystals; don't put them against the sides of porous cup, but have some pieces of coke next to it. On top of the sulfate and wire loop put a layer of coke. Continue the process, alternating copper sulfate crystals and coke until the mass is within one inch of the top of the porous cup. Fill the space around the zinc in porous cup with coke, the latter pieces to be the same size as those in the outer jar and also at the same height.

Next pour water into both the porous pot and outer jar until it is on a level with the coke, or one inch below the top of the porous pot. Connect the two binding posts together by a wire until a current flows, then disconnect them and the battery is ready for use. It will be found that, unlike the regular pattern of Daniell cell, the zinc in this battery will keep free from copper when it is left on open-circuit, and when used on a closed circuit the zinc keeps very clean. The pieces of coke in the outer jar soon become coated with copper, and owing to the large surface exposed, the resistance is lowered, which allows a larger current to flow. The voltage of this cell is over 1 volt. To charge a storage battery it is best to use 4 cells connected in series, that is connect the outer jar binding post of one battery to the zinc of another cell, repeating this until all of the cells are connected together, then connect the terminals of the end cells to the storage battery. Connected thus, in series four of the new type of Daniell cells gives about 4¼ volts. In charging a storage battery it is best to have a sufficient number of primary cells so as to give double the voltage of the storage battery; this makes the charging chemicals in the former last longer and the primary batteries keep in better condition than when they are worked to their full capacity.

Editor's Note.

The second illustration shows a cell which is recommended by the editor. It will be noted that instead of the copper wire a copper netting is used, and instead of a zinc pencil, a zinc cylinder. This arrangement gives about ten times the amperage of the former, due to the large opposing surfaces. This battery is exactly the same as the one described by Mr. Standiford. The advantage of this battery is that due to the large surfaces used, the ampere hours capacity of the battery is very much larger.



Build and Fly A
Model Aeroplane
This Summer!

Build a real, flying model of any of the famous Aeroplanes listed below. IDEAL Scale Drawings and Building and Flying Instructions show how you can build 3-ft. models of real 'planes.
Send now for drawings and instructions for the one you want to build.

Curtiss JN4D-2 Training 'Plane (Just Out)
NC-4 Naval Seaplane
DeHavilland Battle 'plane
35c EACH POSTPAID
Curtiss Military Tractor
Bleriot Monoplane
Nieuport Monoplane
Taube Monoplane

Catalogue of IDEAL Model Aeroplanes and Supplies 5c, if you write at once; regular price 10c

Ideal Airplane & Supply Company
Making Model Aeroplanes since 1911
159-161 Wooster St., Cor. West Houston St. New York City

What 15 Cents Will bring You From the Nation's Capital

The little matter of **15 cts.** in stamps or coin will bring you the Pathfinder **13** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for the Nation; a paper that prints all the news of the world and tells the truth and only the truth; now in its **27th** year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, briefly—here it is. Send **15c** to show that you might like such a paper, and we will send the Pathfinder on probation 13 weeks. The 15c does not repay us, but we are glad to invest in new friends.

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, Box 976, Washington, D. C.



"BOW LEGS and KNOCK-KNEES" UNSIGHTLY
Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.
PERFECT SALES CO.
149 N. Mayfield Ave., Dept. 50, Chicago, Ill.



YOU Can Double Your Ability to Earn Money! Hold Friends! Win Love and Happiness! Our System of Personal Efficiency tells you **how!** Success Studygram and Personality Sketch for 10c and birth date. Thomson-Heywood Company, Dept. 350, Chronicle Building, San Francisco.

STAMMER

If you stammer attend no stammering school till you get my big new FREE book and special rate. Largest and most successful school in the world curing all forms of defective speech by advanced natural method. Write today
North-Western School for Stammerers, Inc., 2331 Grand Ave., Milwaukee, Wis.

ALL THE PARTS AND PLANS



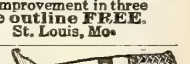
HERE BOYS
75cts. (No stamps.) Cloth wings, any color, 2 hours FUN making it. Flies 75 feet. Airplane Circulet 4 cts. (stamps) shows 7 other models. Money back if not satisfied.
NIFTY NOVELTY & TOY CO.
Mail Order Dept., Newark, N. J.

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**

BE AN EXPERT
Penman
Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. **Complete outline FREE.**
Write C. J. Ozment, Dept. 44, St. Louis, Mo.

AUTOMATIC FIBRE LIMBS



Easy Payments—Do Nature's Work. **AGENTS WANTED** who wear leg. Good Pay. FREE Fibre Sample.
Describe Stump to
WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.

Nature's Jewels

By WILLIAM M. BUTTERFIELD

(*Continued from page* 258)

Among such masses on the earth the size of the crystals range from a minute speck, hardly visible under the microscope, to huge prisms nine feet across and four hundred feet high. The shapes are almost incalculable in the number of their variations. But there are only about seventy-two elements, each of which form its separate family design, as of course there is only about this number of primary shapes. Some kinds are formed under enormous pressure, as the diamond beneath the earth's surface; some harden slowly like basalt; others form quickly like ice. All are produced by a common mechanical process in which the loss of heat in a liquid is the principal cause.

Heat in various degrees required for making the transformation causes every known mineral substance to assume at least two forms, a liquid and a solid, not to mention a third form (gas or vapor) which all mineral substances are at some period compelled to take, but which does not usually enter into the process of crystallization. These three forms of matter, as all the combined substances of the earth are called, are seen in panoramic splendor in the sky, or in the oceans and fresh water bodies that form nearly four-fifths of the earth's surface.

It will be interesting to examine these in order that we may better understand how force, such as heat, gravitation, cohesion and such agents in mass are called, act upon matter. The blue of the sky, the ever-changing clouds, the mists, fogs and dews illustrate for us different densities of water vapor. We have all observed vapor in the act of forming; we have seen it change into the various stages under the heat of the sun, and we understand from these common observations that heat can and will convert water into vapor. Water, therefore, in its rarest form (as we see it in the blue vapor gas of the atmosphere) presents to us an understandable example of matter in a gaseous form.

Commencing with this gas, nature reduces in gradual stages the high degree of heat that is responsible for it, and soon we see a series of reverse changes. First, light, fleecy clouds; then thick, heavy, black masses; and finally a fall of rain. Having reached this stage we see water as a liquid, the form we best know. But with still lessening degrees of heat we shall see water form into ice which is the third or solid form.

One is always surprised at these changes, and it never seems possible that water can be converted first in one direction and then in an entirely different one without being destroyed. Let us review this interesting part of the story and observe the simple mechanical movements that cause the changes and preserve water from destruction.

Water is a compound formed of two elements—hydrogen and oxygen and each element is composed of countless invisible and extremely minute particles called *atoms*. These atoms are indestructible and are always separated from each other by a kind of matter called *ether*. Each atom, according to its kind, is supplied with two or more attracting poles that somehow attract atoms to each other. Therefore, the tendency of all atoms of the same element is to fly towards the others, thus forming as compact a mass as the forces which control them will allow. In compounds, such as water, the atoms of one element have what is called an affinity for those of another, and form compound particles called

The foreman says



"I suppose it's because I used them myself when I was at the bench, but it does seem as though the best men in the shop have a preference for Starrett Tools.

"Of course, most of them sort of got into the habit of relying on Starrett for fine work when they were apprentices and journeymen.

"Speaking of apprentices — that little red book there, 'The Starrett Book for Machinists' Apprentices,' has saved me more time and helped more young fellows to learn how to do things right than anything else in the shop.

"When a young lad asks me how to do this or that, I usually tell him or show him, and then ask him if he has one of those books. I've noticed that as soon as he gets one of them he doesn't have half so many questions to ask.

"Starrett gets out another book, 'The Machinists' Data Book,' that's just about as big a help to the experienced machinist. It's got all the tables and formulas and so on that he ever needs, and it isn't cluttered up with a lot of engineers' stuff that he doesn't use.

"Yes, I bought one of each of the books down at the hardware store, as soon as they came out. They cost me seventy-five cents each, but they're worth it."

The L. S. STARRETT COMPANY

THE WORLD'S GREATEST TOOLMAKERS

Manufacturers of Hack Saws Unexcelled

ATHOL, MASS.

Starrett Tools



Machinists the world over have put their faith in the accuracy of Starrett Tools for thirty-nine years. Write for illustrated Catalog No. 21 "I.E"

42-989

NEW MOTORS

FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle 1800 R. P. M. with pulley

1/4	H. P., 110 volts, induction, full load start	$28.50
1/2	H. P., 110-220 volts, induction, full load start	$38.50
1/2	H. P., 110-220 volts, repulsion, for compressor	$52.50
1	H. P., 110-220 volts, repulsion, with sliding base	$76.50
2	H. P., 110-220 volts, repulsion, sliding base	$116.50
3	H. P., 110-220 volts, repulsion, sliding base	$142.50
5	H. P., 110-220 volts, repulsion, sliding base	$184.50

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

6 volts, 10 amp.	$19.50
15 volts, 10 amp.	$24.50
40 volts, 6 amp.	$31.50
110 v, 2½ amp.	$31.50
110 volts, 5 amp.	$46.50
40 volts, 30 amp.	$78.50
110 volts, 18 amp.	$106.50
110 volts, 26 amp.	$146.50
Moving Picture Arc Generator 60 v., 35 a.	$106.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., complete with base and pulley.

½ H. P.	$46.50
1 H. P.	$64.00
2 H. P.	$81.00
3 H. P.	$96.00
5 H. P.	$112.00
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only	$36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase. Voltage as specified.

110-220 v., A.C., 150 watts, 15 v., with switchboard	$68.50
110-220 v., A.C., 150 watts, 30 v., with switchboard	$68.50
110-220 v., A.C., 175 watts, 24 volts, with switchboard	$68.50
110-220 v., A.C., 250 watts, 36 volts, with switchboard	$88.50
220 volts, 2 phase, 600 watts, 24 v., without switchboard	$75.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL 1/4 H.P. 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley

WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $22.75 Each Reg. Val. $32.50

MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 12, West End, Pittsburgh, Pa.



"Here's Where We Got Our Start"

"Look, Nell—this coupon! Remember the night you urged me to send it in to Scranton? Then how happy we were when I came home with the news of my first promotion? We owe it all, Nell, my place as Manager, our home, our comforts—to this coupon."

Thousands upon thousands of men now know the joy of happy, prosperous homes because they let the International Correspondence Schools prepare them in their spare time for bigger work. You will find them in city, town and country—in office, factory, shop, store, mine and mill, on farms and on railroads.

There are clerks who became Advertising Managers, Salesmen and Executives; carpenters who became Architects and Contractors; mechanics who became Engineers and Electrical Experts; men and boys who rose from nothing at all to splendid responsible positions.

More than a million men and women in the last 29 years have advanced themselves in position and salary through I. C. S. help. More than 100,000 are studying right now. You can join them and get in line for promotion.

The first step to success in the I. C. S. way is to choose your career from this list and mark and mail this coupon here and now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6241, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER
☐ Electrician
☐ Electric Wiring
☐ Electric Lighting
☐ Electric Car Running
☐ Heavy Electric Traction
☐ Electrical Draftsman
☐ Electric Machine Designer
☐ Telegraph Expert
☐ Practical Telephony
☐ MECHANICAL ENGINEER
☐ Mechanical Draftsman
☐ Ship Draftsman
☐ Machine Shop Practice
☐ Toolmaker
☐ Gas Engineer
☐ CIVIL ENGINEER
☐ Surveying and Mapping
☐ MINE FOREM'N OR ENG'R
☐ ARCHITECT
☐ Architectural Draftsman
☐ PLUMBING AND HEATING
☐ Sheet Metal Worker
☐ Navigator
☐ CHEMICAL ENGINEER
☐ SALESMANSHIP
☐ ADVERTISING MAN
☐ Window Trimmer
☐ Show Card Writer
☐ Outdoor Sign Painter
☐ RAILROADER
☐ ILLUSTRATOR
☐ DESIGNER
☐ BUSINESS MANAGEMENT
☐ Private Secretary
☐ BOOKKEEPER
☐ Stenographer and Typist
☐ Cert. Pub. Accountant
☐ Traffic Management
☐ Commercial Law
☐ GOOD ENGLISH
☐ STATIONARY ENGINEER
☐ CIVIL SERVICE
☐ Railway Mail Clerk
☐ Textile Overseer or Supt.
☐ AGRICULTURE
☐ Poultry Raising
☐ Automobiles
☐ Spanish
☐ French
☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

Discover Your Talents!

Why is it that some men make a success of everything they touch while others work their lives out, and remain failures?

Why is it that some climb to the heights with little effort while others plod along for a lifetime in the same old rut?

It's not luck, nor pull—it's knowing how to direct your energies most effectively. It's discovering where your talents lie, and putting all your efforts along the lines where you **can** succeed.

Don't struggle along any longer, **against your own personality.**

Let Dr. S. S. George, the eminent psychologist and former U. S. Army expert, help you discover your talents. Dr. George has made his lifework the analysis of men's abilities.

His mental and vocational analysis course with 1,500 vocations classified, will be mailed to you on approval. Don't wait a single day. Get in touch with your abilities. This service may be worth thousands of dollars and invaluable happiness to you. Send only $3.00 for complete course and lists.

MONEY REFUNDED IF NOT SATISFIED

At the end of 5 days, if you are not completely satisfied, we will refund your money in full.

Vocational Guidance Institute, 2255 Broadway, N. Y.

molecules. The molecules of water are composed of two atoms of hydrogen and one of oxygen.

This, in brief, is a description of the structure of water. Now, if in our imagination we place the molecules apart or cause them to come together just as we actually can a cupful of small pebbles, we may form a mental picture of the mechanical movements that are responsible for the different degrees of density of substances, causing the three forms of water. These bodies are the furthest apart as vapor gas, semi-distant as water and nearest when it has been converted into ice. One can also see clearly that these movements can go on forever without destroying water.

Because water has proven such a convenient substance for illustration, let us go a little farther with it. We have seen that compound liquids have molecules composed of atoms of its different elements. These molecules can be destroyed by the atoms separating of their own will or energy; that is, they appear to have an action more resembling vital force than a mere mechanical or automatic movement, but only noticeable at the time liquids freeze or turn into solids the time when atoms are close together.

It is at this time that nature constructs her crystals, and it is in the construction of these forms that the atoms show their peculiar powers. So far as we are able to learn from observation, they are all formed in the same way and all appear, when observation is possible, to be endowed with constructive powers. By this we mean that the billions of individuals of any one of the seventy-two or more elements will, under like conditions, develop shapes that are taken only by members of their family. This constructive power in each form is entirely the product of the mechanically controlled atoms of the element.

In a compound, when freezing, the atoms in the molecules are made to lose their affinity for each other and fall apart, thus destroying the molecules. Then the atoms of each element fly to its kind to arrange themselves in the order necessary to form their family crystals, and this change is remarkable for these bodies do not exist in a separate state in liquid or in gas. We can see the effects of these independent movements if we examine crystal formation under a lens. In the orderly development of the forms, growths show the mathematical exactness with which each atom attaches itself in, what would seem, its self-appointed position. It is in this manner that the elements of a compound develop their independently formed crystals. In the next process there are two, the dry and the wet. These forms feed, as it is called, from the liquid; that is, the atoms continue to attach themselves, thus forming large or small crystals.

Living stone is not an idle thought, for many stones or other solids grow in the manner we have described. The crystals show various other indications of that mysterious something which we are pleased to call vital force or life. They are influenced by geographical location, for instance, and to such an extent that experts can tell, by certain locally influenced development in members of a single element, the locality in which they were created. Vibration, concussion, galvanic or electrical currents, not to mention heat in various degrees, have their share of influence also. Then they show many characteristics that are usually thought to be only the rightful possession of the highly developed animal and plant. Some are peaceful, unassuming, defenseless; others are warlike, thus eating into, bending or entirely destroying the growth of others; then there is the obnoxious parasite, living at the expense of its host.

But we have seen that the crystal, a mere product of atoms, is not really endowed



The Electric Safety razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."

A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.

Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

VIBRATING ELECTRIC RAZOR CO.
729-31 West Broadway, Council Bluffs, Iowa



Navigation
Taught by Mail

Be a ship officer in merchant marine—earn big money — see the world. Captain Warren Sheppard's Course on Ocean, Coast and Lakes Navigation ready. Officially adopted by the U. S. Navy. Endorsed by Merchant Marine. Merchant ship officers earn up to

$412 per month and expenses

Whether you are on the sea or intend to go, enroll now. Send today for valuable illustrated booklet, "Your Future is on the Seven Seas." It is free.

WORLD TECHNICAL INSTITUTE
Dept. "E", Fuller Building, Jersey City, N. J.

Charge Storage Batteries
For Convenience or Profit

From any alternating current lamp socket with the Cambridge Rectifier. For home or garage use. As simple as turning on a lamp and fully guaranteed.

Quickly saves its cost and doubles the life of your battery. Always ready when you want it. Rectifier Bulletin R sent on request.



Bulletin Y of Wireless Telegraph Apparatus sent for 3 cent stamp.

Clapp-Eastham Co.
131 Main St.
Cambridge, Mass.

The Cambridge Battery Charger, Price **$25**

TELEGRAPHY

Both wire and wireless, and Station Agency taught thoroughly and quickly. BIG WAGES NOW PAID, some of our recent graduates procuring $138.00 per month to start. Great opportunities for advancement. Our school the oldest and largest—annual enrollment 600 students. Endorsed by railway, telegraph, wireless and government officials. Expenses low—chance to earn part. Catalog free. Write.

DODGE INSTITUTE, 22nd St., Valparaiso, Ind.



"Lighting Fixtures"
Ready to Hang

(Direct from Manufacturers)

Completely wired, including glassware. New designs.

Send for catalogue No. 18

ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

An HOUR a DAY
MAKE YOUR SPARE TIME PAY!

Take subscriptions for ELECTRICAL EXPERIMENTER. It's easy—every electrical man wants ELECTRICAL EXPERIMENTER —and we'll pay you well. Write now to

Subscription Department
ELECTRICAL EXPERIMENTER, 233 Fulton St., N. Y.

with independent action, and that which it seems to do voluntarily is really the result of atoms performing their functions. We have followed the course of atomic movement from the formation by these bodies of vapor-gas, of water and from water to the formation of crystals. Let us now go a step farther.

We will take ice as an illustration of the method of solids forming from the individual crystal. Water is a mineral species and its crystals are hexagonal or six-sided; these form into compound stellate or star-shaped forms. Ice is transparent owing to the close contact of the crystals which compose it; this makes the individual crystals blend so as to render the mass optically as well as mechanically continuous. Looking at a piece of ice, therefore, we do not see the crystals, altho we CAN see the stellate compounds at the moment the ice starts to freeze quite plainly. A block of ice may be described as growing from a single stone, thus the atom attracting other atoms and developing a hexagonal crystal; this crystal forming with others a stellate form and the stellate form building with others the block of ice.

If the reader will glance at our chart of drawings he will obtain a fairly comprehensive idea of crystal shapes. In the upper left-hand corner, Fig. 8, are six snow crystals showing compound forms somewhat like the ice crystal spoken of above.

All of the various elementary forms are divided by certain mechanical influences into three common kinds of growth, the needle or hair varieties (Figs. 9, 10, 11, 15) or a filamentous arrangement of the stones; the prismatic or knotted varieties, of which many forms resemble the polished jewels of man; and the flat or leaf kinds, illustrated by the scale-like crystals of mica (Figs. 8, 12, 13, 18).

The sharp edges of these geometrical forms, their high finish and brilliantly smooth surfaces, together with their machine-made appearance, make crystals always seem as tho a product of some human creative genius rather than the work of nature. When one observes growing crystals as one may in salt, borax or sugar solutions, the exhibition of Nature's jewel building is made doubly interesting by knowing something of the methods that are used. The interest in a diamond is increased when one knows that it is formed in the manner we have described and not cheapened by knowing that rock crystal, glass or ice is formed in much the same way. Altho there are many solids, combinations of particles or invisible grains recreated by Nature or by man, the original materials of which they are composed was made from liquids in the form of crystals. And all can, like ice, be reconverted into liquid or gas to undergo a common readjustment which the Creator has provided.

EDISON MEDAL PRESENTATION.

The annual meeting of the American Institute of Electrical Engineers was held in New York in the Auditorium of the Engineering Societies Building on May 21, 1920, at 8:30 P. M.

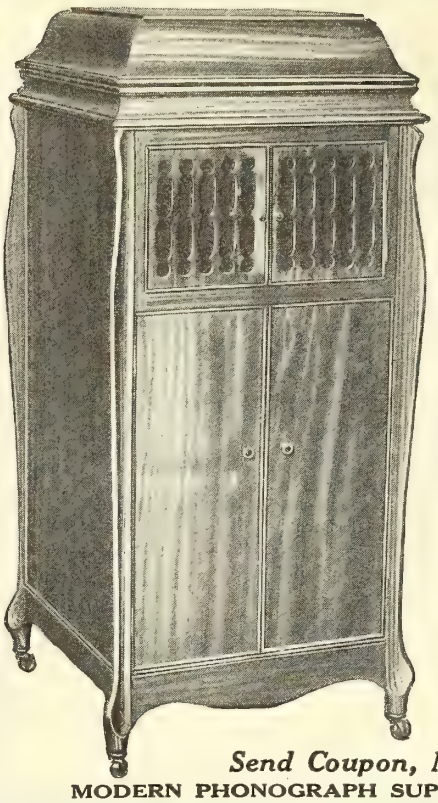
On this occasion the Edison Medal was presented to Mr. W. L. R. Emmet "for Inventions and Developments of Electrical Apparatus and Prime Movers" in accordance with the award of the Edison Medal Committee of the Institute.

The program for the Edison Medal presentation included: 1, The Edison Medal, by Carl Hering, Chairman Edison Medal Committee; 2, Achievements of W. L. R. Emmet, by H. W. Buck; 3, Presentation of the Medal, by Calvert Townley, President A. I. E. E.; 4, Response, by W. L. R. Emmet.

Non-members of the Institute including ladies were cordially invited to attend this meeting.

YOU can *Easily* BUILD This PHONOGRAPH

TREMENDOUS SAVING IN COST



You don't need to be a cabinet maker. We have made it an easy and a pleasant job with

Our Simplified Plans We furnish blue prints, diagrams, motor, ready-built horn, cabinet pieces and all metal parts complete. You do the assembling, **6 models to choose from.** A few hours' work, and you will have as fine a type of phonograph as any produced, and at a price away below what you would pay in a store.

KEEP THE SAVINGS IN YOUR POCKET

Machines play all records, have a wonderful tonal quality, excelled by none. No need now for any family to be without a phonograph because of the cost. THE MAKAFONE solves the problem. BUILD IT YOURSELF AT LESS THAN ONE-FOURTH REGULAR COST, but equal to the high priced cabinet machines. Free Records with each outfit. SEND TODAY FOR FREE CATALOG and full particulars of our wonderful offer. *Many a manufacturer got his start in this way. Why not you? Build machines and sell to your friends.*

Agents Attention You can make and sell these machines from our plans at a profit of $50 to $75 each. Others are selling two and three a week. Here is your opportunity to make big money and become independent. Pleasant and profitable work.

Send Coupon, Now—To-day

MODERN PHONOGRAPH SUPPLY CO.
298 Springer Bldg., 313 So. Clinton St., Chicago.

Modern Phonograph Supply Co.
298 Springer Bldg.
313 So. Clinton St., Chicago, Ill.

Gentlemen: Please send me full particulars of your Makafone proposition, without obligation to me.

Name .....

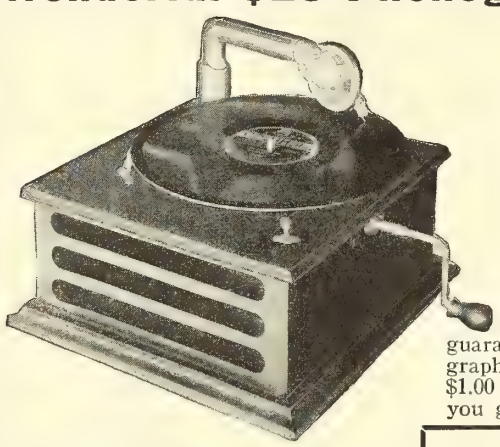
Address..... State.....

HEAR CARUSO IN YOUR HOME

Greatest Phonograph Bargain Ever Offered **Send $1 Only**

This is your opportunity to buy direct from the manufacturer

Wonderful $25 Phonograph for $10.98



Plays all Makes of Records
Any Size or Cut

Send $1 and Coupon

Extra loud, clear, sweet-toned sound box, silent, powerful spring motor, automatic regulator, starter and stopper. Cabinet finished in Colonial mahogany. The metal parts highly nickeled. Will last a life time and is fully guaranteed in every respect. Phonograph will be shipped upon receipt of $1.00; you pay the balance, $9.98, after you get the phonograph.

Plays Victor, Columbia, Edison and Emerson Records

Send $1.00 today

Columbia Sales Company

53 Academy St., Dept. 690, Newark, N. J.

CUT OUT AND MAIL AT ONCE.
COLUMBIA SALES COMPANY
53 Academy St., Dept. 690, Newark, N. J.

Gentlemen: Enclosed find $1. Ship at once one guaranteed phonograph. If satisfactory, I agree to pay the balance, $9.98, after I receive the machine. If not satisfactory I will return the same, and you will refund my money.

Name .....

Address .....

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.

Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. **Guaranteed by the maker.** Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness. Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope **just** as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.

EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.

"The 100% WIRELESS MAGAZINE"

RADIO NEWS now in its second year holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO NEWS leads all other wireless magazines. The July issue has 72 pages; there are seventy-four separate purely radio articles and 107 illustrations. *Over forty thousand copies were printed and circulated.*

20c
The Copy

$2.00
A Year

Canada and Foreign
$2.50 A Year



Each issue of RADIO NEWS contains 72 pages (or more) and an artistic cover in two colors. The illustrations average 120 every month and there are from 60 to 80 up-to-date articles, some by our greatest radio scientists, in every issue.

THIRD $100.00 RADIO PRIZE CONTEST

A new radio contest. The third one offering $100.00 in prizes began in our May issue.

For Full Particulars, See JULY Issue of

RADIO NEWS

Send 20c for Sample Copy Today

SPECIAL OFFER

Gentlemen:
Please enter my subscription for RADIO NEWS for the term of one year for which I enclose herewith $2.00. As a special offer you will also send me for 25c extra your great Wireless Course containing 160 pages, 350 illustrations, size 6¾ x 10" with fine flexible cloth cover. I have written my name and address in margin.

Here Are 3 Books You Should Have

Read This Special Offer



For a limited time we will send all three for only **50c** when included with a one-year subscription to ELECTRICAL EXPERIMENTER (Science & Invention). This offer is limited—it may be withdrawn at any time. Don't wait, get these books NOW and guarantee yourself twelve wonderful numbers of the "EXPERIMENTER."

Any amateur in the "wireless game" can easily construct a complete sending and receiving station, and will have his choice of many varieties after reading these wonderful books.

Remember, all three will be sent you postpaid just as soon as we receive your subscription and 50 cents toward the cost of the books.



How to Make Wireless Receiving Apparatus

A wonderful book for the man who would construct his own apparatus. Size 5¼ x 7½ inches. Containing 100 pages and 90 illustrations. Compiled of the writings of twenty-five Radio experts. Every amateur should have this book in his wireless room.

How to Make Wireless Sending Apparatus

In every detail equal to "How To Make Wireless Receiving Apparatus." Size 5¼ x 7½ inches. Containing 100 pages and 88 illustrations. Dealing at length on Quenched Spark Gaps, Rotary Gaps, and Oscillation Transformers.

EXPERIMENTER PUBLISHING CO., Inc.
Book Department
236 Fulton Street, New York City, N. Y.

Design and Construction of Audion Amplifying Transformers—Radio and Audio Frequency Type

by E. T. Jones, late Associate Editor of RADIO NEWS, a wonderful book—the only one of its kind in print—should be on the shelf within easy reach of every amateur. Every line of this book is written so that you can understand it. Every detail in the manufacture and construction of Audion Amplifying Transformers is described at great length. Never before have these instruments been described in print. They have always been considered strictly a "trade secret." The book contains many illustrations and diagrams that make it a simple matter to build the Transformers described.

EXPERIMENTER PUBLISHING CO., Inc.,
236 Fulton St., New York, N. Y.

Gentlemen:—You may send me the three books described in the "Experimenter" and enter my name for a year's subscription to the ELECTRICAL EXPERIMENTER MAGAZINE for which I enclose $3.50.

Name .....

Address .....



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

TELEPHOT.

(392) R. M. Thomson, of Foxton, Colo., has the following to say:

I beg to submit the following idea for seeing faces at a distance by electricity and would be pleased to have your opinion regarding it.

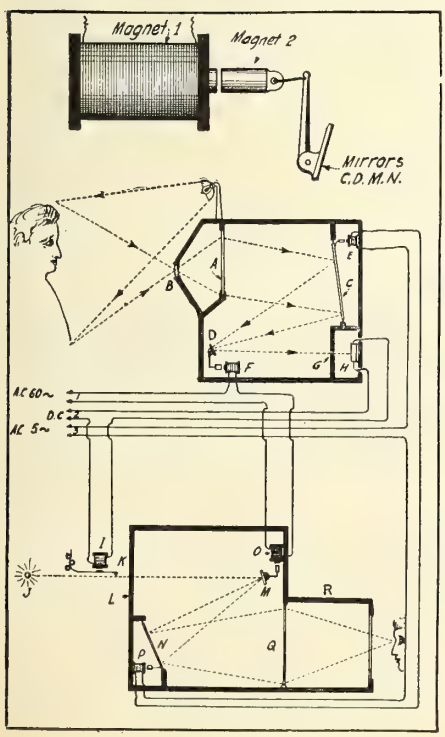
At the transmitting end the image is thrown on the ground glass plate (A) by the lens (B). From here it is reflected by the mirror (C) (whose reflecting surface is about one-sixteenth of an inch wide and five inches long) to D.

These mirrors (C, D, M, N) are vibrated as shown in the upper left-hand corner of the sketch. As like poles repel and unlike poles attract, the magnet (1), when energized by an alternating current, will vibrate magnet (2) with the same speed as the alternating current. E and P should have a current of about five cycles and F and O about sixty. C and N vibrate from left to right and D and N vibrate up and down. The idea of these vibrating mirrors is to send part of the picture over the wire at a time and to reproduce it at the receiving end so quickly that it appears as a complete picture to the eye.

The picture, now condensed into one ray of light, falls on the selenium cell (H) thru a pinhole (G) in the form of impulses which are sent over the wire to the magnet (1) at the receiving end. This magnet attracts K according to the electrical impulses and interrupts the light ray from J. The light ray then enters the dark box (L) thru a pinhole. Here it strikes the small vibrating mirror (M) which reflects it to N and to the ground glass plate (Q) in the same shape as on A.

The alternators for circuits 1 and 3 of course would not run exactly together so that the mirrors (C and D, M and N) would not cover the same surface of the picture in the first half of a cycle of circuit 3 than in the second half. The ground glass plate (Q) is shaded by a second box (R) to keep the interior of the main box dark.

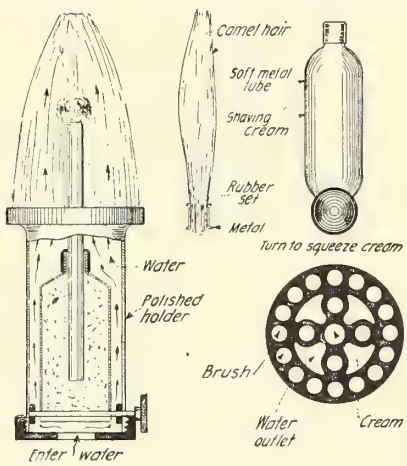
A. A very interesting idea, which might be developed into a working model. It looks feasible on paper and we thing a patent might be obtained on same. We would advise our correspondent, however, to build a model by all means first, as upon this everything hinges. We might say that while on the whole the idea looks new and original, the scheme of the vibrating mirror is not original, having been used some years ago by the Pole, Szecepanik, altho we do not know whether actual models had been built by him at the time.



SHAVING BRUSH.

(393) Geo. Hortig, Montreal, Canada, writes us: "Could you give me advice whether a patent can be secured on a shaving brush as per illustration. How is a patent secured and is there any money in marketing such an invention.

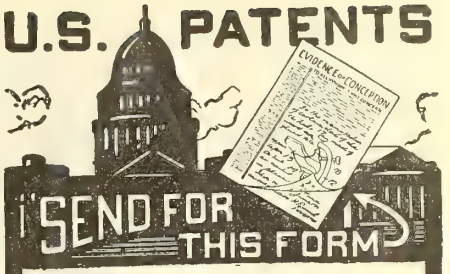
A. This seems to be a good idea, and we think it will fill an actual want. The combination of the shaving cream tube and the brush in connection with the automatic dispenser should make an instant hit with the average man who has to shave every day and who has not much time to fuss around. If the device can be manufactured cheaply, it should have a good demand. We would advise our correspondent to get in touch with a patent attorney.



AUTOMATIC DOOR OPENER.

(394) Robert Klaus, St. Louis, Mo., writes: I enclose several sketches for an automatic garage door opener for different types of doors, and the same plan could be used on many other types. I would like to have you tell me whether or not a patent could be secured on this."

U.S. PATENTS



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE ON CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

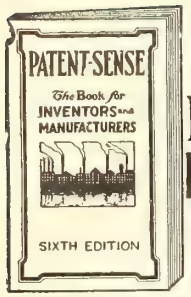
Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg.
Pittsburgh Offices: 514 Empire Bldg.
Philadelphia Offices: 135 S. Broad St.
San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... *Address*.....



"The Book for Inventors and Manufacturers"

SIXTH EDITION

By return mail FREE. Write LACEY & LACEY Dept K. Washington, D.C.



Get This Book !

Contains first hand, practical advice by an experienced inventor. NOT on how to get your inventions patented, but how to dispose of them after patented with the greatest advantage to you; what kind of agreements protect you; contracts and offers to avoid. Full of valuable pointers; every page one of interest and advice.

$1.50 will bring you a copy of THE INVENTOR'S MANUAL OF VALUABLE INFORMATION

G. E. Perry Company, Publishers
Dept. 20 1328 Broadway New York

PATENTS & TRADE-MARKS
—FREE BOOKLET ON REQUEST—
MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES —
WARNER I. CUBBERLEY, PATENT ATTORNEY
229 NATIONAL UNION BUILDING
WASHINGTON D.C.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?

Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.
1926 Broadway, New York

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.

OFFICES
364 University St. Montreal, Canada
919 F St., N. W. Washington, D. C.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.

MUNN & CO., 622 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 622 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

PATENTS C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

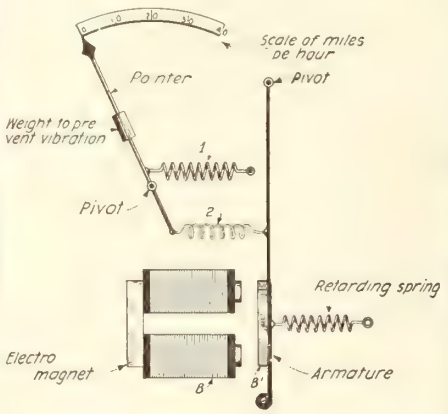
A. The scheme contained in this idea is a good one, and altho we think it is rather somewhat complicated, we believe that a patent can be obtained. How valuable such a patent would be we have no means of knowing. There is no doubt a demand for automatic door openers, particularly doors used on garages, but how big this demand is we have no means of knowing.

SPEEDOMETER.

(395) F. Kilgore, Largo, Fla., writes as follows: The invention which I will now describe is called an electric speedometer. Its chief use would be on automobiles. The electric current would be supplied by the storage battery of the car. For simplicity I will describe the part showing distance first.

At the front wheel of the auto is a circuit maker which completes the electric circuit three times for each revolution of the wheel. For different size wheels a different ratio would be employed so that the auto would travel four feet ahead for each completion of the circuit. In the circuit is an electromagnet located at the dashboard of the car. The armature of this would move up to the electromagnet every time the car moved four feet ahead. Attached to the armature is a ratchet which gradually revolves a cog wheel and shows the distance the auto has traveled.

As to the parts showing speed we will start again at the circuit breaker or maker. This keeps the current flowing for only 1/30 second no matter how fast or slow the auto is traveling. Such circuit breakers are reliable enough, being used in one of the best systems of auto ignition. Thus the amount of time the current is flowing is proportional to the speed of the car. And the amount of time the armature is in the B position (see illustration) is proportional to the same.



Springs 1 and 2 tend to contract, but spring 2 has the greater power when the armature is at B, thereby keeping pointer at zero. But when armature is at B, then No. 1 has greater power and pulls pointer around to 40. So the distance the pointer is moved to the right is proportional to the speed of the car.

Is this device patentable?

Is there any similar one already on the market?

Could it be manufactured cheaply enough to compete with other speedometers already on the market? It would possess two distinct advantages. First, there is no connecting chain which is the most troublesome part of the common speedometer; second, there are no permanent magnets to weaken and permit the speed readings to be low. The current consumed by properly made instrument would be low, about 2 amperes for 1/30 second from a 6 volt storage battery. A condenser could be added if necessary to prevent sparking.

A. The idea, while ingenious, is not new by any means. There have been on the market speedometers of this sort, and there are in use now some types that seem to be a good deal simpler, altho not embodying the exact features of the idea shown in the illustration. For that reason we are doubtful if a patent could be obtained on the device.

WIRELESS 'PHONES NEAR, SAYS MARCONI.

Guglielmo Marconi, the inventor of wireless telegraphy, recently said that the United States heads the list of all countries in wireless inventions.

"A strange phenomenon is that the most progressive countries of Western Europe have not yet developed wireless telephones, while China, the most backward nation, daily uses the wireless telephone for communication between the cities and the rural districts,' Signor Marconi stated.

"Within this year wireless telephones will displace the present clumsy system with great economic advantage, eliminating the cost of the telephone lines and their upkeep. They will also do away with the interruptions due to atmospheric causes."

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.
225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea Send for free sample copy. One year's subscription 50c.

BE AN EXPERT



Auto and Tractor Mechanic
Earn $100 to $400 a Month

Young man, are you mechanically inclined? Come to the Sweeney School. Learn to be an expert. I teach with tools not books. Do the work yourself, that's the secret of the

SWEENEY SYSTEM

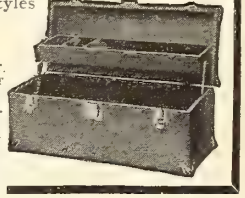
of practical training by which 5,000 soldiers were trained for U. S. Government and over 20,000 expert mechanics. Learn in a few weeks; no previous experience necessary.

FREE Write today for illustrated free catalog showing hundreds of pictures men working in new Million Dollar Trade School.

LEARN A TRADE Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
66 SWEENEY BLDG. KANSAS CITY, MO.

PERMANENT

It outlasts tools! Union Tool Chests are so strong and sturdy that they last for many, many years. Oak, with lock-cornered joints — Full nickeled hardware — Flush door pulls—Drawers that never stick. Built in 24 styles and sizes.



Write for Catalog, prices, and name of dealer. Sold on "Satisfaction or Money-Back" guarantee.

UNION TOOL CHEST CO., Inc.
36 Mill St. Rochester, N. Y.

UNION TOOL CHESTS

MEN Intensely interesting booklet free. Wonderful results. Winslow H. Chase, Washington, D. C.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

"I Would Not Part with it for $10,000"

So writes an enthusiastic, grateful customer. In like manner testify over 100,000 people who have worn it. Conserve your body and life *first.*



The Natural Body Brace

Overcomes **WEAKNESS** and **ORGANIC AILMENTS** of **WOMEN AND MEN.** Develops erect, graceful figure. Brings restful relief, comfort, ability to do things, health and strength.

For Children Also

Wear It 30 Days Free at Our Expense

Does away with the strain and pain of standing and walking; replaces and supports misplaced internal organs; reduces enlarged abdomen; straightens and strengthens the back; corrects stooping shoulders; develops lungs, chest and bust; relieves backache, curvatures, nervousness, ruptures, constipation. Comfortable and easy to wear.

Keep Yourself Fit

Write today for illustrated booklet, measurement blank, etc., and read our very liberal proposition.

HOWARD C. RASH, Pres. Natural Body Brace Co.
286 Rash Building SALINA, KANSAS



Are You Flat Chested? Are Your Lungs Weak? Do You Lack Vitality? Is Your Carriage Faulty?

If any of these conditions fit your case you urgently need my book.

CORRECT BREATHING and CHEST EXPANSION

Each one of these conditions can and should be remedied. My book will teach you how. Send for it now before you forget. **25c coin**

PROF. ANTHONY BARKER, D. C.
127 W. 42nd St., 3561 Barker Bldg., New York

Become a Specialist in Accountancy

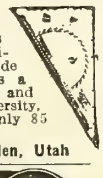
Write today for particulars of the most unusual course of its kind in existence. Learn how you may get a thorough training in this remarkably profitable profession and besides become a specialist in any branch you may elect. C. P. A. instructors of highest standing. **FREE BOOK** tells just what you want to know. Address—

International Accountants Society, Inc.
Dept. 721 2626 S. Michigan Ave. Chicago, Ill.

You can be a DRUGLESS PHYSICIAN

A well-paid profession is open to you. The field beckons to both men and women. Combined home study and college course. Heal without drugs. Free catalog. International College of Drugless Physicians, Dept. E.E.7 4200 Grand Blvd., Chicago.

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only 85 cents Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah

Learn the Sign-Show Card Business



Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.

EARN $25. TO $75. WEEKLY

You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.

DETROIT SCHOOL OF LETTERING, 687 D. S. L. Bldg. Detroit, Mich.

Learn Watch Repairing



Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates.

Ask for our Free Book. It explains our system and terms.

THE DeSELMS WATCH SCHOOL
720 Perry St., ATTICA, IND.

The T Tube "Sub" Locator

(*Continued from page 261*)

ment was also used while the ship was *under way,* which was known as the "K" Tube. This usually trailed out of the immediate vicinity of the ship's propeller and wake in such a way that any unusual or suspicious sound was heard by the listening operator, at which time he would communicate the fact to the commanders of the "sub" chasers, who in turn stopt the ship and then made use of the regular "T" device, as the "K" tube gave only very approximate and unreliable sound indications.

From Fig. 1 the exact position of the "T" Tube may be judged. While the ship was under way, the "T" Tubes could not be used of course and were drawn up to an aperture specially made on the bottom of the ship in such a position as to be quite close to the ship's bottom; in fact, in a sort of flush receptacle specially made for the purpose. This prevented the "T" Tube from coming into contact with any possible foreign projections or other missiles which might damage or tear away the apparatus.

"T" Tube Tells of Submarine Suicides.

In one of his recent discourses on the part played by the American Navy in hunting down Hun submarines off the English coast and in other localities, Admiral William S. Sims has romatically related some startling facts little known to the world outside of naval circles.

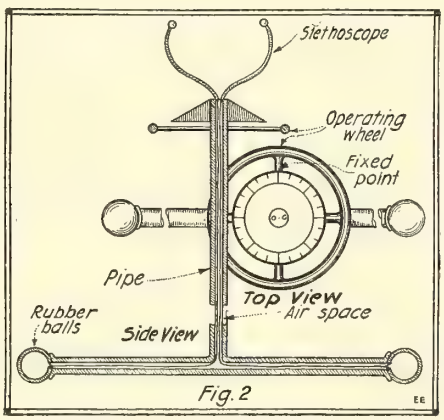


Fig. 2. Side and Top Views of "T Tubes"—Also Called "C Tube" By Naval Men,—In Which the Stethoscope Listening Tubes Lead Down thru a Pipe and Then Divide, One Going to Each Rubber Ball. The Rubber Balls Are Submerged In the Water and Are Very Sensitive to Any Sound Which May Be Transmitted to Them Thru the Water.

In one particular instance, and after a submarine had been chased after a considerable length of time, the closest watch failed to show any further movement of the enemy. Presently efforts could be detected by the ever listening "T" Tube operators on the part of the enemy crew to apparently effect repairs on the damaged U-boat, or else to try and get her propeller started; but after a few such attempts silence reigned again. But all at once a startling and unusual sound was heard by the listeners at the "T" Tube apparatus on the submarine chasers which were hovering in the vicinity where the German had submerged—it was nothing less than the sound of a revolver, and . . . before the listening sailors unglued their ears from the underwater sound detectors, they counted twenty-five shots. The answer was that that particular enemy sub-



THE HEART OF THE HAMMOND
Interchangeable Type

One of the Greatest Achievements of Science and Invention.

Hammond MULTIPLEX

"Many Typewriters In One"

For the Mathematician, Engineer, Chemist, Astronomer, Surveyor, Navigator—there is no typewriter like the Multiplex Hammond! The Multiplex does many things that *no other typewriter* can do!

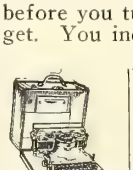
The Mathematical Multiplex contains the characters and signs used for writing in higher and lower mathematics, and for engineering, mechanics, etc., as well as for all the ordinary work that can be done on any typewriter. Just note these fine styles of Multiplex type—

TWO STYLES OF TYPE, or *two to five different languages,* carried on the machine AT ONCE. "JUST TURN THE KNOB" and change *instantly* from Roman Type, to *Italics,* or Miniature Roman, or our Beautiful Script Type, or from English to Greek, Russian, German, French, etc. *Any other type or language can be substituted in a few seconds.*

The above gives a slight idea of the versatility of the Multiplex which has literally revolutionized typewriting.

Mail the coupon for Booklet showing the many type sets and languages available on the Multiplex. The new Chinese Phonetic is now ready. The Multiplex is the only typewriter in the world on which you can write China's new national language and by turning the knob change instantly to English or any other language.

Fill out the Coupon and mail to us *now*—before you turn this page and possibly forget. You incur no obligation.



Also—an Aluminum PORTABLE Model

For Traveling—for home. Weighs about 11-lbs. Full capacity. Ask for special folder.

THE HAMMOND TYPEWRITER CO.
589 East 69th Street New York City

Name .....

Address .....

.....

Please write your occupation below.

MURDOCK No. 55



2000 OHM SET.....$4.50
3000 OHM SET..... 5.50

That these Murdock No. 55 Sets have earned a nation-wide reputation for value, is due, not so much to the fact that they are, without question, the best low priced receivers obtainable anywhere, as it is to the recognized fact that they closely approximate in operation the sensitive performance of the most expensive sets.

The customary assurance of "Satisfaction or Money Back" affords the opportunity of proving the exceptional value of these 'phones at no risk to you.

Other instruments — MURDOCK MADE—of recognized merit at equally reasonable prices are illustrated in Bulletin 19B, a copy of which will be mailed on request.

WM. J. MURDOCK CO.
55 Carter St.
CHELSEA (BOSTON 50) MASS.
509 Mission St. San Francisco, Calif.

marine would never again attack Allied shipping, for it meant that the crew had found it impossible to navigate the craft in any direction, not even upward to the surface, presumably, for they had all committed suicide. Whether or not the crew found it possible to raise the submarine to the surface or not, but declined doing so in order to escape capture will always remain a mystery.

In Fig. 1 the method of signaling to other sub chasers the position of "spotted" enemy submarines is shown, and this is in the form of a large needle or arrow

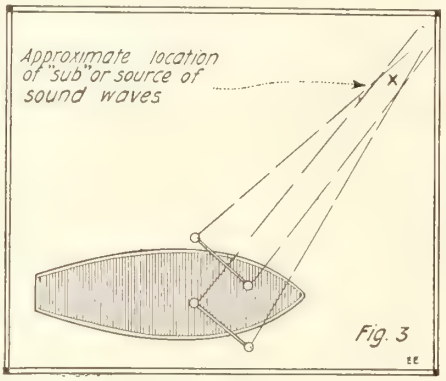


Fig. 3. This Diagram Shows How a "Fix" Is Determined By 2 "T Tubes" On a War Vessel, As Indicated By the Cross. The Usual Procedure for the Submarine Chasers After Determining the Position of the Enemy, Is to Pass Over the Spot Where It is Thought to be and Let Loose With a Series of "Depth Bombs," Which Usually Finishes the Enemy Or Seriously Injures Him.

mounted thru a universal joint on a standard, erected on the top of the chart house of the submarine chaser; or in other words, upon the upper bridge. When a sub chaser spotted an enemy submarine, one of the officers moved this arrow until it pointed in the direction of the enemy. For this purpose the horizon was considered as divided off into a complete circle of 360 degrees, the same as a compass. When the arrow pointed directly upward or in a direction in line with the top of the mast, the geographical indication noted was north. When the tip of the arrow pointed at right angles toward the right, looking at the bow of the boat, the direction was east. Similar, the tip of the needle pointed downward for south, and at right angles to the left for west, with the usual intermediate compass points. The position of this arrow was read by direct visual operation thru a telescope or binoculars in the daytime, and at night its position was easily read due to the fact that the arrow carried a white light at the tip and a red light at the tail.

Super-Sensitive Microphone ONLY $8.00



This instrument is offered at an extremely low price. It is excellent for building your own amplifier. Can also be used in many experiments where a sensitive microphone is required.

Detectagraph, $18.00

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

Send for One To-day and Convince Yourself



Detectagraph $18.00



THE $18.00 MICROPHO DEAF-PHONE

is a super-sensitive instrument which has been developed to meet the demands for a practical and efficient hearing device at an extremely low price. It is equal to any $35 instrument made and superior to most of them. The outfit consists of One Super-Sensitive Transmitter with cord connector; One Super-Sensitive Ear Piece with small black cord; One Black Single Headband; Black Case and Two Batteries.

Adjusted Model "B" Horn, with No. 20 High Grade Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete.



Write To-day for Free Booklet

G. BOISSONNAULT CO.
26 Cortlandt St. New York
Makers of Super-Sensitive Microphone Apparatus

Summer Radio Course *Classes Now In Session*

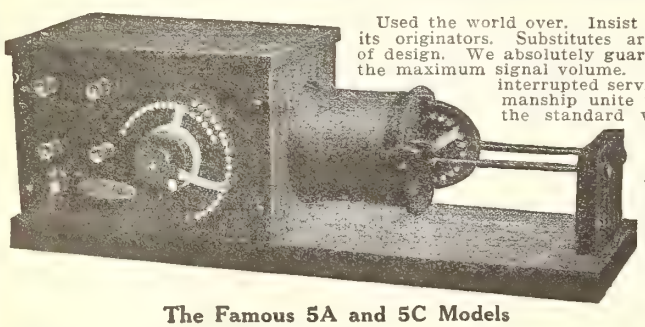
YOU may begin at once our complete course preparing you for commercial radio license. Rapid progress, individual attention, classes of limited size.

Ask for new descriptive booklet

Y. M. C. A. RADIO SCHOOL
Marcy Avenue near Broadway
Brooklyn, N. Y.

Telephone, Williamsburg 3800.

TRACO QUALITY
RECEIVING TRANSFORMERS



Used the world over. Insist on the genuine, built by its originators. Substitutes are expensive, irrespective of design. We absolutely guarantee our tuners to give the maximum signal volume. Delicate refinement, uninterrupted service and high class workmanship unite to make TRACO tuners the standard whereby all others are judged. If your Dealer does not handle them, order direct from us.

LIBERTY DETECTOR VALVES. RADIO AMPLIFYING PHONES, type used by the **UNITED STATES, BRITISH and FRENCH GOVERNMENTS,** now in stock, for sale. Send stamps for bulletins.

The Famous 5A and 5C Models

THE RADIO APPARATUS CO., Pottstown, Penna., U. S. A.

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 22 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 80 Big Pages, 300 illustrations, 200 instruments and apparatus, etc. Big **"Treatise on Wireless Telegraphy."** 20 FREE coupons for our 160 - page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 22 measures 6" x 9". Weight ½ lb. Beautiful stiff covers.

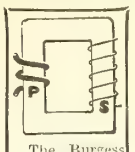
WIRELESS

Send 6 cents in stamps or coin for which we will send our latest Cyclopedia Catalog No. 22 as described.

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City



Electricity
taught by a practical man



The Burgess Service is so universally successful, that we give positive assurance of perfect satisfaction on completing the course or money refunded. There are no strings tied to this—you are the judge.

Hundreds of Burgess-trained men and boys have advanced to better positions by means of the practical electrical knowledge easily learned at home by this method. Give a little of your spare time and you can do the same.

Home Study For Beginners and Experienced Men

This home study course is based on the years of practical experience of Yorke Burgess who gives personal attention to each student. Burgess students are invariably promoted and get better salaries. Beginners get employment in electrical work after taking the course a short while. Burgess students are in demand, over 85 per cent are now engaged in electrical work.

FIFTY-FIFTY EASY TO LEARN—EASY TO PAY FOR

A simple method of learning practical electricity—supplied on easy payments, including apparatus, instruments, materials, etc. Start any time—stop any time. Your payments cease if you are not satisfied. Send for Burgess catalog today. Gives full information without cost or obligation.

YORKE BURGESS, Supt.

BURGESS ELECTRICAL SCHOOL, 745 East 42nd St., Chicago, Ill.

BURGESS BLUE BOOK

a practical and handy reference book for

ELECTRICAL MEN AND STUDENTS

Contains over 200 CALCULATION FORMULAS and WORKED OUT PROBLEMS showing their use. DRAWINGS of ELECTRICAL MACHINERY DEVICES—INSIDE CONNECTIONS—ALTERNATING CURRENT CALCULATIONS and hundreds of every day problems are also covered. Recommended by electrical men all over the country. Purchased by electrical concerns for their employees and customers.

PRICE $1.00

Send a dollar bill, money order, check or stamps.
We refund your money if the book does not meet your approval.

BURGESS ENGINEERING CO., 750 East 42nd St., Chicago, Ill.
YORKE BURGESS, President

Consulting Electrical Engineering. Power Plants, R. R. Signals, Electric Railroads, Industrial Problems a Specialty. Information furnished on electrical subjects. Inventions perfected.

Electrical Slide Rule

Invaluable to Any Electrical Man

In response to many requests, Mr. Burgess has prepared a set of simple and concise lessons for those who desire to take up the use of this practical instrument.

A HIGH GRADE SLIDE RULE

in a leather case, and a COMPLETE COURSE OF INSTRUCTION will be supplied at a very reasonable

SPECIAL COMBINATION PRICE

We have selected the best rule for the purpose. The simple lessons will enable you to understand its use thoroughly.

Write us for full information

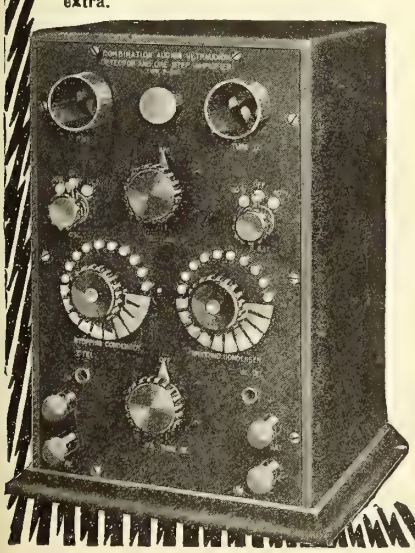
BURGESS ELECTRICAL SCHOOL
745 East 42nd St. Chicago, Ill.

DE FOREST

Here's a Receiver with Eight Distinct Advantages

DeFOREST Agencies are located in all Principal Cities. Ask your regular Electrical Dealer to get you DeFOREST Apparatus.

Combination Audion-Ultra Audion and One-step Amplifier; Type P-300. Size 12½"x9⅜"x7⅜". Price $73.50. Vacuum Tubes, $7.00 each extra.



A COMPLETE, compact and inexpensive Receiving Set having improvements and refinements which increase efficiency and eliminate many objectionable features of receiving apparatus.

No longer is it necessary for you to have two or three expensive, inconvenient and cumbersome tuners spread all over your operating table when working all wave lengths. With this new DeFOREST tuning system you can work any and all wave lengths with the one tuner shown at the right. This Set has distinct advantages of minimum table space and of convenience in coupling not equalled in any other type of apparatus. The entire Set is complete in the two cabinets shown here. The Genuine DeFOREST "Honey Comb" Coil System of Tuning is employed—no superior system has ever been invented.

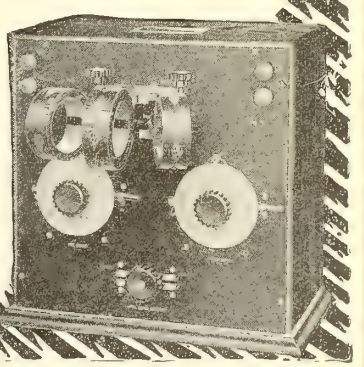
This is a new DeFOREST production embodying a unique and superior tuning system. Possession of this Set means more efficient and satisfactory operation; more pleasure and practical benefit for every Amateur. Its price is remarkably reasonable for the quality of apparatus and the distinct advantages the Set offers. Find out more about it at once.

These Eight Advantages

are not duplicated in any Receiving Set at double the price:

1—Responds to any wave lengths, 150 to 25,000 meters.
2—More flexible in coupling.
3—Lower distributed capacity; less high frequency resistance and decrement values.
4—Eliminates cumbersome switches, inefficient taps and losses from dead ends.
5—Vernier Air Condensers of unusual design.
6—Signals come in louder and clearer.
7—Superior in efficiency, workmanship, convenience and appearance
8—Requires minimum table space; note sizes of cabinets.

Tuner: Type T-200. Size 13⅜"x12½"x8". Price $77.50 without Coils.



Send for a DeFOREST Manual

a 56-page book containing full information about this and many more DeFOREST instruments, as well as giving much useful information for the Amateur. Mailed anywhere upon receipt of 10 cents.

DE FOREST RADIO TELEPHONE AND TELEGRAPH CO.
Inventors and Manufacturers of High Grade Radio Apparatus.
1399 Sedgwick Ave., New York City

Lee De Forest, Inc., Western Distributors. 451 Third Street, San Francisco, Cal.
(Shipments Direct from San Francisco Stock)



DUCK'S

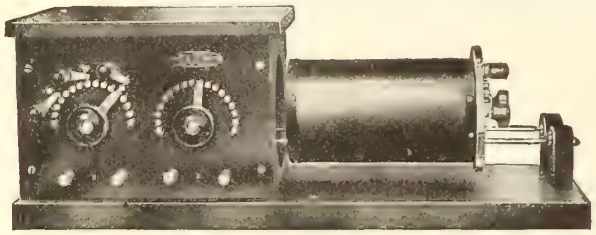
New Big 200-Page No. 14 Wireless Catalog and 100 Page Electrical Catalog

The wireless catalog mailed for 12c and the electrical catalog for 6c, either in stamps or coin, which amount you are privileged to deduct on your first order of $1.00. Catalog positively not sent otherwise.

This edition of our wireless catalog is the most complete and elaborate we have ever put out. It embraces everything in wireless worth while. As an encyclopedia of information it is invaluable. It is printed on excellent paper and with a beautiful cover. Your amateur friend will tell you that there never has been any wireless catalog to take the place of Duck's, and above all that you can absolutely rely on the quality of every instrument listed in this catalog. In a word it is all worth while catalogs in one.

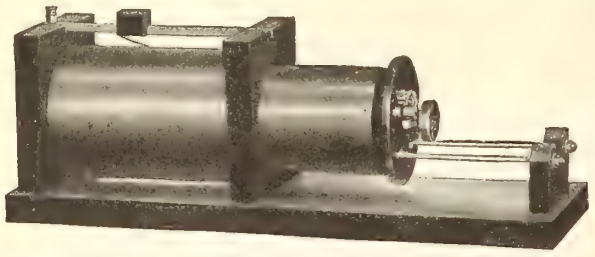
Audio Tron bulbs prepaid $6.00

We discontinued selling Audio Tron bulbs and accessories for a short time but we have again resumed their sale and also panel sets, and can guarantee immediate delivery.



NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER

A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $27.50.



OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

The secondary on our new type Arlington is divided into three sections with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type, permitting a looser coupling. It is a beautifully finished instrument.

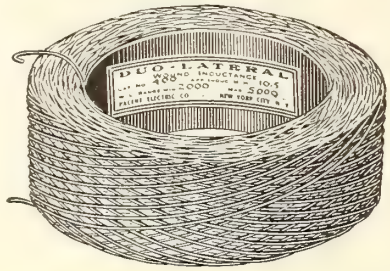
Price only $15.00

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio

SOMETHING NEW!
DUO-LATERAL WOUND COILS

THE DUO-LATERAL COIL now being offered for the first time is not to be confused with any other type of machine wound inductance which has been on the market for some time.

The Duo-Lateral Coil made in various sizes for general and specific application has the following distinct advantages which make it superior to any other coil for amateur and commercial work alike.



1. *Lower natural period.*
2. *Lower high frequency resistance.*
3. *Very low distributed capacity.*
4. *Lower direct current resistance.*
5. *Higher self-inductance.*
6. *Mechanically stronger.*

Bulletin P1, EX, containing valuable engineering data, constants and prices of numerous sizes of Duo-Lateral Coils covering practically every wavelength used, is yours for the asking.

MANUFACTURERS, DEALERS, JOBBERS and DISTRIBUTORS—write for our proposition.

SALES AGENTS for Electrical Products Mfg. Co., A. H. Grebe & Co., Richter & Byrne, Rawson Electrical Instrument Co., Dubilier Condenser Co., The Magnavox Company and others.

Pacent Electric Company, Inc.

Builders and Specialists in Radio, Electrical and Laboratory Equipment.

150 Nassau Street Telephone: Beekman 5810 **New York City**

Uttmark's
Nautical Academy
Radio School

8 State St. New York, N. Y.

Phone Bowling Green 8079

Complete instruction in radio operating in all branches, for Merchant Marine, Ocean Steamships, Telegram Service, Aerial Mail Service, etc. Preparing for Government Examinations.

Elementary and Advanced Classes
Day and Evening Classes
Write for Circular.

Three Types of Amateur Spark Gaps

By PIERRE H. BOUCHERON

(*Continued from page 299*)

ner that each gap is made air-tight. When sparks occur between these very small spaces the gaps remain comparatively cool and the quenching effect takes place very quickly and effectively. Particularly is this true if the spark chambers are made *absolutely air-tight* and the draft of a small electric fan be directed upon the entire arrangement.

This type of gap usually consists of a number of flat copper or bronze discs separated by so-called *gaskets* or *insulators* consisting of either mica or specially treated paper compositions. These discs and insulators are arranged in a trough and comprest together by means of a clamping lever. Each gap unit may be spaced from 1/50 to 1/100 of an inch. In general practise it is customary to allow approximately 1,200 volts for each 1/100-inch gap section.

Altho the gap will work much more effectively on higher frequencies, it may be arranged to give fairly good results on a 60-cycle supply source as well as with spark coils of any size. Such use, however, necessitates careful adjustment of a reactance coil which must be placed in the primary circuit of the transformer. When employing the quenched gap, less condenser capacity is required than when other gaps are employed. Two decided advantages are: the *decrement* of a transmitter is considerably decreased and the gap is practically *silent* while in operation.

Fig. 3 shows the construction details of a quenched gap suitable for amateur use. The base is made of slate, bakelite or hard wood and is 10 inches long, 6 inches wide and about ½ inch thick. If procurable, a cast-iron base would, of course, be preferable. Each pedestal forming the trough may be in the form of pieces of cast iron or steel 4½ inches high, 2 inches wide and ½ inch in diameter. These two are separated at a distance of about 7 inches and fastened to the base by means of No. 10/24 machine screws.

A, B and C of Fig. 4 show cross-sections of three sparking discs suitable for this work. In order to secure good results with a gap of this type, it is very necessary that these discs be properly and accurately constructed. If possible it is suggested that the work of grinding and milling be done by a machinist. Better yet, some radio supply houses are in a position to furnish these plates direct to the amateur. The plates should be about 3 inches in diameter, ⅛ inch thick and have a sparking surface of 1 inch, and a gasket surface of ¼ inch as shown at C of Fig. 4. D of Fig. 4 shows a front view of one of the spark gap discs with suitable explanations.

The gaskets or washers which are used to separate the metal discs should have an outside diameter of 3½ inches, an inside diameter of 1½ inches and should have a thickness of from 1/32 to 1/64 of an inch. These washers should be made up of any insulating composition and probably can be bought at approximately the required size. In order that they be the means of effecting an air-tight joint between the plates when clampt together, these washers should previously be soaked in some mixture such as paraffin or varnish.

When the plates and gaskets are placed between their respective end pieces and arranged in the trough, the pressure adjustment handle is twisted until all gaps are prest tightly together. When a spark has taken place within a gap for a short time, the heat will cause the insulating mixture

on the gaskets to melt slightly, thereby filling all possible grooves so that the gap will be absolutely air-tight. To insure this an extra turn or two of the clamping device should be made while the gap is warm. The number of gaps used under any given power condition may be easily varied by means of an adjustable clip similar to the one shown at E of Fig. 4.

In building small experimental quenched gaps, the writer has often used an ordinary clamp of the type shown at F, which may be purchased at any hardware store for a small sum. This can be of the 5 or 7-inch variety. In fact, this clamping arrangement has proven excellent, the only fault being that the thread on the clamping lever is rather coarse and does not permit of a fine pressure adjustment. It can be used, however, to good advantage if the experimenter does not wish to go to the trouble of constructing the arrangement shown at Fig. 3, and particularly for small gaps employing four or five units suitable for spark coil work. As a matter of record many amateurs have constructed quenched spark gaps by employing several pennies or ten-cent pieces, separated by mica washers of slightly larger diameter and clamping the whole arrangement together in a suitable manner.

And now for a word of advice. Except for the dimensions of the quenched gap discs which must be accurately milled to produce good results, it really is not necessary that the experimenter follow the exact dimensions given for these three spark gaps. For instance, there is no reason why he should not use No. 8/32 screws if he does not happen to have No. 10/24 screws on hand. Where, however, it is a matter of strength, it is of course better to employ screws of larger diameters. These general directions may also apply to the various sizes of bases, pedestals, rods, uprights, etc. Unless one intends to construct a finisht product of commercial appearance, it is often more practical and certainly less expensive to make use of material and parts on hand than to purchase ones of exact stated dimensions.

Another word of advice is that if the experimenter intends to do very much apparatus construction work, it would be well for him to purchase reliable tools as the need occurs for them. In fact, it is almost impossible to build anything very exact without having a hack saw, a hand drill, a full set of drills, taps and dies, suitable for the construction of small instruments. A small foot-power lathe will be found to be a most welcomed member of the experimenter's tool family.

Alarm Number 18

By CHARLES S. WOLFE

(*Continued from page 266*)

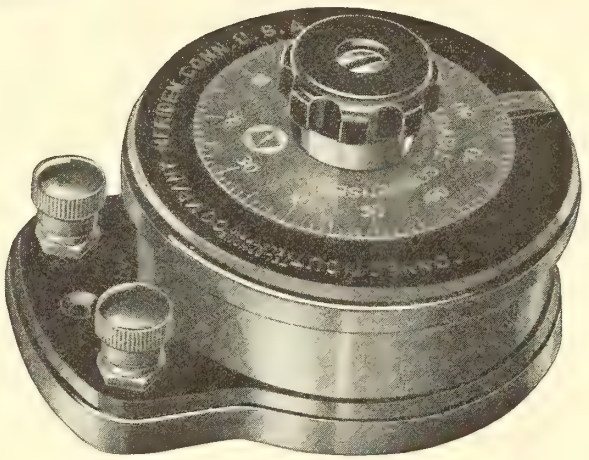
them are there with their eyes glued on that box we get an alarm from 74. Now they all admit they haven't the faintest idea of who is doing the thing, or how he's pulling it off."

"Let's see," Fenner said, thoughtfully. "You have to have a key to open those boxes, don't you? If my dope is right, the keys are in the hands of trustworthy citizens who live in the neighborhood of the box in question. Have any of them been asked for their keys?"

"No," retorted Davidson, "They haven't. My own opinion is that the scoundrel who is sending these alarms in has found some way of striking the alarm by tampering with the wires where they lead into the box."

"No," demurred Fenner, "I don't think so. About the only way that could be done would be to get above the box and short circuit it. The person who did that would

CONNECTICUT RADIO



More Efficient Readings with the CONNECTICUT Variable Condenser

YOU can do efficient work near the ends of the scale if your readings are made in connection with the new CONNECTICUT Variable Condenser. Its wide range of capacity, its ease of operation, and security of adjustment mark it an important contribution to the science of radio. The simplicity of design means that the best way of doing the thing has been found.

Other points of advantage are explained in our booklet "THE CONNECTICUT Variable Condenser." Send for it.

Mention Your Dealer's Name

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut

ORIGINAL TRADE MARK MECANEL ELECTRIC TELEPHONES



SET NO. 1—This set is a very desirable outfit for the experimenter. Contains carbon transmitters and mono-coil receivers. Can be taken apart and reassembled without affecting instruments. For connecting, use bell-wire and two batteries for distances up to 200 ft., for further distances add additional batteries. The instruments are 2½" x 1" and ruggedly made. **PRICE $1.00.**

SET NO. 2—A highly developed set, similar to those used by the Signal Corps of the U. S. Army during the recent war. Can be put up in a few moments practically ANYWHERE. This set is proving very popular amongst the BOY-SCOUTS both in the United States and Canada. In connecting, it only requires two wires or one wire and a ground. **SIMPLE DIAGRAMS AND DIRECTIONS WITH EACH SET. PRICE $1.50.**

SET NO. 3—This is a real SIGNALLING TELEPHONE SET and not a cigar-box contraption as the ordinary run of low-priced telephones prove to be and is the result of long and costly experimenting and is the only one made whereby you can TALK AND RING OVER ONLY TWO WIRES or one wire and a ground. A special constructed CUT-OUT-HOOK-BELL does the trick. When making a call, simply lift telephone off hook, you will then hear a buzzing sound in your receiver which indicates that a BELL is ringing at the other end and which will continue to ring until someone answers by lifting their telephone off the hook, presses his switch and you both are now ready to talk Can be put up in about 15 minutes with bell wire and batteries. Saves many a step and lots of walking for it can be used over distances of several hundred feet. Requires no special skill in installing. **SIMPLE DIAGRAMS AND DIRECTIONS WITH EACH SET. PRICE $5.00.**

WE GUARANTEE these telephones to work satisfactorily or money refunded.

If your dealer does not handle MECANEL TELEPHONES write us direct enclosing CASH, CHECK or MONEY-ORDER and we will ship postpaid.

INLAND SPECIALTY CO.

1562 N. Robey St. Chicago, Ill.

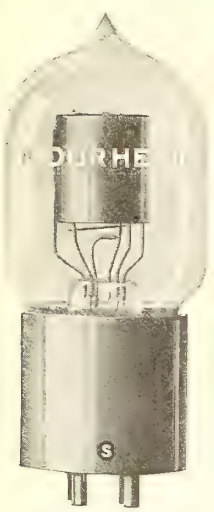
have to hang there long enough to send four rounds, and in that time he'd be bound to excite suspicion. Don't think much of your theory, Chief."

The exasperated man threw up his hands in helpless rage. "All right!" he roared, "Get a better one then. You are the electrical brains of this place. Go get me this whelp. And for God's sake get him quick. Do you realize what this thing means? It's demoralizing the department, that's what it's doing. The firemen are getting to the point where they don't care if they answer a call or not. They figure that it's a fake before they start, and they are taking their own sweet time about getting out of the house. I saw number eight truck go by here about an hour ago. If it hadn't been for the paint and brass work you'd have sworn it was a sight seeing bus. First thing you know we'll get a real fire and it'll get away from them before they reach it. I tell you Fenner, it's got to end right now, and you are the chap I'm counting on to end it. Get out! Get busy! Do something. If you need help, telephone me, and I'll send you a whole regiment. Hop to it! Shoo!"

Outside the building Fenner looked at me and whistled. "Now what do you think of that?" he asked, "Rather a large order, isn't it? Pick out the one chap in a whole city who is amusing himself by calling the wagon and pick him out *pronto!* Davidson must think I can hop in and out of the fourth dimension at will."

I saw that he was about half sore, and decided that the best way to sooth him was to secure action of some kind quick. So I lead off diplomatically. "Well, where do you propose to begin your campaign?" I asked. "Let's find out what box was pulled last, and look it over for suspicious markings."

"Such as what?" demanded Fenner, still



THE MOORHEAD ELECTRON RELAY

THIS ELECTRON RELAY

OF ALL VACUUM TUBES
IS THE MOST EFFICIENT

SPARK RECEPTOR

The Moorhead Electron Relay is the original tubular vacuum valve brought out by the Moorhead Laboratories in 1915, now supplied with the standard four prong base for convenience. This tube has the familiar "hissing" point and low B battery potential characteristic of the perfect vacuum detector; and of all vacuum tubes is the *most efficient spark receptor.*

Used in conjunction with the Electron Relay is the Moorhead VT Amplifier-Oscillator shown by recent Navy tests to have the highest amplification constant of any vacuum tube known to the radio art. A combination of two or more VT tubes as amplifiers with an Electron Relay as the initial detector or oscillator is the *ideal receiving combination* for long distance amateur or long wave reception. In ordering ask for—

THE MOORHEAD PERFECT VACUUM TUBE COMBINATION

DEALERS *Write for prices and particulars*

The Moorhead Electron Relay—price $6 each. Immediate deliveries. Order from your dealer or write direct.

The Moorhead VT Amplifier-Oscillator —price $7 each. Immediate deliveries. Order from your dealer or direct.

AMATEURS Write for descriptive literature

Both tubes licensed under the DeForest Audion and Fleming Patents.

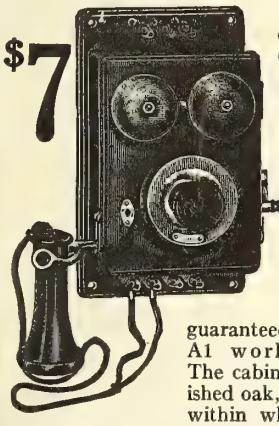
ATLANTIC RADIO SUPPLIES CO., 8 KIRK PLACE, NEWARK, N. J.
PACIFIC RADIO SUPPLIES CO., 638 MISSION ST., SAN FRANCISCO, CAL.

Reference—The American National Bank—San Francisco
DISTRIBUTORS FOR MOORHEAD LABORATORIES, INC.

For Homes, Offices, Factories, Farms

Complete Wall Set Magneto Telephone

Western Electric Type



$7

This is a complete commercial telephone station. They were bought from telephone exchanges who put in Central battery types. Slightly used but guaranteed to be in A1 working order. The cabinet is of polished oak, piano finish, within which is contained the powerful magneto, the 300 Ohm polarized ringer, an induction coil. The magneto is exceptionally efficient, being of the two bar type with brass gear transmission. The extra sensitive microphone, mouthpiece and two gongs are mounted on the front of the cabinet, giving the entire instrument that desirable appearance of compactness and efficiency. Guaranteed to work over 20 miles. The telephone receiver is a double poled one, and has a hard rubber case. Seven binding posts are provided for connections.

The instrument is one which we can offer with pride to our patrons at a ridiculously low price. It is unobtainable anywhere else at less than $15.00 and is an instrument unequaled in value for the price we ask. Size over all 11x10x8 in.

Long Distance Telephone Set—
One station..... $7.00
Shipping weight, 15 lbs.

Two stations
Shipping weight, 25 lbs..... **$13.00**

Send 6c in stamps for our big 160 page Wireless and Electrical Catalog No. 22.

The Electro Importing Co.
231 Fulton Street, New York

MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE
Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.

LEARN WIRELESS

At the **OLDEST, LARGEST** and **BEST EQUIPPED** school of its kind in New England. Thousands of satisfied graduates all over the world. Splendid opportunities now in the Merchant Marine. Day and Evening classes. Summer Session. Start any Monday.

EASTERN RADIO INSTITUTE
899 Boylston St. Boston, Mass.

Make Your Own
ELECTRICAL APPARATUS
with the help of our
RELIABLE BOOKS
Send for price list No. 138
COLE & MORGAN, INC.
Publishers
188-190 Greenwich St. New York

nettled, "Bloody finger prints, death's heads? Something of that sort?"

"No," I replied, cheerfully, "But it occurred to me that if some one was shorting these boxes we might find some bared insulation, or something of the kind to give us an inkling of how this bird is doing his stunt."

"There is no earthy use of going near any of these boxes," said Fenner, decidedly, "For as I told Davidson, the man who sends an alarm from any box can only do it with the necessary speed by opening the box and pulling down the handle in the regular way. To cling to the post on which the thing is fastened and patiently make and break the circuit would be bound to be fatal to the simp that tried it. Somebody would be bound to see him at it. Whoever is doing the sending is not working from any box. He has tapt the line somewhere in an out of the way quarter, and is turning in these alarms from one spot only. You can bet on that. And about the only thing that I see to do is to follow up each circuit until we find the tap. That's some job."

We wandered along with the crowd rather aimlessly, each busy with his own thoughts, vainly trying to find a starting point for our work.

Finally I broke the silence that had fallen between us. "Why does a person do this sort of thing, anyway?" I asked, "Why cause all this excitement for no reason at all? If it was getting somebody something I could understand it. But no one seems to be ahead on the transaction. There doesn't seem to be any motive for the thing at all."

Fenner laughed shortly. "For fun, I guess," he said, "Likes to watch the engines whiz by."

Then he brightened suddenly, and grasped my arm. "Which gives me the first real idea I've managed to think of since we left Davidson. Let us assume that this bird turns in alarms just for the pleasure he gets out of seeing the apparatus on the jump. All right. To avoid suspicion, he doesn't send in one number repeatedly, he jumps all over the city. This effectually prevents attention from being drawn to one locality. But—as each different number calls the apparatus over a different route, it stands to reason that he misses his fun about nine times out of ten, unless——"

"Unless he has some means of sending in that alarm from the spot he happens to be standing on at the time," I interrupted. "And that spot might be anywhere in the city limits at any time."

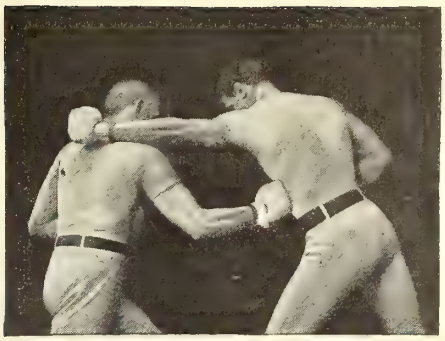
"Not on your life, young fellow," retorted Fenner. "This lad has no pocket fire alarm set, take it from me. He's located. And he must be located some place where he can see every response, granting that he goes to all this trouble in order to watch the apparatus travel. Now, in general, there is only one place where that spot could be."

"I don't follow you so well," I said, dubiously.

"Why, imbecile, there is only one spot that the engines are bound to pass no matter what route they take, and that is the block in which their engine house is located. At last we are getting somewhere. Once we find out how many companies there are, and where each is located we've got our hunt narrowed down nicely. Sounds reasonable, does it?"

"I have to admit that it does," I said, grudgingly, "But there are enough companies to keep us busy for a week. And Davidson wants action."

"Well, he wasn't getting so much of it when we left, was he? He'll just have to wait until we wade thru a bunch of elimination tests. I've got all that dope at home. Let's go out to the house and find out how many companies we have and where they are located."



If the test should come to you tonight to fight for your life or the safety of a loved one, would you know how to strike an effective blow, or to cripple your opponent with jiu jitsu or bone-breaking hold? Isn't it a fact that you are not ready? I will teach you.

Who wants to learn Boxing at home?

IF you remonstrate with a bully for striking a smaller man, and he turns on you, can you hold your own? Wouldn't you like to? Or, if you are walking with your mother, sister, or best girl, and someone passes a slighting remark, won't you be ashamed if you can't take her part? Can you?

Less than 2% of the men and boys in this country know anything about the art of self-defense. That means when someone says "Come on put on the gloves," less than 2% are ready.

Wouldn't you like to learn how to box? Wouldn't you like to learn easily and quickly—right in your own home—**at less than half the cost of a single term of lessons by the old method?**

I have developed a "shortcut" method of teaching boxing. You can learn the fundamentals in 5 lessons, and outbox older and stronger opponents after two weeks' study. My original method has enabled me to teach boxers difficult blows and guards they could not learn by the old method. Prof. Mike Donovan heartily endorsed this "Shortcut" method and helped prepare these lessons. Boxing instructors and Y. M. C. A. physical directors are taking the course to use in their work and urging pupils to take it to save time and money.

I start you with movements you are familiar with—holding out your hand for a coin, the breast stroke in swimming, etc. The first thing you know I have you striking correct blows, putting weight and steam behind them, parrying blows, ducking, feinting, etc. I teach you the rudiments in front of your own mirror. When you finally go up against an opponent, you know how to hit, what to expect, and how to guard against it.

It's almost unbelievable. But you can find out whether it's so without paying any money; I will send you my course on approval—that's my way of overcoming doubt.

The cost is less than you would pay for a single term of lessons. I will include instruction in shadow boxing, eight bone-breaking and jiu jitsu holds, eight standing wrestling holds for use against violent attack, a set of daily exercises to keep you in good condition, and also a free book on boxing blows and guards. If, after ten days' examination, you do not want the course, you can send it back. If you want to keep the course, pay only $5 instead of the former price of $10.

But you needn't send any money yet—simply mail the coupon for a free trial to the Marshall Stillman Association, Suite E-7, No. 461 Fourth Avenue, New York.

Free Trial Coupon

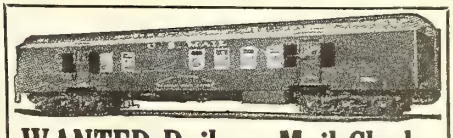
Marshall Stillman Assn., Suit E-7, 461 Fourth Ave., New York

You may send me on approval your complete Course, including five "Shortcut" Boxing Lessons, 1 set of daily exercises, 3 rounds of Shadow Boxing, 8 bone-breaking holds and releases, 8 holds in standing wrestling, and a free book of "Blows and Guards." I have always been faithful in paying my obligations and I give you my pledge that you may feel safe in trusting me as agreed and that I will either return the course, or remit $5 (Canada $6, foreign countries $7) in 10 days.

Name .....

Address .....

.....



WANTED-Railway Mail Clerks

$1600 to $2300 year

Hundreds needed. Examinations Everywhere. July 14 Aug. 11

FRANKLIN INSTITUTE
Dept. W101 Rochester, N.Y.

Sirs: Send me without charge (1) sample of Railway Mail Clerk Examination questions; (2) list of government jobs open to men and women and (3) free book describing them.

Name.....

Address.....

WIRELESS TELEPHONE COURSE

Covering Theory and Practice of Electricity—Radio—Blue Print Reading and Wireless Telephony. 4 in 1 Course. The small payment of $5.00 starts you in this easy, interesting course. Immediate action will assure you of a good future. Don't delay.

FREE Audion tube, experimental electrical outfit, and other apparatus furnished each student, FREE. Write TODAY to

CHICAGO ELECTRICAL ENGINEERING CO.

DEPT. W. 1000 DIVERSEY PARKWAY CHICAGO, ILL.

WIRELESS MANUAL-W12

Our 180 Page Combined Manual and Catalog Illustrates and Accurately Describes the Uses of Standard Radio Instruments.

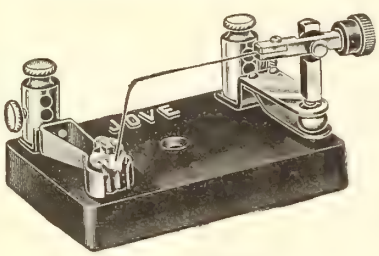
We Make a Charge of 25c for it, Issuing Coupon Receipt Redeemable on a Purchase of $5.00 or More.

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.

Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble. Ready about May 25. Send in your request now.

MANHATTAN ELECTRICAL SUPPLY CO., Inc.

New York—17 Park Place
Chicago—114 S. Wells St.
St. Louis—1106 Pine St.
San Francisco—604 Mission St.



(GHEGAN PATENT)

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

Send stamp for new edition 42E Catalog.

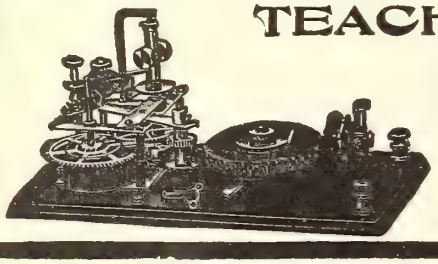
J. H. BUNNELL & CO., 32 Park Place, New York

"THERE'S MONEY IN IT"

AT HOME **LEARN TELEGRAPHY** AT HOME

MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter. THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
26 L Cortlandt St. New York

Skinderviken Transmitter Button



was placed on the market June, 1918. 28,000 Buttons have been sold in about 2 years and hundreds of complimentary letters have been received. Orders are pouring in from all over the world and branch offices will be opened up in several foreign countries this summer. If you are interested to know more about this little marvel of a Transmitter Button, write for circular illustrating and describing this Button and also send ONE DOLLAR for a super-sensitive detectiphone Button to your dealer or direct to

J. SKINDERVIKEN, 414 Broadway, New York, N. Y.

The inventor and sole manufacturer

"I hate to look at that list," I grumbled, as we boarded the street car. "When we get the total number of fire houses in this village, something tells me we are going to realize what a nice, sweet little task we're in for."

"Maybe so, and maybe not," said Fenner, calmly, "In the first place, I think the list of likely houses will amount to about six."

"How do you arrive at that conclusion?" I demanded. "I don't see much pick among them. One house is about as good as another when it comes to guess work, and that's what we'll be up against after all."

"Not so much real guess work after all, because I'm taking the view that every engine house that's located on a corner is not as likely a place to look for our playful friend as one that's situated in the middle of a block."

"Just why?" I wanted to know.

"Well, because a house located on a corner would not cause its apparatus to pass a given spot as often as one located between corners," replied Fenner. "Granted?"

"I guess so," I retorted. "Altho it seems like a slim chance to me all around."

"When you are looking for a needle in a hay stack your chances are slim. Can you suggest anything more plausible?"

I had to admit that I couldn't and so when we arrived at Fenner's home we noted down the number of fire stations in the city, and their location. We found that there were some twenty-five companies, only six of which were located between blocks. This fact caused Fenner's spirits to soar.

"My boy," he exulted, "Unless I miss my guess we will never have to look up one of the remaining nineteen. I have a hunch that the culprit is living close to one of these six, and now I'm going to try to narrow that down some."

"How?" I asked, mystified.

"Watch your uncle," was his retort, as he reached for the telephone. He called the number assigned to our City Hall, and got Davidson on the wire. I heard him ask for a list of the numbers of all the boxes from which the fake alarms had come, and then for several moments he was busy jotting down the information that was coming to him over the wire.

When he had hung up the receiver, I grinned at his scowling face. "The whole seventeen?" I asked, indicating the pad that he held in his hand.

"The whole twenty," he corrected, gravely. "We've been having some more wild goose chases since we left the hall, and Davidson's anger has reached the Nth power. He threatens to discharge all the plain clothes men within the next twelve hours unless the guilty party is brought before him so that he can rend his flesh. Davidson's entire being seems to be yelling for gore. Let's make some time, fellow, I want to look these fire houses over before dark, if possible."

"Thought you were going to narrow those six down to something less," I reminded him.

"Right," he said, "But I can do that as we walk along. There's no secret about the process. I'm going to look up the location of these boxes, and any house that would send an engine to every alarm that has been turned in will be the object of our first visit. You see, all engines don't go out on every alarm. The city is districted. I'm still working on the theory that it won't do any one any good to turn in an alarm unless he can see the smoke wagons fan."

"Great stuff!" I applauded. "Let's look over a list of box locations."

This busied us for a time. Finally, out of our researches we reached the following conclusions. First, that the various alarms which had been turned in came from boxes whose locations were so widely differing that any attempt to deduce evidence from

the facts was useless. But second that engine company number eight would have been called out on every alarm except two. As Fenner said, enough was sufficient, more especially when you took into consideration that number eight's quarters was one of the between block locations.

Shortly afterwards we were strolling apparently aimlessly up the block toward number eight's station. Both of us were scrutinizing closely the wires strung from the cross arms of the poles along the street. We easily located the alarm wire, but two or three turns up and down the square failed to reveal any suspicious leads branching into any dwelling or store along either side of the street.

Fenner grew disgusted as close scrutiny failed to yield us anything of value, and we eventually blew down to number eight where he introduced himself to the captain. This individual was in none too good humor, and it took much diplomacy and a 'phone call to Davidson to secure us the necessary liberty around the place.

The good captain was highly incensed at the wave of false alarms that had swept over the city. I imagine he was a rather good natured chap when things were right, but the last couple of days had badly strained his disposition. He commented picturesquely on the happenings of the last forty-eight hours.

"Wild goose chase after wild goose chase," he grumbled. "Every time the gong rings it's another senseless run. Believe me, if I ever lay my hands on the lu-lu that's making a plaything out of the system he'll think all Hell's a-popping. A joke's a joke, but this business of sending overworked firemen out at any old hour is too much of a good thing. And the worst of it is that we get pretty nearly every alarm here."

At Fenner's request he led the way to the roof of the building, and once alone we began operations. Taking our field glasses, which we had brought along for the purpose, we stretched ourselves near the edge of the roof and carefully scanned every foot of the wiring along the block. The glasses brought things so close that we might as well have been on the poles themselves, but the closest scrutiny failed to reveal any tap in the alarm wire.

Fenner was rather disappointed, for, as he confest, he confidently expected to find a tap of very fine wire some place along the street.

I spied the aerial first. To ease the strain on my eyes, I had lowered the glasses, and was gazing out over the roof tops. There was a typical amateur outfit a few roof tops down. I nudged Fenner. "Look," I said, "There's an interference factory. A lot of the Q. R. M. we get around this burg originates there, I'll bet. Bet you it's a one inch spark coil."

And then, remembering the *Educated Harpoon,* I added, "Couldn't be that that kid is sending in these alarms by wireless, could it?"

Fenner grunted. "It could—not," he growled. "This fire alarm system is a closed circuit affair, son. When you send in an alarm you shut off the juice instead of turning it on. That allows the armature of a relay to fall back and close an alarm circuit. Short of a ton of apparatus rigged up on one of these poles, your young friend over yonder couldn't start anything with his ether plow."

And then I saw his face change. "Good night," he muttered, "I wonder!"

"You wonder what?" I queried.

"Let me alone a moment, Bill," he replied, "I want to think. Look at the birdies or something."

For a long time he lay there silently. I began to grow impatient. Then he suddenly began to laugh.

"What's so funny?" I demanded, nettled at this unseemly display of mirth. "Tell

"ASK ANYONE WHO HAS USED IT"

WHAT OUR PATRONS SAY

"You manufacture a brand of phones that surpass all of equal price and most of higher price." (Name on request.)

BRANDES WIRELESS HEADSETS

CLEAR TONE LIGHT WEIGHT
DEPENDABLE SERVICE

Score 100% efficiency in actual use. Sharp, Unblurred, Readable Signals assured by



"Superior" Set, 2,000 ohms, $7

"BRANDES MATCHED TONE"

Exactly matching the tone of both receivers in each set and thus eliminating all confusion due to unmatched harmonics.

TRIAL OFFER

Buy a Brandes Superior Headset and use it critically for ten days. Then, if it doesn't come up to our claims or your expectations, return it and your money will be cheerfully refunded. Test it—compare with others—for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphragms toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.



"Navy" Set— 3200 ohms, $14.

SEND 4c FOR CATALOGUE E

C. BRANDES, Inc.
32 Union Square, Room 814
New York City, U. S. A.
WIRELESS RECEIVER SPECIALISTS

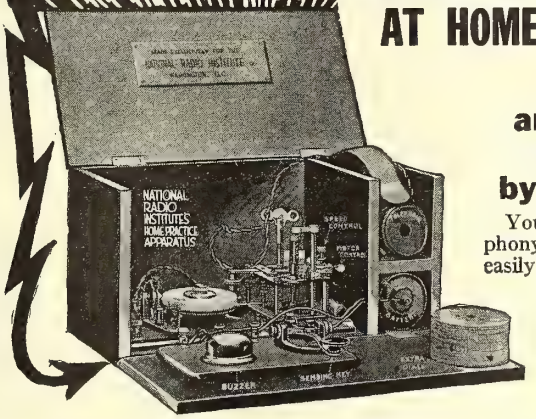


"Transatlantic" Set— 2800 ohms, $10.

Complete Line of Brandes Receivers for those in Canada. Send stamp for Pamphlet "E"
Scientific Experimenters, Ltd., 11 St. Sacrament Street, Montreal, P. Q., Canada

LEARN WIRELESS

AT HOME QUICKLY AND EASILY



Radio Telegraphy and Telephony Can Now Be Mastered at Home by Marvelous New Method

You can learn Wireless Telegraphy and Telephony in spare time at home quickly and easily, by mail, through the famous Home Study Course of the National Radio Institute and with the help of the wonderful Natrometer outfit which we will send you. Then you can travel if you want or locate in land station work near your home.

Salaries Up to $15,000 a Year

Our graduates start work as Senior Operators at $125 a month with all living expenses paid. Advancement to high positions is rapid. The pay in various branches of wireless work is as follows:

Radio Engineers $2,500 to $15,000 a year; Radio Aids $6 to $15 a day; Aerial Mail Service $1,500 to $2,400 a year and 10% bonus; Radio Inspectors $1,200 to $3,500 a year. Our Graduates are guaranteed positions upon securing their official license after taking our course.

This Fine Natrometer Set To Every Student

We send you this wonderful set to use while taking our Home Study Course. It becomes your personal property on completion of the course. The Natrometer automatically sends you messages at varying speeds as you would receive them from distant stations.

Special Privileges to National Radio Institute Students

Combination course in Wireless Telegraphy and Telephony for price of one course;
Post Graduate Course free.
Complimentary membership in N. R. I. Relay League with handsome blue and gold membership pin;
Handsome diploma suitable for framing;
Complete automatic Natrometer outfit and carrying case;
Personal help in securing position.

Send for Free Book

Send the attached coupon TODAY for free copy of our valuable and interesting book "Wireless, The Opportunity of Today" telling how we help you win success in Wireless.

NATIONAL RADIO INSTITUTE
America's First and Foremost, Established 1914
Dept. 243, 14th & U Sts., N. W., Washington, D. C.

SEND COUPON FOR FREE BOOK

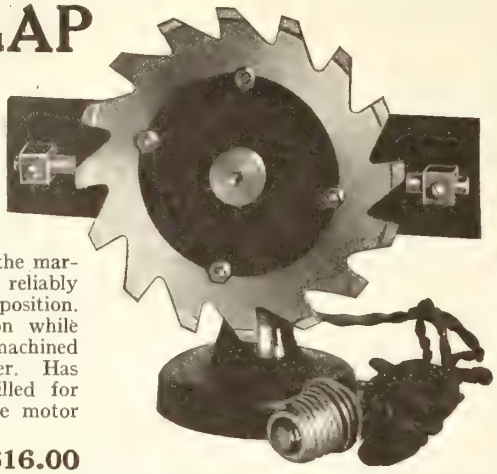
NATIONAL RADIO INSTITUTE *Print Your Name and Address Carefully*
Dept. 243, 14th & U Sts., N. W.
Washington, D. C.

Send me your Free Book "Wireless The Opportunity of Today." Tell me about your famous Home Study Course in Wireless Telegraphy and Telephony—your post graduate course—membership in the N. R. I. Relay League and your Special Instrument Offer.

Name..... Age.....
Address .....
City..... State.....

ROTARY GAP

Cat. No. YM1



A new development in the rotary line has been made expressly for Young & McCombs. Improvements on the well known saw tooth rotary wheel, make this gap the equal in tone and efficiency to any selling for twice the money. It is the only gap on the market which will run smoothly and reliably in either a horizontal or vertical position. Can be run in a vertical position while screwed to the wall. Rotor is machined cast aluminum with formica center. Has liberal sparking space and is drilled for either 1-4 or 3-16 shaft. Variable motor speed switch in base.

Price, complete - $16.00

ROTORS ONLY

YM1a—Rotor and standards only.....$7.00
YM1b—Standards with base and binding posts 2.50

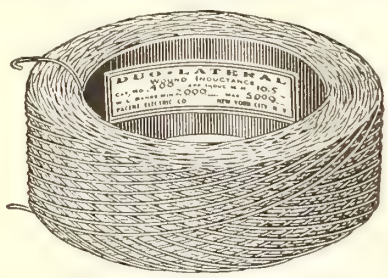
ROTORS AND STANDARDS

YM2—Plain rotor, as illustrated.....$4.50
YM3—Saw-tooth rotor, designed for Harmonic Chord tone..... 4.75

Send 4c in stamps for 50-page Catalog

Young & McCombs
L. P. BEST PRES.
ROCK ISLAND, ILL.

Address Orders to Dept. 67



NEW RADIO PRODUCTS AND PERSONAL SERVICE

In endeavoring to give personal service to our ever growing clientele, we realize that new and more modern products make for the betterment and improvement of radio work and to this end we offer you the latest scientific achievement in radio.

DUO LATERAL WOUND COILS

made in several different sizes covering every wave length, these coils have staggered winding, a lower natural period, lower high frequency resistance, very low distributed capacity which makes it an ideal part of any set and superior to all other coils, for amateur and commercial work.

Radio Engineers have made extensive tests on these coils and give them their highest recommendations.

These coils can be had in working Wavelength, ranging from 130 to 25,000 meters priced from 90c to $4.00. Mail orders promptly filled from stock.

We also carry a large stock of high grade electrical apparatus, including a very complete line of heating appliances.

You have our most courteous invitation to spend a few moments in our spacious show rooms to look over our complete stock. We will gladly show you any instrument or part you may desire to examine. It will be a revelation to you, besides it is part of our service.

OUR WORD OF HONOR TO YOU IS OUR GUARANTEE. LET US PROVE IT.

Write Dept. A1 for Literature and Price Lists.

CONTINENTAL RADIO AND ELECTRIC CORP.

J. Di Blasi, Secretary—J. Stantley, Treasurer

6 Warren Street, New York

DEALERS

We shall be pleased to send our revised schedule of prices and discounts on request. Delivery on our standard equipment can be made immediately from stock, subject to prior sale.

WIRELESS SPECIALTY APPARATUS CO.

Engineers, Designers, Manufacturers

Boston, Mass., U. S. A.

me when it's time for me to begin and I'll join you."

For answer he sprang up and headed for the trap door leading into the fire house. "Come on, Bill," he called over his shoulder, "Come on and I'll try to catch the wild goose."

"What wild goose?" I panted, as I followed him down the steep ladder, "Who's a wild goose—what's a wild goose?"

"Why that wild goose that the captain and his men have been chasing for so many hours."

He past rapidly thru the station house, and out onto the street. There he vouchsafed a little information. "We are going to call on our brother amateur," he said, "And please try to look innocent. Right now you remind me of Dr. Watson."

We knocked at the door of the house on which we had seen the aerial. A young chap of about fourteen came in response. Fenner grinned amiably. "We would like to see the young man that has the wireless set," he said, cordially: "Is he at home?"

"That's me," said the lad. "What do you want?"

"I've been thinking about getting into that game myself," said the not too truthful Fenner, "And when I saw your aerial I thought maybe you might be able to give us some pointers."

Instantly the kid thawed. "Come in," he invited, "I'll show you my set. Got some pieces of stuff around here from when I was learning, maybe I can sell you. That was before I got my big set."

I had visions of a quarter inch spark coil. The boy led the way upstairs, talking over his shoulder. "Used to use a coil," he said, "'till dad got the juice in. Then I got a transformer. Current's direct, tho, and I have to use an interrupter."

I got a violent nudge from Fenner just then altho I didn't see that anything very significant had turned up so far. We were ushered into the boy's room, where a rather shabby old loose coupler, an erratic crystal detector of uncertain vintage, and a pair of fairly decent 'phones were doing duty as a receiving set. Fenner, the rogue, profest ignorance of the functions of all the junk laying around, and soon had the kid delivering a regular lecture, which was a scream.

Finally, conversation lagging a little, the boy dropt into the chair in front of his apparatus, his fingers closing idly over the key. As Fenner put questions at him, he kept drumming away on that heavy old key until it began to get on my nerves.

Suddenly the quiet of the neighborhood was broken by the wailing shriek of a siren. A clamor arose below us in the street, as with bell clanging and siren screeching, number eight roared by in answer to an alarm.

Instantly the youngster was on his feet and was leaning half way out the window. "There she goes," he yelled over his shoulder, his eyes burning feverishly, "Lord, how that fellow does beat it."

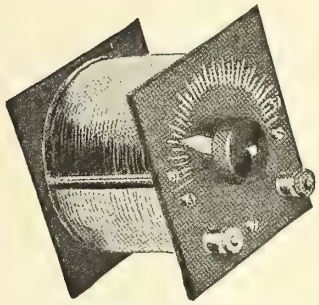
He watched until the speeding engine turned a corner and was lost to sight. Then he turned to us in the room, his eyes still full of boyish excitement. Fenner was regarding him quizzically. "Yes," he said, gravely, "There he goes to box number 18. But you are going along down to the police station with me."

The terror in the boy's face was pitiful to see. In vain he denied, pleaded, begged. Fenner was iron. "Down you go," was his ultimatum, "You can tell your story to the chief."

At that the poor kid went to his knees in a perfect frenzy of terror. "No, no," he wailed, "Don't take me down there. I'll admit that I did it. I'll do anything for you if you'll let me go. I'll promise I'll never

DEALERS

Variable Condensors of the Better Type



R34-43 Plate $5.50 List

Note the square end piece on the cut of our condensors, facing the operator, also these condensors are enclosed in clear glass cases. Scales on these instruments are calibrated to 2½ degrees.

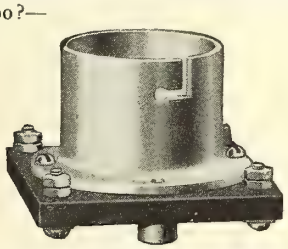
Rotary Spark Gaps
Transformer Coils
Control Panels
Regenerator Sets

A very complete line of wireless apparatus. Write for dealers discounts and catalogue.

THE TEWNO COMPANY
150-152 Chambers Street, New York City

O, What a Pal—

was Mary, but say, boy, do you know an up-to-the-minute radio installation is SOME pal, too?—



We manufacture high grade apparatus only. Here is a good value—The Ace V. T. Socket —with grid leak at

$1.50 each

Better buy Ace equipment than be sorry you did not. Ask your dealer.

THE PRECISION EQUIPMENT CO.
2437 Gilbert Ave., Dept. E, Cincinnati, Ohio

Brooklyn RADIO AMATEURS

If you want good standard wireless apparatus, we cordially invite you to examine our complete line of all famous Manufacturers: Radisco, Grebe, Murdock, etc. Everything for the Amateur from Contact Points to Complete Stations sold at catalog prices.

Agents for RADISCO Apparatus

Including Coils, "B" Batteries, Indicating Dials and other parts distributed by them. Mail orders given prompt attention.

Open Evenings until 9.30 P.M.

KELLY & PHILLIPS
312 Flatbush Avenue, Brooklyn, N. Y.

Send To-day for the "Electrical Worker's Friend"

An electrical book of 66 motor drawings with complete instructions for rewinding and reconnecting A.C. motors. **Special at** **$4.00**

Or write for full particulars of this valuable book

SMITH & SMITH PUBLISHING CO.
Dept. B. 1524 Lowrie St., N. S., Pittsburgh, Pa.

do it again. I only did it for a little fun—honest! Please don't arrest me!"

"Brace up, kid," said Fenner, "Not for the world would I let you off. Down you must go and tell the chief what you've been up to. But I'll do my best to have him let you off. Come now. Don't let your folks see that there's anything wrong yet, and maybe I can get you out of this scrape."

With a mighty effort the boy got himself together, and a half hour later we led him, white faced and trembling before Davidson. For a long while Fenner and the chief whispered together at the desk. I couldn't catch what was said, but from the scowls that Davidson shot at the kid and the earnestness of Fenner, I judged that my friend was having his hands full in securing clemency for the lad.

Finally the conference broke up. Fenner came to me and took me by the arm. "Come on, Bill," he said, "Let's go."

Mystified, I moved reluctantly towards the door. I saw Davidson slowly unloosen the leather belt from around his waist, saw him seize the unfortunate youth and draw him across his knee. We shut the door behind us. The case was being *settled out of court!*

Once on the street, I turned to my friend. "And now," I said, "Would you mind giving me a little idea of what this is all about. I didn't see that kid do anything out of the way. I don't see how you caught him, or how he did the trick. Slip me the dope."

Fenner laughed. "I thought you mist it," he said, "It was a slick trick the kid was getting away with, all right. He sent that alarm in while you were looking at him, and you never tumbled."

"He did?" I said, blankly, "With what?"

"With his telegraph key," replied Fenner, calmly.

"How?" I asked, "by wireless?"

"Not the kind you mean," chuckled Fenner, "Not with the set. But by wireless, nevertheless. He used one side of the telephone circuit. It runs right alongside of the alarm wires on the pole. You've heard of that cute little phenomenon called induction, haven't you? Well, that's what he put over. He used direct current. *He induced a counter E. M. F. in the alarm circuit of the same value as the current flowing there.* Result, zero current in the alarm circuit every time he pusht his key. Back dropt the armature of the relay, closing the other circuit, and in went the signal. He used a resistance to reduce his current rapidly and yet gradually to zero. This prevented another pulse on the alarm circuit when his current went off. Thus he prevented double signals, which would have advertised the fake. Once he got everything nicely adjusted, he had the city fire alarm system at his mercy. Pretty clever for a fourteen year old, eh?"

"Holy Smoke, I'll say so," I gasped, "How did you get onto the stunt?"

"More good luck than good management," replied Fenner, "When you showed me that aerial it set me to thinking. I knew that he couldn't turn in an alarm with a regulation set, and I began to ponder over the different methods by which the trick could be turned. It dawned on me that you could induce a current in that system, and it also struck me that the only person in the neighborhood who seemed to have any knowledge of the laws of electricity was the owner of that aerial. Then I took a chance, and happened to hit it. At that, if he'd have left that infernal key alone, I wouldn't have been sure. But I sat there and counted the alarm as he turned it in. Then I knew that I had caught the captain's wild goose."

"Some stunt," I commented. "I'm glad they didn't do any worse to the kid."

"So am I," admitted Fenner. "I like to see that gang going myself. Let's go and try out that circuit you picked up."

Fit YOURSELF for the Joy of Life

THERE'S no place in our live-wire business and social life for the weak, sickly man who is of no use to himself or anybody else. Health, Strength, Energy, and the Ability they give a man, to win SUCCESS, are the only qualities that count. Nobody will care anything about you, or even give you a second thought, if you go staggering through life with some miserable chronic ailment, weakness or bad habit making you a misfit in the busy, wideawake world; holding you back, keeping you from doing anything worth while and slating you for the shelf or junk heap before your time.



STRONGFORT
The Perfect Man

Get Out of the Rut

Don't be content to end your life a miserable failure. Don't let a sickly ailment ruin all your chances of success. It won't cure itself. You will never be any better until you **exert your will,** get hold of yourself, lift yourself out of the rut that is growing deeper every day you travel in it. YOU CAN DO IT. You can free yourself from the Constipation that is destroying the tissues of your body and brain; you can get rid of the Dyspepsia and Indigestion that make you feel as though you carried a millstone in your chest; you can cast off the shackles of any bad habit that is sapping your vitality and making you ashamed to face your fellow men. YOU CAN BE FREE FROM YOUR TROUBLES—strong, well, with every chance of making a success in the world, if you will only WAKE UP!—Look the Facts squarely in the Face and ACT AT ONCE.

Win Back Your Health and Strength

I'll show you how to do it, in a way that has never failed. I have made a lifetime study of the methods whereby renewed VITALITY — bringing with it Health, Strength and Energy—is restored by Nature's own methods to the human organism. By those methods I built myself up, until today I am called the strongest man in the world. By them I have built up thousands of weak, ailing, despondent men and women; turned the watery fluid in their veins to rich, tissue-building blood; strengthened their vital organs, developed their muscles, external and internal; given them back health, happiness, hope, ambition and the joy to the full of Living Life.

STRONGFORTISM

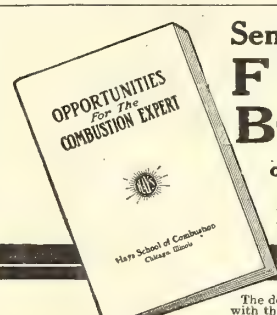
Strongfortism is the Science of Living Life as NATURE meant it to be lived; of taking advantage in the utmost degree of the marvelous recuperative powers she has implanted in the human organism and letting her work the cure of any ills. Nature's way is the only safe, sane, sure way of getting back lost health and strength. Her laws operate for every individual alike, **and never fail.** Those laws, those methods, I have incorporated in the system of Strongfortism and applied them with unvarying success to my pupils in every part of the world. What NATURE, through the practice of Strongfortism, has done for others, she will do for YOU, if you will only give her half a chance. There isn't the slightest doubt about it.

Send for My Free Book **"Promotion and Conservation of Health, Strength and Mental Energy"** will tell you all about Strongfortism and show you how it can do for YOU what it has already done and is now doing for other weak, worn-out, ailing men and women. It makes no difference where you live or what your occupation is. You can practice Strongfortism in the privacy of your own bedroom, if you like, and gain the utmost benefit, if you will devote to it as little as fifteen or twenty minutes a day. You will notice the improvement, physically and mentally, within a few days after you begin, and your friends will notice your improved appearance as well.

SEND FOR THE BOOK NOW. Don't put it off. Every day counts when your vitality is ebbing away. THE BOOK IS FREE, but you gladly would pay a good price for it, if you knew what it would bring you. Send for it today and simply enclose three 2c stamps to cover packing and mailing.

LIONEL STRONGFORT *Physical and Health Specialist*

1329 Strongfort Institute **NEWARK, N. J.**



Send For This FREE BOOK

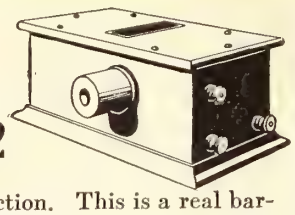
on Combustion Engineering Fuel-Economy

The demand for fuel experts, with the ever-increasing price of coal and oil, was never as great as now. Combustion Experts make big money. The Hays Course in Combustion Engineering has been prepared in simple style at a very moderate fee by the leading fuel experts—Joseph W. Hays, Educational Director, Hays School; W. L. Abbott, Chief Operating Engineer of the Commonwealth Edison Company; Joseph Harrington, formerly Administrative Engineer, U. S. Fuel Administration; Fred R. Low, Editor of "Power"; Prof. S. W. Parr, Department of Chemistry, University of Illinois; David Moffat Myers, formerly Advisory Engineer of U. S. Fuel Administration, Washington, D. C.; Arthur L. Rice, Editor of "Power Plant Engineering"; I. E. Moultrop, Construction Bureau, Edison Electric Illuminating Company. Get into the Combustion Expert class now while the real opportunity exists. Send for FREE book and further details today. **HAYS SCHOOL OF COMBUSTION, 1412-14 So. Michigan Ave., Chicago, Ill., Dept. E-E.**

EXPERIMENTERS—

Here's a genuine bargain

250 Pittsfield ¾ inch Spark Coils *without vibrator only* $2



Powerful well-made coils that regularly sell for three times this price. Slightly shop-worn, but absolutely unused, new coils. Dealer going out of business. We picked up the entire lot for a fraction of its real worth. You benefit by the entire reduction. This is a real bargain that happens once in a lifetime. Act quickly! Mail us $2.00, plus postage for 4 pounds. The least worn coils will be shipped first.

American Electro Technical Appliance Company

Dept. E, 235 Fulton Street, New York City
A full line of reliable wireless equipment carried

Partial List of What We Distribute:

Loose Couplers, $5.00, $10.00, $15.00, $19.00.
Tuning Coils, 4,000 Meters, $4.75; 1,250 Meters, $3.50.
Crystal Detectors, $1.75; DeForest Type, $2.60.
Murdock Variable Condensers, .001 MFD, $4.75; .0005, $3.75.
DeForest Variable Condensers Always On Hand.
Fixed Condensers, .002 MFD, 70c; .003, 90c.
Spark Gaps, 75c, 90c, $2.00.
Oscillation Transformer (Murdock Type), $5.00.
Oscillation Transformer (Signal Type), $16.00.
Lightning Switch, 600 V.-100 AMP., $3.94.
Switch Points 3/16"x3/16", Threaded Shank with Nut, 3c Ea.
Switch Points, 3/16"x3/16" with Machine Screw, 20c Per Doz.
Dials (Black), 3" and 3½", 75c; with Knob, $1.25.
White Metal Dials, 3", 50c.
Binding Posts, 9c, 10c, 12c and 20c.
Paragon Rheostats, $1.75.
Parkin Rheostats, $1.00.
DeForest Rheostats, $1.00.
All the Wireless Press Books.
All the Cole and Morgan Books.
Hawkins Electrical Guides 3c Each
Marconi VT Bulbs, $7.00; Socket for Same, $1.50.
Murdock VT Socket, $1.00; DeForest Type, $1.50.
Western Electric Phones, $12.00.
DeForest Coils, All Sizes.
Complete Stock of DeForest, Murdock and Grebe Manufacture.
Oscillation Helex, Complete to Assemble, $3.00.
Loads of Other Apparatus On Hand.



Send 10c for Catalog.

THE ACME 250 RADIO TRANSFORMER

Has met with such success that we are pleased to announce that we are now manufacturing the

ACME 500 and ACME 1000

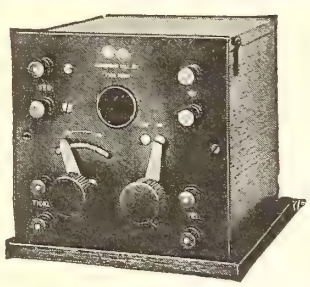
SAME OPERATING CHARACTERISTICS AS ALL ACME TRANSFORMERS — FULL RATED POWER ON ROTARY GAP OF 750 SPARKS PER SECOND

EFFICIENCY 80 to 90% **POWER FACTOR 90%**

ACME APPARATUS COMPANY

28 Windsor Street, Cambridge 39, Mass.

TRANSFORMER AND RADIO ENGINEERS AND MANUFACTURERS



"AT LAST

our Catalogue is off the press and ready for distribution. This Catalogue has been acknowledged by Radio Experts and Associations throughout the country to be the finest Catalogue which was ever put on the market by any Mail Order House whatsoever. This catalogue contains one hundred pages of the most interesting display of Wireless Apparatus ever shown before. In addition to the display of Wireless Apparatus we have listed on the last five pages various hook-ups, starting with the small tuning coil sets and advancing to Audion and Amplifying hook-ups. One page is devoted to Radio Symbols, a photograph of our well stocked store and warehouse is shown in the front part of the book, to give you an idea of the amount of stock we carry at all times. Twenty-four hour shipments are guaranteed on ninety per cent of our orders. Despite the completeness of this catalogue there is a certain amount of apparatus we could not get in in this issue. Any apparatus you are desirous of obtaining, not listed in our catalogue, we can furnish you catalogue from manufacturer and make shipment from our own stock. This catalogue will only be sent upon receipt of 15c in stamps—Catalogue will not be sent if stamps are not remitted.

NOTICE TO WIRE ASSOCIATIONS, SCHOOLS AND VOCATIONAL TRAINING CAMPS: A limited number of catalogues will be distributed free of charge to the Wireless Associations, Schools and Vocational Training Camps throughout the country upon receipt of request from proper authority. Our Information Department is at your service—free of charge. Let our Radio Expert answer your questions—all we ask is that you remit stamped envelope for reply. Make inquiry to Dept. 156.

NATIONAL RADIO SUPPLY COMPANY, Suite 103-4-5 No. 808 9th Street, Washington, D. C.

Arnold

Loose Couplers
Combination Loose Coupler Parts and accessories.
Send 3c stamp for literature which is sure to interest you.

J. F. ARNOLD 2082 Lexington Av. N.Y. Established 1910

LEARN WIRELESS AT HOME

Operators earn $125 to $250 per month; instruments given free; we get you a position.

SOUTHERN WIRELESS INSTITUTE
423 Courtland St. Baltimore, Md.

The Story of Glass

By PROF. FLOYD L. DARROW

(*Continued from page 269*)

Defeat was not written in their vocabulary, however, and they persisted in spite of every obstacle and adverse circumstance. Then came the World War and with it, the importations of optical glass from Europe ceased. Something had to be done and what had before been only a highly desirable goal, at once, became a necessity and a patriotic duty! After three years of diligent research, interspersed with temporary failures, the Bausches succeeded in making optical glass of a very high grade.

When the United States entered the war it became imperative that the Government should have large quantites of glass for purposes already enumerated. Immediately the Bureau of Standards and the Geophysical Laboratory at Washington took up the problem and Major F. E. Wright, Ph.D., was assigned to take charge of the work. In addition a number of glass manufacturers thruout the country placed their plants at the service of the Government.

DIFFICULTIES OF MAKING OPTICAL GLASS.

For good optical glass there are six fundamental requirements: (1) Correct optical and physical properties; (2) freedom from striae; (3) freedom from bubbles; (4) high light transmission; (5) freedom from strain. The skill and machinery to meet these requirements did not at that time exist in this country. There were needed a stirring device that would eliminate the striae, or tiny grooves, melting pots more resistant that corrosive fluxes and freer from iron and sulfur than any then being made in the United States, and the purest batch materials. Most essential, too, were skilled workmen, of whom, as already stated, there were none in this country at that time. But with characteristic American enterprise and as the result of an amount of technical and practical experimentation unprecedented in the history of the glass industry, these conditions were quickly and successfully met.

The most insidious foe of pure glass is iron, which is always present in sand, the one fundamental ingredient of every kind of glass. To free the sand of this troublemaker a huge electro-magnet is past over it. This removes all but traces of the iron and then the sand is washed with acid and water. In glass for other than optical purposes the iron is not so carefully removed but the green color, which it imparts, is neutralized by the addition of manganese dioxid. The reddish tint of the latter constituent neutralizes the green of the iron.

HOW OPTICAL GLASS IS MADE.

The first step in the manufacture of optical glass is to preheat the clay pot for a *period of seven days* to a temperature of 2,500 degree Fah. Then into this are weighed at intervals of fifteen minutes for one hour cullet, i. e., optical glass of an inferior quality from a previous melt, in lots of 100 pounds each. This is followed with pure batch materials in successive lots of 400 pounds, each at intervals of two hours, accompanied by hand stirring. The mass is then machine stirred for four hours, after which it is removed from the furnace, covered with earth and allowed to cool, or anneal, *slowly for four days.* And it is right at this point that the most critical part of the whole procedure comes. *The resulting product should be structureless, perfectly uniform and absolutely free from crystallization.* If crystallization or "devitrification" as it is called, sets in the glass will be ruined for optical purposes. This condition will result from the too slow cooling and gives rise in the body of the glass to a

Brush Up
ON
Theory and Code
GET A
Commercial License

Jobs are always waiting for good operators. Study where you get the close personal attention of the finest and most experienced men in the Radio field. We placed approximately three hundred men last year.

Y. M. C. A. RADIO SCHOOL
152 East 86th Street, New York, N.Y.
"The Best Radio School in the East"

NOTE:—We have on hand a select list of Radio text books and blueprint diagram of complete commercial ship set, which we recommend for home study.

No Seals-No Secrets
—But Service!

Inspection of the interior of any Radio apparatus bearing the mark:

GREBE RADIO

reveals design and workmanship fully in keeping with its outward appearance.

GREBE RADIO apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service. Our interest in the purchaser does not terminate with the sale.

Ask your dealer to show you our line of supergrade apparatus.

A. H. GREBE & CO., Inc.,
70 Van Wyck Blvd., Richmond Hill, N.Y.

NEW DIAL INDICATOR



Fits standard ¼" Shaft. Made of same quality as our smaller dial. Black composition. White filled engraving. Bevelled edge.

3" Dial.....$0.75. With Knob.....$1.30 Postpaid
3⅞" Dial..... 1.00. With Knob..... 1.70 Postpaid

Moorhead Electron Relay New Style....$6.00
Moorhead V.T. Amplifier..... 7.00
Moorehead Extra Hard V.T..... 7.50

Shipping weight 1 pound. Guaranteed. Licensed under Fleming and De Forest Patents.

Our new Catalog now ready, send 10c for it.

For sale at all RADISCO Agencies and by

A. H. CORWIN & CO.
4 West Park St. Newark, N. J.

large number of beautiful crystals of a mineral known as "Wollastonite." At other times this devitrification manifests itself in the formation of very small crystals of some one of the mineral ingredients and renders the glass dim or opaque. The only remedy for this condition is more rapid cooling and occasionally this process must be artificially hastened by playing a stream of water over the pot of glass as it is removed from the furnace. Another cause of this devitrification of glass is the solution and subsequent crystallization of small portions of the melting pot itself, for molten glass is one of the most corrosive substances known to science. This last source of trouble, however, may be eliminated very largely by proper stirring.

After the glass has cooled sufficiently, the pot is broken away and the chunks of glass are sent to the examination room. All portions not having the qualities of good optical glass are sent back to be used as cullet for another melt, while the good glass goes to the press room. In the press room the chunks are slowly reheated until soft, and then prest into slabs in powerful hydraulic and pneumatic machines. They are then annealed and laid in frames on a grinding table covered with fine sand or emery and ground to a smooth surface. The polishing is accomplisht by driving to and fro over their surfaces an iron block covered with felt and rouge. Rigid inspection for striae and bubbles follows. The latter are detected by looking thru the slabs toward a dark cloth, while a narrow ray of light enters the glass at right angles to the line of sight. Defective spots are marked and removed by sand blast. All accepted glass is reheated, prest and very slowly annealed.

GRINDING AND POLISHING.

Of all the manifold uses to which glass is put there is none that requires so many hours, and even months and years, of painstaking work as the grinding of lenses. After the glass maker has done his work and succeeded in producing glass of perfect optical qualities, this labor may all be brought to naught by lack of skill in grinding. While we cannot describe here this most important work, it may be pointed out that the giant Yerkes refractor, the largest telescope lens in the world weighs a half a ton and *required two and a half years* for the grinding at a cost of $125,000. The block of glass for the big 36-inch refractor of the Lick Observatory was poured at the Paris glass works twenty times, with a month consumed after each pouring in the *annealing,* before a satisfactory product was obtained. The manufacture of camera lenses, too, has become a highly specialized art, as rigidly exact and painstaking as the making of a large refractor. So large must the output of these lenses be that much of the hand grinding and polishing has long since been superseded by motor-driven machinery. Incredible as it may seem this grinding is carried to an accuracy of *one fifty-thousandth of an inch.* In the objective of a compound microscope there are six lenses, the smallest of which is only one-sixteenth of an inch in diameter. The machinery for grinding it is a marvel in itself, and the grinding is done by trained technicians who have worked at the art from boyhood. By the sense of touch they are able to determine the progress of the work, and the finished product must be as perfect as the largest refractor.

The requirements imposed by the treatment to which *chemical glassware* must be subjected are rigid in the extreme. It must be thin so that the unequal heating of inside and outside in breakers and flasks will not cause breaking. It must have a higher melting point than has ordinary glass. It must be able to resist the corrosive action of strong acids and alkalis. For these reasons potash is substituted for soda in its composition and being of higher melting

$100 to $350 Profit Every Month

Actual Records HB Monthly Profits

C. H. Tucker, Oklahoma, $275.00.—Du-Quoin Battery Sta., Illinois, $105.00.—Miller Battery Co., Illinois, $470.00.—Peal, Indiana, $185.00.—A. R. Justice, Kansas, $136.00.—H. I. Chaney, Ohio, $439.00.—S. A. Gourney, Louisiana, $130.00.—Valley Battery Co., Pennsylvania, $130.00.—A. S. Gray, Kansas, $128.00.—F. T. Hill, Indiana, $141.00.

Remember, these are average monthly profits not special tests. We have letters from these HB users in our files, and hundreds more giving like reports. What these men have done, you can do. Big, quick, clean profits—easily made.

An HB Battery Charger Pays for Itself from Your Profits

All it takes to start a big, profitable, permanent battery charging business is the first small cash payment on an HB Charger. Profits start rolling in as soon as the HB outfit is uncrated and hooked up to your power lines. Your profits easily carry the small monthly payments. It costs 10c to 15c each to charge batteries, any voltage. Customer pays 75c to $1.50. Figure your profits! No burn-outs, no expensive renewals—nothing to wear out or break. HB Chargers are stoutly built of sturdy, wear-resisting materials and last for years of hard 24-hour-a-day service.

Small Cash Payment-Almost a Year to Pay the Balance on Easy Terms

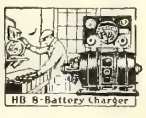
There is an HB Charger to fit any size battery business. The only capital needed is the small cash payment. Experience in electrical work is not necessary. You buy your HB Charger on our absolute guarantee of complete satisfaction or money refunded. Our long time easy-payment plan is an additional guarantee. Hundreds of men are making big profits in HB Battery Charging. Why not YOU? Choose the size Charger you need, then mail the coupon for complete information. Start NOW, when the demand is greatest. Make those profits.

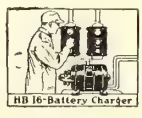
Use this Handy COUPON Send it TODAY

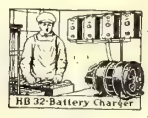
TEAR HERE

HOBART BROTHERS COMPANY,
Box 77E, TROY, OHIO

Send me complete information about the HB Charger marked (X), also details of your Easy Payment Plan.


HB 8-Battery Charger


HB 16-Battery Charger


HB 32-Battery Charger

Name .....
Address..... State.....

Radio Men
The Mutual Purchasers Association will save you money on all
Wireless Apparatus
Write Dept. E.E. for details.
MUTUAL PURCHASERS ASS'N,
2-4 Stone Street, New York

You can be quickly cured, if you
STAMMER
Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.
Benjamin N. Bogue, 768 Bogue Bldg., Indianapolis

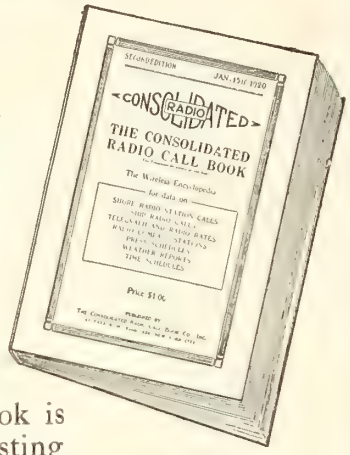
The Second Edition of the

Consolidated Radio Call Book

Will Be Out in Two Weeks

It was unavoidably delayed

owing to the vast amount of work involved in bringing it right up to date and in compiling the big amateur section that will be a special feature. We urge all those who have placed their orders to be patient—you'll be glad you waited when you receive your copy, which will be very soon.



The Consolidated Radio Call Book is the only book in print officially listing all the radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.

All Amateur Calls Also Listed

SPECIAL

Given Free with Each Copy

A Wireless Map of the World **in colors** is given absolutely free with each copy. This map shows the locations of all the high powered RADIO stations in the world, including the time signal stations. In addition it tells at a glance how far away any of these stations are. Of greater interest are the time zones, which enable the amateur to compute instantly the correct time for the zone in which he is located from any time signal station.

Price $1.00 Prepaid

Either Direct from us or for sale by the following responsible Dealers:

American Electro Technical Appliance Co., 235 Fulton St., New York, N. Y.
Atlantic Radio Co., 34 Batterymarch St., Boston, Mass.
L. Bamberger & Co., Newark, N. J.
J. H. Bunnell & Co., 32 Park Place, New York City
California Electrical Supply Co., 643 Mission St., San Francisco, Cal.
L. W. Cleveland Co. 441 Congress St., Portland, Me.
Cutting & Washington Co., 6 West 48th St., New York City
De Forest Telephone & Tel. Co., 1391 Sedgwick Ave., New York City
Dewey Sporting Goods Co., 268 West Water Street, Milwaukee, Wis.
Doubleday Hill Electric Co., 719 Liberty Ave., Pittsburg, Pa.
A. T. Hovey, 61 Belvidere St., Boston, Mass.
Lester I. Jenkins, 923 Purchase St., New Bedford, Mass.
F. S. Katzenbach Co., 35 E. State St., Trenton, N. J.
Klaus Radio Apparatus, Eureka, Ill.
Arno A. Kluge, 638 So. Figueroa St., Los Angeles, Cal.
Manhattan Electrical Supply Co., 17 Park Place, New York City. 114 S. Wells St., Chicago, Ill. 1106 Pine St., St. Louis, Mo. 604 Mission St., San Francisco, Cal.
McCarthy Bros. & Ford, 75 W. Mohawk St., Buffalo, N. Y.
A. C. McClurg & Co., 218 So. Wabash Ave., Chicago, Ill.
Mohawk Electrical Supply Co., 325 So. Warren St., Syracuse, N. Y.
National Radio Supply Co., 1405 U St., N. W., Washington, D. C.
Newman-Stern Co., 1874 E. Sixth St., Cleveland, Ohio.
Nola Radio Co., 134 Chartres St., New Orleans, La.
E. P. Noll & Co. 21 No. 7th St., Philadelphia, Pa.
George W. Parezo & Co., 808 Ninth St., N. W., Washington, D. C.
Pioneer Electric Co., 137 East 5th St., St. Paul, Minn.
F. D. Pitts Co., 12 Park Square, Boston, Mass.
Precision Equipment Co., 2437 Gilbert Ave., Cincinnati, Ohio
Radio Corporation of America (Marconi Co.), Gay and Pratt Sts., Baltimore, Md.
Radio Distributing Co., 4 West Park St., Newark, N. J.
Radio Engineering Co., 614 N. Calvert St., Baltimore, Md.
Radio Equipment Co., 630 Washington St., Boston, Mass.
Reuter Electric Co., 34 East 6th St., Cincinnati, Ohio.
Rudolph Schmidt & Co., Inc., 51 Main St., E., Rochester, N. Y.
Shaffer's, 107 Granby St., Norfolk, Va.
Shotton Radio Mfg. Co., Scranton, Pa.
Smith Novotoy Electric, Inc., 20 West 5th Street, Charlotte, N. C.
Southern Electrical Co., Third and E Sts., San Diego, Cal.
H. E. Williamson Electric Co., 316 Union St., Seattle, Wash.
Young Men's Christian Association, 715 South Hope Street, Los Angeles, Cal.
Jos. M. Zamoiski Co., Baltimore, Md.

Published by

Consolidated Radio Call Book Co., Inc.

41 Park Row, New York City

point it is more difficult to blow. Some of the most skillful work of the whole industry is to be seen in the marvelous facility with which these genie of the blowpipe fashion the many intricate and often delicate pieces of chemical apparatus. Formerly this glassware was all made in Europe, particularly at Jena, Germany, long famous for the superior quality of its chemical glass. But the War has changed all this and we now make in this country glass in all respects *better* than what was imported in former years.

PLATE AND WINDOW GLASS.

Plate glass is *machine made.* In huge furnaces the melting pots are heated and when the melt is ready a traveling crane seizes the pot and pours its molten contents upon a casting table, consisting of a cast iron plate over which is suspended a heavy iron roller so adjusted that it may be set at any desired distance above the table-plate. After it has been rolled to the proper thickness the plate of glass is transferred to the annealing oven, where it slowly passes thru a long tunnel heated to a high temperature at the starting end and gradually cooling to ordinary temperature at the other. It is removed from the oven and cemented by Plaster of Paris to a large revolving table where it is ground at first with coarse emery dust, then with finer material and finally it is polished with mechanical rubbers covered with felt and iron oxid.

Window glass is now blown by machinery into huge elongated cylinders until the walls are of the proper thickness and then it is cut lengthwise and flattened out in a flattening furnace. The cutting is done by stretching along the glass a small iron wire and passing thru it a current of electricity. This heats the wire to incandescence and the glass breaks along the line. Bottles are blown to shape in molding forms. So, too, are lamp shades. Glass is frosted either by immersion in a solution of hydrofluoric acid or by directing against it a blast of sand, by the force of comprest air.

The color of glass is due to the presence of small quantities of metallic oxides. Cobalt gives blue. Iron and chromium give green and cuprous oxide or metallic gold produce ruby glass. The gold is present in the form of small metallic particles thoroly disseminated thruout the mass. With the very intense light and high magnifying power of the ultra-microscope these infinitely small particles stand forth like glistening points, and are seen to move to and fro in zig-zag paths with a very rapid motion.

In former years the glass industry in this country was governed very largely by the "ancient rule of thumb" but every glass plant now has its chemical laboratory and has come under the sway of the finger of modern Science.

STUDENTS DANCE TO RADIO JAZZ.

Music was transmitted half a mile by radio and was sufficiently loud at the receiving end for dancing, according to announcement from the University of Pittsburgh, which, with the Carnegie Institute of Technology, conducted the experiment.

The Tech orchestra sat in Central Hall and played a jazz tune, while the Pittsburgh University students gathered in Heinz House, half a mile away, and danced two numbers. Prof. Edwin R. Rath at the experiment station of the university transferred the music by the use of a Magnavox and two strings of electric wires.

The Pitt experiment station is nearly half a mile from Tech Hall and the Heinz House is equally distant from the experiment station and the hall. In this roundabout way the music was transmitted a distance of a mile.

RADIO APPARATUS

Distributors of Reliable Radio Apparatus for Experimenters in Every Branch of the Radio Field.

"Pittsco" the Sign of service.

PITTSCO

All we ask is a trial!

HONEY-COMB COILS

LITZENDRAHT WIRE. (While they last.)

LL-75	330-1030	meters	$1.60
LL-100	450-1460	"	1.70
LL-150	660-2200	"	2.00
LL-200	930-2850	"	2.10
LL-250	1300-4000	"	2.30
LL-300	1550-4800	"	2.50
LL-400	2050-6300	"	2.80
LL-600	4000-12000	"	3.00
LL-750	5000-15000	"	3.20
LL-1000	6200-19000	"	3.50
LL-1250	7000-21000	"	3.90

Note:—These are the genuine De Forest litz coils.

Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.

Dept. D

12 Park Square, Boston 11, Mass.

Radio Parts Supplies

Bakelite-Dilecto sheet, rod, tubes. Hard fiber sheet, rod, tubes. Copper and brass sheets, rods and tubes, brass and iron machine screws, brass wood screws, molded knobs, switch points, and levers. Binding post, sheet aluminum. Hard rubber sheet, tuning coil cylinders, etc., etc.

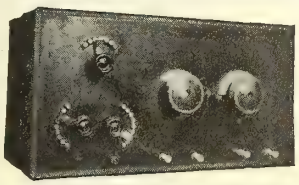
Complete price list sent for 5 cents in stamps.

KEYSTONE RADIO COMPANY

Drawer 307 **Greenville, Pa.**

Formerly O. L. Bortz Machine Co.

BUILD YOUR OWN WIRELESS RECEIVING SET



You can **SAVE** at least **$25.00** By buying parts and assembling yourself

Think of the pleasure and practical experience you will gain in making your own set, with wavelength range from 170 to 2,500 meters.

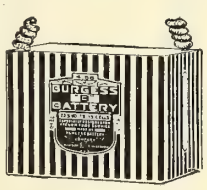
We furnish full-sized Blueprint and complete detailed instructions for making this set and prices of parts for $1.00.

Write today and get started

K. & G. WIRELESS SUPPLY CO.

Dept. 15A, 152 Chambers Street, New York City

BURGESS "B" BATTERIES



These batteries proved so successful in Government Apparatus that they are being used by progressive amateurs. Made in three sizes and now available for general use. For full information write to

BURGESS BATTERY COMPANY

Harris Trust Bldg. -:- **Chicago**

READ THE CLASSIFIED ADDS ON PAGES 348-351

Shafts of Light Regulate Street Traffic

By EDWIN F. LINDER, M.E.

(*Continued from page 256*)

Having brought both vehicles and pedestrian transit to a stand-still, he now opens up traffic for automobiles going east on the "Avenue." To accomplish this he presses the "white D" button which operates the mechanism in such a manner that it moves the ruby glass wing and leaves the searchlight beam *exposed;* thus projecting a white beam from the head of the column D; thereby giving the right of way to the eastbound traffic on the south side of the "Avenue." At this time other traffic is stopt at the three other points A-B and C.

Having gained control of the situation the officer desires to permit the people to pass on foot from A to C and from B to D, while the vehicles are moving in both east and west directions along the "AVENUE." To give the proper signal, he allows the ruby glass to remain over the searchlights at A and B, pushes the "white C" button, thereby giving the "clear" signal to west bound traffic on the north side of the "AVENUE."

The same method is used for controlling the north-bound and south-bound traffic on the "STREET," of course in order to give the proper signals the officer must operate the switches controlling the mechanisms for that purpose.

It can readily be seen that in the event of an emergency, demanding the immediate halting of all traffic, such as clearing the passages for fire-apparatus or ambulance service, the projecting of all four shafts of red light at the same instant would be so conspicuous that they *could not escape detection* by any one, even tho a mile away. It would also give ample notification to the officers at the intermediate posts between such busy traffic signal stations to prepare for the on-rushing fire engines by warning people to keep on the sidewalks.

The Aurora Borealis

By PROF. LINDLEY PYLE

(*Continued from page 255*)

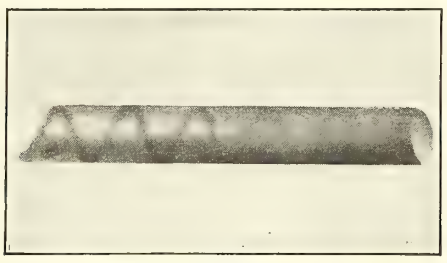


Figure 2.
Spiral Formation of Cathod Rays in a Uniform Magnetic Field Where the Lines of Force Are Oblique to the Direction of the Emission of the Rays.

of trajectories in his own theory, calling attention to the fact that his positively charged particles will turn around the magnetic axis of the earth in the opposite direction—in his own words, "paths of positively charged particles are the mirror image of the negative ones with respect to a plane thru the sun and the magnetic axis of the earth." The positively charged alpha-particle has much greater mass than the negatively charged cathode ray particle; it is deviated less by the gases it penetrates; and it has other properties differing markedly from those of the negatively charged particle. Vegard feels that the positive particle theory gives a simpler explanation to auroral forms, especially the drapery structure, than does the negative particle theory. Very possibly the ultimate theory will be an amalgamation of these two. Possibly



Choose as Your Profession Electrical Engineering

Electricity offers a brilliant future to the young man who is about to choose his career. Never before has there been such wonderful opportunity in this great field. Big paying positions in electrical work the world over are open to trained men—men who possess specialized, practical knowledge. Come to the School of Engineering of Milwaukee—the largest and best equipped electrical school in America. Here you are trained in both theory and practice by a faculty of over 90 experts. You learn in large, finely equipped laboratories.

B. S. Degree in 3 Years

If you have 14 high school credits or equivalent, you can become an Electrical Engineer with a Bachelor of Science degree in 3 years. If you lack these credits they can be made up in our Institute of Electrotechnics in a short intensive course.

Earn While You Learn

By our special system you may earn your way while learning. Our Employment Department will secure you a position to which you may devote a part of each day, spending the remainder at the school. This plan both solves the students' financial problems and provides splendid experience at the same time. Low tuition fee and Fraternity House for all students who wish to secure board and room **at cost.**

Fall Term Begins October 1st

Write for Catalog

Write to-day for our free, illustrated catalog. Read about this wonderful institution and the great opportunities that lie before you. Find out about our specialized method of training and the details of our "Earn While You Learn" plan.

SCHOOL OF ENGINEERING OF MILWAUKEE

Dept. A-17—373 Broadway, Milwaukee, Wis.

School of Engineering of Milwaukee,
Dept. A-17—373 Broadway, Milwaukee, Wis.

Please send me your free illustrated catalog on Electrical Engineering and give me full details of your "Earn While You Learn" plan.

Name .....

Address .....

Town..... State.....

Age..... Experience.....

FREE — **Radio Handbook & Catalogue**



Contains much valuable radio information, tables and data. Describes a remarkable line of wireless instruments including "Red Head" 'Phones, Arlington Tested Minerals, DeForest, Murdock and Signal Apparatus. Write for this book today.

The Newman-Stern Co.

Dept. E. E. **Cleveland, O.**

Red Head Radio Phone



$7.00

The accepted standard in wireless receivers. If they are not BETTER than anything you've ever seen return them for full cash refund. Our Radio Handy Book and Catalogue, free on request, describes them, and many other instruments.

The Newman-Stern Co.

Dept. E.E. **Cleveland, O.**

ARLINGTON TESTED CRYSTALS



Why buy minerals on a gamble? Be SURE when you put a crystal in your detector that it is EXQUISITELY SENSITIVE. Buy Arlington individually tested Minerals, Galena or Silicon, post paid on receipt of price.

35¢

THE NEWMAN-STERN CO.

Dept. E.E. **Cleveland, O.**

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures but 4¼ Inches Long. Takes Regular .22 Calibre Cartridges

The new Baby Double Action Hammerless Revolver has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of Efficiency and Practicability. It is small in size yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety that guards against accidental discharge, making it quite safe for young and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be appreciated. The ammunition used is the standard 22-calibre cartridge obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable, six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel cylinder, and it weighs only 4½ ounces. The price of the Baby Revolver is only $6.50 sent by mail, p.pd. to any address.

$6.50

AGENTS WANTED

Cut Your Own Hair WITH THIS

ONLY 35c

SAFETY HAIR CUTTER Can cut your own hair with this marvelous invention. Cuts the hair any desired length short or long. Does the job as nicely before your own mirror. You can cut the children's hair at home in a jiffy. Can be used as an ordinary razor to shave the face or finish around temple or neck. Sharpened like any razor. Lasts a lifetime. Saves Ra cost first time used. PRICE ONLY 35c, postpaid. Extra Blades 5c.

JOHNSON SMITH & CO., Dept E20 3224 N. Halsted Street, CHICAGO

THE U.S. BABY TANK **It goes with real Yankee Pep—by its own power**

Most remarkable Toy ever invented. By drawing the Tank backward, either with the hand or over the floor or table and then placing it down, it will crawl along, overcoming all obstacles, in the same life like manner as the larger Tank that proved so deadly in the great war. What makes it go is somewhat of a mystery, for there is no mechanism to wind up as is usually understood with mechanical toys, yet this tank will keep plodding along ten times longer than the ordinary run of toys. It will perform dozens of the most wonderful stunts; it will go backward or forward at will, and altogether will give you more fun and amusement than any other toy yet brought out. 2¾ inches long. Each packed in colored box. Price only 35 cents prepaid, three for One Dollar, or $3.00 by the dozen, postpaid to any address in the world.

Johnson Smith & Co.

MAGIC FLUTE

Wonderfully Sweet Toned and Musical

The Magic Flute, or Humanatone, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it, which when once acquired after a little practice, will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is as charming as it is surprising. 25c ppd.

Post Paid **25c**

JOHNSON SMITH & CO., Dept E20 3224 North Halsted Street, CHICAGO

Good Luck Ring

Quaint and Novel Design

A VERY striking and uncommon ring. Silver finish, skull and crossbone design, with two brilliant, flashing gems sparkling out of the eyes. Said by many to bring Good Luck to the wearer hence its name, Good Luck Ring. Very unique ring that you will take a pride in wearing. ONLY 25 CENTS.

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, emits rays of white light, rendering it powerfully visible in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES. Quite simple to use. Anyone can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles, make your own Luminous Crucifixes, Luminous Rosaries etc. Small bottle, price 25c. Larger sizes, 50c and $1 postpaid.

Mystic Skeleton 10c pd

A jointed figure of a skeleton 14 in. in height, will dance to music and perform various gyrations and movements while the operator may be some distance from it.

Serpent's Eggs

Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most life like manner. Price per box, 10c ppd.

JOHNSON SMITH & CO., Dept. E20 3224 North Halsted Street, CHICAGO

All the Latest Surprising and Joke Novelties

Pharo's Serpents Eggs, box	10c	Mesmerized Penny-riddles the law of gravitation	20c
Miniature Water Pistol	10c	Mysterious Tumbler and Vanishing Coin Trick	25c
Cleopatra's Snake (very lifelike)	10c	Magic Plate Lifter	20c
False Mustache (fool your friends)	6c	Great Burglar Puzzle	10c
Automobile Puzzle (Latest)	20c	Wire Puzzles, 12c, 22 different, $2.50	
Mysterious Ghost, shines at night	10c	"Rec-Trick" Funk Bonbon	10c
Rubber Dagger (sensational)	20c	Inkless Pen (writes with water)	10c
Lookback scope (see behind you)	10c	Imitation Bed Bugs	10c
Great Mind Reading Mystery Cde	10c	Smart Ring	25c
Thurston's Mysterious Trick Cde	10c	Glass Watch	25c
X Ray Novelty	10c	Multiplying Billiard Ball Trick	25c
Trick Pencil	15c		
Rubber Tacks (a good joke)	10c		

JOHNSON SMITH & CO., Dept. E20 3224 North Halsted Street, CHICAGO

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

SAVE OVER HALF

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

Write Today for Our Free Blue Print Offer

Agents wanted for our ready built phonographs

Choraleon Phonograph Co.
707 Choraleon Bldg., Elkhart, Ind.

EASIEST SHORTHAND

Learn in 8 evenings home study: then acquire speed with K. I. Shorthand. Amazingly simple, easy. Approved by experts. Write dictation, messages, etc., rapidly as spoken, after brief pleasant practice. Favorite method for personal use; make notes at lectures, meetings; keep confidential diary. Big help in any profession or business, and in your career. Used in Army, Navy, courts, commercial schools; by public and private stenographers, teachers. Silent cost. K. I. Shorthand—for busy people, including YOU. Proof Lessons, Guarantee and Brochure with Testimonials free, postpaid. Address:

KING INSTITUTE, EL-300-Station F, NEW YORK CITY

SELL SANITARY BRUSHES!

You can make big money because the need of our goods is great! A hundred different kinds of brushes for homes, hospitals, public buildings, garages, barber shops, etc. Splendid sales helps and fine sample cases free to salespeople. Unique plan of gaining entrance to homes by invitation. Credit to reliable people. Learn about the best line sold direct to the user -- the big line of everyday, useful home goods!

BIG COMMISSIONS AND PROTECTED TERRITORY

NORTH RIDGE BRUSH CO. Box 32, FREEPORT, ILL.

charged particles may be operating whose nature may be as yet unfamiliar to us, since there seem to be well authenticated cases of auroral rays penetrating the atmosphere to within a kilometer of the earth, or roughly two-thirds of a mile. This corresponds to a luminescence-producing radiation more extreme than any that has yet been observed in any laboratory experiment.

Incidentally the aurora gives interesting information regarding our atmosphere in that Lenard has shown that auroral displays at a height above 300 kilometers (say 200 miles) indicate the presence there of gases of very small density such as helium and hydrogen. This checks certain trustworthy calculations of the composition of

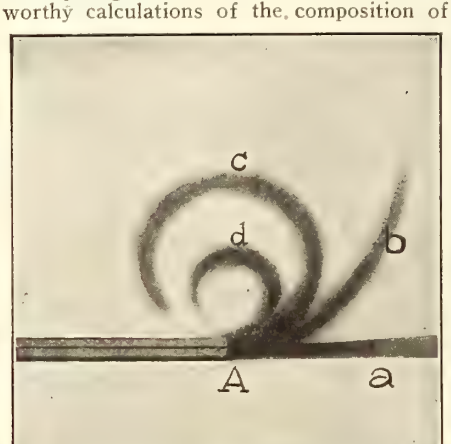


Fig. 1

Spiral Movement of Cathode Rays in a Uniform Magnetic Field Perpendicular to the Direction of the Emission of the Beam. A. Cathode Consisting of an Aluminum Wire Exactly in the Opening of a Small Glass Tube Giving a Very Fine Pencil of Rays. a. Pencil of Cathode Rays Before the Magnetic Field Has Started. b, c, d. Three Different Circular Spirals of the Rays for Three Different Values of the Magnetic Field.

the atmosphere at varying heights in which there has been found a thick layer of practically pure hydrogen at a height of over 60 miles. Störmer's study of the long and faint auroral rays in this hydrogen layer enabled him to compute the probable temperature thereof—a temperature of approximately—175° C., nearly 300° Fahrenheit below the freezing point of water.

Surely in the face of the checking of experimental and observational evidence with theoretical deductions we cannot but accept the theory that auroral displays are closely connected with an electrified emanation from the sun. Certain details of the theory need further development, but that time is near at hand when Science can claim to have "explained" what has always appeared to mankind as one of the most mysterious and magnificent of natural phenomena.

Triple Camera Photos Lightning Flashes

By ALFRED GRADENWITZ

(*Continued from page 259*)

By comparing the third view with the two stereoscopic pictures, the main flash of lightning is found to coincide with less than 0.001 second with the last partial discharge of the hindmost cloud lightning, thus proving with nearly absolute certainty an *electrical connection* between two discharges entirely independent in space.

LIGHTNING FLASHES NOT INSTANTANEOUS.

These researches proved especially valuable as a means of ascertaining the origin of the paths of lightning flashes. Similarly as an electric spark, a lightning flash, as a rule, is not produced instantaneously, but is

Is Your Blood Starving For Want of Iron?

Iron is Red-Blood Food—Nuxated Iron Helps Put Roses Into the Cheeks of Women and Gives Strength and Energy to Men

If you were to go without eating until you become weak, thin and emaciated, you could not do a more serious harm to yourself than when you let your blood literally starve for want of iron—iron that gives it strength and power to change food into living tissue, muscle and brain. Without plenty of iron in the blood, no matter how much or what you eat, your food simply passes through you without doing you any good—you don't get the strength out of it and instead of being filled with youthful strength and energy you are weak, nervous and all run-down. If you are not strong or well you owe it to yourself to make the following test: See how long you can walk or how far you can walk without becoming tired. Next take two five-grain tablets of ordinary Nuxated Iron three times per day after meals for two weeks, then test your strength again and see how much you have gained. Numbers of nervous, run-down people who were ailing all the while have most astonishingly increased their strength and endurance simply by taking iron in the proper form. But don't take the old kinds of iron simply to save a few cents. You must take iron in a form that can be easily absorbed and assimilated like Nuxated Iron if you want it to do you any good, otherwise it may prove worse than useless. You can procure Nuxated Iron from your druggist on an absolute guarantee of satisfaction or your money will be refunded.

PROSPECTIVE STUDENTS

B. C. N. will give you your N.D. degree in two years, day and night classes. This institution teaches Electrical Therapeutics, Static, High Frequency, Violet Ray, Galvanic Current, X-Ray, Osteopathy, Orthopaedics, Chiropractic, Psychology, as embodied under the Triplicity of Sciences known as **Natureopathy.** The field is unlimited right now for Natureopathic Physicians. Our experienced faculty of fourteen practical physicians will guide you surely and carefully to attain success. Earn while you learn if you so desire. Graduates of single branch schools who are here now say that the Blumer System is the most wonderful drugless healing system in existence. Write today for our catalogue. Start right. Address Executive Secretary,

BLUMER COLLEGE of NATUREOPATHY
97 Ann St., Dept. H., Hartford, Conn.

15 cents postage will bring to you "The Scientific Natureopath." Address Publicity Dept. of the above college.

Telegraph Pictures

BY ELECTRICITY



Complete sets of two machines of this marvelous equipment at ridiculously low prices. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Will transmit pictures, maps drawings and hand writing. Picture telegraphing is the coming science. Write today.

J. LEISHMAN CO., Dept. T Ogden, Utah

Sanity in Sex By WILLIAM J. FIELDING

A popular presentation of the vital problems of sex. Intensely interesting. Gripping. Frank. Convincing. Descriptive circular on request.

Price $1.75, postpaid

DODD, MEAD & COMPANY
445 Fourth Avenue New York

Chicago Medical School

Offers Accredited

DAY AND EVENING COURSES

in medicine and surgery leading to the degree of DOCTOR OF MEDICINE. Also offers through its affiliated college opportunity to complete premedical credits. WORK YOUR WAY PLAN.

Address **REGISTRAR**
3832 RHODES AVE. Dept. 7 CHICAGO

Battery Charging Pays



$100 to $200 extra profit every month in HB Battery Charging. You can make big profits. This HB Charger will recharge 1 to 8 auto storage batteries at one time, with a current cost of only 10c to 15c per battery. Autoist pays 75c to $1.50. Figure your profits.

Small Cash Payment Puts This Money-Maker In Your Garage

Balance in easy monthly payments which earnings should easily pay, with good profits besides. No risk. Absolute money-back Guarantee. Write TODAY for full particulars.

HOBART BROS. CO., Box 71E, Troy, Ohio



Packard

Wireless Transformers

Will give you a greater sending range. 1600 miles have been covered with a ½ K. W. Write for Bulletin EE.

The Packard Electric Company
Warren, Ohio

MEMORIZE CONTINENTAL CODE ALMOST INSTANTLY

This method THE short cut to success

After September 1st FIFTY CENTS
Until then

COMPLETE CHART
and full instructions TWO DIMES

C. K. DODGE
Box 300 Mamaroneck, N. Y.

AMATEURS

YOU REQUIRE SWITCH POINTS AND BINDING POSTS FOR THAT NEW SET.
SWITCH POINTS THAT ARE ACCURATE.
¼" Diameter and ¼" High, Shanks for 6-32 Nut—SIZES as below, Postpaid.
This Month Only
⅜" Shank, Nickel Plated, $1.00
½" Shank, Nickel Plated, 1.00
⅝" Shank, Nickel Plated, 1.00
Dependable Radio Equipment and Parts
See catalogue No. 9

DORON BROS. ELEC. CO.
Manufacturers, Hamilton, Ohio

The
WIRELESS EQUIPMENT COMPANY, Inc.

Furnishes all kinds of reliable radio apparatus at lowest prices. Send for latest bulletin No. 146C on new apparatus.

188-190 Greenwich St. New York

30 DAY SPECIAL OFFER

THE WIRELESS EXPERIMENTERS MANUAL (E. E. Bucher's New Book) Price $2.25
and one year's subscription to THE WIRELESS AGE $2.00

Both for Only $3.75
Postage outside U. S. 50c extra. Send for catalog.

Wireless Press
326E Broadway
New York City

SPECIAL SUMMER SALE! **GROUND WIRE** 8c per ft. $7.00 per 100 ft.

Lightning Switches, 600 V., 100 Amp., only.... $4.00
Original Audiotron Adaptors..... $1.75
Standard "VT" Sockets with positive contacts. $1.00
Moorhead Electron Relays with Standard VT base $6.00
(Fully Licensed and Guaranteed. See Moorhead Adv.)

RADIO EQUIPMENT CO.
630 Washington St. Boston, 11, Mass.

CATALOG J.

Contains 24 pages of reliable apparatus, standardized parts and raw materials. Complete line switch points, knobs, switches, rod, aerial wire, etc.

Send 5c in stamps for your copy today.
Shotten Radio Mfg. Co., P. O. Box 3, Scranton, Pa.

started by several brush-like "preliminary" discharges, following up one another by jerks. This was strikingly illustrated by Walter's triple-camera lightning flash pictures. In one case the preliminary discharges of three branches were found to have occured 0.00885, 0.00795 and 0.00569 second respectively, before the main discharge, so that the total time of production of the lightning flash was 0.00885 second.

The course taken by a lightning flash in time, as well as in space, shows enormous variety. The human eye, of course, is quite unable to separate the individual discharges following up one another at small fractions of a second. On the other hand, there are also flashes actually consisting of a single instantaneous stroke. There are sometimes separate discharges quite different in shape following up one another; these, of course, constitute independent flashes of such short duration that even the moving plate will reproduce them as well defined lines. Another frequent case is the simultaneous flashing up of several independent discharges. In such cases, there might, of course, be an electrical connection between the various flashes, and such phenomena, as in the case above discust, have actually been brought out already by lightning flash photographs with Professor Walter's triple camera.

How to Make a "Tattooing" Machine

By DAVID T. WEINBERG

(*Continued from page* 293)

diagram, since this tube acts as a sleeve in order that the needle will not penetrate the skin too deeply. This tube is also to contain the coloring fluid.

In the left-hand wooden end-piece slot the center so that a 6/32 screw will move freely—the slot extending ½ inch in length. Next drill a hole in the base so the tube can pass thru and have the tube fit flush against the end-piece, even with the slot. Then drill and tap a 6/32-inch hole at the upper end of the tube, so the screw will fit, thus allowing adjustment.

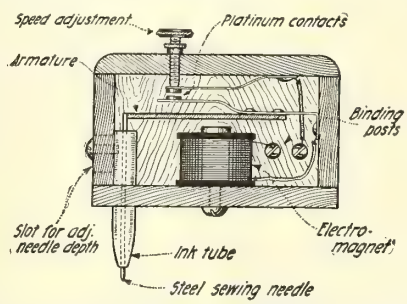


Diagram Showing the Construction of Electric Tattooing Machine, Which Can Be Readily Constructed From the Electro-magnets Found In An Old Buzzer Or Bell.

Under the top-board which is practically of the same dimensions as the base, place a springy piece of metal, either brass or steel, and attach a platinum or silver contact point to same; then arrange it as in diagram onto the top piece so that the contact will touch that on the vibrator.

The last few steps in completion of the tattooing machine are now at hand. Obtain two small binding posts and attach them to the frame as shown.

To use this tattooing machine connect a flexible telephone cord to the binding posts and to the terminals of about two or three dry cells in series, then turn the thumb screw until the vibrator operates at full rate of speed. Adjust the sleeve so that the needle when vibrating will project about 1/32-inch or a little less.

In tattooing, use an ink free from acid. Regular tattooing ink can be purchased from supply houses. After tattooing, wash the skin with peroxid.

DRAFTING



Learn at Home!

Employers everywhere are looking for skilled draftsmen. They are offering splendid salaries, and good positions are always open.

No line offers greater opportunity for advancement. Drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture.

There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving men and women just the training they need for success in Drafting and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help but never were opportunities so great as now.

Let the I. C. S. help *you.* Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6239, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____
7-26-19
Present Occupation_____
Street and No._____
City_____ State_____

SKINDERVIKEN BUTTONS $1

Radio Apparatus Bought, Sold, Built

C. McCONNELL
38 Warner Street
Springfield, Mass.



HERE IT IS

A sign for your den. Exceedingly attractive. Printed in bright red on white cardboard. No electrical bug should be without it. 7¼" x 11¼". 10c each in coin ONLY. Send stamp for postage.
LEONARD BECK, 1298 Carroll St., Brooklyn, N. Y.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section ten cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the September issue must reach us not later than July 25.

The Circulation of the Experimenter is over 160,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Auto Accessories.

Auto Parts. Save 10 to 50% on gears, axle shafts, and other auto parts. We can furnish parts for more than 300 different models. Write us your needs. Money refunded if parts are not satisfactory. Auto Tire & Parts Co., Cape Girardeau, Mo.

Fords run 34 miles per gallon with our 1920 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all Motors. Runs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee. 30 days' trial. Air-Friction Carburetor Co., 270 Madison Ave., Dayton, Ohio.

Blueprints. Automobile Armatures. See ad under "Electrical". Charles Chittenden.

Battery Charging Profits $100 to $250 clear monthly with HB equipment. Your lighting current or engine operates. No expense to you. Easy payment plan lets outfit earn own way. Satisfaction guaranteed. Write Hoberts, Troy, Ohio.

"Protexun" fits over your regular plug. Stops porcelain breakage. Keeps out rain. Prevents fires. Very interesting. Write for details. Irl Hicks, Centralia, Mo.

Auto Motor Supplies—Buick, Michigan, Stoddard Dayton, Cadillac, Overland, E. M. F. Continental and Buda Motors all types $50 each and up. Special high tension 2 and 4 cylinder Magnetos, $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for late catalogue. Address Motor Sales Dept., 12 West End, Pittsburgh, Pa.

Tires—Direct to you prices. Exclusive representatives wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Bond 8,000 Miles. Sample Sections furnished. Mellinger Tire Company, 980 Oak, Kansas City, Mo.

Aeronautics.

Propellers for aeroplane propulsion. Small propellers for motorcycle driven snow and ice sleds. Road speedsters and hydroplanes, five ft. diameter $12, others in proportion. Can supply hub mountings, bearings, counter shafting and sprockets. Complete pamphlets free. Crawford Motor and Aeroplane Mfgr., 144 S. Kampart St., New Orleans.

Motor Engines and Dynamos.

Small Motors and Generators—¼ h.p. A.C., $22.75; ½ h.p., $38.50; ¾ h.p. A.C., $67.50. Battery charging sets, charging lighting and moving picture arc generators. Motors for all phases of current. Prompt delivery. Wholesale prices. Write for late catalogue. Address Motor Sales Dept., 12 West End, Pittsburgh, Pa.

Compressed air rotary motors for model airplanes. Three sizes, ⅜", ½" and ⅝" bone steel cylinders, aluminum pistons and crankshaft case. Send stamps for circular. Model Machine Shop, 415-17 East 71st St., New York.

Agents Wanted.

Free. Latest issue. New formulas. Tells how to make your own goods. Write today. S. & H. Manufacturing Laboratories, 22502 Boylston Bldg., Chicago.

Men and Women make big daily cash profits in handling our Patented "Stick-On" Window Lock. Locks window when open for ventilation. Stops rattling. Instantly attached or removed. No screws or tools necessary. Prevents children from falling out of open window. Big demand; sells on demonstration; as many as one dozen to each home. Whole or part time. Mail 10c for sample and proposition. Address Room 202, 147 Fourth Ave., New York City.

Make $30.00 next Saturday. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Michigan.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Make and sell your own goods. Formulas by Expert Chemists. Manufacturing processes and trade secrets. Write for formula catalog. Chapin Mystic Company, Washington, D. C.

Agents Wanted—(Continued)

Mexican Diamonds flash like genuine, fool experts, stand tests, yet sell for 1-50th the price. Few live Agents wanted to sell from handsome sample case; big profits; pleasant work. Write today. Mexican Diamond Imptg. Co., Box F1, Las Cruces, N. Mex.

Agents—$40-$100 week; free samples; gold sign letters; anyone can put on store windows; big demand; liberal offer to general agents. Metallic Letter Co., 433-Z, N. Clark, Chicago.

Wonderful Chance. Men's shirts and furnishings at wholesale rates or make $10 daily as agent starting real business. Goodell Co., 110 Duratex Bldg., New York.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Signs for store and offices. Entirely new. $50 week easily made. Chicago Sign System, G-326 River St., Chicago.

Insyde Tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts; quickly applied; cost little; demand tremendous; profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, Ohio.

Salesmen Wanted.

Salesmen—City or traveling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment services rendered members. National Salesmen's Training Association, Dept. 158H, Chicago, Ill.

Salesman—Side or main line, to sell low-priced 6,000-mile guaranteed automobile tires, 30x3½ non-skid sells for $13.95; other sizes in proportion. Good money making proposition for live wires. Master Tire Co., 1414 So. Michigan, Chicago.

Sell tires direct to car owner. 30x3 non-skid $11.75. Tubes $2.25; other sizes in proportion. Guaranteed 6,000 miles on liberal adjustment basis. Big commissions paid weekly. Experience or capital unnecessary. Auto Tire Clearing House, 1555 West 15th, Chicago.

Help Wanted.

Detectives Make Big Money. Travel, be your own boss. Either sex. We instruct, small cost. Write Johnson's Detective School, 232 Sheldon Ave., Grand Rapids, Michigan, Dept. A.

Detectives Earn Big Money. Excellent opportunity. Particulars free. American Detective System, 1968 Broadway, New York.

Detectives and Investigators are in demand. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. American School of Criminology, Dept. E, Detroit, Mich.

Be a Mirror Expert. $3-10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Men wanted. Become Auto Experts. $45 week. Learn while earning. Write Franklin Institute, Dept. W, 806, Rochester, N. Y.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Firemen, Brakemen, Baggagemen, $140-$200. Colored Porters by Railroads everywhere. Experience unnecessary. 897 Ry. Bureau, East St. Louis, Ill.

Wanted—Men-women, over 17. Hundreds Railway Mail Clerks. $1,300-$2,150. Examinations everywhere, July 14-Aug. 11. Vacancy list free. Franklin Institute, Dept. W 26, Rochester, N. Y.

Stop daily grind, start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 48, Marion, Indiana.

Motorcycles—Bicycles.

25.00 up, guaranteed rebuilt motorcycles, Henderson, Excelsior, Indian, Harley-Davidson. Bicycles $5.00 up. Tires and accessories at wholesale. Illustrated Bulletin A free. Ash Motor Corporation, 162 N. Clinton Ave., Rochester, N.Y.

Personal.

Are you satisfied with your present position or are you contemplating a change? I am skilled in helping good men and women better themselves by means of "selling" their services to best advantage. Not an employment agency, no commissions, you handle yourself in confidential manner. No failures need apply. Tell something about yourself and receive free personal letter of advice. J. S. King, Elkton, Kentucky.

Be Popular. Make People Like You. Make more money; develop winning personality. Send 50c for "Success Secrets." Tells How." Madame Vivian, Box 175 E-3, Chicago.

Business Opportunities.

Patents for sale. To sell, buy or obtain patents write Patent News-309, Washington, D. C.

I Made $30 a Week evenings with a small Mail Order Business Home. Free Booklet tells how. 2c postage. Alex Scott, Cohoes, N. Y.

Enter a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen; $300 to $1,500 necessary. You handle own money. Will allow expenses to Baltimore if you will qualify. For particulars address Secretary, 416 N. Howard St., Baltimore, Md.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

Be Independent—We teach by mail how to manufacture unexcelled toilet goods. Particulars free. School of Cosmetics, Box C, Omaha, Neb.

"Money-Talks." The Business magazine published for progressive people. Send for sample copy. P. O., Box 236-B, Newark, New Jersey.

Wanted—By a reliable party, four hundred dollars to help finance a profitable specialty selling business. Party furnishing capital will be given one-twentieth interest in all profits for two years in addition to liberal interest on their investment. This is not a get rich quick scheme, but an opportunity to safely place a limited amount of money, returns from which are much larger than from ordinary good investments. Full information given only on receipt of stamped envelope. No attention will be paid to postal inquiries or circular letters. Address K. C. 20, c/o Electrical Experimenter.

Business Chances—A magazine of Opportunity—Gives complete plans for starting your own business. One copy may mean your fortune. Sample 10c. Three 25c. Better yet, send dollar for year and I'll send my dollar book of "1000 Money-Making Secrets" Free. Lewis, 2849½ Normal, Chicago.

Wanted—Advertising managers everywhere. $50 to $150 weekly. Experience unnecessary; learn in spare time. Details free. Koehler, Dept. 25, 1961 S. Hoover, Los Angeles.

3,384 Moneymaking Plans. Formulas. Trade-Secrets. "Encyclopedia Business Opportunities." 3 volumes $1. Ideal Book Shop, 5501-EV North Robey, Chicago.

Breed Canaries—Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Va.

Turn Your Spare Time Into Money for that apparatus you want. Start a profitable, permanent home business. Steady weekly income. No investment but your brains and spare time. Positively no soliciting, agency proposition. Write today. Address Opportunity, Box 175, Fredonia, N. Y.

Novelties.

Here, Boys! Read Nifty Toy Co. ad page 324.

Toy Aeroplane Propeller that will actually fly; three for fifty cents; stamps accepted. C. Illingworth, Mission City, B. C., Canada.

Unusual Goods. Unusual Bargains. Large complete catalog mailed for 10 cents coin. C. E. Dewey, Canton, Pa.

"Rainbow Wonder Wheel". See the beautiful ever-changing colors. Price 35c. Beehive Co., 4337 N. Lowell, Chicago.

Volume VIII.
Whole No. 88

Science and Invention

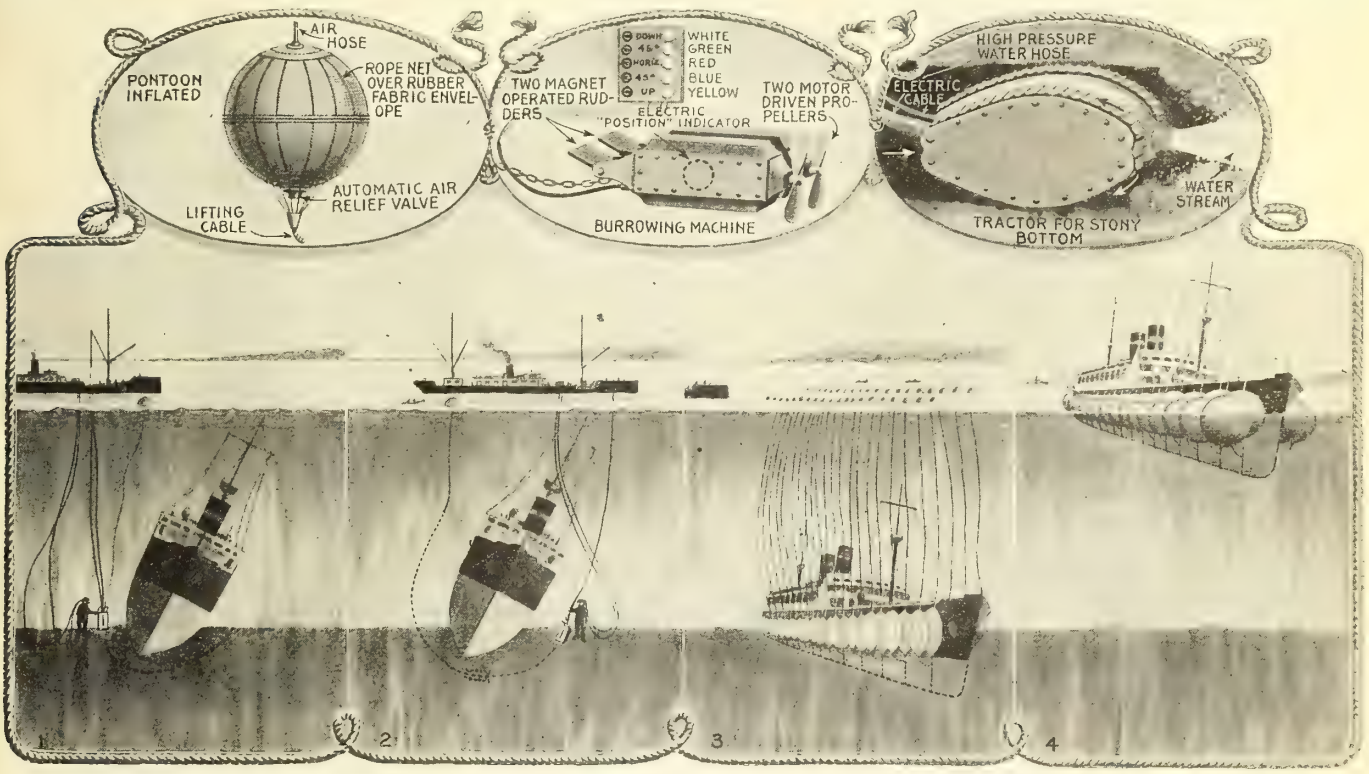
H. GERNSBACK – EDITOR
H.W. SECOR–ASSOCIATE EDITOR

AUGUST
1920
No. 4

Electric Sand-Hog to Salvage Ships

By ERIC A. DIME

THE recovery of treasures from the bottom of the sea has been a dream of inventors since times immemorial. The wrecks, which rest in the silt and sand of the ocean's floor, have served as an incentive to men to devise ways and means whereby the hidden wealth could be raised and salvaged. The idea of lifting sunken vessels is now receiving possibly more attention than it ever did in the history of the world. The reason for this salvaging interests, but also those that are lost annually through unavoidable maritime accidents. In European waters and along our Atlantic coast the ocean's bottom is strewn with hundreds of wrecks which could be salvaged if a proper equipment were employed for raising the vessels. There is nothing new or remarkable about raising wrecked ships. Such feats are taking place practically all the time. According to statistics at hand, altho they are not of recent



The Latest Scientific Device for Salvaging Ships Is This Electrically Driven Sand-Hog, Which Burrows Its Way Down and Around th Ship, Permitting Cables to Be Past About the Hull. Finally, Pontoons Are Fastened to These Cables and Inflated, Lifting the Ship

is the immense tonnage of ships lost during the World War.

According to well-informed authorities, it is claimed that the vessels sent to Davy Jones' locker, while the hosts of the fighting nations were contending supremacy on land and sea, represent a tonnage of 15,000,000. The monetary value involved in this tonnage is about eight billion dollars, which is a sum greater than the national debt incurred during our Civil War. To make the comparison more striking and interesting it might be said that this staggering sum is greater than the total output of gold in the United States, and it is in excess of the wealth taken from the diamond mines of South Africa during their entire period of exploitations.

It is not only the ships, lost during the war, which are attracting the attention of date, we find that up until August of last year the salvage department of the British Admiralty had recovered 440 vessels sunk during the war. These ships represented a value of $250,000,000.

The ships, which so far have been raised, are those resting in shallow waters or at depths of about 100 feet. Wrecks, which are lying at depths of from 200 to 300 feet or more have up until the present time remained where they are, because there has been no satisfactory method employed whereby such vessels could be lifted from the ocean's floor. It is conceded that any ship could be raised, provided a sufficient number of pontoons could be attached to the vessel for lifting purposes. But the drawback so far has been the lack of supports for holding the pontoons in position and allowing them simultaneously to give a direct upward lift sufficient to raise the ship.

THE ELECTRIC SAND-HOG INVENTED.

A device to overcome all these difficulties has recently been invented by a New Yorker, a Mr. A. B. Saliger, who has spent several years in perfecting a machine that is unique in construction and from all appearances practical in application. He calls it the *burrowing machine,* and it is so different from anything else used for the salvaging of ships that he has been granted basic claims on it. As its name implies the *burrowing machine* is employed to dig its own way thru sand, silt and gravel in which a wreck rests on the ocean's bottom. The device is made to carry or haul a line under the hull of the ship, and when that is accomplished it is an easy matter to string heavy cables under the vessel and then attach the pontoons to the cables for lifting purposes.

The *burrowing machine* resembles a double torpedo, or two torpedoes joined together like a pair of Siamese twins. The front has two propellers, some fifteen inches in diameter, rotating in opposite directions. The machine is 4 feet wide, 2 feet high and 5 feet long. The rear is equipt with a pair of horizontal rudders, very much like those of a torpedo. The main body of each sec-

(*Continued on page* 434)

Man-Made Rubies

By O. IVAN LEE, B. Sc.

The Wonderful Story of the Artifical Ruby that Rivals the Genuine Stone in Lustre, Hardness and Color

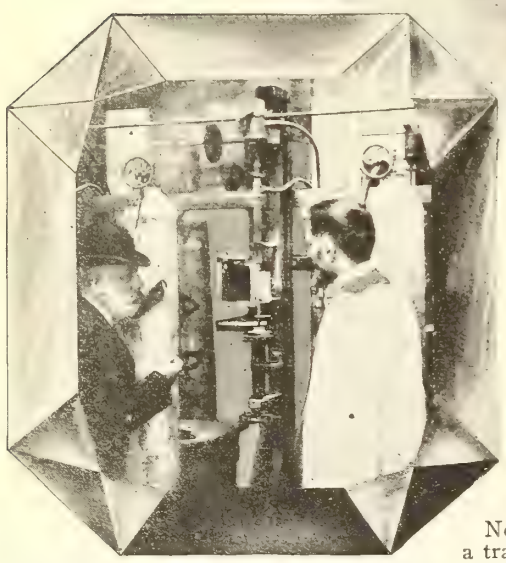


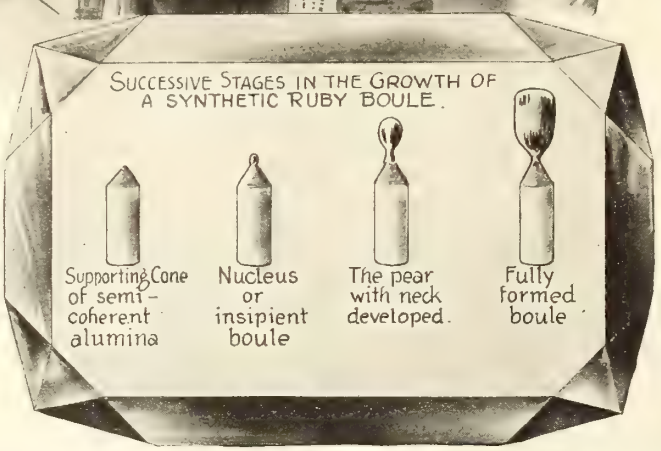
Photo at Left Shows Two Large Ruby Boules in the Collection at Columbia University, New York City. The Boule at the Extreme Right Shows Fracture Cracks Caused by the Unequal Expansion and Contraction and Set-Up Particularly by the Rapid Cooling of the Outer Surfaces of the Boule. From These Boules the Most Perfect Rubies Imaginable Are Cut.





For Centuries the Ruby Was "the Gem of Gems;" Some of the Greatest Tragedies in History Have Occurred Because of the Desire to Possess Famous Rubies. But Today Every-One Can Have a "Ruby." The Inset Photo at the Left Shows One of the Famous Oxyacetylene Gas Furnaces in Paris, France, Where the Synthetic Rubies Are Made by the Thousand.





The Progressive Diagram at the Left Shows the Successive Stages Gone Thru by the Synthetic Ruby Chemist in Building Up the Chunk of Precious Glass-Like Substance From Which Future Rubies Are To Be Cut to Adorn the Fingers, Arms and Necks of the Fair Sex. Synthetic Rubies Are Available in All Sizes Up to 50 carats.

FROM remotest times, an ever accumulating lore of gems and precious stones has been past on from generation to generation, and altho prosaic science has classified and card-indexed this vast array of heterogeneous information, not yet has it completely explained or eradicated that primitive impulse which attracts us irresistibly to stones which sparkle. There is still something of the savage in all of us; and it may be that things which glitter appeal to the same instinct which finds a fascination in flames.

Of the many varieties of gems which have stood the acid test of the world's favor, the diamond and the ruby easily lead, for if the former is the premier of jewels by reason of its hardness and fire, the latter is the peer of all colored stones—tinged as it it with the hue of the blood which gives us life. They are thus symbolical of the evolution of the race which has struggled upwards thru centuries of fire and blood—their very existence may be mineralogically paraphrased in the Darwin theory as the "survival of the hardest."

No doubt coincident with the growth of a traffic in gems was their extensive imitation, for since the beginning of time, the possession of anything rare, beautiful, expensive or exclusive has been a challenge to duplication with something just as good, and *cheaper!*

The Egyptians and Romans were skilled in imitating precious stones, indeed, the art of making glass owes much to this base incentive, and their skill was made the foundation of a craftmanship which in later ages produced counterfeits of which the buyer had ever to beware.

The science of mineralogy developed during the Nineteenth Century did much not only to systematize the classification of gems and make easier their identification, but, since mineralogy is a handmaiden of chemistry, a new hope was born—not that of imitating, but actually *creating* the gems themselves. Heretofore, with the debatable exception of pearls which had been produced in the Orient by introducing foreign matter into the pearl forming mollusk, all the attempts at counterfeiting had been frankly *imitative*. In the light of exact chemical knowledge of gem materials, the possibility of reproducing their substance was now seen, and from this conception has been painfully evolved a true miracle of the atoms—the commercial manufacture of veritable rubies.

WHAT THE RUBY IS.

Essentially, the ruby is the oxid of that modern and indispensable metal, aluminum. It occurs naturally as the mineral *corundum,* a familiar variety being the abrasive *emery.* which, however, contains in addition a large proportion of iron. Before going further, it should be explained that practically all gem stones when absolutely pure, are colorless, the particular color which a certain kind of stone may possess is then accidental and not inherent, and merely a detail of the problem of reproducing its *characteristic substance.*

Boiled down, then, making a true ruby necessitated only the making of transparent alumina, that is, apparently, merely *fusing* it.

Under ordinary conditions, aluminum oxid becomes liquid in the vicinity of 2,000 C. (3,632 F.). The fusion of alumina was actually accomplisht over a hundred years ago, for it is recorded in 1819 that if two

rubies were exposed on charcoal to the flame of an oxy-hydrogen blowpipe, they could be melted thereby into a single bead. The pioneer experimenters and their followers, endeavoring to make rubies were evidently so engrost in trying to make *crystalline* alumina and so beset with their individual difficulties, that they could not see the woods for the trees and for a long time never realized the value of its hint which lay at hand.

By purely chemical methods, numerous workers were successful in producing crystallized aluminum oxid, but since in each case the crystals obtained were exceedingly thin and often microscopic, the material obtained could not be utilized for cutting. If the reader has ever had the opportunity of examining a well crystallized piece of that synthetic abrasive *par excellence,* carborundum or silicid of carbon, it will have been noticed that the hexagonal crystals are excessively thin, compared to their diameter. The writer has before him a particularly pure such specimen in which the crystals are perfectly transparent and of a beautiful emerald green color. They are harder than the ruby and nearly as hard as a diamond. One of them measures half an inch in diameter. But for the fact that they are scarcely thicker than the paper on which this is printed, there is little doubt that carborundum would be a popular synthetic gem, having no existence in the mineral kingdom, barring the fact that it has been found in meteorites. This, then, illustrates the form of the crystalline rubies obtained by the fusion methods, and why they were unsatisfactory.

One chemist fused alum and potassium sulfate, another alumina and borax, a third aluminum fluorid and boric acid, and clever improvements were made on the principle involved in these reactions, the object of which was to crystallize aluminum oxid from a lower melting solvent or flux, just as salt is deposited from a concentrated brine solution. In spite of slow cooling, lasting not infrequently for weeks, no commercially available material was made, and the small crystals obtained were very costly.

In the latter part of the 19th Century, one of the would-be ruby makers re-discovered the fact that rubies could be fused, or, more correctly, *welded*—but not until some years later was it found that welded rubies were crystalline in structure and not amorphous like glass. On this account the value of the discovery was again overlooked.

With the general introduction of the oxyhydrogen flame, renewed efforts had been made to fuse aluminum oxid into transparent corundum, but without success. Quartz, which melts higher, was fused, but the alumina, altho clear as long as under the flame, persistently became opaque when the test was removed. One of these experimenters, after years of fruitless endeavor has recorded his belief that it was impossible to achieve the desired material because of this tendency. It had been found, too, that aluminum oxid virtually sublimes: that is, the melting point and boiling point were so close together that the alumina suddenly becomes fluid and then quickly boils away. This fact has mitigated against the employment of the electric furnace in making rubies.



Photos Courtesy of Heller & Son

The Top Tray Here Shown, Represents One of the Most Interesting Collections Ever Gotten Together. It Shows the Ingredients or Chemicals Used to Produce "Synthetic" Rubies in the Fierce Heat of the Oxycetyline Flame and Thereafter, the Successive Stages in Forming and Cutting Various Shapes. The Lower Tray Shows Several Dozen Varieties and Shapes of "Synthetic" Rubies, Each One of Which so Closely Resembles a Genuine Ruby Obtained from Mines, That Even Experts Are Fooled Unless They Have the Very Highest Precisional Instruments. No Average Jeweller Could Tell by Looking at Them, Whether or Not They Are the Scientific or Genuine Ruby. The Electroscope or Ultra-Powerful Compound Microscope Only Will Tell the Difference. They Are of Exactly the Same Hardness and Invariably Possess the Same Lustre and Color as the Stone Gotten from Mother Earth, Except That Instead of Requiring Hundreds of Years in Which to Crystallize and Form, These Scientific Rubies Took but a Few Moments to Make in the Skillful Hands of the Modern Chemist

THE FIRST RECONSTRUCTED RUBY APPEARS.

All these difficulties were very discouraging, and so, one by one, the workers gave up the quest as hopeless. One day, however, rubies were offered for sale in Europe, whose source could not be satisfactorily accounted for. It was said in explanation that a ruby mine had been discovered near Geneva, Switzerland, but eventually the secret came out. It seemed that a Swiss priest had been experimenting with natural ruby chips obtained from the lapidaries, had fused these fragments into larger stones, cut them and circulated them as mined rubies—which was perfectly true in one sense. Naturally, the profit was a handsome one. These *reconstructed* rubies, as they are termed, are even yet an article of commerce, and altho the technique of their manufacture has been much improved, they are still inferior in color, tenacity and structure to the artificial ruby of which they were the forerunners: that is, the *synthetic* ruby.

Since it was now conclusively demonstrated that natural alumina could be successfully fused, it only remained to apply the same process to chemically prepared material and the honor of perfecting this industrially belongs to Prof. Verneuil, of Paris; but it must not be imagined that his task was an easy one or that anyone could have turned the trick.

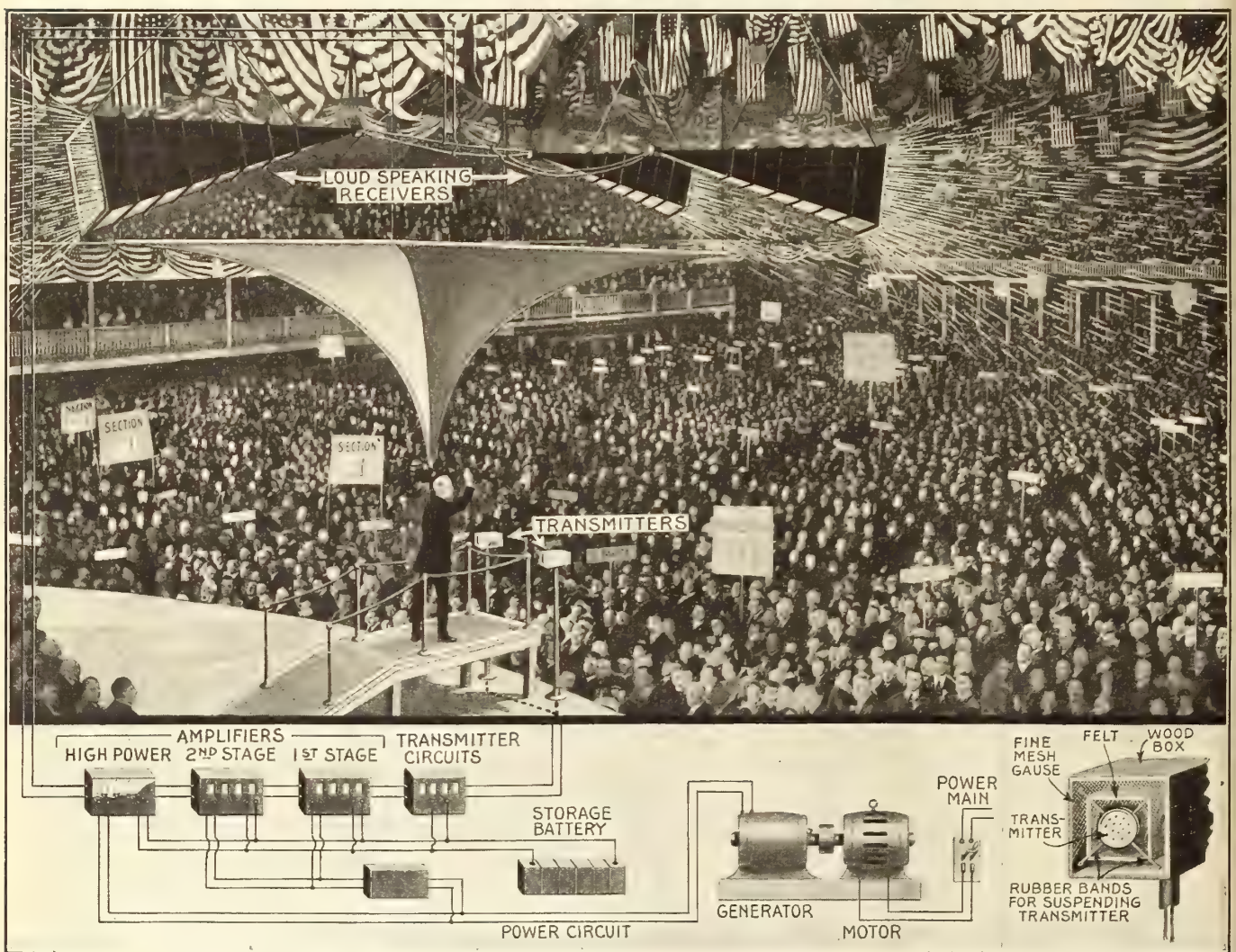
THE GLORY OF THE CHEMIST—THE SYNTHETIC RUBY.

The machine now used is a special type of oxyhydrogen blowpipe producing a temperature of from 1,900 to 2,400 C. (3,452 to 4,352 F.). The blow-torch is built of two concentric tubes, the inner one of which carries oxygen, the hydrogen passing thru the annular space between the two tubes. The gases are supplied from convenient tanks. The torch is placed in a vertical position and the powdered aluminum oxid placed in a little box with a sieve for a bottom and opening directly into the oxygen tube. This is one of many ingenious and all-important details which Prof. Verneuil devised, for it can be readily appreciated that a blast of flame directed on a pile of light and non-coherent alumina powder would blow it away before it had any opportunity to attain a welding temperature. A little hammer, actuated by electromagnetic means,

(*Continued on page* 416)

100 H.P. Voice for Conventions

FOR the first time in its history the attendance at the Republican National Convention was too large to hear the speaker's voice. So now electricity, in the guise of the *loud-speaking telephone,* wraps its strength around the voice of the orator and gives it power and volume to reach the distant auditor with all its expression and its timbre intact. National conventions have depended more on visual rather than audible interest. There has, of course, been a scientific interest, but there has also been a romantic side to the work, which was mostly done in the laboratories of the Bell System, situated on one of the busiest and noisiest waterfront streets in New York. Amidst all the rattle and bang of a thousand teams and motor trucks pounding the stone pavement, teamsters thinking of nothing but their right-of-way were startled to hear a strange voice, apparently close to their ears, deliberately and clearly counting above all the confusion, "one, two, three,



The Republican and Democratic Conventions Both Had the Assistance of "Madame Science" This Year in the Guise of a Powerful, Loud-Talking Telephone. Fitted With Audion Amplifiers, These Loud Talkers Enabled Everyone in the Crowd of 15,000 People to Hear the Speakers—Even the Women, Who Usually Do Not Talk as Loud as the Men.

chorus of applause which all could hear, but much of what has been said was read rather than heard even by those who were present.

Just in time for the Republican Convention the engineers of the Bell Telephone System successfully completed a voice magnifying apparatus embodying newly discovered features of telephony, which the inventor of the telephone could not have foreseen. In the Coliseum's vast auditorium the experts of the American Telephone and Telegraph Company, the Western Electric Company and the Chicago Telephone Company worked for ten long days installing the intricate apparatus thru which electricity, the master magician, served clear and distinct sound to the occupants of the most distant seats. There was little to see of the miracle-working mechanism in the great convention hall. An inconspicuous transmitter of speech, raised up a few feet from the front of the speaker's platform, and overhead were suspended several receivers, rectangular wooden horns, ten feet long, with their open ends pointed towards various parts of the auditorium. The flags and bunting were still the conspicuous eye-catchers. Without seeing how it is done, the audience found that as far as hearing was concerned the great crowd was telescoped by the public address system in close proximity to the speaker's platform. Under the floor and behind the walls ran the wires which lead to and from the *Audion speech magnifying apparatus,* itself hidden away in an unseen part of the building.

The loud speaking telephone system which the Bell System placed in the Coliseum at Chicago, and in the San Francisco convention also, has been in process of development for about ten years. The experiments have been numerous and of great four," or reciting some rhyme like "Hickory, dickory, dot, the mouse ran up the clock." Those teamsters could hardly see the horn on the roof of the lofty laboratory building, nor guess that tests were being made which would facilitate the nomination of a presidential candidate. The best the teamsters could do was to wonder how they could hear these tests in spite of the nearest load of angle iron which was clattering over the cobbles.

On a foggy night a little group of Bell telephone engineers crossed the Hudson River and from the roof of the Pennsylvania Station listened while the same ryth-

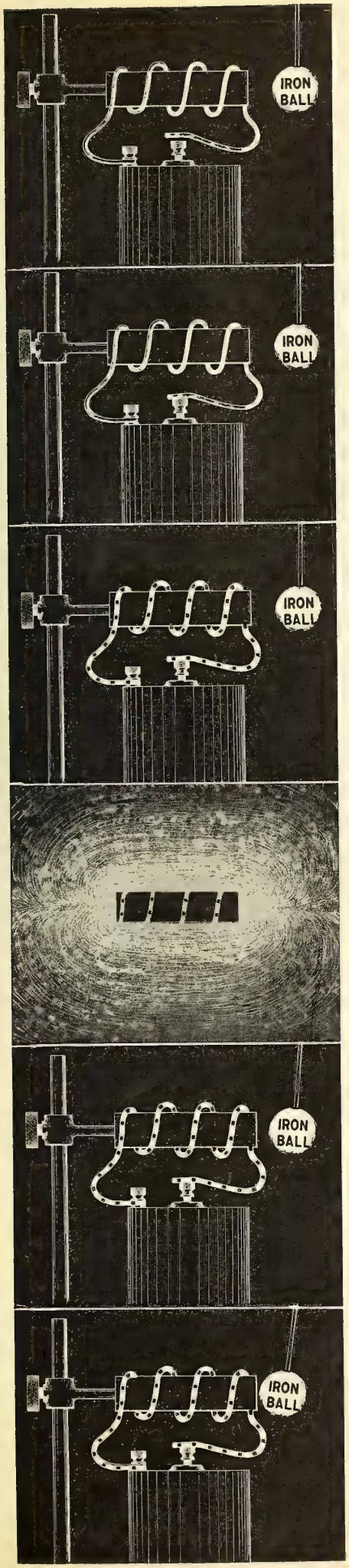
(*Continued on page* 441)

"Movies" of the Unseen

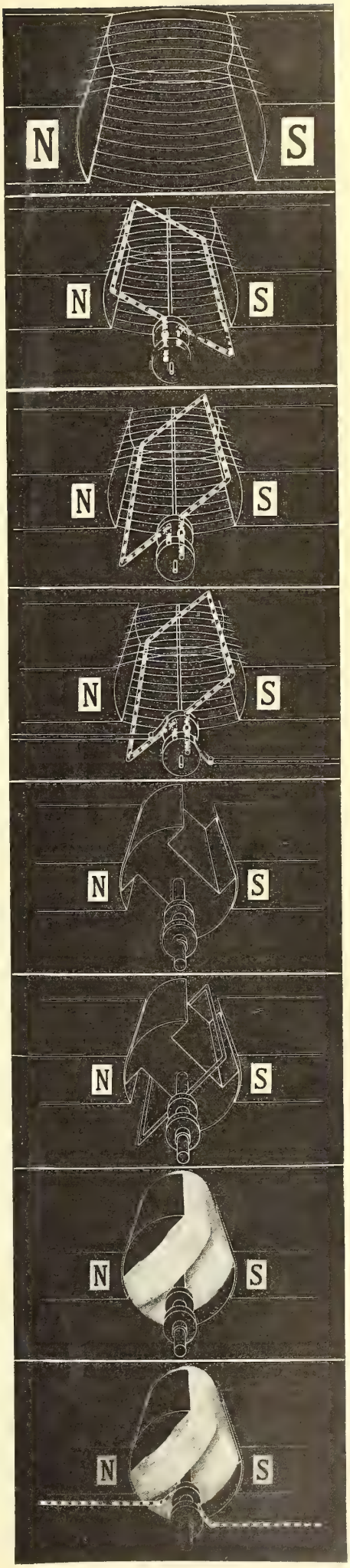
By JEROME LACKENBRUCH

IF you could SEE an idea; if the imaginings of an inventor's mind could be photographed and shown to you objectively; if the electrical theories written about in text-books could be brought to life and represented in diagrams that change and explain their development as you look at them, the task of learning just how electricity and magnetism act and what really happens when a generator is creating an alternating current, would be greatly simplified. Modern ingenuity has found a way to show these things. In fact, anything that can be imagined, may now be presented in pictorialized form. And this comparatively recent discovery of the means to show ideas in a way that anyone may comprehend them is due to an invention connected with the making of motion pictures. The particular method employed is known as the animated technical drawing and is the invention of the Bray studios.

In showing electrical phenomena on the screen, about 1,500 to 2,000 individual drawings, together with about a dozen backgrounds, must first be made. These are traced on celluloid composition plates and



The Movie Strip at Left Shows a Few Stages of the Several Hundred Drawn by the Artist in Making the Actual Motion Picture,—"the Story of the Electro-Magnet and How it Works." First, the Circuit is Shown Closed, Then With the Current Flowing, Next the Magnetic Field Produced About the Magnet, and Finally the Ball Being Attracted to the Magnet Pole.



Right-hand Film Strip Shows a Few of the Pictures out of Several Hundred Employed to Illustrate Vividly "the Action of the Dynamo." The Actual Movie of the Dynamo is Wonderful Indeed,—the Armature Wire and Core Spinning Around, Cutting the Magnetic Flux Lines and the Current Passing Out Thru the Brushes in a Very Clear Manner.

the plates then photographed on a table by an inverted motion picture camera. The negative film is then developed as an ordinary motion picture; and the reel is cut and edited so as to reveal the subject in its clearest form.

As the aim of the art of the motion picture is to tell a story by means of pictures, the animated technical drawing must illustrate every phase in the process of the subject it presents. Often simple comparisons are employed and the particular phase of the subject to be explained gradually dissolved into the film. For example, in explaining the meaning of voltage, a stream of water is shown running thru a cross-section of piping. Now the water pipe fades into the picture of a wire, and the flow of an electric current indicated. Several drawings are made to show the current in motion; and when these have been photographed on the film negative and then shown in a projection machine, the illusion of moving current is attained.

One of the accompanying diagrams shows the first attempt at a series of animated technical drawings to explain the action of *Magnetism.* The diagram contains a battery, an iron core with a wire wound about it, and an iron ball suspended a short distance from the bar. Now in this first diagram the apparatus is drawn on a black background, but the wire that is seen to be disconnected is drawn on an individual plate, placed over the background and thus photographed on the film negative. The reason for this is that the connecting wire is later removed and another, showing the connection made (second figure from top), substituted. In this way, the same back-

(*Continued on page* 429)

First Electric Welded Building

By H. B. PAYNE*

THE interesting thing about electric arc welding is not so much the method which is employed, but rather the constantly widening application that it has as an industrial process. Since the discovery of electric arc welding, considerable progress has been made in developing various kinds of equipment to make its use more easy and general. But the real science of electric arc welding lies in the human skill behind the equipment.

Electric arc welding consists in passing the current thru the material to be welded and a piece of wire attached to the opposite side of the circuit. In building construction, one wire from the secondary winding of the welding transformer is connected to the steel frame or beams, while the other wire connects thru a flexible cable to a fusible wire electrode held in an insulating handle. Heavy smoked goggles must be used.

One of the noteworthy achievements of the electrical engineer has been the recent demonstration of the practical application of electric arc welding to steel construction work.

An electric welding company needed a new building as an addition to its plant in Brooklyn and needed the building in a hurry. The electrical engineers were confident that such a building could be constructed by welding instead of riveting, and that there were specific advantages which would result from such a method of construction.

In the *first* place, the construction work could be done during twenty-four hours of the day without disturbing the people in either commercial or private life, because the process is absolutely silent, the nerve-racking noises of riveting being entirely eliminated. *Second*—The necessity for fabricating steel is entirely eliminated, and likewise the necessity of waiting several weeks until such parts should be fabricated and made ready for erection. *Third*—By electric welding joints of 100 per cent strength were made possible, as against the ordinary sixty or seventy per cent strength possessed by a riveted joint. *Fourth*—There was possible reduction in the actual weight of metal required in the various members, and *Fifth*—Actual tests had conclusively demonstrated that construction work by electric arc welding could be done at lower cost than by riveting.

Before the builders could proceed with their plans it was necessary to obtain permission from the various city building departments, and such permission would only be given if certain tests were made which would satisfy the building officials that a *welded structure* would be absolutely safe and would compare favorably in all other respects with a *riveted steel* framework. Certain samples of welded joints were requested for tests.

A specific sample of a lap weld of 1¼x⅜-inch bars, the ends lapt 1¼ inches and welded across the edges, was submitted. This welded sample was put in the machine in direct tension and developed the full strength of the bar, as the break occurred in the bar three inches above the weld, and developed a strength close to 60,000 pounds per square inch without affecting the weld. *These welds were cut across but showed no line of markation between the welding metal and the original bar metal.*

Another sample consisted of two angles set at right angles and lap welded at the intersection, the three-inch legs vertical (2x 3x⅜ inches). This sample was set in the machine so that there was a horizontal lever arm of 8 inches from the center of pressure to the center of weld and intersection, and developed a beam load of 11,375 pounds at the weld or a torsional stress of 91,000 pounds at the weld with no apparent distress to the weld. The angles buckled to such an extent that they failed to resist pressure.

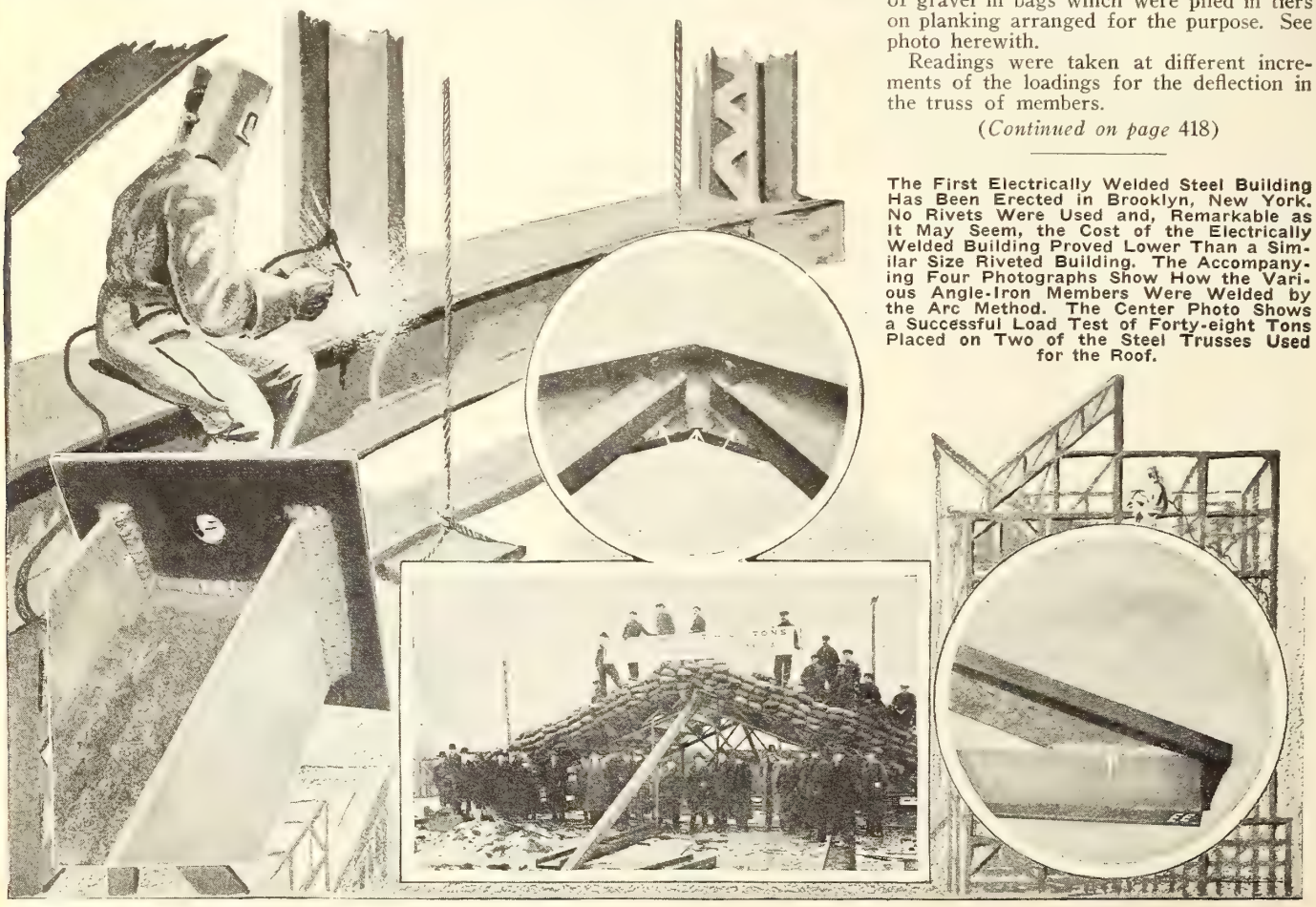
WELDED STEEL TRUSSES FULFILL TESTS.

The tests of these samples were entirely satisfactory to the city building officials. Permission was subsequently given to proceed with the erection of the steel framework, but there was still another test to be made of the steel trusses of forty-feet span, which were to be used to sustain the roof. These trusses were of fan-type of design, and all members were electrically welded together, no bolts or rivets being used. The trusses were spaced twenty feet apart, supported by 8x8 II-beam columns 19 feet high; on the sides of these columns brackets were fastened to carry an overhead traveling crane of five-ton capacity. The weight of each truss was about 1,400 pounds, the top and bottom chords were composed of 4x5x⅜-inch tee irons and the struts were 3x2x⅜-inch angles, the purlins were 10-inch 15-pound channels.

The trusses were designed for a live load of 40 pounds per square foot, each truss supporting a panel of 800 square feet. They were tested at a load of 120 pounds to the square foot, or a total load of forty-eight tons on the two trusses. The load consisted of gravel in bags which were piled in tiers on planking arranged for the purpose. See photo herewith.

Readings were taken at different increments of the loadings for the deflection in the truss of members.

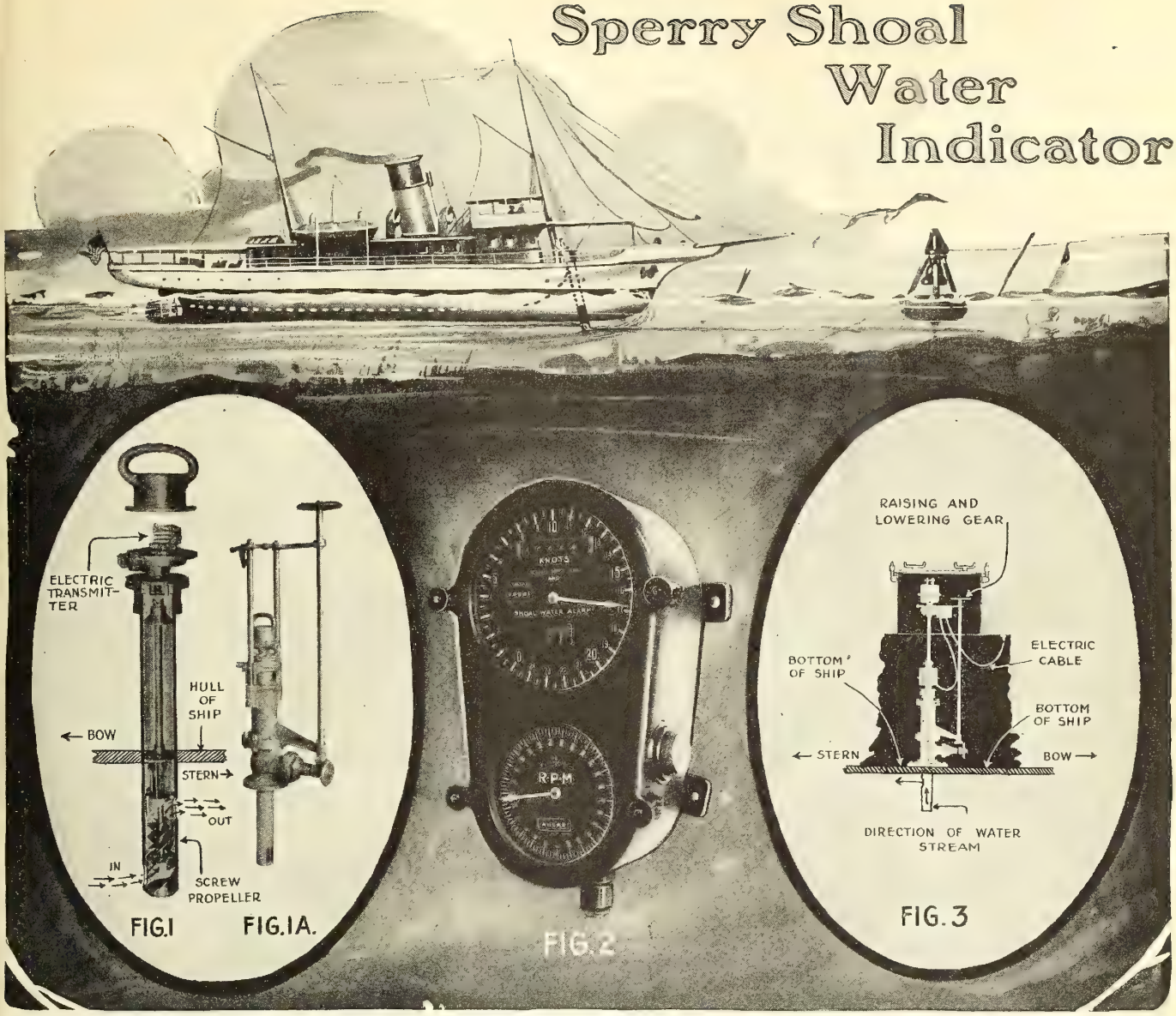
(*Continued on page* 418)



The First Electrically Welded Steel Building Has Been Erected in Brooklyn, New York. No Rivets Were Used and, Remarkable as It May Seem, the Cost of the Electrically Welded Building Proved Lower Than a Similar Size Riveted Building. The Accompanying Four Photographs Show How the Various Angle-Iron Members Were Welded by the Arc Method. The Center Photo Shows a Successful Load Test of Forty-eight Tons Placed on Two of the Steel Trusses Used for the Roof.

*Supervising Engineer, the Electric Welding Co.

Sperry Shoal Water Indicator



The Very Newest Thing in Marine Inventions is the "Sperry Shoal Water Indicator," Here Illustrated in Detail and Also in Actual Use on a Large Yacht. The Principal Apparatus is That Shown at Fig. 1 and Fig. 1-A, and This is Mounted Well Forward in the Bottom of the Hull. The Arrows Indicate the Current of Water Passing Thru the Bottom of the Indicating Tube, and in Doing So, Rapidly Spins the Worm-Shaped Propeller Which is Connected with an Electrical Impulse Transmitter. Suitable Indicating Instruments (See Fig. 2) Are Mounted in the Pilot House and on the Bridge, and When a Predetermined Depth of Shallow Water Has Been Reached, an Electric Bell Announces the Alarm. The Instrument Can Be Set to Give an Alarm for Any Desired Depth of Water.

"WE are in shallow water" exclaimed the captain on a large Trans-Atlantic liner which was speeding on its way to the American shore.

"How is that possible when we are fully 500 miles from land?" asked an interested passenger.

"That gong on the wall just rang—that's my indicator. The question of whether or not shallow water has an effect upon the vessel traveling thru it to such an extent that the indicator will ring, has been positively affirmed by the new device called the Sperry Shoal Water Indicator and Log Transmitter."

Recent tests conducted in an effort to obtain information on this interesting subject have been carried out by the principal navies of the world during the speed trials of their respective ships. The outcome of all these tests have given to the world facts which have been nothing short of astounding.

Ships moving in shallow water at ordinary speed are greatly retarded, yet readings have been obtained which show that ships traveling at 30 *knots per hour,* have a seemingly higher rate of speed in a like amount of water, and that the resistance of the water is proportionately decreased with speeds above the figure here quoted.

Upon examining the graphs or curves for different depths of water showing retarding action and resistance on a vessel of ordinary speed, having an overall length of 50 feet and a mean draft of 25 feet, we find that a vessel traveling at 11½ knots in 75 ft. of water with 16 per cent resistance, will increase its resistance to 97 per cent when in 35 ft. of water, at which time its propeller speed will have to be appreciably increased. The instrument in question makes use of just those conditions heretofore outlined in a very unique manner.

A water velocity tube, about 3 inches in diameter, projects thru the bottom of the ship for about 12 inches, when the device is in operating condition. There are openings at opposite sides, one facing the bow and the other the stern, to allow for a flow of water thru the tube entering one opening and out the other. This takes place whenever the ship is in motion, and during the course of flow, advantage is taken of the flowing stream by making it turn a helical propeller located in the central lower portion of the projecting tube. See Fig. 1.

The shaft of this propeller is geared to another shaft, which in turn is continued upward to the end of the tube, where the small electric transmitting unit is located. Impulses from this unit affect an indicating instrument located in the ship's pilot room and in any other parts of the vessel where additional instruments may be necessary or desirable.

The tube itself can be raised into the hull, in which case a valve is actuated so as to prevent water from flowing in. All joints are made watertight and at no time can any perceptible amount of water flow into the ship, and inasmuch as the space occupied does not exceed 50 inches in height, it is really quite a negligible quantity in a vessel of even small size.

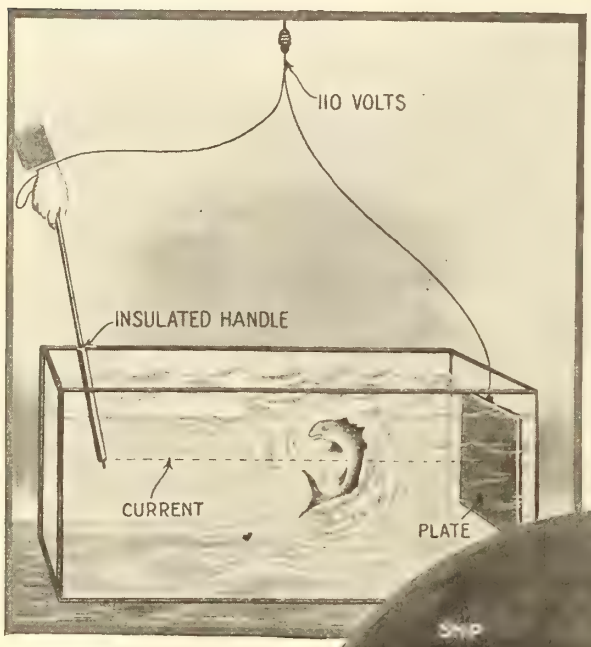
The *indicator and shoal water alarm* which is placed in the pilot room, is composed of two dials, see Fig. 2. On the upper dial, a reading of the actual speed of the vessel in knots is shown by a pointer. In a small slot numerical indication of the total knots traveled can be readily determined, and in a similar slot, we obtain an inference of the trip distance traveled to great exactitude, allowing for a fractional knot reading down to one one-hundredth of a knot. A contact for shoal water alarm is located at the lower center. In the lower dial a slot needle indicates whether we are going *ahead* or *astern.* In addition, an adjustable indicator shows when the ship

(*Continued on page* 456)

Electrocuting Sharks

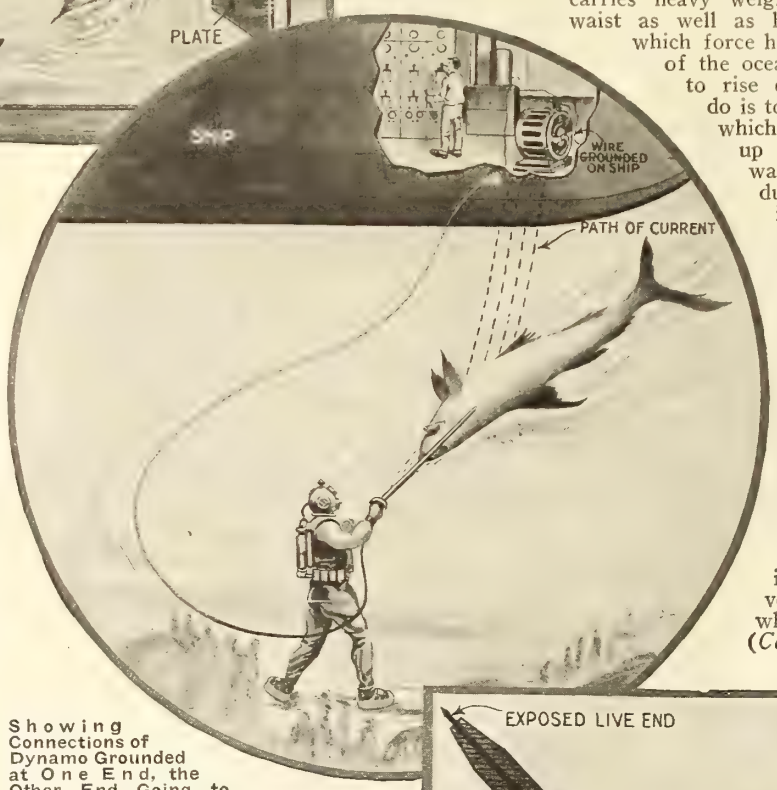
By H. GERNSBACK

SOME ago, in our Sept. 1916 issue, the writer publisht an account of a new method of electrocuting sharks whereby electric cables, hanging from the sides of a boat or ship, were baited and thrown into the sea. When the shark tried to devour the bait, the current was turned on. Due to the fact that the shark was in a highly conducting medium—sea water,—and as one end of the dynamo was grounded on the boat's plates, the shark would be instantly electrocuted. Of course, such a system does not eradicate the shark pest, as sharks do not always come to the surface, nor do they always take advantage of the bait.



Experiments Showing How Fish is Affcted by Electrical Current Without Wire Touching Him at Any Time.

In the South where the sharks are numerous and where the pearl fisheries and the sponge industry thrive, many casualties occur yearly due to the sharks attacking the divers, and there is no method in use now which safeguards the divers. With this idea in mind, the writer advances an idea which is the subject of our cover illustration. In other words, we take the battle right into the sharks' domain itself. We do not wait until the shark comes up so that we can pot at him, or otherwise destroy him, but we hunt right in its own habitat, underneath the surface of the ocean.



Showing Connections of Dynamo Grounded at One End, the Other End Going to Cable, Manipulated Thru a Pole by Diver.

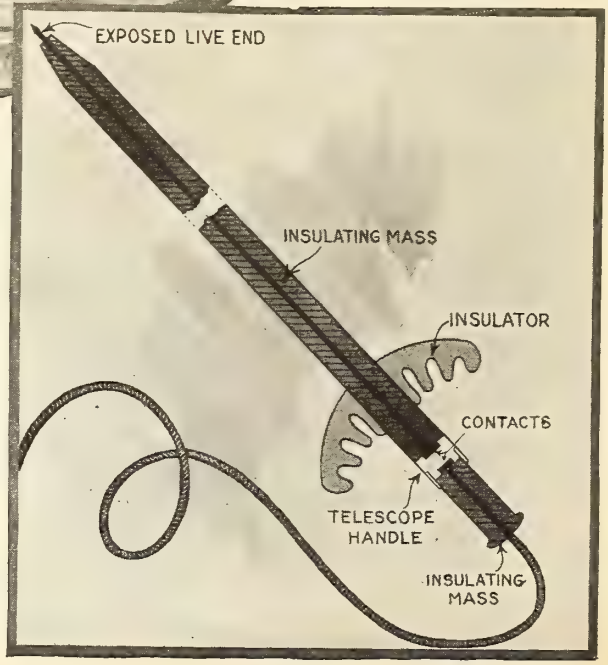
Several curious things occur when we begin electrocuting sharks or fish in this manner. Actual tests made by the writer have brought out the following:

In our illustration No. 1 is shown a glass tank containing a fish, a grounded plate and a handle carrying a wire, the end point of which is bare. If we turn on the 110 volt current *without at least touching the fish,* he will begin to swim around frantically, altho no wire or plate touches him. The reason is of course that the current from the wire tip passes from the salt water to the plate, and inasmuch as the fish is right in the path of the current, a certain amount of current naturally must pass thru his body. The closer the live wire comes to the fish, the stronger the effect will be, and if we come within about two inches from the fish, it often happens that the latter will jump clear out of the tank, as has been demonstrated in these experiments. Small fish when touched by the wire will be electrocuted almost instantly with 110 volt current. Of course, here the problem presents itself that we cannot possibly touch the fish by means of the live wire, because as mentioned above as soon as the wire comes near him, the fish will try frantically to clear out of the path of the current. Hence, it is necessary to switch off the current until the dead wire actually touches the fish. Then as soon as contact is establisht, the fish will of course be electrocuted. Upon these experiments the shark electrocuting idea is based.

In practice the divers are preferably provided with self-contained compressed air apparatus strapped to the back and front as shown in our cover illustration. Such apparatus are on the market already and can be bought now. The idea of using self-contained air apparatus is obvious because it gives the diver more freedom of action, and does away with dangerous air pipes and life lines. Furthermore, inasmuch as high tension cable is used, it would not be wise to use these air and life lines as will be readily understood by a moment's reflection. On board of the mother ship from which the divers descend, we have the usual high tension dynamo of about 1500 to 2000 volts, one side of the dynamo being grounded. The other side connects to the high tension cable which plays out to the diver as he descends. The diver himself carries heavy weights strapt around the waist as well as heavy lead shoe soles, which force him down to the bottom of the ocean. In case he wishes to rise quickly, all he has to do is to disengage the weights which will make him shoot up to the surface of the water with great speed due to the air contained in the tanks which gives him great buoyancy.

At the end of the rubber insulated electric cable we find a sword-like pole, which is well insulated, and which may be made of bamboo or any other material that is strong and light. The electric cable runs carefully insulated thru the entire length of the pole but is not insulated at the very end. A small point which is to pierce into

(*Continued on page* 424)



Construction of Electrocuting Pole, Showing Live End and Insulating Shield to Protect Diver.

Marvels of the Ear

By JOSEPH H. KRAUS

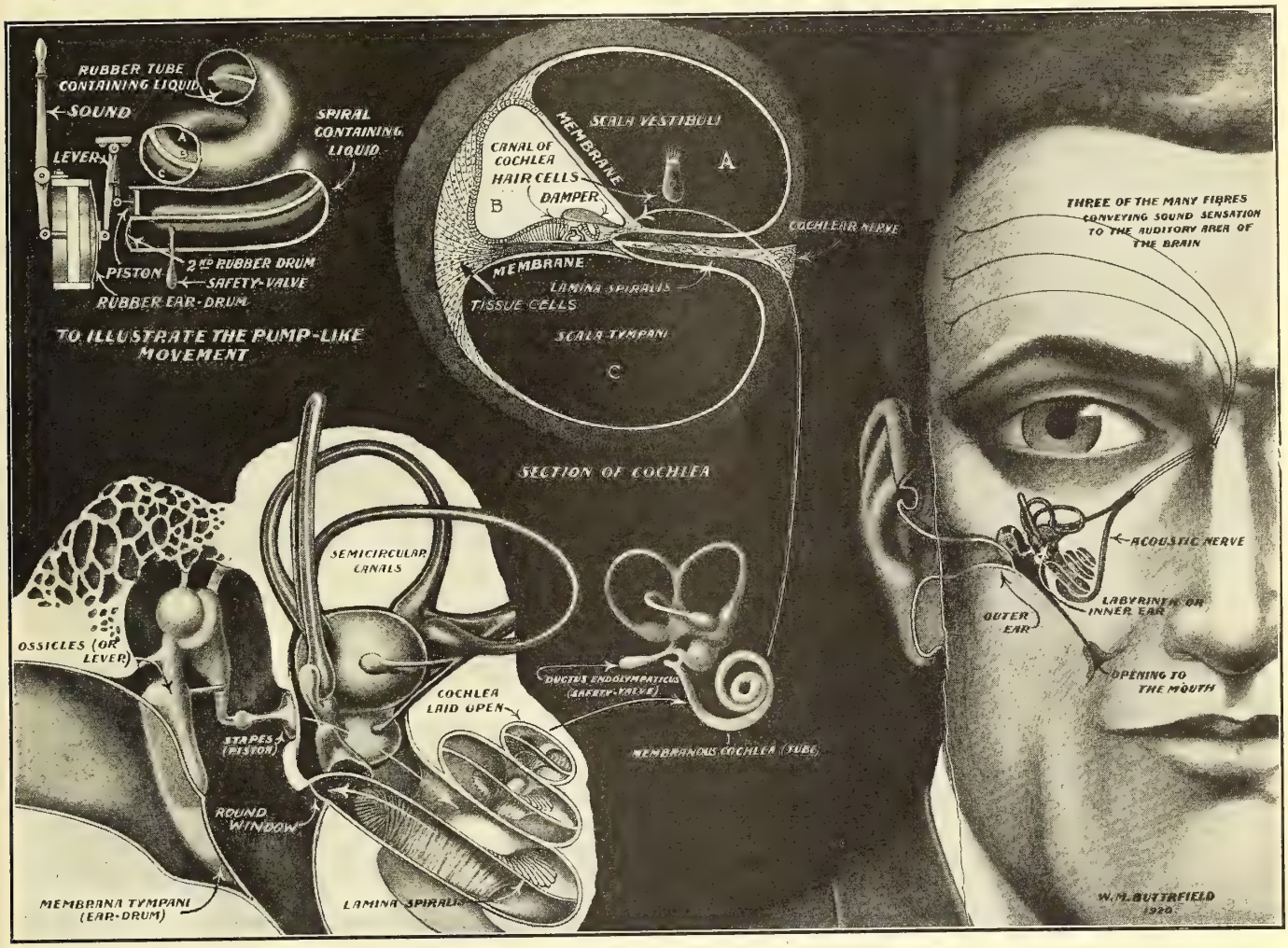
How We "Hear"

IN a previous discourse on sound in this journal we have learned of several of the more novel surprises in the world of sound, which not only interest everyone, but which are at the same time not generally known. Perhaps no more wonderful study has ever presented itself than the subject of "how we hear"—and even to-day this function is not very clearly understood.

sure; thus an increase in pressure will force that membrane inward and the fall favors its outward motion.

In contradistinction with other membranes this membrane in the ear has no vibratory sound of its own; in other words, *has no period.* If it had one, it would uncase, and medical authorities have establisht the fact that even the entire absence of the ear drum will not produce deafness, altho it does effect keenness of perception of auditory sensations of a slight nature.

The function of the canal is merely to assist in keeping out insects and dust, being lined with hair and also to maintain an even temperature at the drum. Between



The Above Illustration Gives Us a Representation of the Action of the Ear Which Will Be More Clearly Understood by the Analogy at the Upper Left-Hand Corner. Here We Find a Spiral Tube Divided Into Two Parts by Means of a Rubber Tube and a Partially Solid Wall, Each Filled With Liquid. The Upper Part Communicates With the Lower at the Top of its Spiral. When Any Movement of the Pump Handle Is Produced, the Rubber Ear-Drum Moves a Certain Definite Distance, Which Is Amplified Thru the Lever Arrangement and the Smaller Cross-Sectional Area of the Second Piston. This Compresses the Liquid Contained in the Upper and Lower Spiral Tubes Communicating That Pressure to the Lower Part Where the Second Rubber Drum (Round Window) Bulges Outwardly. The Pressure Also Has an Effect Upon the Rubber Tube Compressing the Liquid Within It and Sometimes Causing a Flow Into the Safety Valve; the Rubber Tube Itself Is Made Up of Flexible Walls, the Bottom Part of Which Has a Series of Strings Along Its Length. Its Strings Are Thus Caused to Vibrate in This Way Exciting Little Cells Upon Them and Giving Us the Sensation of Sound. In the Diagram to Its Right We See the "Rubber Tube" Marked "Canal of Cochlea." The Strings Are Located in the Lower Membrane With the Hair (Sensitive) Cells Upon Them, and a Damper to Prevent Excessive Vibration. By Comparison With the Anatomical Diagram, the Analogy Will Be Readily Seen.

The auditory organs themselves are divided into three parts, *external, middle* and *internal ear.* The foremost one we shall not consider at the present time to any great extent, because it serves only a slight function in hearing. This consists of the ear (the external ear or the one which we see) and the tube or canal entering the side of the head up as far as the drum. It can be *entirely absent* and not affect hearing except that localization of the position from whence any particular sound comes is lost considerably.

Sound, as has been said, is of vibratory nature, and when impinging on the drum of the ear, medically known as the *tympanic membrane,* we get a rise and fall of pres-

doubtedly vibrate in resonance with some particular sound to which it is attuned, and we would get a false impression of intensity. However, being made cone-shape and having a convexity outward with its fibers of construction running circularly and radially and in addition to the fact that it is tightly stretched, it follows that each and every portion of the cone will have a different period of vibration and the whole diafram will be aperiodic.

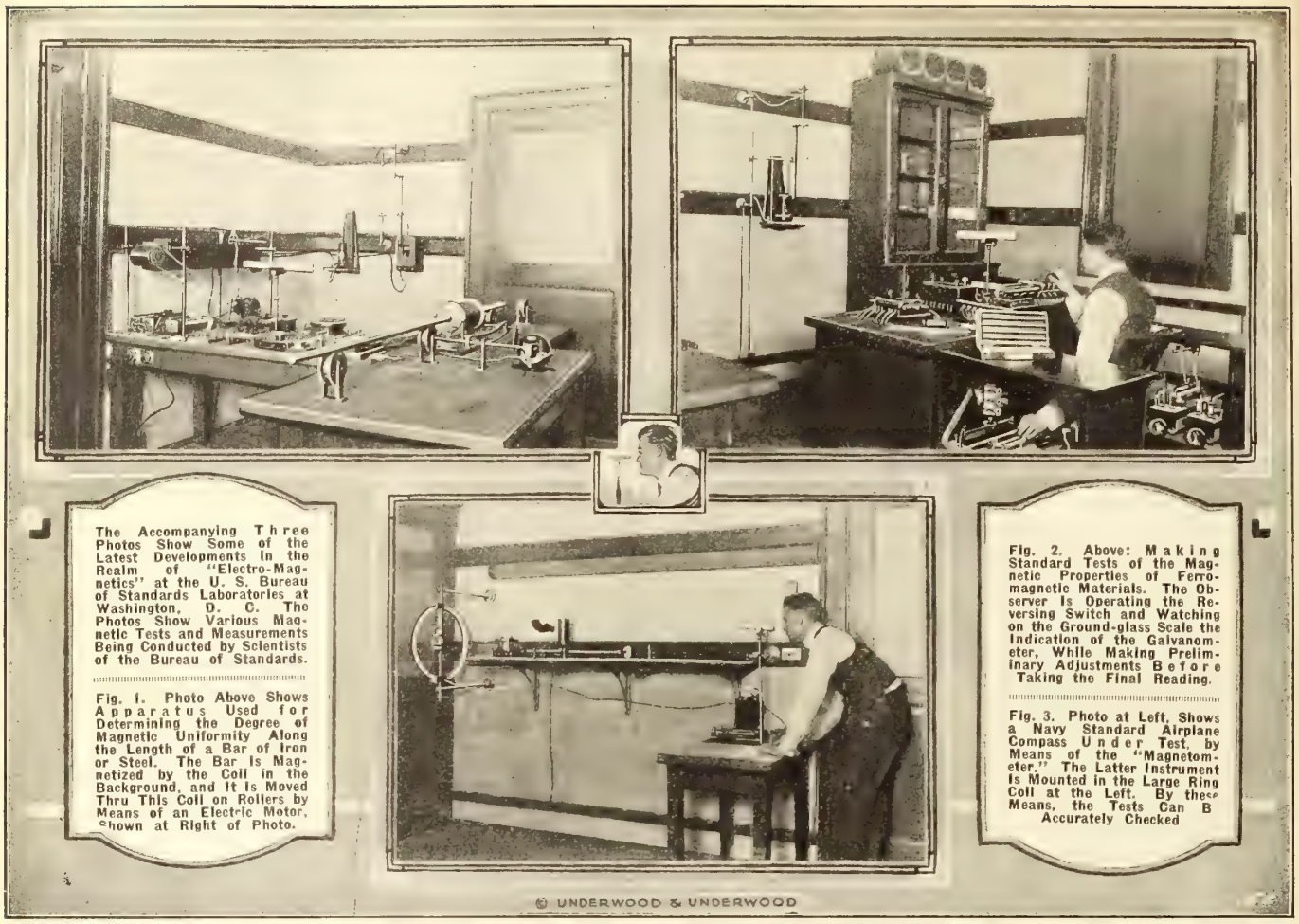
BROKEN EAR DRUM DOES NOT PRODUCE DEAFNESS.

Many people have thought that the ear drum, if broken, produces deafness. Strange as it may seem, such is not the

the drum and the internal ear is a chain of tiny bones situated in the intermediate division; this division is called the *middle ear.* These bones connect the large membrane or drum with a small membrane 1/20 its size.

This latter membrane has been termed the *oval window* (fenistra ovalis), and as our diagram indicates, the bones themselves are combined into a powerful lever action which multiplies the force of the drum movement. This movement tho in its amplitude is diminisht two-thirds; the pressure at the end (oval window end) is therefore naturally increased one and a half times thru the bone action alone.

(*Continued on page* 422)



The Accompanying Three Photos Show Some of the Latest Developments in the Realm of "Electro-Magnetics" at the U. S. Bureau of Standards Laboratories at Washington, D. C. The Photos Show Various Magnetic Tests and Measurements Being Conducted by Scientists of the Bureau of Standards.

Fig. 1. Photo Above Shows Apparatus Used for Determining the Degree of Magnetic Uniformity Along the Length of a Bar of Iron or Steel. The Bar Is Magnetized by the Coil in the Background, and It Is Moved Thru This Coil on Rollers by Means of an Electric Motor, Shown at Right of Photo.

Fig. 2. Above: Making Standard Tests of the Magnetic Properties of Ferro-magnetic Materials. The Observer Is Operating the Reversing Switch and Watching on the Ground-glass Scale the Indication of the Galvanometer, While Making Preliminary Adjustments Before Taking the Final Reading.

Fig. 3. Photo at Left, Shows a Navy Standard Airplane Compass Under Test, by Means of the "Magnetometer." The Latter Instrument Is Mounted in the Large Ring Coil at the Left. By these Means, the Tests Can Be Accurately Checked

© UNDERWOOD & UNDERWOOD

The Electro-Magnet in Science

THE accompanying photographs illustrate magnetic tests and measurements being conducted at the Magnetic Laboratory, Bureau of Standards, Washington, D. C. Investigations are in progress to determine to what extent these laboratory methods can be employed to advantage in investigational and commercial work for the detection of flaws or chemical segregations in iron and steel bars, for the measuring of core loss in all electrical apparatus, and for any problem connected with the properties of ferro-magnetic materials.

STANDARD MAGNETIC PERMEAMETERS.

Standard tests of the magnetic properties of ferro-magnetic materials are made by means of the compensated double-yoke apparatus shown in this photograph. The observer is operating the reversing switch and watching on the ground glass scale the indications of the galvanometer, while making preliminary adjustment before taking a reading. There are several sets of magnetizing coils for the measurement of various sizes of specimens. The bars in the box in the foreground are standard bars for checking measurements. Figure 2.

MAGNETIC UNIFORMITY MEASUREMENTS.

If a bar of steel is chemically and mechanically uniform along its length, it is also magnetically uniform, and consequently any variation in chemical composition or mechanical condition will be indicated by a corresponding variation in its magnetic properties. Figure 1.

For "September"

Liquid Air,—What It Is, and What It Does. Illustrated.

Can We Live on an Electric Diet? A French Experiment.

The Fourth Dimension and Hyperspace, by Frank M. Gentry. Popularly explained with diagrams and pictures.

Big Rotogravure Feature Section. Don't miss it!

Hammering Electrons Out of Matter. By Harold F. Richards, Ph.D.

Eclipses, What Are They? By A. M. Harding, Ph.D.

Archimedes, the World's First Inventor. In Rotogravure.

How Big Are Molecules? A popular exposition. Illustrated. By Rogers D. Rusk, M. A.

Murderous Rays—a gripping scientific story—written by a Scientist. By Harold F. Richards, Ph.D.

The apparatus shown in the photograph is used for determining the degree of magnetic uniformity along the length of a bar of iron or steel. The bar is magnetized by means of the horizontal coil thru which it is past on rollers driven by an electric motor. Variations in magnetic permeability are indicated by deflections of a sensitive galvanometer connected to test coils surrounding the specimen and mounted inside the magnetizing coil.

In the photograph the indications of the galvanometer are being recorded on a photographic film mounted on a drum and rotated at a constant speed.

TESTING THE STRENGTH OF COMPASS NEEDLES.

One test that may be applied to magnetic compasses is to measure the strength of the magnetic needles, which is called the "magnetic moment." The measurement is made by noting the deflection of a small suspended magnetic needle when the compass to be tested is placed opposite to it. This deflection is indicated on a ground glass scale by a spot of light from an incandescent lamp which is reflected from a small mirror mounted on the suspended needle.

In the photograph, a Navy Standard airplane compass is being tested. The measuring instrument, "magnetometer" as it is called, is mounted within a ring upon which is wound a coil of wire. By means of a measured electric current in this coil, the instrument is calibrated, so that it is readily possible to tell just what value of magnetic moment corresponds to a certain deflection on the scale. Figure 3.

First Electric Locomotive

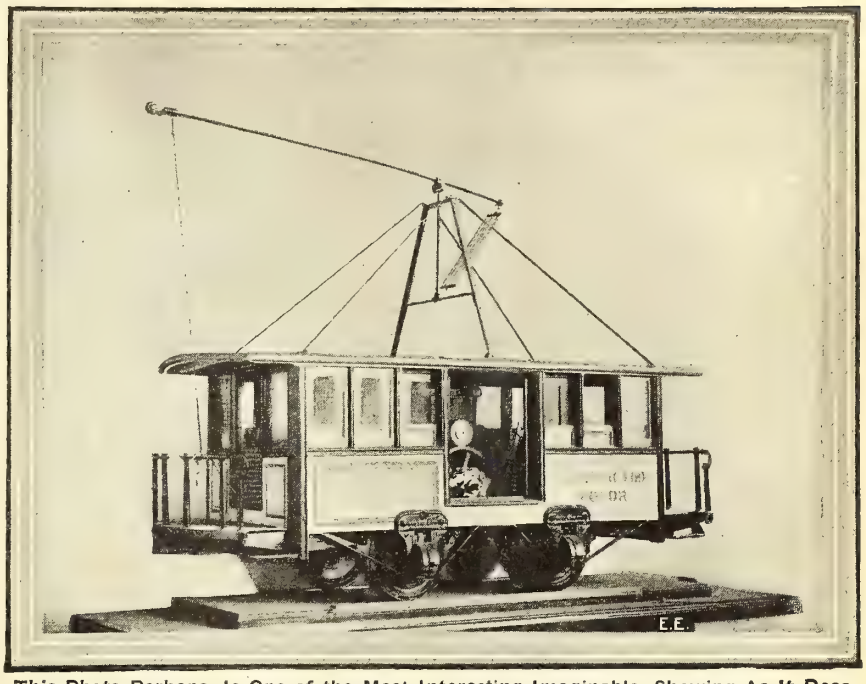
By HARVEY H. SMITH

Only thirty years ago the first electric locomotive in the United States, and so far as is known, in the world, designed for hauling freight made its trial trip from Ansonia to Derby, Connecticut. This locomotive, which was the forerunner of the huge electric motors in use to-day, was considered a marvel of engineering achievement at the time of its introduction.

The original locomotive which is now in the Hartford barns of the Connecticut Company, and a model of which appears in the accompanying photograph, was constructed by the Pullman Palace Car Company and weighs 35,000 pounds. The electric equipment, consisting of a 76 H.P. motor, was manufactured by the Depoele Electric Manufacturing Company.

The first trial trip took place May 1, 1888, over the Ansonia-Derby, Birmingham route. In ordering the car it had apparently been forgotten that a low railroad trestle existed near the Derby dock, for it was found that the body of the car was too high to allow clearance. The roof was accordingly removed and a collapsible trolley frame improvised for the initial trip. On one side of the passage under the railroad trestle was kept a box containing a flexible insulated cable which was connected to the trolley wire, the free end being a brass contact piece. When the collapsible frame was lowered to the roof, the plug was inserted in a socket contained in the wooden block on top of the car near the base of the trolley frame, and the cable was paid out, thereby providing power for the car to operate under the trestle.

Laminated copper brushes were used, and as the brush holders would sometimes work loose, *the motorman usually stood with his hand pressing on the handle of the brush holder to secure good contact!* As a result of sparking the ends of the brushes frequently fused, making it necessary to trim them with a pair of shears carried for the purpose. Think of it!! In case the locomotive moved backward unexpectedly the ends of the brushes would catch in the commutator bars and bend over, also necessitating trimming the copper before proceeding.



This Photo Perhaps, Is One of the Most Interesting Imaginable, Showing As It Does, the Exact Model of the First Electric Locomotive Built in the United States, and Probably the First Practical Engine of Its Type in the World. Its Trial Trip Occurred in 1888. Its Initial Journey Was Hailed as a Huge Success, at the Time.

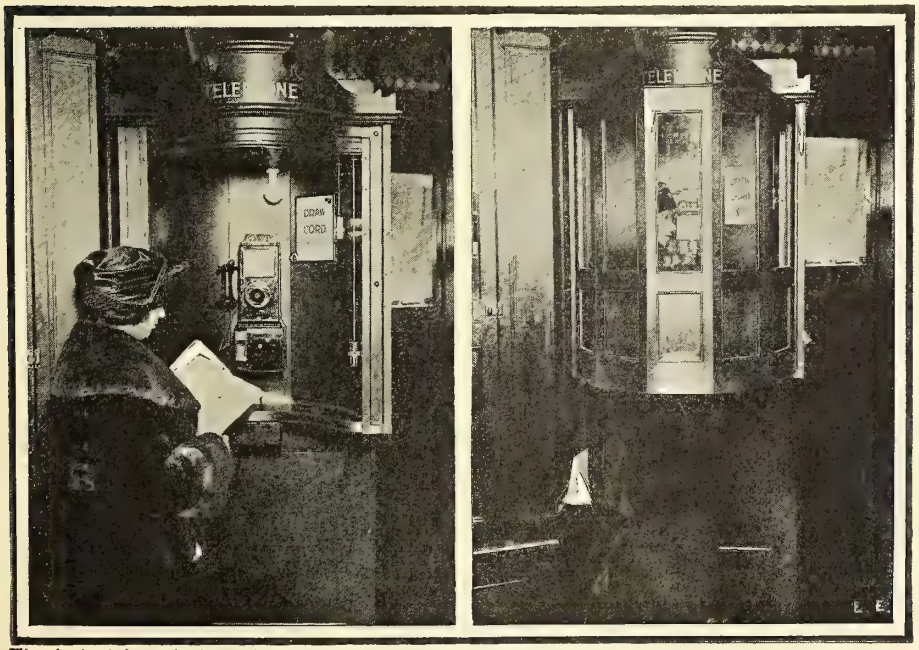
Lightning arrestors had not been introduced and burnouts often resulted from electric storms. So frequent were the delays from this source that the management adopted the practise of suspending operation during storms. The freight motor had the distinction of being reversible and therefore could be operated from either end, a feature which the passenger cars did not have at this time.

The motorman's position when operating was inside of the body, where he stood in a pit or depression in the car floor, a provision necessary to give him "head clearance."

The only untoward event of the first trip was a derailment half way to Derby junction, but no serious delay resulted and the management considered the first trip a "huge success." The Ansonia *Sentinel* said of the trip: ". . . 'All aboard for Derby,' someone shouted and a man seated on the top of the car swung the traveler around to the wire, the current descended, and away sped the car like a thing of life."

Better Telephone Booths

By K. H. HAMILTON



The Latest Idea in Telephone Booths Is Here Illustrated, and Instead of Having to Step Into a Half Clean, Full Length Booth in the Form of a Closet, You Simply Step Into This Open Semi-Circular Frame, Pull a Cord, and the Half Length Booth Closes Around You. Another Pull of a String Opens It.

The atmosphere of a telephone booth on a heated day in summer will be more bearable when the new design comes into general use. It is operated by a string, and hangs from the wall enclosing the user to about the hips of an average height person. The bottom is not closed as is seen but permits a free circulation of air at all times.

In operation a user finds the telephone fully exposed and the booth door rolled back out of sight. Within two signs reading—"Please pull cord," are in evidence. The first use of cord closes the booth door around the user, the second permits it to roll back into its original position when not in use. The door is a circular glass one working easily on three-point ball bearings.

The new booth has many advantages to recommend it. First, it requires less material to build, and second, less space for its installation. Dust and dirt that naturally collect on the floor of the closed booth is avoided as the floor is readily accessible to the scrubber of the regular room floor where booths hang from the wall.

Booths of this description are being used in Boston and several other cities, and have been invented by a regular telephone man, Mr. John J. Barry, a telephone manager in an Eastern city.

Jules Verne

The World's Greatest Prophet

By CHARLES I. HORNE, Ph. D.

Professor, College of the City of New York

DO the scientific students, young and old, of the present generation realize one half of what they owe to that remarkable master of the last generation? We who as boys in the 1860's and 70's were brought up on Verne's stories, we who caught the first vivid glow, who gave the first enthusiastic scientific response to his romances, we know all that the world owes him. But has the new generation forgotten?

Jules Verne was the world's greatest scientific prophet. He was its greatest inventor, not in the immediate sense of having laboriously worked out each practical step of some new machine, but in the broader sense of having conceived, foreseen, planned out the general road along which advancing science was to make its way. That was Verne's real service. He illumined the path; he inspired a thousand thousand of us to take the road, to build as he had urged. And we have justified his faith, we have reached his goals. Not all of them—that is why I am speaking now. I would call the attention of our world not only to the Verne visions which have become our facts, but also to those which still lie beyond.

The master himself in his older days—he died in 1905 at the age of seventy-seven—compared his own art with that of the writer whom he regarded as the ablest of his followers: H. G. Wells. He said that Wells looked a thousand years ahead and, soaring with imaginative fancy, wrote of all that mankind might possibly achieve; whereas Verne himself had always been careful to keep in touch with the actual science of his day, to study it closely and then take just the one step forward which he was convinced science was about to take. This explains exactly where Verne's genius lay, why his prophesies have so many of them come true and why today we look with special curiosity on those which have not yet been achieved. We ask ourselves not "Will they be achieved?", but only "How soon?"

Among those Verne visions which have already materialized, doubtless every reader knows "Twenty Thousand Leagues Under the Sea" and its sequel "The Mysterious Island," with their romance of Captain Nemo and his submarine. There were no submarines when that tale began in 1870. The first successful one was developed by the American inventor Lake in 1897, and only with the remarkable "supersubmarines" constructed in the last year of the Great War have we really paralleled Captain Nemo's boat.

Similarly in "The Steam House," publisht in 1881, the master planned an automobile such as our five ton autotrucks of today are equalling. In that first tale of the self-propelling carriage, Verne depicted ordinary steam as his motive power; he had not conceived the greater energy of the gas-driven machine. Later, however, in his "Master of the World" he uses gas and electricity as the sources of power of an automobile, giving it just about the speed, a hundred miles an hour, which our racers show in the daring contests of today.

So too with the air-machine. In "Robur the Conqueror" publisht in 1886, Verne not only pictured the conquest of the air, as it was to be accomplisht some twenty years later, he even foresaw the struggle between the two great types, the "lighter than air" and the "heavier than air," and he awarded the triumph where the Great War has placed it, with the "heavier" machine. In the war we saw, as his vision had seen, the unwieldy "dirigible," the Zeppelin, prove itself of little value compared to the easily controlled "plane," the Sopworth bomber and the Curtiss sea-plane.

In the aerial realm as in the sea and land vehicles, Verne developed his ideas with time. The air-machines in "Robur the Conqueror" pale before the marvelous machine depicted in his later book "The Master of the World." Here the earlier hero, Robur, reappears with an invention which travels equally in the air, on the land, on the seas, and under the seas. We are just stumbling toward that development today. The seaplane travels on the water or in the air; we have a new automobile which seeks the aid of wings. Last month our scientific papers were talking of a practical water-automobile, or equal sea and land traveller. So step by step we are overtaking the master. He is no longer with us to point yet on and ever on.

Electricity is prominent in all of these prophetic books. Verne saw well the future part it was to play. Electric machines, some not wholly realized yet, form the main source of light and power in his visioned world. In some books he pursues electrical uses into yet further details. The "Castle of the Carpathians" centers its story on the invention of a phonograph before Edison had made one for us. The "Floating Island" depicts dozens of electrical and mechanical devices. It reaches beyond the telephone and describes a "telautograph" by which electric messages are written, and a "kinetograph" by which electric pictures are drawn.

THERE is hardly a civilized human being today who has not heard of Jules Verne and his marvelous scientific prophecies, a great many of which have come true. He forecasted the submarine, the airship, the phonograph, and dozens of other inventions long before the respective inventors had ever dreamed of them. The accompanying article by Professor Horne is particularly valuable for the reason that Mr. Horne not only has translated a good many Jules Verne's books from the French into English, but has also edited the only complete English set of all of Jules Verne's writings and for that reason is pre-eminently fitted to do the great subject justice. We know that our readers will appreciate this very important article.—EDITOR.

As to chemistry, Verne's "Dr. Ox's experiment" foreshadows the value of oxygen gas as a stimulant and reviving force. His "Star of the South" deals with the making of synthetic diamonds. His "Underground City" takes us into the miner's world of coal and its dangerous gases. Comprest air and comprest food are among the master's earliest conceptions.

Most marvelous perhaps of all are his stories of great guns and high explosives. In the World War when Germany suddenly bombarded Paris from a seventy mile distance, many scientists declared the thing absurd, impossible. Paris, they said, had been bombed again from air machines, not bombarded by a gun. They should have known their Jules Verne better. His first concept of such a cannon, hurling a projectile at once above the atmosphere and so escaping friction thru the main distance of its flight, was developed fantastically in his "Trip to the Moon." We have not yet duplicated that giant gun which shot the voyagers forth beyond our planet's gravitation; but our scientists now tell us that we could do so—if it would be of any "earthly" use.

More nearly in line with the actual developments of the War were the explosives pictured by the master in his "For the Flag," a truly illuminative work, and in his "Purchase of the North Pole." But most amazing of all in its preknowledge of guns and explosives and destructive gases, and also of the human forces behind them, was his "Millions of the Begum." When in the years after Verne's death I was called on to edit a definitive edition of his works. I felt it necessary to apologize for the "Begum" book with its hideous and awful picture of the German scientist, so ready in destruction, so exact with his mechanisms, so brutal in his soulless use of them. Even with the master's word for it, I could not then believe in such a German mind. You will understand the World War better if you reread the vision of it in the grim and terrible prophesies of this, Verne's *ugliest* book, written decades before the World War.

The present brief review can not cover the entire field of Verne's romances. In the realm of travel and adventure he was as preëminent as in the realms of science. Witness, for instance, his "Round the World in Eighty Days," of which each daily installment was cabled word for word from France to America that an eager public here need not wait a steamer's passage and thus remain so much behind their French co-readers. Or witness his "Michael Stroghoff," which became the great dramatic spectacle of the age.

In his "Desert of Ice" he carried us to the North Pole and made us see its bleak and empty world very much as Peary has since done. He built a story also on the South Pole. "The Sphinx of Ice." Here, however, he avowedly carried on a fantasy begun with our great American romancer, Poe; so Verne was pledged to Poe's beginnings and visualized for us a southern world of heat and wild peoples and electrical mysteries wholly foreign to the bleak land Shackleton and other explorers have since explored. The "Sphinx of Ice" thus stands alone as the one Verne book which time has contradicted.

Of still further reachings into the unknown, on which man can not yet render a verdict, were Verne's "Journey to the Center of the Earth," which no man seems soon likely to achieve; and his "Off on a Comet," which takes the reader to our sister planets. Yet it is notable that in both these books, as in the "Trip to the Moon" and its continuation, the "Tour of the Moon," later knowledge has followed the lines suggested by Verne. Here again instead of playing with idle fantasies of unknown worlds, the master studied all we know of other planets and our own, and keenly judged what conditions visitors to the farther worlds would be most likely to encounter. His genius searched ever for

(*Continued on page* 421)


AEROPLANE
DIRIGIBLE
MOON ROCKET
LONG DISTANCE GUN
MOTOR TRUCK
SYNTHETIC DIAMONDS
AROUND THE MOON
PHONOGRAPH
ADVENTURE BOAT SAINT MICHEL
VERNE'S HOME
Jules Verne
THE WORLD'S GREATEST PROPHET
TELAUTOGRAPH WRITES AT DISTANCE
KINETOGRAPH
SUBMARINE-AEROMOBILE
VERNE'S TOMBSTONE
SUBMARINE
PAUL

Water—The Elixir of Life

By WILLIAM M. BUTTERFIELD

WOULD you, gentle reader, wish to be a modern Ponce de Leon and sail away, as he did, in a high-pooped Spanish galleon made gay with silken streamers, embroidered gold and painted sails; would you, surrounded by a choice band of jolly noblemen, sail in this romantic craft across summer seas to the mysterious New World and the palm-fringed shores of Bimini; would you, with this gallant company, seek on the planes of this garden of the seas for the Fountain of Perpetual Youth; would you, a nerve-racked, supersensitive modern citizen, wish to be young again and live happily evermore?

Would you? Of course you would! For surely, deep down somewhere in your mind, lies this inherent longing, fully as old as the race, or born beneath the cinnamon boughs, eight thousand or more years ago, as Hindoo sages taught their Brahminical followers, that a Fountain of Youth existed somewhere. This fountain, our modern publicity experts place in actual location in modern mineral springs, such as at Baden-Baden, Carlsbad or the Hot-Springs, and a credulous public accepts the romance as willingly as the Brahminical adepts did on their famous journey across the seven rivers of the Ponjaub; such is the great desire and longing for Youth.

The ancient philosophers had a belief, quite like the modern one you will have to admit, that to see, or at the most taste or bathe in the waters of this mysterious fountain, was sufficient to bring perpetual youth, health and vigor to any one fortunate enough to reach it. Ponce de Leon set out on his memorable pioneer tour with this belief, and millions of the more fortunate of us have been doing the same thing, ever since then. Yet it is, strange to relate, a fountain as mysterious and illusive as ever, for there are no authentic records of permanent transformations, or even cures having been made during this age-long search. Would you like to know why? I will try to tell you, and at the same time help you discover the *real* fountain of health, if not of perpetual youth.

There actually are only a few pounds of water and a little charcoal that constitutes the difference between the vigorous body of a youth with a round rosy face, and the shrunken shank and withered features of an old man,—yet you cannot obtain the difference from a magical fountain of youth; Nature never does Her work by performing what man is pleased to call "miracles," miraculous as that work may seem. We smile at the hymns of the Vedas for portraying their deities as living upon the earth for life-times, extending over hundreds of thousands of years, as in the case of Vishnoo,—yet listen respectfully to any physician of ordinary reputation express, with positively no proof, a belief that the men and women of our time should live 200 years. And we believe, tho he fails to give a remedy that carries a universal guarantee, to insure those who try his plan, that they will surely reach that "allotted time." The pronouncement voices, you see, the same old desire that is as prevalent; and we cannot help believing.

It may seem strange to the reader why, thru all these years, the world has been seeking some peculiar kind of water, but this is not mystifying when we consider that the average adult, say of average weight, is composed of 138 pounds of plain water and only 12 pounds of "highly organized" man or woman, just 12 pounds of clay and 6 pails of water. Water is, as any one can see, of considerable importance in our physical makeup, but the old Hindoos, Ponce de Leon or our average citizen, is as ignorant of this well-known fact as can be; yet each sought, or is seeking for help from water; this is the strange part of the whole story.

Pushing the investigation still farther, we find that the anatomy of man, tho liberally irrigated, is comparatively solid as animals go, for there are innumerable others more bountifully supplied with *aqua purae*. A species of sun-fish often caught on the shores of Long Island, and sometimes weighing 30 pounds, contains only ½ ounce or less of flesh; and the common jelly-fish is but 10 parts solid to 1,000 parts water. Vegetables are almost all water, so that the food a man eats adds to his body supply. Thus, besides the 3 pints of water (or half a ton a year) that an adult must drink daily to supply the ordinary requirements of the system, they take into the body still more in their food, in about the following proportions:

Bread, cake, pies, pastries, etc., are more than half water, apples are 81 per cent. water, pears and peaches 89 per cent., musk and watermelon 98, grapes and berries 99, potatoes 75, carrots 83, beats 88, cabbage 92, trout 81, lamb 73, beef 74, and veal or pork 75. The cigar a man smokes is 30 per cent. water, the match he lights it with contains it both in the stick and the head. and the combustion of both match and cigar

(*Continued on page* 417)



Water Is the Savior of Man's Earthly Existence—in a Material Sense. Our Food, as Clearly Shown in the Author's Illustration Above, Is Mainly Composed of Water. The Black Miniatures Within Each Specimen Represents the Relatively Small Solid Portion of Each. The Balance Is Water.

Electric Household Wrinkles



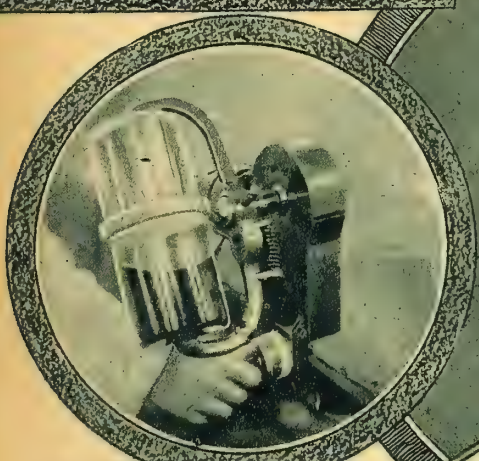
When the Janitor Goes on a Strike, or When the Coal Is Too Low in the Basement to Start the Water Heater, This Immersion Heater Which Heats a Whole Dishpan of Water in a Jiffy, Stands Ready to Help. It Has a Heating Surface Ten Inches in Diameter.



By Adjusting a Lamp Shade and Bulb Over the Telephone, This Instrument Becomes Considerably Dreat Up. The Mouthpiece is Concealed by a Bunch of Flowers Thru Which Conversation is Carried On.



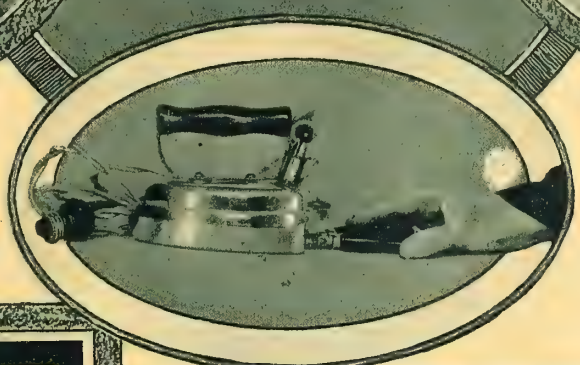
An Illuminated Letter Basket for the Hall Table. The Lamp and Shade Are Hung Over the Handle of the Basket and the Light, Falling on the Basket, Tells "Father" the Minute He Enters the Door Whether He Has Any Mail or Not.



This New Electric Mixer, Which Clamps to the Kitchen Table, Mixes Your Drinks in a Thoroly Sanitary Way by Revolving the Glass Container. No Mixing Rod Is Exposed to Dirt and Flies as in the Old Style Mixer. The Glass Container Comes Apart in the Center for Filling and Washing Purposes.



When One Becomes Weary of Certain Phonograph Records or When They Are Cracked, They May Be Made Very Useful "Citizens" by Becoming Stands for the Electric Iron. There Is Enough Wax in Them to Keep the Iron Smooth.

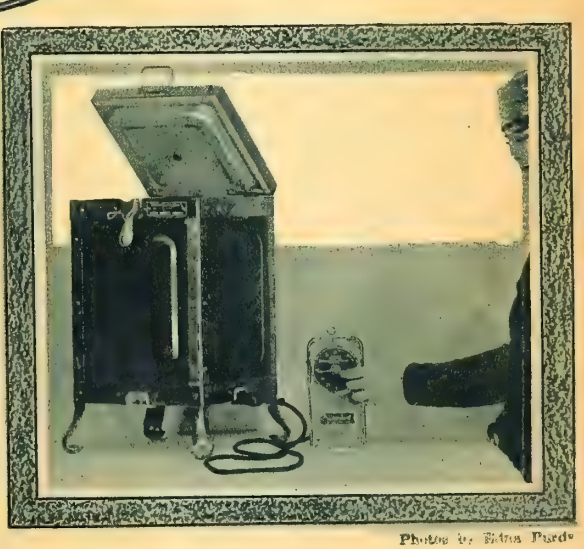




Above: The Electric Iron Now Has a "Companion" In a New Base Which Holds the Curling Iron, so That the Heat from the Iron May Be Used for Curling Purposes.

At Left: Have Your Photographer Make a Positive of Any Negative on Glass. Frame the Positive, and Adjust an Electric Light Bulb in Back so That the Light Will Illuminate the Portrait. When the Positive Has Been Colored the Effect Is Specially Pleasing.

The New Electric Fireless Cooker Permits the Housewife to Put Her Food Cold into the Cooker, Adjust the Electricity by the Clock Attachment, and Then Go Away Knowing That Her Food Will Be Properly Cooked When She Returns.



Photos by Edna Purdy



"So Suddenly Did This All Happen That I Scarcely Realized What Was Going On, Until I Glanced Down at My Shirt Front. Imagine My Unutterable Horror When I Saw the Tell-Tale Patch of Red Light Cast on My Shirt Directly Over My Heart! For a Moment My Heart Actually Stood Still, Then the Blood Began Racing Madly in My Veins, Pounding in My Temples Till I Thought They Must Surely Burst."

The "Ultimate Ray"

By RAY WHITCOMB

TO Trevis Reynolds, I am indebted for the one big adventure in my otherwise drab and prosaic existence, for had he not casually mentioned Marvel Creek as an ideal trout stream, I might never have discovered the existence of Pax Marriote and would consequently have avoided an experience of uncanny and exquisitely terrifying nature.

I doubt not but that nine-tenths of you who read this narrative will sagely wag your heads and mentally observe that "they're not all dead yet." I realize that I cannot reasonably ask a skeptical world to give credence to a tale that sounds like a vision from the realms of delirium,—a figment of a shattered brain; but I do ask thinking people to remember that the long strides of modern science have made possible a score of inventions which other generations must have looked upon as supernatural, as utterly beyond human achievement.

Being chief electrician in a large commercial lithographing establishment I found little time for recreation during the long winter months, and accordingly looked forward with genuine pleasure to my two weeks vacation in the late Spring, when I could get away from the eternal stench of printer's ink and the racking din of the press-room. Victor Bryce, assistant bookkeeper, was to have his vacation at the same time, and as we both enjoyed fishing, it was decided to try out Marvel Creek.

Accordingly, a sultry morning in May found us casting in the cool, racing waters of a mountain stream, many miles from the turmoil of the city. I had excellent luck and by noon was ravenously hungry. After a hearty meal, I left Bryce to doze in the warm sunshine, and, slipping a hatchet in my belt, started out for a stroll up-stream.

I wandered along the bank, heedless of time, clambering over boulders, sitting down to rest occasionally, pelting stones at trees, tumbling rocks into the riotous waters, and behaving generally like some truant schoolboy; when suddenly I felt a chill. In surprise, I glanced at the sky. The sun, which had been shining brightly when I left, was just disappearing behind the dark thunder cloud, and others hung low and threatening over the surrounding hills. A deathly silence prevailed, the awesome and ominous calm of Nature which preludes a mighty outburst.

One glance was sufficient to cause me to start rapidly retracing my steps. Colder grew the air, and colder; while the increasing gloom rendered my progress more and more difficult. Once, I slipt, narrowly missing a bath in the cold waters, and now came a distant rumbling that rolled and echoed weirdly.

I decided that is was useless to attempt to reach camp before the storm, and as a big raindrop struck my neck, followed by another on my arm, and yet another, I turned and started into the woods in search of some temporary shelter. Lightning flickered faintly in the south and the darkness became so intense that I could scarcely see the trees about me.

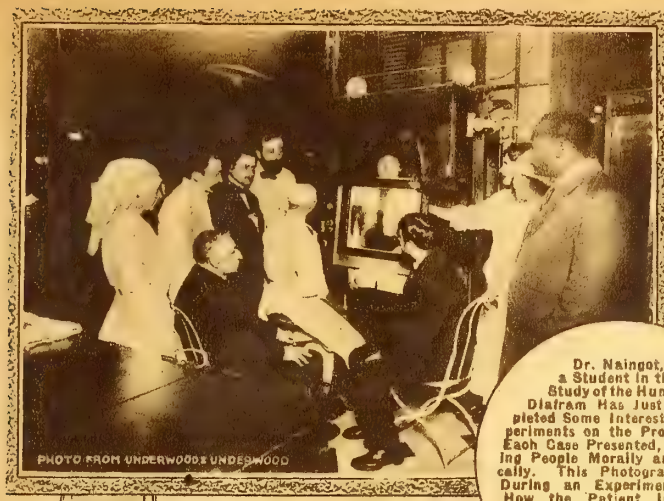
The downpour increased and soon a dazzling flash of lightning streaked across the heavens, followed by a mighty clap of thunder. In the ensuing darkness, I struck my head against a low branch and sank to the ground, exhausted and half dazed by the blow. The rain came down in torrents and soon drenched me, while the lightning split the darkness intermittently and the thunder crackled in one incessant tattoo.

During a particularly brilliant flash, I caught a fleeting glance of something that looked like a wall not far off, and raising myself to my knees, I waited. Then came a momentary blaze of light, and, with a little cry of relief, I staggered to my feet and went stumbling blindly forward. In one short instant, I had seen that I was at the edge of a clearing—that scarcely a hundred feet away stood a house.

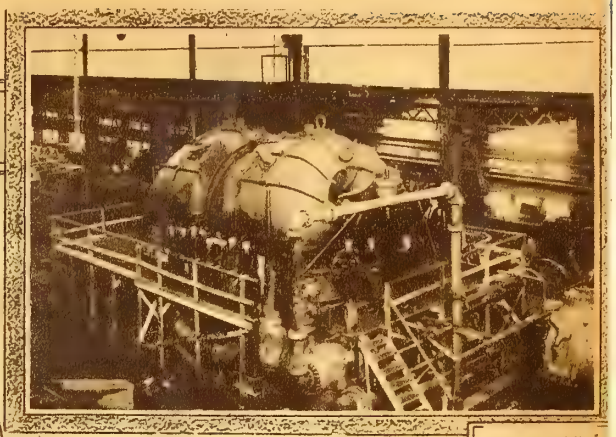
Guided by another flash, I reached the building, found the door, and not waiting to knock, sprawled onto the floor, kicking the door shut behind me. There I lay,

(*Continued on page* 442)

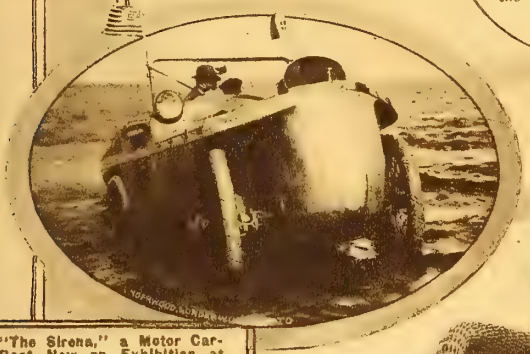
Science News in Photos



Dr. Naingot, a Student in the Study of the Human Diafram Has Just Completed Some Interesting Experiments on the Prognosis of Each Case Presented, Classifying People Morally and Physically. This Photograph Taken During an Experiment Shows How the Patient is Placed Behind the Screen of an X-Ray Machine, Revealing the Outline of the Diafram.



The World's Largest Steam-Electric Generator, Capable of Delivering 60,000 Kilowatts or 80,000 H.P.



"The Sirena," a Motor Car-Boat Now on Exhibition at Atlantic City, N. J., is a Fully Equipped Motor Car, Capable of Making 60 Miles an Hour on Land, and When the Driver Wishes, It Can Be Driven Into Any Stream at a Speed of 20 Knots.



It is an Easy Matter to Find a Way With the Least Obstacles for the Baby "Buggy" on a Dark Street by Putting on an Electric Light as Shown in the Illustration. Photo by Lisa L. Chase.

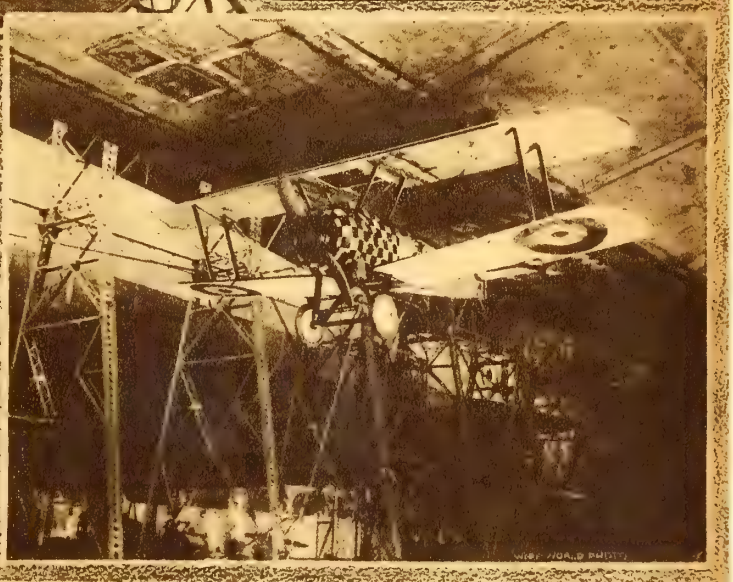


Miss Beatrice Irwin of New York, an Exponent of the Higher Culture in Electric Lighting, Who is Doing a Great and Interesting Work in Developing Harmonious Color Schemes for the Lighting of Residences. Miss Irwin Demonstrates the Various Effects of Well Planned Colors

Max Rindskoff, Inventor, on the New York City Police Boat "Hylan," Demonstrating How His Life-Line Hurling Gun Works. The Gun Shoots a Life Line Accurately 1,400 Feet and Has the Highest Commendation of the U. S. Steamboat Inspection Board.



Beneath the Giant Airship R-34, Which is at Present Stationed at Howden, Yorkshire, England, an Airplane is Hung To Be Used for Short Maneuvers While the Giant Airship is in the Air. There Are Trapdoors in the Bottom of the Airship Thru Which a Pilot Can Drop Directly into the Airplane.



The "Master Key"

By CHARLES S. WOLFE

I FOLLOWED Fenner thru the door of Davidson's office. We found the worthy Chief of Police seated behind his desk, from which vantage point he greeted us with an unusually cheerful "good morning."

He seemed in rare good humor, and I noted the quizzical uplifting of Fenner's eyebrows as he advanced to the desk and leaned lazily against it.

"We received your message, Chief," drawled Fenner, "and we came right down. What have we now—murder, mayhem, larceny or abduction?"

Davidson rose. "Come on into the office and let him tell you the story himself," he said over his shoulder, as he led the way, and with aroused curiosity we trailed after him.

Seated at the table was a well drest young man whose face bore no trace of the mirth that seemed to have gotten the best of Davidson. As we entered he glanced up quickly, and I imagined I saw the shadow of disappointment cross his features as Davidson introduced Fenner.

"Meet Mr. Fenner and his friend," said Davidson. "Joe, this is Mr. Watson, son of John Watson, who has the ice plant. Fenner here, Mr. Watson, is the man I think you want. Tell him your story. You'll excuse me, for I'm rather busy this morning."

Davidson left us, and as we seated ourselves across the table from Watson, I began studying him covertly. For he was a well-known figure around our town. Son of one of the wealthiest of our citizens, he was prominent in all the big social activities of the "upper set," and a member of all the exclusive clubs. His name was constantly appearing in the public prints, and I made the most of this opportunity to get a line on the man.

He spoke in low, cultured tones, not looking directly at us, and toying with a paper knife in a nervous fashion as he talked.

"I find myself in a most embarrassing situation, Mr. Fenner," he said, "and Davidson tells me that he is unable to give me any assistance, because the matter cannot be considered as legitimately in his line. I suppose he's right, and also I admit that I am showing poor sportsmanship in asking aid in this business, but you will understand that it is not the money involved that leads me to unfair play. I am in a fair way to become the laughing stock of the city,



See What Kind of a Detective You Are! This Man Was Locked in a Room With Bolts on Both Sides of the Door and Yet He Got Out—and All the Bolts Were Still Locked. Also, He Didn't Go Out Thru the Window! How Did He Get Out, Then? That's the Mystery.

Davidson laughed outright. Involuntarily I started. It was the first time that I had heard a laugh out of the usually taciturn chief. In fact, I firmly believed that the very farthest he would ever get in that direction would be a broad grin. And I realized that something unusually humorous must have come up to betray the police head into open mirth.

"None of the bunch you so glibly named, Joe," chuckled Davidson; "in fact, we have nothing. Everything is going nicely. I don't need you at all. But I've got a bird in my private office there who needs you badly. I'll say he does. Oh, boy! Wait 'till you hear his story!"

"Sounds interesting," admitted Fenner. "What is it? Usually obedient daughter eloped with the family chauffeur—something of that sort?"

and at all costs this must be prevented."

"And what is the difficulty, Mr. Watson?" Fenner asked, politely, as the clubman paused.

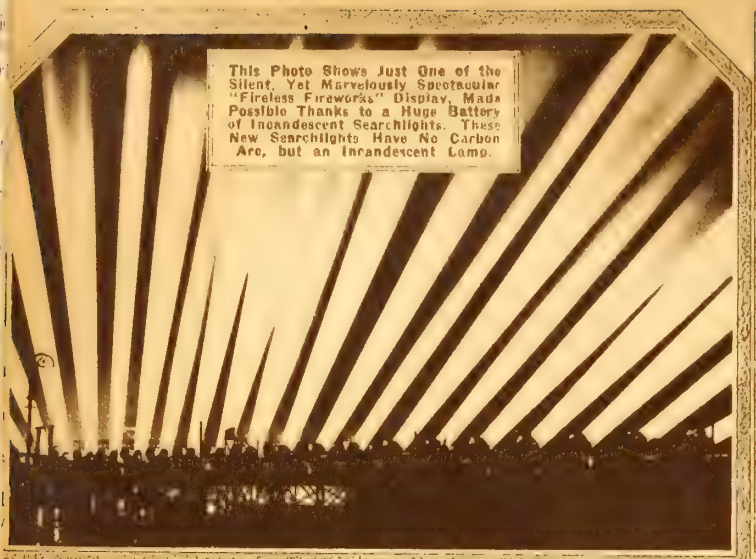
"It is a silly bet that I was foolish enough to make at the Lynx Club with young Fair yesterday afternoon. We were discussing some of the popular books of the day, and finally worked around to a detective story which is having quite a run. Maybe you've read the thing—chap is murdered in a room to which there is no apparent ingress possible without detection—that sort of stuff. I remarked that all this kind of business was drivel—that in everyday life such things could not, and did not, take place. Young Fair, with all the romanticism of youth, defended the writer and his clan. Said that things occurred in reality that outdone the

(*Continued on page* 431)

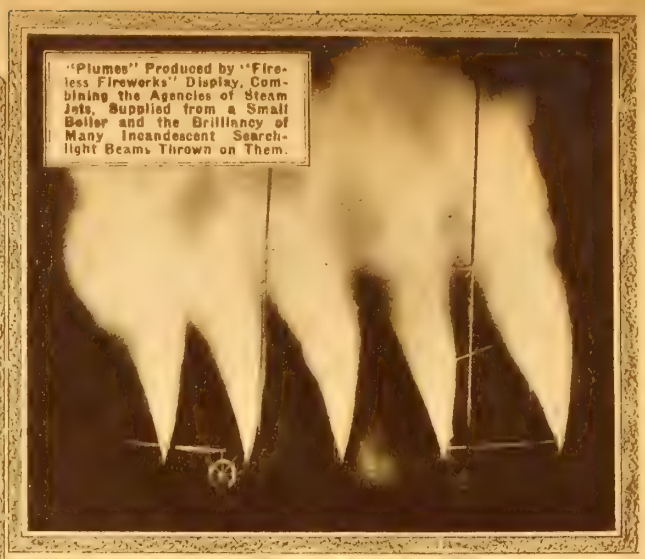
ODD PHOTO CONTEST



(SEE STORY ON PAGE 378)



This Photo Shows Just One of the Silent, Yet Marvelously Spectacular "Fireless Fireworks" Display, Made Possible Thanks to a Huge Battery of Incandescent Searchlights. These New Searchlights Have No Carbon Arc, but an Incandescent Lamp.



"Plumes" Produced by "Fireless Fireworks" Display, Combining the Agencies of Steam Jets, Supplied from a Small Boiler and the Brilliancy of Many Incandescent Searchlight Beams Thrown on Them.



This Searchlight Incandescent Lamp Is Capable of Producing 10,000,000 Candle-power in the Beam. It Is Shown Here Compared to the Ordinary 25-Watt House Lamp.





This Photo Shows a Particularly Interesting Effect Produced by the Combination of Escaping Steam and the Powerful Flashes of Light from a Battery of Incandescent Searchlights of the Latest Type.

Another View Showing the Wondrous Brilliancy and Novel Effect Which Can Be Produced Against the Sky at Night, When a Battery of the New High-power Incandescent Searchlights Are Properly Arranged and Focused.



"Pin-wheel Effect," Produced by Flashing the Beams from a Bank of Incandescent Searchlights on Figures Formed by Escaping Steam.

The Picture Herewith Shows How "Feathers" Can Be Formed by Steam and Then Illuminated in Any Color Desired, or by Ever-changing Colors.



"Fireless Fireworks"

By E. W. DAVIDSON

Of the General Electric Company

IMAGINE attaching a searchlight to the lighting circuit in your house some night and throwing a beam of light so powerful that a man standing a mile away in this beam would have light enough to read a newspaper! It can be done. This is not to say it will be done often, however, for various protective devices would be necessary. But the incandescent searchlight, which can operate on either an alternating or direct current circuit with proper auxiliary devices, has establisht itself, replacing arcs of medium size for many purposes.

The first use of the new type of searchlight for spectacular effect was made at Saratoga Springs on the night of June 19 when that city turned on its new street lighting system in the midst of an illumination carnival. The powerful beams of 18 searchlights, playing thru the heavens that night, were cast by *incandescent lamps*—a fact unknown to most of the thousands who witnest the celebration.

These 18 beams wrought skilfully produced columns and curtains of steam into great, soft-tinted phosphorescent fans and plumes. They streaked the black sky with beauty, tracing bombs up into the night and dyeing little clouds of powder smoke with variegated tints. They turned the glare of ordinary fireworks into a radiant effulgence such as few Saratogans had ever seen. Their brilliant light helped make memorable the Saratoga festival of light.

But their use is by no means limited to gay, spectacular illumination. The incandescent is fast replacing the arc in searchlights of the type used by river steamers and coastwise vessels. Where a tower or high building facade is to be flood-lighted, the incandescent searchlight supplies accurately directed beams for the high points which are too dimly lighted by ordinary flood lamps. Where construction is proceeding at night and distances or heights are beyond the reach of smaller reflectors, these searchlights, ranging from a few hundred thousand up to ten or eleven million candle-power are playing their parts.

The new type of searchlight is the natural outgrowth of the lamp which succeeded, in the parlor stereopticon, the sputtering arc which rendered such doubtful service in the hands of amateurs. The stereopticon incandescent was such a markt improvement in steadiness, simplicity and economy over the arc that is was developt into proper sizes for small and medium moving picture projectors. The next step into the searchlight field was logical.

W. D'Arcy Ryan and his corps of experts in the General Electric Company's Illuminating Engineering Laboratory who made the searchlight of both arc and incandescent types what it is today, labored long before they found the best method of shaping and mounting filaments so as to secure concentration of the light source in the incandescent lamp sufficient to produce a strong beam. Tungsten wire of various diameters wound into helical loops were tried in long coils and short—and even in a conical shape—but exhaustive tests showed that three types were superior to all others.

In a 115-volt, 1000- or 1500-watt lamp capable of producing from one to two million candle-power in the beam, six perpendicular coils of filaments are mounted in the form of the letter C, the convex side of this arrangement presented to the mirror.

The other two secure greater concentration for longer throws by operating at far lower voltages with correspondingly higher currents. A 32-volt, 1000-watt lamp, good for about four million candle-power, has four perpendicular coils mounted at the corners of a closed square. The third and most powerful of all is a 12-volt lamp of 100 amperes capable of developing as high as twelve million candle-power in a beam of 3 degrees. It has a grid of five coils mounted in a single plane. Of course, to operate these lamps on land, transformers or resistances are required, depending upon whether the circuit is alternating current or direct current. The 32-volt lamp will operate with no appurtenances on the average boat circuit, which is usually of 32-volts pressure. The globes for all these lamps are of hard glass, lead glass being too soft to withstand the tremendous heat generated.

Beginning this year, sane Fourths of July have taken on new glory with the brilliant aid of these incandescent searchlights. Spectacular color effects and beautiful ground and aerial displays have been worked out by Mr. Ryan for scores of great outdoor night pyrotechnics such as those at the Panama-Pacific Exposition, the Hudson-Fulton celebration and other illuminations nationally famous. Many of these have adaptations which could be used and doubtless will be used in "fireless fireworks" shows of the future based on incandescent searchlights which cost less, operate more economically and are far more adaptable to varying conditions than arc searchlights of medium size.

The Chances For Experimental Chemists

EXPERIMENTAL CHEMISTS!

The young chemist of to-day will be the consulting and analytical chemist of to-morrow. The reasons why the field of chemistry is bound to grow and why it should be adopted as one of America's greatest and most important technical and commercial institutions, is interestingly explained by Mr. Henderson in the accompanying article. We believe in the future of the American chemist. He is ordained to accomplish great things in the days that are to come. Let him make a good start now.

THE war-time closing of the wireless stations, the most popular and best developed field for the experimenter, made it necessary for thousands of scientifically inclined young Americans to find some other field of activity upon which to expend their surplus time and energy. The writer wishes to suggest a line of work in a field which would not be thus affected and one which offers a splendid opportunity for patriotic service, namely: the field of Chemistry.

Due to German supremacy in the chemical industry, this country was, before the war, dependent upon Germany for a large proportion of the chemical products needed in its industries, and when the German markets were closed to us, many of these industries were seriously affected. We must secure chemical independence from Germany as well as make the world "safe for democracy." The war of arms, in which we strove to destroy Germany's military supremacy, brought about a war of brains in which we must combat her chemical supremacy. Every experimenter in the country should get a working knowledge of the principles of general chemistry, and if possible, of analytical and industrial chemistry, as well, in order that he may be prepared to play his part in the struggle to free the United States from its dependence upon any foreign country for chemical products.

The writer therefore suggests that a national society be formed to promote the study of chemistry, and that SCIENCE & INVENTION sponsor the movement and act as the official publication of the society. SCIENCE & INVENTION is the best fitted magazine in this country for such a task. Its work in organizing the amateur wireless operators of the country, and in building up the greatest amateur wireless association in the world, is well known, and it has a splendid reputation for supplying the latest and most authoritative wireless and electrical news to its readers. It is already publishing a large number of chemical articles, and it would be but a step from this work to the organization of a national society for young chemists, a sort of Junior American Chemical Society.

The object of the society would be to encourage the study of chemistry, to bring all the chemical experimenters into one great organization, to enable local societies to be formed of experimenters who live in the same locality, and to build up a market for chemical supplies for amateurs, so that the supply houses will be justified in carrying large stocks of supplies, and in selling them cheaply. This last point is very important. When the wireless game was new, and there were but a few wireless experimenters, the demand for amateur wireless materials and instruments was so small that supply houses carried very incomplete lines, and were forced to charge almost prohibitive prices to make any profit at all. As more and more experimenters became interested in wireless, and as they became better organized, the demand for instruments and materials became so great that the supply houses were able to carry a much more varied line, and sell it cheaper. This movement went on until a great variety of equipment was available at very reasonable prices, and the study of wireless was within the reach of almost everyone.

The same thing will be true of the study of chemistry. If a large number of experimenters take up the study, organize, make known their wants, the supply houses will begin to carry large lines of chemical equipment and reagents at low prices, and this in turn will encourage more experimenters to take up the work, until a great organization will be built up which will be of immense service to the country in developing chemists to meet the ever-growing need.

JOHN C. HENDERSON
(Member American Chemical Society).
Akron, O.

[*An excellent suggestion. We would like to hear from our chemical enthusiasts what they think of the idea. Write us one and all!—Editor.*]

ODD PHOTO CONTEST

See Page 375 of Rotogravure Section for Photos.

$1.00 Paid for Each ODD PHOTO Accepted and Publisht

1. A REAL "DYNAMIC" PICTURE.

What do we see here?—*dynamos growing in gardens?* Well, "things aren't always what they *seem* to be," and this is no exception to that rule. This freakish photo was produced by a double exposure, showing in the foreground a man and woman seated on a bench among abundant foliage, and in the background a powerful dynamo, so large that the man in front of it is only about three-quarters of its height.

Contributed by HORACE ROURKE.

2. SOME HIGH FREQUENCY SPARK!??

This illustrates a *seemingly* realistic high frequency phenomenon, which is simply a delusion produced by the utilization of a common "Daylo" flashlight, which was used for the purpose of focusing properly; and the movement of the flashlight to and about the group pictured, was recorded on the film after the shutter had been opened.

Contributed by HARRY L. BURNAH.

3. AN UNUSUAL NIGHT PHOTO.

This is a picture of the illuminations of the "Parliament Buildings and Post Office" of Victoria, Canada, taken at night, by means of a twenty-five minute time exposure.

Contributed by G. V. MALLOWS.

4. A SKYROCKET IN MOTION.

This picture at first glance would apparently appear to be one of a skyrocket, taken while in flight, but in reality is an actual photograph of the path taken by the moon, sometime in July, 1919. Very few photos of this nature have ever given satisfactory results, and it is not very often that the moon can be photographed in this manner, and still have the picture show its *actual* path as clearly as this.

Contributed by EDGAR R. MALLORY.

5. UNUSUAL "LIGHTNING" PHOTO

This print was made from one of several plates exposed during a thunderstorm at night, some time ago. I stood upon the topmost step of the porch, and faced directly across the street. Down the street to the left (about 125 yards) was a street lamp of the arc type. Before opening the shutter and drawing the slide, I faced the shadows of the porch rather than risk a flash coming when I was in the middle of the operation. Then with the camera all set, I swung around and pointed it at the storm. A flash came, and I turned the camera away to the shadows, but upon second consideration, decided that the flash was not brilliant enough, and would expose the same plate again, which I did, and caught a very vivid flash.

Upon developing the plate, I was astonished at the result and have since figured it out this way: The two flashes are of course understandable, and I figure that the other lines were caused by the arc lamp in the distance, as I swung the camera from darkness under the porch, to the sky. Where the solid line changes to dotted ones, the effect is caused, according to my theory, by the speed of the moving lens separating the alternating current feeding the arc.

Contributed by LANDON W. L. EDMONDS.

6. RE-INCARNATION?!!

Do you believe in re-incarnation? If not, perhaps another look at the accompanying photograph may change your opinion. The individual pictured, evidently has faith in the motto, "If at first you don't succeed, try, try again!" and is making an easy matter of studying "Skull"-ography—enjoying a "weed" at the same time.

Contributed by GERARD ZANKE.

7. X-RAY OF DOLLAR WATCH.

Herewith is shown an X-ray picture taken of a dollar watch taken thru the 1/16" thick brass plate enveloping the works, which latter are very clearly shown. A chain and glasses were also attached to the watch, but these are minor features in this extraordinary photograph. X-ray pictures such as this, especially when taken under ordinary conditions, very seldom if ever give the splendid results obtained in this photo.

Contributed by HENRY VOGEL.

8. SOME GHOSTLY HANDS, EH! WHAT?

Altho at first one would presume this to be a picture of a pair of *ghostly* hands, it is none other than a photograph of a lightning arrester used on distribution line tests for the purpose of determining the wet flash-over voltage, to approximate the operating conditions. This arrester was tested on 60 cycles, the capacity of the testing outfit being 50 kilowatts. The voltage applied in this case was 48,000, the insulator being very wet. The flash pictured caused no damage to the arrester. The air gap was set for 13,000 volts distance.

Contributed by W. G. McKENZIE.

9. A "TANK" IN ACTION?

This is a photograph of a miniature tank in action, and is so very realistic in appearance that it is indeed difficult to believe that the startling, weird effects were produced thru trick photography. The unusual lighting effects were obtained by placing a small amount of flashlight powder directly in front of the camera, and the results were far above any expectations.

Contributed by GEORGE ALEXANDERSON.

10. HE SEES HIMSELF FIVE TIMES!

This photograph is one of a man seated at *apparently* five different places around the table. It was taken by one exposure of the film. Two large mirrors were placed at right angles on top of the table, and the person sat directly in front of them, with his back to the camera. Thus the only authentic picture is the one where he is seated backward the other remaining views being only reflections. The room in which this photograph was taken was a poorly lighted one, thereby making it necessary to employ artificial means of illumination—hence a 500-watt nitrogen bulb was placed just over the camera, producing the desired results.

Contributed by CARLETON SUTLIFF.

11. AND WHAT IS THIS?

The weird looking picture shown herewith is one of "The Gyroplanes" in motion at Luna Park, New York, taken by means of a time exposure. This is *indeed* an odd photo! And the effects produced are not alone beautiful in appearance, but are seldomly obtained in such a striking aspect. Who could guess on first inspection, that this queer photograph was one taken of the revolving Gyroplanes?

Contributed by K. STRICKFADEN.

12. REMARKABLE ICE-COVERED WIRES.

This is a photograph of some remarkable ice-covered wires, taken during some very unusual weather conditions, in Petaluma, Calif., last January. It was raining heavily at the time this picture was taken, and the temperature was about 32 degrees Fahrenheit, thus causing the falling rain to freeze on the wires—the ice on some parts of the wire being over two inches thick!

Contributed by FRED W. TUCK.

French Airmen Predict Ten-Hour Transatlantic Flight

To fly from France to New York in ten hours is the latest and most ambitious dream of French airmen and inventors. They declare that it will be done within the next few years by means of two new inventions, which enable an airman to fly at a height of 40,000 feet, where, owing to the reduced air pressure, a speed of 450 kilometers (282.6 miles) an hour can be maintained.

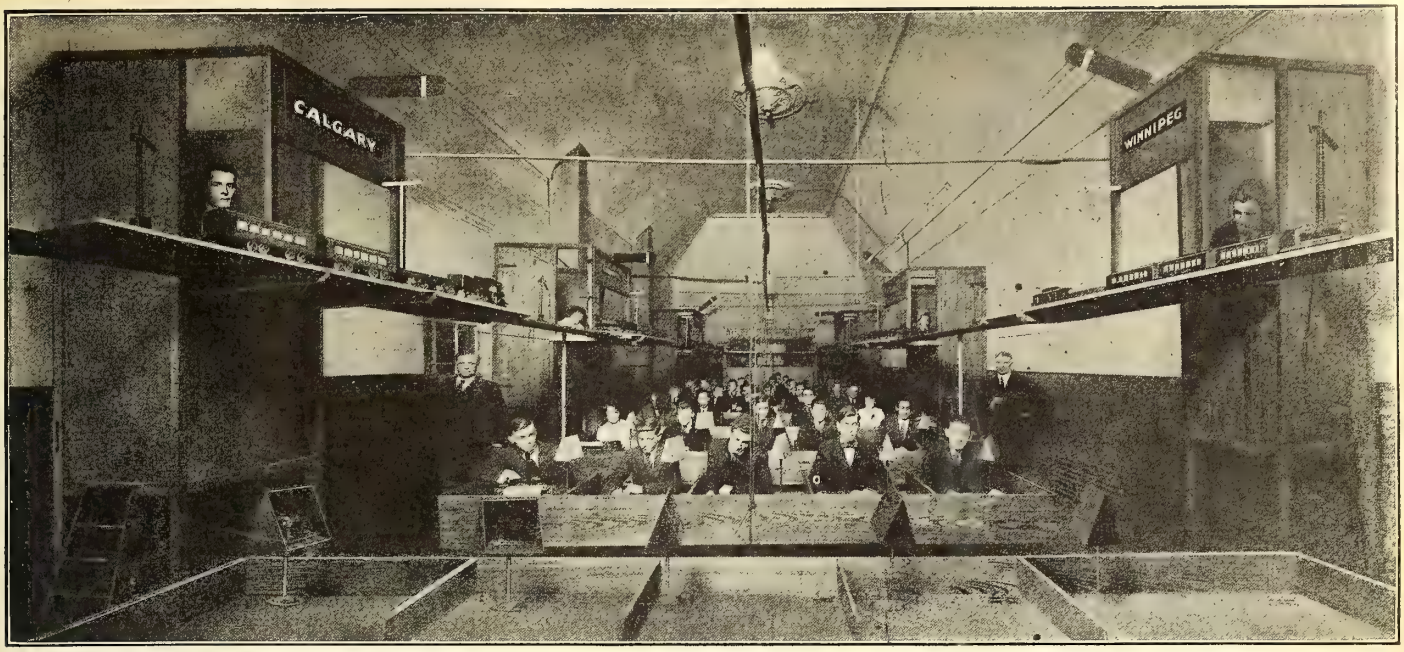
Two difficulties which face the inventors are, first, to secure the functioning of the engine and driving force of the propeller in that rarefied atmosphere, and, second, to secure a life-supporting atmosphere for the airman and passengers.

The first of these difficulties has been largely overcome by an invention which was recently used by Lieutenant Henri Roget, who flew from Paris to Lyons, a distance of nearly 285 miles, at a speed of 156 miles an hour. Roget flew at a height of 15,000 to 18,000 feet all the way and was able to maintain his speed in the rarefied atmosphere by means of an invention which comprest the air fed to the carbureter to normal atmosphere.

Since then a controlled trial has shown that a motor giving 178 horsepower at water level and ninety-five horse power at 1,500 feet can be made to give 166 horse power when the air is comprest by the new apparatus. To that extent the effect of rarefication of the air has been overcome, and it seems certain that, the principle having been established, further development will be rapid.

The second difficulty is to secure breathing air for the fliers. The example of the submarine is here invoked. There is no more difficulty, it is stated, in making an inclosed chamber provided with air at normal pressure which will travel above the clouds than in making one which travels below the water.

Once these two problems are effectively solved full advantage can be taken of the non-resistance of the upper air. To go quicker one will have only to go higher, and, incidentally, to go cheaper, for on the faster voyage less fuel will be burned. In those days we will have a nightly service of airplanes following the dawn across the Atlantic and dropping down in New York in time for breakfast.



In This Canadian Railway Telegraphy School the Students Derive the Utmost of Practical Learning, Not to Mention a Host of Pleasure from Operating This Complete Electrical Railroad System, Which Is Equipt with Interlocking Block Signals, Switches, Etc. This Miniature Railroad Is One of the Most Complete Ever Installed in Any Railway Telegraph School, and Is a Credit to the Instructors Who Have Built It.

School Has Miniature Railroad

"Learn how to do things, by doing them," is the policy of one of the large Canadian railway schools, and in order to carry out this effect to better advantage, this school has been equipt with a complete model of a trans-continental railroad system, including among other things sidings, yards, switches, stations with semaphores, train-order boards, switchboards and telegraphs connecting each station with an outside telegraph wire and one with the dispatcher's table and, of course, a complete telephone system.

An extremely unique feature is added, namely, that of controlling the trains entirely by radio-dynamics, or better known as wireless control. Each individual train can be started, reversed or stopt at the will of the dispatcher independently of any other train on the tracks. In this way the pupils obtain a complete course by the use of these six-foot models, which stop and start off again on their run.

The semaphores at each station enable another method of signalling; all of them are worked automatically, the same as in the large railroads.

For night dispatching, all trains, semaphores, signals, markers, and switches of any nature are equipt with electric lighting systems which assist the pupils in correctly dispatching the trains even when the room is enveloped in darkness.

The phonetic system of memorizing is used and the school thoroly equipt with telegraph instruments, so that a complete course in telegraphy at the same time may be obtained. Many railroad officials who have visited the institute and inspected the equipment were amazed and pleased by the remarkably complete methods and the exact replica of the trans-continental systems.—

Photo courtesy Canadian Schools of Telegraphy and Railroading.

Electric Light Cures Diseases

ONE of the main objects of the invention here illustrated is to provide an apparatus of the character stated by means of which the lower portion of the body may be subjected to the action of heat and light rays from all sides, so as to effectually penetrate the body and to kill the disease germs and reduce inflammation and promote circulation. A further object is to provide an apparatus which is specially adapted to fit about the lower portion of the body for treatment of diseases of the bladder and similar troubles. Further objects will appear from the following detailed description.

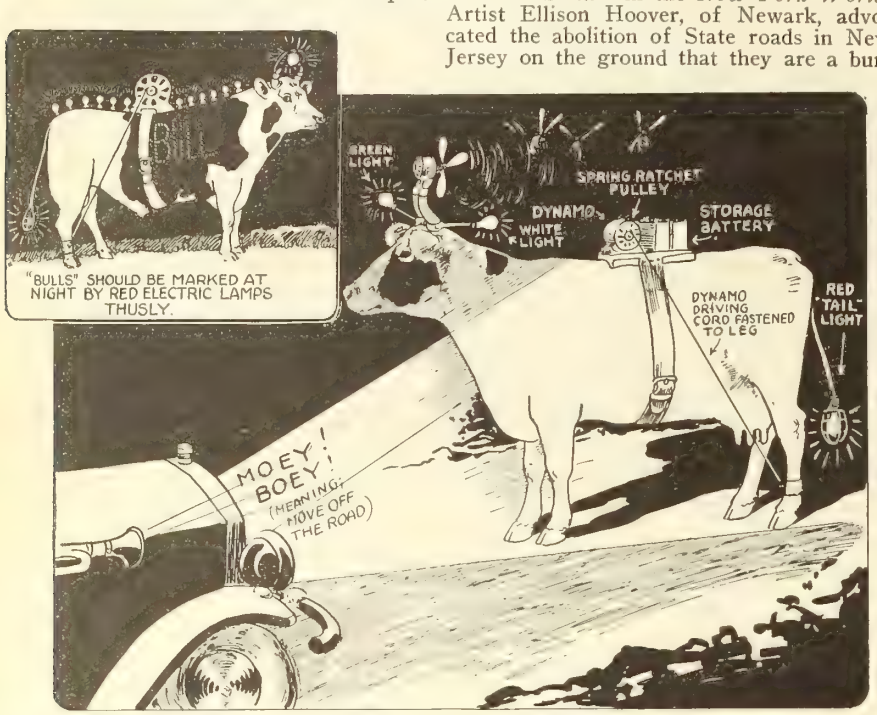
In practise, the patient is placed upon the cot, after which the upper section of the casing is lowered so that the sections completely inclose the lower portion of the patient's body, as shown in the diagram. The two sections fit snugly together at their adjacent ends, so as to form tight closures, and a suitable cloth or pad may be placed about the patient's body and the edges of each of the end plates of the respective sections; this cloth serving to prevent escape of heat from the casing. After the patient has been properly placed upon the cot and the casing has been closed as described, the lamps are illuminated so as to generate light and heat. The light and heat rays are directed by the reflecting inner surfaces of the sections of the casing onto the patient's body and penetrate the same, the dry heat thus produced and the light rays coacting to kill the disease germs and reduce inflammation, while promoting circulation and the growth of the friendly germs, thus effecting a cure. "I have found this apparatus, due to its adaptability to concentrate the heat and light rays upon the body so as to cause penetration of these rays into the body, very efficient in the treatment of diseases and affections of the lower cavity of the body"—says the inventor of this newest electrotherapeutic treatment apparatus, Mr. Vern Linn Ruiter, of Roseburg, Ore.



The Accompanying Illustration Shows One of the Latest Electro-Therapeutic Devices for Treating the Lower Portion of the Body, Especially for the Treatment of Diseases and Ailments in the Lower Abdomen.

Electric Lights for Cows, By Cows!

The recent tie-up of the railroads and the increasing traffic on the highways have caused considerable uneasiness on the part of the leading members of the Cedar Grove, New Jersey, Board of Poultry Trade, says "Farmer Smith" in the *New York World*. Artist Ellison Hoover, of Newark, advocated the abolition of State roads in New Jersey on the ground that they are a burden and expense to the poor taxpayers.



"Tie That Little Bull Outside" Would Seem to Apply to the Accompanying Electric Bull Story, but When You Come to Think About It, It Isn't as Crazy as It Looks. A New Jersey Farmer Has Suggested Placing a Small Dynamo Similar to the German Trench-Light Generator on the Back of the Animal and as It Walks the Dynamo Will Supply Current for the Lights and Perhaps a Storage Battery—Even Down to a "Tail" Light.

The whole trouble has come about thru the passage of the bill at Trenton which fines the owners of bulls (live) when said animals are found upon the highways without chaperons.

Further, automobilists are complaining about horses and cows roaming on the roads after dark without lanterns for tail lights. As autos have to have lights why not animals, it is argued.

The board was pleased to receive the report of Wallie Dobbs, Chairman of the Highways Committee. Wallie states that he has received from F. Bergamo, inventor of the Superheated Hen's Nest, the outline of an invention which Mr. Bergamo is perfecting in Newark. This provides for a dynamo to be attached to the backs of horses and cows which is operated by a shaft attached to a leg, much like the driving rod on a locomotive. This dynamo generates electricity, which is stored in batteries also strapt to the animals' backs and from which are run wires connecting with electric lights.

Thus it can be seen that white and green lights can be placed on the right and left of a horse's head, while a red light can be placed on the rear of the animal, so as to warn automobilists and others that there is an animal on the highway.

It was suggested by Hogo Peebles that in the case of bulls twenty-five red lights, twinkling like movie signs, be placed at convenient intervals on the beasts' backs.

A motion to have the battery feed electric fans to shoo off the flies was voted down.

Giving Batteries the "Third Degree"

By S. R. WINTERS

The wag who satirized life as being one d—— thing after another, may have gotten his "tip" from the life tests of storage batteries, which consist of a continuous series of charges and discharges, completing two cycles every twenty-four hours. Anyway, the United States Bureau of Standards has devised an automatic apparatus for such testing of dry cells and storage batteries, aiming to displace the prevailing methods, which are claimed to be arbitrary in their applications.

The "telephone," "ignition," and "flashlight" tests are the three ways of examining dry cells and storage batteries at present, involving the discharge of the cells thru resistances for varying periods of time. The newly-developed method of the Bureau of Standards might be called the "clock" test, judging by the prominence of a timepiece which controls the selective relays. The apparatus is adaptable to any form of testing at intervals, requiring the closing of electrical circuits at a specified time. A continuous series of life tests can be made, two complete cycles every 24 hours, without the presence of an observer.

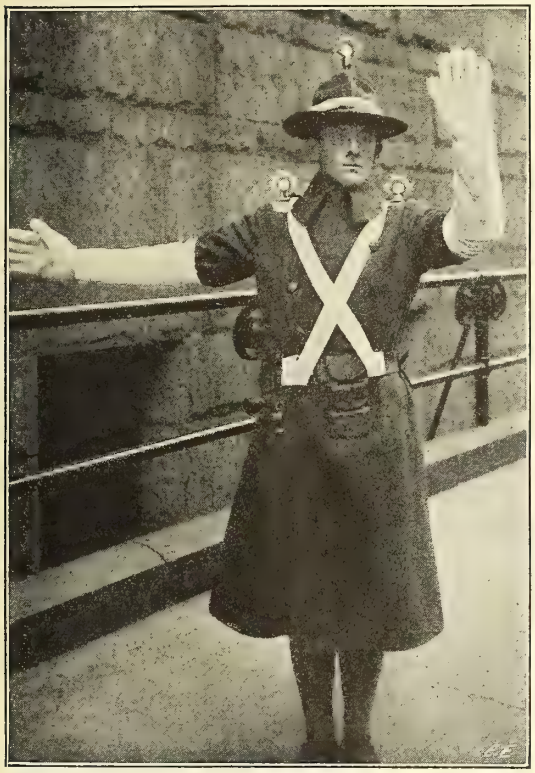
The apparatus is capable of controlling a considerable number of widely varying periodic tests at the same time. There is an absence of rapidly moving parts, and the accuracy with which the intervals of discharge are timed, is equal to the regulation of the clock. The pendulum timepiece contains an electrical contact, the circuit being closed once every minute, and supplies an electrical impulse to one of two selective relays which are contained in the glass case. As each impulse is received, the shaft at the left hand end is advanced by one-sixtieth of a revolution, making one complete revolution every hour. Each hour this shaft furnishes a similar impulse to the coils at the other end of the apparatus, which causes the shaft at the right hand end to rotate. There are 24 teeth in the wheel at this end of the shaft, making one revolution in 24 hours.



Here We See One of the Government Experts at the Bureau of Standards Laboratories Putting Dry and Other Form of Battery Cells Thru Extensive Tests. The Batteries Can Be Periodically Discharged at Regular Time Intervals by Means of an Automatic Circuit Closer Attached to the Clock at the Right.

Illuminated Traffic Cop

The first traffic cop in the world to be "lit up" has been discovered in Boston, Mass. Owing to the great congestion of traffic at certain street intersections in Boston, it has been found necessary to protect the traffic officers with some sort of conspicuous marking, and the electric lights placed on the peak of the campaign hat and also on the shoulders were decided upon. The light on the hat is red, those on the shoulders are white. To make the officers still further discernible they wear broad white straps criss-cross across the breast and long white gloves on their hands. The "juice" for the lights is in two batteries carried in the pockets of the overcoat.



The photo shows Sergeant R. E. Blackeley, of Company D, Motor Transport Corps, Boston State Guard, our first illuminated traffic cop.

Boston, Mass., Has the Credit of Being the "Brain Center" of the United States, So We are Not Surprised to See the Latest Idea in Illuminated Traffic Cops Hatching Forth from That City. This Should Prove a Great Boon to Traffic Not Only On Stormy Nights, But On Street Crossings Which are Not "Over-illuminated."

This idea would seem to be a popular one. Possibly a little later they will rig up the red light to flash for "stop" and the white or green light to flash for "proceed." The blinking on and off the lamps being controlled by a push button conveniently located. Another good idea in this direction is the illuminated glove. Several patents have been taken out on these. Battery lamps serve the purpose very nicely.

Drink With "Legal" Kick

Here is a perfectly legal way of putting a *kick* in the drink. Two wires are connected to a medical coil. The other end of one wire is connected to a metal holder holding a glass of water. The other wire is connected to some tin foil wrapt around the glass. Z-z-z-z. John Barleycorn never could produce so strong yet so safe a kick.

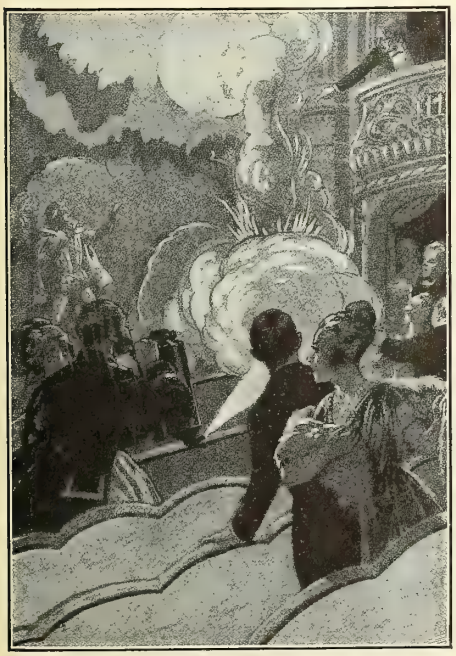


Photo from Edna Purdy

Chicago Shows Us the Way to Get a Drink with a Real "Kick" In It. Hook a Charged Wire to the Metal Cup.

NEW DRY FIRE EXTINGUISHER.

This latest invention comes from Germany where it is widely advertised and seems to have considerable merit. In German it is called *Total Automatischer Schnell-Kohlensäure Feuerlöscher,* meaning total-automatic Quick-Acting Carbonic Acid Fire Extinguisher! As the name says, the apparatus is worked by means of carbonic acid gas, which as is well-known, readily extinguishes flames. As our illustration depicts, all that is necessary to do is to turn the extinguisher in the direction of the flames, twirl a knob when the gas which is immediately generated by the extinguisher is made to pour over the flames, thus extinguishing them. How well the device works we have not been informed, but it seems to meet with considerable favor at the present time in Germany.



This Ferocious Looking Fire Extinguisher is the Latest Thing in Such Devices Developed in Germany. It Has a Long, High Sounding Name Which Means a Total-Automatic, Quick-Acting, Carbonic Acid Fire Extinguisher. It Works By Means of Carbonic Acid Gas Which is An Excellent Fire Extinguisher.

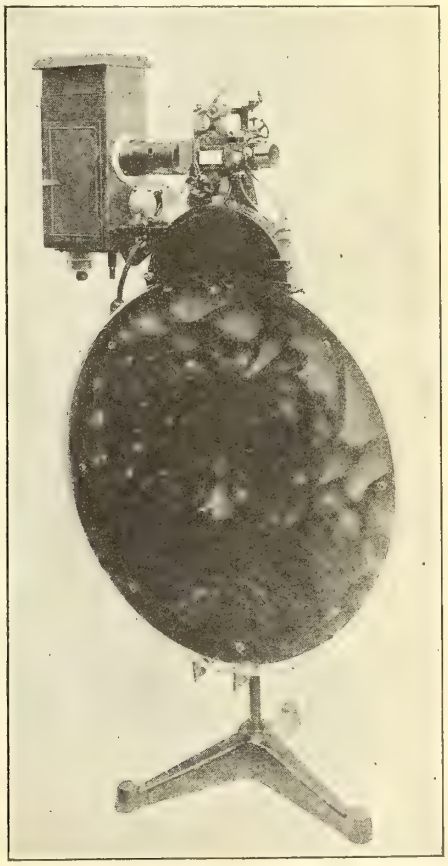
NEW ADVERTISING "MOVIE" MACHINE.

Here is a new machine which takes the motion picture and makes it a universal medium for advertising, publicity and education. It is claimed to be simple, practical and inexpensive. It makes good the wish of business men, educators, bankers, propagandists — all who want a message carried to the largest number in the most forceful manner at the smallest cost.

This clever advertising machine projects a motion picture any reasonable size. It does not require the services of an operator. It uses standard film and is automatic. It projects a picture over and over —a dozen times to a thousand times. There is no stopping to rewind or rethread the film and no danger from fire. The film can be stopt at any point and a picture held as long as desired. Also it can be used in daylight as well as in darkness.

The device is suitable for use in store windows, in class rooms, in waiting rooms, in hotel lobbies, in lodge rooms, in offices, in exhibition rooms, in homes, on steamboats, on railway trains, as a billboard attraction—any place where there is ordinary electricity.

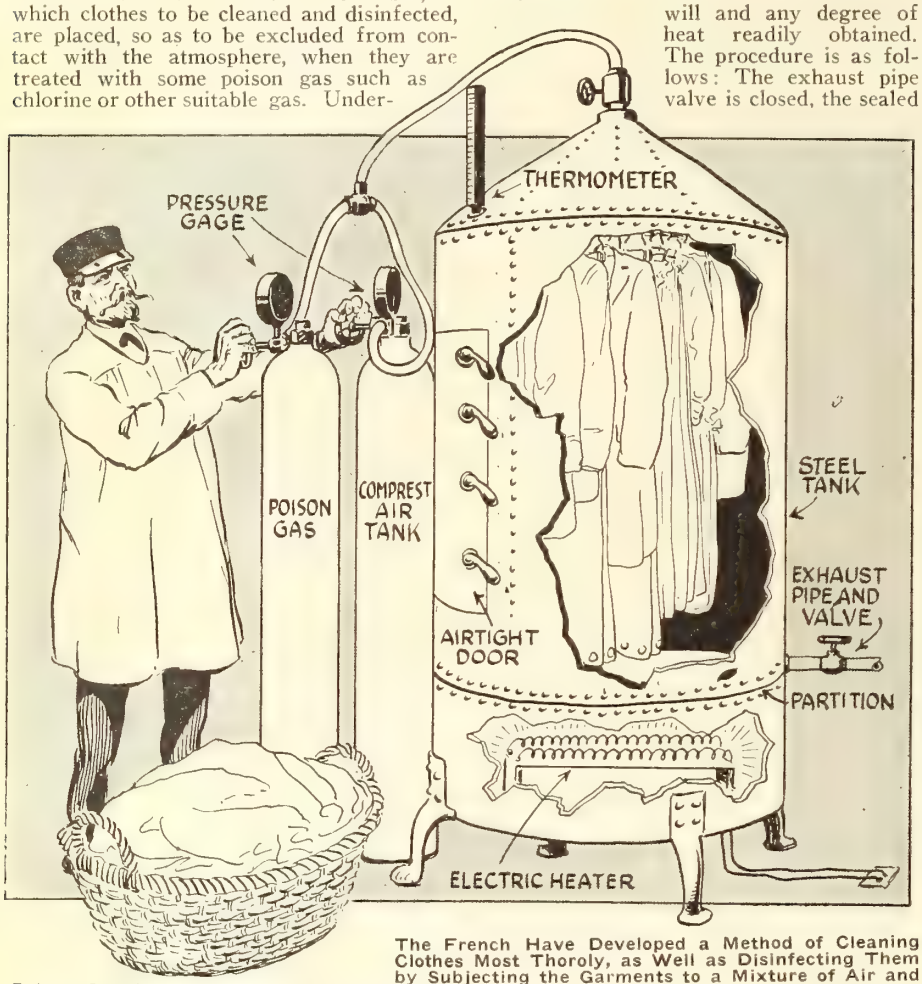
This automatic projector is the invention of John P. Burnett, of Chicago. Mr. Burnett is an experienced mechanician and inventor. Along with many others he heard the cry for a simple, automatic, motion picture projection machine — a machine that would give perfect continuous projection, anywhere, any time.



The Latest in Electric Automatic Movie Projectors.

Poison Gas Cleanses Clothes

In the accompanying illustration is shown one of the latest inventions in France, in the form of a steel treatment chamber, in which clothes to be cleaned and disinfected, are placed, so as to be excluded from contact with the atmosphere, when they are treated with some poison gas such as chlorine or other suitable gas. Underneath the steel disinfecting chamber, there is placed an electric heater, the strength of the current of which can be controlled at will and any degree of heat readily obtained. The procedure is as follows: The exhaust pipe valve is closed, the sealed air-tight door opened and the clothes hung within the round steel chamber. As many clothes as desired can be placed in the chamber as the gas will easily pass right thru them, and permeate every portion of them. The steel outer door is then closed by means of the levers shown, and the operator (the operative here shown is a typical French workman drest in a hat, trousers and blue denim gown, similar to that worn by the American laboratory workers, but only of three-quarter length) then opens up the valves and watches the gages on top of the tanks, regulating the mixture of poison gas and air to the proper amount.



The French Have Developed a Method of Cleaning Clothes Most Thoroly, as Well as Disinfecting Them by Subjecting the Garments to a Mixture of Air and Poison Gas Such as Used During the War, While an Electric Heater Heats Up the Gas Within the Chamber to any Degree Desired. The Operation Takes but a Short Time.

The temperature is carefully watched in all of the operations so that the clothes will not be scorched or burned and the gaseous atmosphere within the compartment is raised to as high a temperature as possible, as the heat tends to expand the gas and causes it to penetrate thru the clothes more evenly.

After the clothes have been treated several minutes, the exhaust valve in the pipe line which leads outside the building into a neutralizing tank, is opened, and the residual gas blown out of the treatment chamber by having the poison gas valve closed tight and opening the comprest air valve from a storage reservoir for a fraction of a minute. The door to the gas chamber is then opened and the clothes removed.

One of these poison gas disinfecting outfits will be installed in almost every hospital where all kinds of diseases are constantly being met with; the problem of killing these disease germs in clothes having heretofore been considered impracticable and the clothes therefore burned.

It would seem that this system solves the problem, and besides it is the most sensible idea for cleaning and disinfecting our everyday clothes at periodic intervals, as disease germs often lodge in the most unsuspected places.

Luminous Eyes for Nursery Zoo

In the two accompanying illustrations, our artist has portrayed two scenes, showing the "before and after" effects on the children who are unexpectingly greeted by the members of the nursery zoo after they have retired. Possibly, they had not noticed the effect of the luminous, radiumized eyes of Fido, Old Bruin and Jumbo—the Smaller.

But whether this was the case or whether Nursie thought to play a joke on them, the surprise is well shown in the illustration at the left, and so would you be surprised, even tho you are a grown-up—if, out of the inky blackness of your sleeping chamber, you suddenly awoke and beheld three shining pairs of eyes, staring forth with a strange greeny phosphorescence; for all of which surprises and novelty we have to give thanks to Miss Florence Garrigue, of Danvers, Mass., who has been recently awarded a U. S. letters patent on this toy.

But the aforegoing was not apparently the main idea entertained by Miss Garrigue when she invented this toy, for she says in her patent:

It is well known that many children have a natural aversion for darkness and will not go to sleep unless the parent or some other person remains in the room or within sight of the child, or unless a light is left in the room. In many instances, however, children are forcibly compelled to go to sleep in a dark room and as a result develop nervous diseases, which are retained thru a greater or less portion of their lives.

The present invention contemplates the production of a toy, such as a doll or other simulation of a living being—for example, a dog, cat, bear, etc., having *luminescent eyes* which toy may be taken to bed with the child and which the latter may be assured will watch over it during the night, thereby allaying the fears of darkness.

A further object of the invention is to provide a doll or other object of the character specified having a soft and pliable body which may be handled by the child in the night, as well as the day-time, without danger of injury to the child and which will be provided with eyes having a luminous appearance.



And What Are the Kiddies so Scared About? You Would Be Scared, Too, if You Happened to Wake Up of a Sudden and See Several Pair of Luminous Green Eyes Staring at You Out of the Darkness of Your Bed-room.

But Their Fears Are Quickly Turned to Joy When Nursie, in Response to Their Cries of Alarm, Winks on the Electric Lights and the Luminous Radium Eyes Are Discovered to Belong to Fido and His Friends.

The Electric Hairdresser



The "Hairometer," a Device That Gives the Hair a Turkish Bath at a Temperature of 300 Degrees, Being Demonstrated in London. The Heat Is Supplied by Electricity and It Is Said the Device Will Produce New Growth Rapidly.



At the Beauty Show Recently Held at the Palm Garden, Fifty-eighth Street and Third Avenue, New York City, a Permanent Wave Apparatus, Which at First Sight Seems to Remind One of a Highly Perfected Skull Crusher, Proved Its Worth as a Permanent Waver. The Machine Can Wave up Fifty-two Curls at One Time. This Photo Shows the Apparatus and How It is Attached.

"An Eye For An Eye"

The picture here reproduced illustrates one of the most remarkable optical freaks that we have come across in some time. It shows the clear reflection of the photographer who took the picture, in the dog's eye, said canine being one of the champion Airedales exhibited at the Dog Show, held during the last winter season in New York City.

It is seldom that one sees as clear a picture as this one, altho the phenomenon of the image reflected in the pupil of an eye, either human or animal, is fairly well known. Undoubtedly you have often looked in the eye of your pet dog and under the proper conditions were surprised to note the reduced yet perfect miniature image of your own countenance reflected in the animal's eye.

There has been for, many years, a theory that when a person is murdered, that the image of the murderer is recorded on the retina of the victim's eye, and that if the police authorities could photograph this image within a reasonable time after the death of the victim that it would render the task of discovering the actual murderer as simple as child's play.

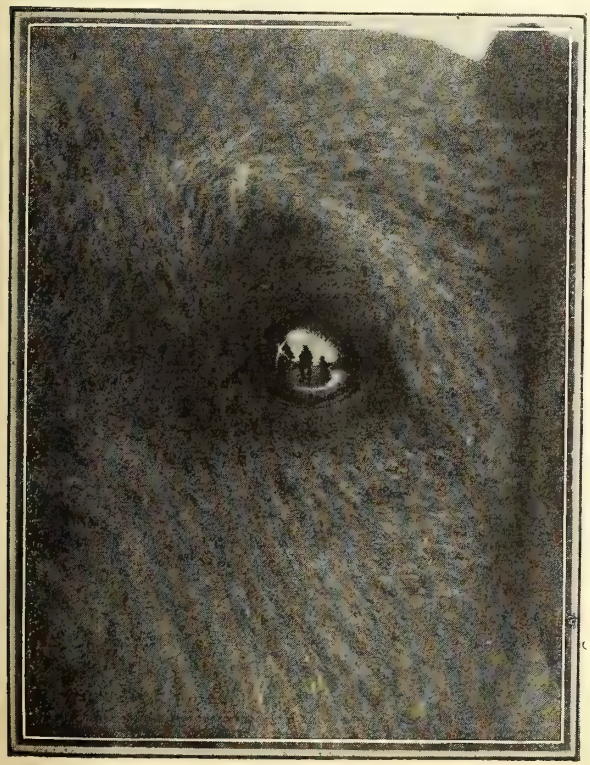


Photo at Left Shows Image Photographed in an Airedale Terrier's Eye. The Original Image Was Much Clearer, of Course.

It must be said that there are many wonderful things about the eye, whether human or animal, that we do not yet understand, and the scientists of tomorrow will undoubtedly cause us to be really astonisht at the slight amount of knowledge we now possess of this most wonderful of all Nature's miraculous achievements.

Ex-Kaiser's Lights Getting Rusty!

The latest cable from Europe brings the tidings that the Ex-Kaiser's erstwhile domicile in Berlin, the former home of the greatest militarist of all time, is rapidly degenerating so as to resemble anything but a royal abode.

The present photograph shows how the birds have started to make their nests in the electric lights on the exterior of the brilliant palace which formerly housed the Hohenzollern family.

The cable does not say very much as to what is going on in Holland, where the ex-ruler of Germany daily saws a carload of wood or so, but presumably the little birdies do not get much opportunity to build nests in the electric lights about his present abode.



The Ex-Kaiser's Beacon Lights Are Getting Somewhat Rusty, and the Little Birdies Are Chirping Merrily as They Proceed to Build Their Nests in Them.

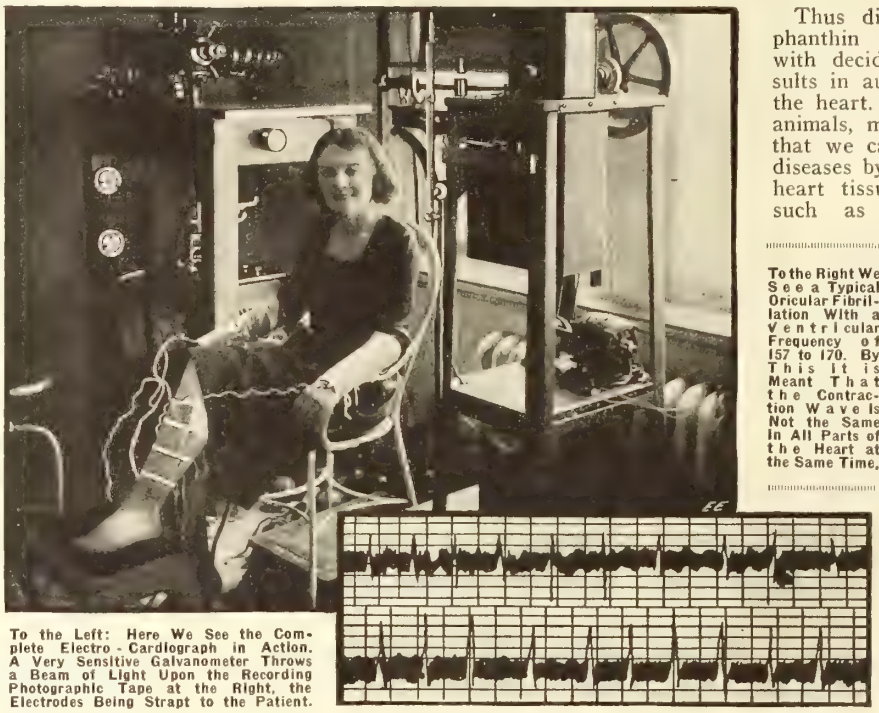
Electricity for the Treatment of Heart Diseases

THERE have recently been a number of controversies and newspaper reports as to the relative improvement which might result from the use of electricity, and also salts of calcium and potassium in large quantities, in the treatment of diseases of the heart, such as auricular fibrillation, auricular flutter and palpitation. Such reports are, however, discredited by the medical fraternity in general.

The most remarkable effects toward discovering what the heart is doing and what the causes of its improper functioning are, has been made possible by the use of the electro-cardiograph, an illustration of which appears on this page.

This device was described at length in the May, 1917, issue of this magazine, so we will dismiss it here with but a casual mention. There are three electrodes used, strapt onto both arms and the left leg of the patient. These are connected to the electro-cardiograph. The instrument itself is really a modified Einthoven galvanometer, consisting of a very powerful magnetic field excited by a direct current, and in the air-gap between the poles of this electro-magnet there is suspended a fine quartz filament. The image of this filament, when deflected by a current, is projected thru two small holes that extend thru each pole-piece.

These holes are the condensing microscopes and the projecting microscopes which serve to focus a fine beam of light upon a moving film actuated by means of an electric motor. Inasmuch as the heart contractions are of an electrical nature (viz., each contraction produces a current), by the simple employment of a Wheatstone bridge method the successive contractions of the heart are readily determined and photographically recorded upon a moving tape.



To the Left: Here We See the Complete Electro-Cardiograph in Action. A Very Sensitive Galvanometer Throws a Beam of Light Upon the Recording Photographic Tape at the Right, the Electrodes Being Strapt to the Patient.

To the Right We See a Typical Oricular Fibrillation With a Ventricular Frequency of 157 to 170. By This It is Meant That the Contraction Wave Is Not the Same In All Parts of the Heart at the Same Time.

Recent reports contend that heart diseases can be cured electrically, but it is questionable whether or not electricity applied anywhere externally will have any material effect on either the rapidity of the heart beat or relieve the distressing organic disturbances of the diseased heart, inasmuch as when current is applied to the body it generally is dispersed before penetrating the tissues deeply enough. Therefore it would seem necessary to apply such stimulant to the surface of the heart directly or to its intrinsic nerves. And this, in most cases, is impossible.

It is a well-known fact that pressure on the vagus (a nerve which has a controlling action on the rhythm of contraction of the heart muscles) will cause this nerve to be stimulated sufficiently to slow down the beat considerably; likewise the effects of medicine upon diseased hearts exercise certain notable results.

Thus digitalis and strophanthin have been used with decided beneficial results in auricular flutter of the heart. In experimental animals, moreover, we find that we can produce heart diseases by forcing into the heart tissues certain salts, such as potassium, and again relieve this symptom by the addition of calcium; in the human being, however, it is found highly inadvisable to pump a large volume of a foreign substance into the heart.

As to the use of electricity (as an electric shock, for instance), in order to stop palpitation, we can say, and quite authentically,—that it has been found even in those cases executed in the death house by the electric chair, that the heart continues to beat, sometimes as long as five minutes after the person has been pronounced quite dead by the medical examiners. Not beating strongly, it is true, but one of those hardly perceptible heart beats, and therefore, it would seem that electricity regardless of how applied even to the *killing strength* will have practically no effect on the heart itself, except perhaps to slow the beat if taken in large amounts.

Dr. Robert H. Halsey of the medical department of the New York Post Graduate Hospital and Medical School has done an immense amount of *heart* work, and says: "If there were any truth in the report stating that electricity could be used for the control of palpitation and auricular fibrillation, we, who are engaged in this endeavor would surely be notified immediately."—*Photo courtesy Dr. Halsey.*

Melted Wood!

It is possible to melt wood by heating it in a vacuum, producing a hard, homogeneous substance. *Melted wood* was for a long time only a laboratory curiosity, but it may be that industry shall presently discover practical applications of the greatest interest.

Altho wood is eminently inflammable it melts at a relatively low temperature, but in very precise conditions, and only when it is absolutely removed from contact with oxygen so that its combustion is impossible. This may be understood when we remember what its composition is. When its immediately soluble constituents have been removed, by means of alcohol, for instance, it gives on analysis organic acids, water, oily essences, silicates, sulfates, phosphates, chlorides, and hydrocarbonates of lime, potash, soda and magnesia, carbonic acid, carbonated hydrogen, etc.—that is to say, solely bodies susceptible of being evaporated or dissolved after having cooperated by chemical affinity in the formation of determinate substances.

Starting from these data Messrs. Bizouard and Lenoir, in 1891, studied the problem of the fusion of wood. They operated in a closed vessel at a relatively low temperature—that is about all one can gather from the records of the period.

Their work was taken up by others, and now there is a full operative technic that enables us easily to obtain excellent results. A metal receiver, a sort of boiler having a double bottom thru which superheated steam passes, is filled with bits of wood. It is closed by a lid similar to that used in autoclaves and provided with a tube and stopcock communicating with an apparatus for exhausting the air. When the wood thus kept in a vacuum is heated above 284 degrees Fahrenheit the water and other volatile substances are given off first and are drawn off by means of the exhausting apparatus, after which the heating is continued for about three hours. There then take place a complex series of reactions and phenomena analogous to those that accompany the distillation of wood in a closed vessel, and in this way all the so-called pyrogenous products are separated; these in turn are drawn off, condensed and separated so that they may be utilized commercially. There then remain in the receptacle only the fibrous skeleton of the wood and the mineral salts, which taken together constitute a fusible mass. This is allowed to cool slowly, out of contact with the air, and then placed in a second boiler, which, after the air has been exhausted, is filled with nitrogen under a pressure of 1.5 to 2 atmospheres. The whole is heated to 1,500 degrees Fahrenheit, for two hours, and at the end of this time the wood is melted into a homogeneous, hard mass.

"SCIENCE and INVENTION"

What Prominent Men Think of Our New Name

FROM THOMAS A. EDISON.



The change of name from ELECTRICAL EXPERIMENTER to SCIENCE AND INVENTION better indicates the proper sphere of your journal. Your field is now unlimited and your journal will be of great value in the advancement of invention and industrial application of science.

THOMAS A. EDISON.
Orange, N. J.

FROM PROFESSOR RUSK.

Accept my congratulations on your new name and the increased field of your magazine. The change should win many new friendships and strengthen old ones. You are leaders in your field.

ROGERS D. RUSK, M.A.
McConnellsville, O.

FROM INSPECTOR KRUMM

In answer to your request as to my opinion of the new name SCIENCE AND INVENTION, I consider that it indicates more accurately the broad technical field covered by your always interesting magazine. My best wishes for your continued success.

L. R. KRUMM,
Chief Radio Inspector.
New York, N. Y.

FROM INSPECTOR CADMUS.

The new name is very appropriate. We think it the best magazine of its kind published.

R. Y. CADMUS,
Baltimore, Md. *Radio Inspector.*

FROM THE INVENTOR OF THE MOON ROCKET.



I believe that the change in title to SCIENCE AND INVENTION of a magazine of the scope of the ELECTRICAL EXPERIMENTER is a good idea.

R. H. GODDARD.
Worcester, Mass.

FROM INSPECTOR J. F. DILLON.

In view of the wonderful development of your excellent publication the change of name appears both timely and appropriate. I have found the ELECTRICAL EXPERIMENTER increasingly instructive and enjoyable, filling a distinct need. May its success be enhanced under the new name.

J. F. DILLON,
San Francisco, Cal. *Radio Inspector.*

FROM CAMP MEADE.

We think new name very good; consider your magazine one of best we have.

U. S. TANK CORPS SCHOOL.
Camp Meade, Md.

FROM THE INVENTOR OF THE AUDION.

I believe that the present name of your journal is a better description than the suggested new title. I do not consider the new title, SCIENCE AND INVENTION, as good as the present one under which you have built up a wonderful circulation and clientele, particularly among youthful experimenters.

LEE DE FOREST.
New York, N. Y.

FROM EDITOR TRASK.

You are doing well, I think, to give your magazine the new name of SCIENCE AND INVENTION, because it foreshadows a wider range of subjects for your readers, while not restricting the field you have so entertainingly and ingeniously filled up to this time.

HERBERT A. TRASK,
Editor Post-Dispatch.
St. Louis, Mo.

FROM N. Y. SUNDAY WORLD.

Why change? You have established a high reputation under your old name and new name is little if any better.

EDITOR, SUNDAY WORLD.
New York, N. Y.

FROM EDITOR JONES.

My! How you've grown. And such a handsome boy, too. Why, I remember you when you were such a delicate child that nobody thought you would live very long and as far as I could see no one cared very much. But you evidently recovered from that infantile weakness and you certainly look all right to me. Your father should be proud of you. And your long pants are very becoming too. The last time I saw you it did occur to me that you had outgrown your clothes but your new suit is certainly a success and will enable you to take your place among real people. Just to think that I can remember when you first came to my office, I used to pick you up and promptly drop you in the waste basket along with the advertising matter. But once the pages accidentally spread open and I saw a picture which arrested my interest and I rescued you from the waste basket and gave you the "once over" and as the result I have been watching for you every month ever since.

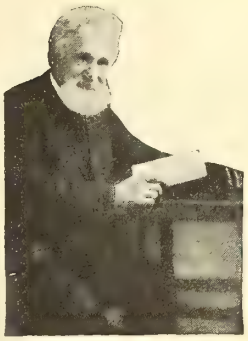
GEORGE J. JONES,
Sunday Editor, Philadelphia Inquirer.
Philadelphia, Pa.

FROM EDITOR VALE.

A far better, broader and more comprehensive name is SCIENCE AND INVENTION. Just the kind of a name that carries with it the great field you are handling so entertainingly and so helpfully. Just the sort of a name that will make your publication do bigger things than you already have done. Just the sort of a name that will impel you to greater service and bring larger popularity.

ROBT. B. VALE,
Sunday Editor, North American.
Philadelphia, Pa.

FROM HUDSON MAXIM



I think the new name SCIENCE AND INVENTION most excellent. It has the necessary breadth for your big purposes. The superb work you have done under the title ELECTRICAL EXPERIMENTER is a prophecy and warrant of the splendid character of SCIENCE AND INVENTION.

HUDSON MAXIM.
Hopatcong, N. J.

FROM THOS. S. FORD.

If the magazine is broadening its scope to fit the name SCIENCE AND INVENTION, I should say that the change is a happy one.

THOMAS S. FORD,
Editor Los Angeles Times Magazine.
Los Angeles, Cal.

FROM KANSAS CITY "STAR."

The title ELECTRICAL EXPERIMENTER is obviously inadequate to express the great scope of your field, which is not limited to electricity nor experimentation. I think that the new name of SCIENCE AND INVENTION is much better.

SUNDAY EDITOR,
Kansas City Star.
Kansas City, Mo.

FROM THE INVENTOR OF UNDERGROUND RADIO.

The ELECTRICAL EXPERIMENTER has been an inspiration in a specific scientific realm. Its influence has reacted into the field of science beyond that of experimentation into the larger sphere of general Science and Invention. Please therefore accept my sincere felicitations upon the enlarged scope of the magazine under the new title SCIENCE AND INVENTION. America has won high renown through the scientific labors and inventive genius of many who have made a distinctive contribution to the Republic of Science. The ELECTRICAL EXPERIMENTER in its inspiration to service and its record of accomplishments has rendered definite and far-reaching co-operation.



JAMES HARRIS ROGERS, PH.D.
Washington, D. C.

"Home Electrics"

By G. L. HOADLEY, M. E.

Vibrating Type Bell

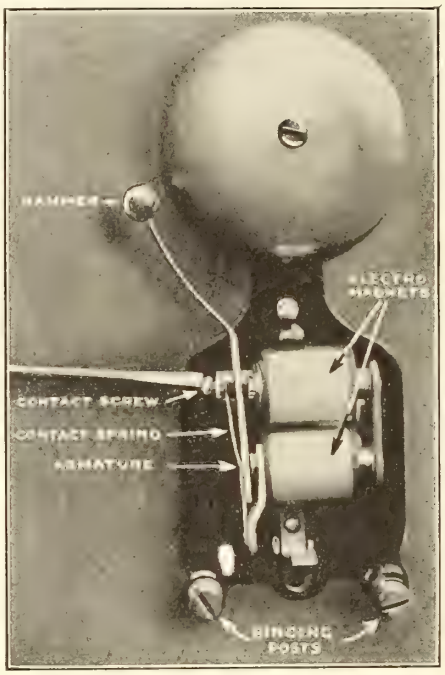
THERE are five different types of bells in general use. Figure 1 shows the vibrating bell which is the one most commonly used. In operating this bell, current enters the binding-post, "a," flows thru the magnet coils, thru the adjusting screw, "c," armature spring, "d," and comes out at binding-post, "a'." The passing of the current thru the coils magnetizes their cores, which attract the armature, "f," drawing it over against them and causing the hammer to hit the gong. This movement of the armature opens the contact between "c" and "d" interrupting the flow of current thru the coils, and causing them to become demagnetized. Spring "d" then pulls the armature back closing contact between "c" and "d" again and the operation is repeated as long as the current continues to flow thru the bell.

SINGLE-STROKE BELL.

An important modification is one by means of which the bell is made to give a single stroke only for each contact with the battery. This is known as the "single-stroke" bell and is shown in Figure 2. One of the cases where it may be used is to transmit preconcerted signals; it is also used in series with the vibrating bell, and when so used both bells must have the same natural periods of vibration; that is, the armatures, tappers, and springs should have the same weight, dimensions, and construction. While the "vibrating" bell can be changed to operate as a "single-stroke" bell by so adjusting the vibrating contact screw that the circuit will not be opened when the armature is drawn over, better results will be obtained by using the "single-stroke" bell, which differs from the "vibrating" type in the manner in which the magnets are connected up to the binding-screws. A careful examination of Figure 2 will show the wires from the magnets go direct to the binding-posts for the "single-stroke" bell so that when contact is made the armature is drawn over against the magnet cores and held there as long as the battery current passes. In Figure 1 the circuit for the "vibrating" bell is completed thru the platinum screw pillar to the binding screw, hence the circuit is rapidly made and broken so long as contact is made with the battery.

COMBINATION SINGLE-STROKE AND VIBRATING BELL.

This bell combines both previous types and may be used for either purpose by properly connecting it. Figure 3 shows its connections. A two-point switch is used to throw into circuit either leads "a" and "b" or leads "a" and "c." When "a" and "b" are



All of the Principal Parts of the Vibrating Electric Bell Are Here Lettered on an Actual Photograph of a Bell—Giving a Clear Idea of Its Make-up.

in circuit the "single-stroke" bell results; while "a" and "c" will give the "vibrating" type.

SERIES OR SHUNTING BELL.

In this type of bell shown in Figure 4, each time the armature is drawn over it strikes a contact which establishes the shunt path "a," "b," "c," "d," "e" around the magnets thru which the current flows rather than thru the bell magnets. This demagnetizes the magnets allowing the armature spring to pull the armature back again, breaking contact "c" and the operation is again repeated. The purpose of bells of this type is to reduce arcing at the vibrating contact, especially on circuits where the electro motive force exceeds five volts.

THE DIFFERENTIAL BELL.

This type of bell, illustrated in Figure 5, is intended mainly for use on circuits of relatively high voltage. Its magnets are wound differentially, that is, so one winding opposes the other. When the circuit is closed one winding is energized and the armature is pulled over to the cores, making contact at "c." This contact at "c" completes the circuit for the second winding, and since the two oppose, the resultant magnetism is reduced to zero. This allows the armature to be drawn back by its spring and the operation is ready to be again repeated.

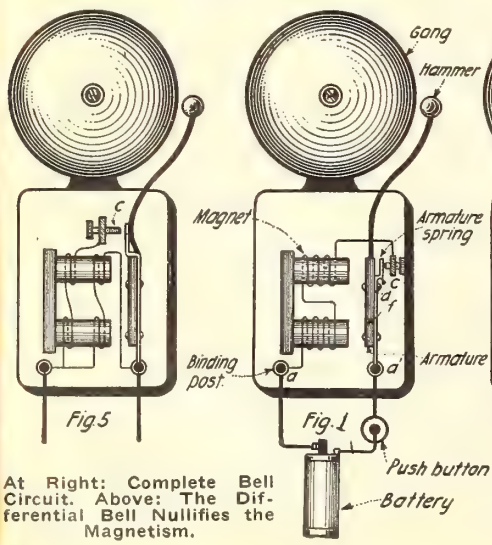
CONTINUOUS RINGING BELL.

In this type, illustrated by Figure 6, the ringing action, when once started, continues until stopt by the person in charge. It is greatly used in cases of burglar alarms, engine rooms, watchman's alarms, telephone central offices, etc. It differs but little from the ordinary vibrating type of bell. In Figure 6 the closing of the circuit causes the magnets to draw the armature over and release the latch, allowing it to drop down by gravity or be pulled down by a spring on the contact point "p." A shunt circuit is thus established around the push button and the bell continues to ring until the latch is restored by hand.

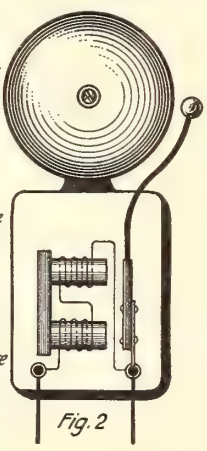
BELL TROUBLES.

Before you hunt for bell troubles, be very sure that your batteries are good and not run down. Batteries, as a rule, are the seat of most bell troubles. Bad contacts are frequently the cause of failure of the bell to ring. Wiremen sometimes simply wrap the terminal wires around the base of the binding screws. This greatly increases the resistance of the wires. Care should be taken to see that the terminal wires are firmly held underneath the binding screws. Again, chloride of zinc is used sometimes as a flux to make a soldered contact at the junction points of the wires with the contact angle brass and contact pillar. This speedily rots the wire and spoils the insulation of the adjacent parts. Soldered joints are certainly desirable, but only resin flux should be used. Corrosion of the contacts at the spark gap is quite common in cheap bells where German silver, platinoids, silver or some white metal is used instead of platinum or iridium. This destroys the continuity of contact.

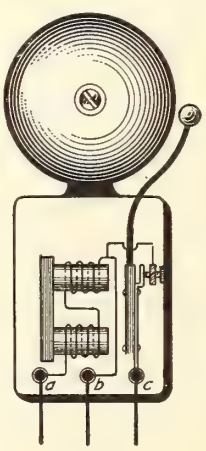
(*Continued on page* 454)



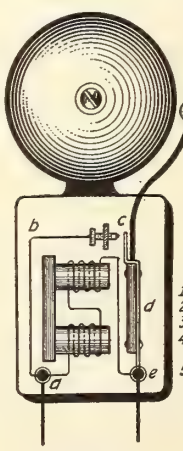
At Right: Complete Bell Circuit. Above: The Differential Bell Nullifies the Magnetism.



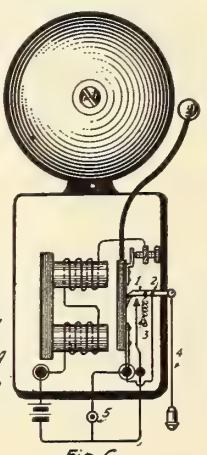
Above We See the "Single Stroke" Bell.



Here Is a Handy Bell—Works Single Stroke or Vibrating.



Here We Have the "Shunting" or Short-Circuiting Bell.



Automatic Switch for Continuous Ringing Bell.

News for "Straphangers"

The new safety car straps here illustrated are formed of a leather strip which is bifurcated and spread apart at a point immediately above the rounded hand-loop, as shown, so as to form a V-shaped strap whose upper extremities are permanently separated a distance of about ten inches by means of an invisible spring-metal spreader that spans the same at a point just behind the running rod. The spreader and strap together constitute a triangle, which is capable of being freely shifted along the running rod by slightly lifting the strap, but which cannot of itself move under the influence of the motion of the car or train. "Bunching" of the straps is therefore not only naturally avoided, but is furthermore prevented by the V-shaped formation of the straps themselves, which insures at all times their proper spacing and uniform distribution thruout the length of the car.

The sides of the straps diverge at such an angle that the direction in which the passenger tends to move under the influence of momentum or inertia is substantially coincident or in a direct line therewith. Consequently, unlike that of the ordinary strap, the hand loop not only forms a fixed support for the passenger, but any tendency on his part to forward or backward motion will at once be resolved into a direct pull or increased tension upon one or the other side of the strap in a prolongation of the direction in which such side is already inclined, thereby making the strap automatically self-bracing, and avoiding all swaying or lurching of the passenger in either direction, and giving him an absolutely firm footing.

In other words, the point of support of the passenger is fixt at the hand loop, as it should be, and not, as in the case of the ordinary strap, at its pivotal support upon the running bar, which latter is generally a foot or more above the point where the strap is grasped. The widely divergent sides of the strap not only prevent forward and backward motion, but serve also to steady the passenger against side motions, such as are produced in turning curves, since they absolutely confine any tendency to lateral movement of the hand loop to a small vertical arc directly in line therewith, thus eliminating the circular horizontal swing of the ordinary strap. Owing to the arc of the circle described by the freely suspended hand loop of the ordinary straps (whether running on straight sections or curves), these straps afford at best a fugitive hold that usually becomes effective only after the passenger has lost his equilibrium. That is productive of great muscular and physical strain, to say nothing of other discomforts that are only too well understood to require further comment.

The spreader that bridges the upper extremities of the car strap can be furnished of spring sheet-metal, arranged in the form of a continuous clip for holding an advertising card, as shown in the illustration.



A Novel Invention is This Idea for Swinging Car Straps. The Strap Swings Only Sidewise and Not Lengthwise of the Car, and at the Top of Each Appears an Advertising Sign.

Electric Lighted Roses in Rose Festival

The metal roses used by Portland, Oregon, for decorative lighting for the Rose Festival were developt as a result of a general demand for something new—something with plenty of light and color.

The metal rose herewith pictured was the result. The roses were approximately 30 inches in diameter and about the same in height. The upper part of the calyx of the rose was formed about a mogul lamp socket, in which was mounted, when finished, a 1,000-watt, bowl-frosted, type C tungsten lamp. There were three circular rows of petals surrounding the lamp, the outer row being carried up to form the body or cup of the blossom. The petals and body of the rose were made of standard gage tinned sheet iron, cut and formed into shape and soldered together. These roses when assembled were painted the color selected for the rose; some were red, some pink and some yellow, and the sepals were painted the proper shade of green on the upper or outside of the rose body. The stem consists of a seven or eight-foot hazel pole, 1½ inches to 2 inches in diameter at the larger end. The natural branches were cut off and two sprays of five-metal leaves each were mounted on wire stems and attached to the main wooden stem of the rose. The leaves, about six inches by nine inches in dimension, were cut from black sheet iron stamped for the veins, soldered to wire stems and painted a leaf green.



Electrically Lighted Roses Like This One, Measuring Thirty Inches in Diameter, Were Used in Decorating for the "Rose Festival" at Portland, Oregon, With Remarkably Beautiful Results.

Electric Pencil Retouches Negatives



The Work of the Photographic Retoucher is Hard Enough at Its Best, and Anything That Tends to Make His Work More Easily Performed and Attractive is a Boon to the Profession Indeed. By Means of the New Electric Vibratory Pencil Here Shown, and Which Can Be Connected to Any Electric Light Socket, the Retouching Work Can Be Accomplisht With a Minimum of Labor and Time and With Much Superior Results to the Older Method.

An electric vibrator in the design of a pencil is now being used for retouching negatives. It does its work noiselessly and much faster than when done by hand. When doing this work the workman usually holds his head, and consequently his ears, very near the work. For this reason the inventor of this device has succeeded in making its operation noiseless. When operating, it is held in the fingers much as the ordinary lead pencil. Connection to electric lighting socket is all that is required for its operation.

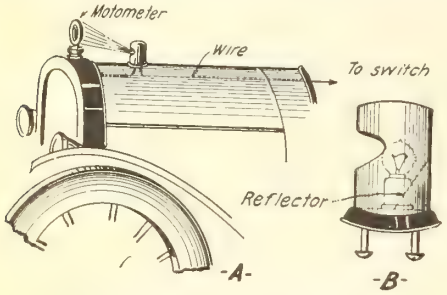
It is a most peculiar fact when we stop to think about it, that the realm of the photographer has been invaded but little by the electrical inventor. Electricity has permeated our household, office and factory, thru and thru,—we have electrical cigar lighters, curling iron heaters, fireless cookers, stoves, shaving mug heaters, and what not,—but the laboratory of the photographer has witnessed but little benefit.—K. H. Hamilton.

MOTOR HINTS

First Prize $25.00.

HOW TO SEE THE MOTOMETER AT NIGHT.

A friend of mine who owns a car came to me complaining that he could not see his "motometer" which is on the radiator cap, when he drove his car at night, and since



A Very Good Idea—a Light Specially Arranged to Illuminate the Motometer at Night. It is Fed with Current from the Storage Battery.

he drove more at night than during the day, I rigged up the following device for him:

First I procured a regular cowl light and black-enameled the inside of it. I then took a piece of bright tin and made a reflector from it, setting it at a forty-five degree angle as shown. After this, I cut a hole in the hood and fastened the light on it. I then attached one wire from the light to a switch and from the positive pole of the battery, to the switch. I ran the other wire to the radiator and soldered it on so as to secure a good connection.

My friend states that the light is giving him excellent service.

Contributed by BILL HOWARD.

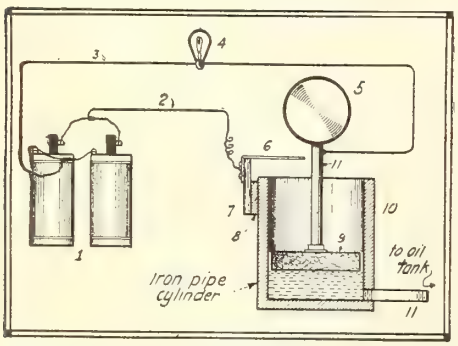
Second Prize $15.00.

GAGE FOR INDICATING LOW SUPPLY OF OIL.

The numbers in the diagram represent the following: 1—Battery; 2—Wire to brass strip; 3—Wire to light and to battery; 4—Electric light to burn when the brass plate 5 goes down on the brass strip 6, when connection is made and the signal light will burn. When the oil gets low the cork 9 will sink and light lamp; 10—The chamber made of one inch pipe.

The disc 5 is made of brass, and 6 is also made of the same material. 8 is a piece of wood so it doesn't make contact with 10. 7 is a bolt or screw with which it is fastened. The screws have gum washers around the bolts, and also on the outside. 11 will fit in the transmission of the Ford car. Just screw one of the lower spigots out, and screw this in. Precaution should be taken to get the right position of the cork, and after it is set correctly, it will work properly. The stem must have two nuts on it to adjust it up and down.

Contributed by WALTER STINE.



A Useful and Practical Wrinkle—an Electric Alarm to Indicate "Low" Oil in the Engine Crankcase.

$50.00 IN PRIZES.
Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

FIRST PRIZE.....$25.00
SECOND PRIZE..... 15.00
THIRD PRIZE..... 10.00

All other accepted articles, which win no prizes will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundreds words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

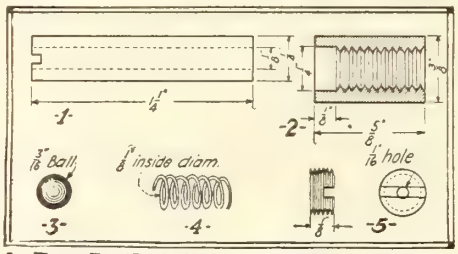
Third Prize $10.00.

PREVENTING WASTE BY EVAPORATION.

The materials of which it is constructed are easily procured from the workshop scrap-pile. A piece of ⅜th inch brass rod, ⅝th inch long (Fig. 2), is drilled lengthwise with a 3/16th inch drill, and tapt with a ¼ inch-18 tap; one end is then drilled for a distance of ⅛th inch, with a ¼ inch drill.

Next take a piece of ¼ inch brass tubing,





A Few Parts Only Are Required to Make This Gas Vent Which Prevents Loss of Gas by Evaporation.

1¼ inches long (Fig. 1), slot one end about 1/16th inch deep with a hack saw, and file the other end absolutely square, as this is to be the *valve seat.*

Make a spiral spring by winding 8 turns of No. 22 gage hard drawn copper wire (phosphor bronze best) on a ⅛th inch diameter nail or rod, with a pitch of about 3/32 inch; fully compress the coil while still upon the rod and release instantly.

The other parts required are a 3/16th inch ball bearing, such as are used in roller skates, and a small piece of ¼ inch stove bolt, about 2 whole threads, having a screwdriver slot cut in one end and a 1/16th inch hole drilled thru it.

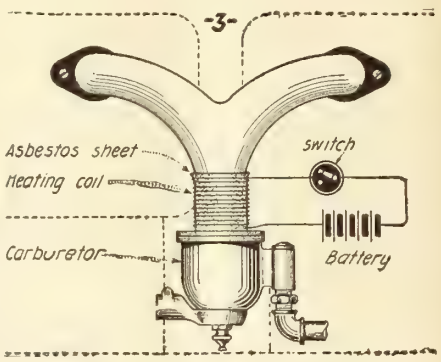
In assembling, the brass tube is inserted in the ⅜ inch rod and soldered. The valve seat and ball are cleaned, the ball placed on the seat and tapt with a hammer (the brass being soft will give), thereby forming a good joint. The spring and screw are inserted and the whole assembly soldered to the tank cap as illustrated in the photo.

The spring is adjusted to suit the user. In the valves I made, they are adjusted to open every time two ounces of gas flows out of the tank.

Contributed by C. H. OELSCHLEGEL.

ELECTRIC MANIFOLD HEATER.

The following device has proven useful in helping to vaporize the gas from the carburetor in damp, chilly weather.



Home-made Electric Manifold Heater for Quick Starting of Auto.

The principal thing to watch in carrying out this arrangement, is to see that the resistance coil is not made so that it will draw enough current to injure the battery. With an ammeter in series with the coil and battery when making the first test or two, this point can be readily watched and guarded against, by using a greater length of wire or a smaller size of wire. A layer of 1/16th inch asbestos is placed tightly around the manifold intake pipe, leading from the carburetor to the engine, as shown, and over this is wound one or more layers of resistance wire, if this is available. Iron wire or German silver could be used and several sizes may be employed, such as No. 26 to No. 28, depending upon what kind of wire is used and the voltage of the battery. Wrap asbestos around coil.

Not over 8 to 10 amperes are necessary, usually, with an 8 to 12-volt battery. This current has only to be turned on for a few minutes.

Contributed by H. SECTOR.

VACUUM CARBON CLEANER.

The vacuum cleaner helps the work of quickly removing carbon from automobile cylinders. Scrapers first loosen the carbon, and the vacuum attachment is then put into the spark plug gap to suck the carbon out.

Photo by EDNA PURDY.

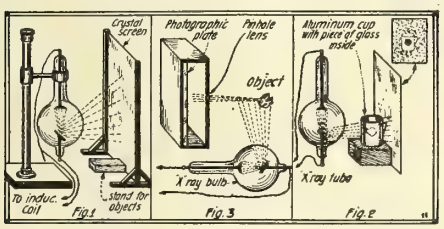


Using Vacuum Cleaner to Remove Carbon from Engine.

Little Known X-Ray Facts

By PHILIP A. WALL

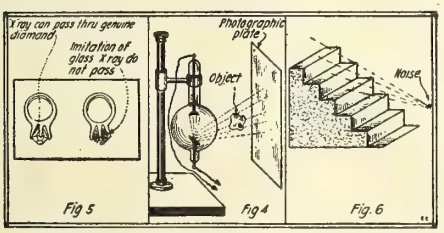
PROFESSOR DAVID LOCKE WEBSTER, well known physicist, especially among college students, certainly justified the title of Popular Experimental Science Lecture when he commenced the series of lectures, on March 5, by giving a highly interesting



Some Interesting Side-Lights on X-Rays. 1, Shows Stand for Objects to Be Examined and Which Are Always Placed Between the X-Ray Bulb and the Fluorescent Screen on Which the X-Ray Image Is Thrown. The Observer, of Course, Stands on the Far Side of the Screen—i.e., the Screen Lies Between the Observer and the Object to Be X-Rayed.

lecture on the difficult subject—"X-rays." The Masachusetts Institute of Technology, famous for its high standard of scientific education, presents every year a course of lectures, one a month, on various scientific subjects, these lectures being attended by members of physics and chemistry classes in nearby High Schools

The course of lectures this year was named, Popular Experimental Science Lectures, and as was said, Prof. Webster certainly justified the title, dealing with the broad subject of "X-rays" in such a clear and interesting manner that the lecture was thoroly enjoyed and understood by all who attended. Prof. Webster's lecture was filled with a great many experiments and also with skillful touches of humor, now and then.



Diamonds Can Be Tested by Means of the X-Ray as Shown at 5. A Set of Stone Steps, by Diffraction, Turns a Noise Into a Musical Note, Fig. 6. X-Rays, However, Are Only Diffracted by Very Small Particles or Crystals.

A brief synopsis of Prof. Webster's speech is as follows:

Altho X-rays are known generally to people in the form of photographs, X-rays themselves are invisible and are only seen by viewing them thru a fluoroscope or a screen coated with barium-platinum-cyanide crystals. (See Fig. 1.) X-rays will pass thru wood and metal in varying degrees, according to the power of the tube and the thickness of the object, but X-rays are completely stopt by glass. (Figs. 2 and 3.) X-rays are not bent as ordinary light, but are perfectly straight and thus produce well defined shadows. By these shadows the popular X-ray photos are made and are now found to be of great use by dentists and doctors besides being used in small capacities by most every scientific man. (Fig. 4.) X-rays are varied by the circumstances—thus heavy substances stop X-rays more than light ones and the X-rays themselves may be *hard* or *soft* meaning high powered or low, depending on whether the voltage applied to the tube is comparatively high or low. Usually X-ray photos are made by direct shadows but they may also be made by *scattered* or *reflected* rays. (Fig. 5.)

By diffraction, a set of stone steps turns a noise into a musical note. (Figure 6.) Similarly with light which is diffracted by the diffraction grating X-rays, however, are only diffracted by very small particles of crystals. (Fig. 8.) X-rays, the same as light and sound, have wave lengths and vibration but very much smaller than either of these. The atoms of an X-ray are so small that if a drop of water was magnified to the size of the earth the X-ray atom would appear large enough to see. The X-rays are high speed electrons, ionized by the passage of a current of high voltage thru a vacuum.

We all know or have seen pictures of the X-ray tube. The green light in the tube itself *is not due* to the X-rays but merely the passage of a current in a vacuum. The vacuum tube must have reached a certain stage of exhaustion before the X-ray effect takes place. If a tube of air is slowly exhausted and a high voltage current past thru the tube, the discharge will change from a plain loud spark to different kinds of violet light and then to greenish light. At this greenish light stage, when but 1/100,000th part of the air remains in the tube, the X-ray effect occurs. (Fig. 9.) The flow of ions is from the anode to the cathode. The cathode in the X-ray tube is a concave mirror, which reflects or deflects the stream of ions. The reflected rays, called *cathode rays*, travel to the side of the tube and the X-rays are produced by the impact of the cathode rays with the glass of the tube. If a magnet is brought near an X-ray bulb, the cathode

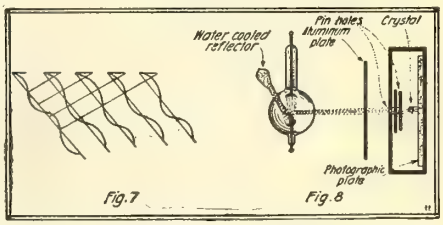


Fig. 7. Illustrating Diffraction of Noise (Sound) by a Picket Fence. Fig. 8 Shows Arrangement of High-Power X-Ray Tube With Lens Holes in Plates and Position of Crystal for Test by X-Ray Diffraction.

ray will be attracted or repelled, thus showing that this ray is a current of electricity. These rays travel fast enough to go around the world several times in a second. X-rays, like other branches of science, are open for new advances both in method of production and use of the ray.

Prof. Webster closed his lecture by showing the beautiful lighting effect of the Coolidge X-ray tube. He also stated that any members of the audience, interested, might experiment after the lecture with the extensive apparatus he used and many young experimenters took advantage of this fact to use high priced apparatus which otherwise they could only read about. Prof. Webster's lecture was so interesting and so filled with experiments that the hour past only too soon as it was enjoyed by all his audience.

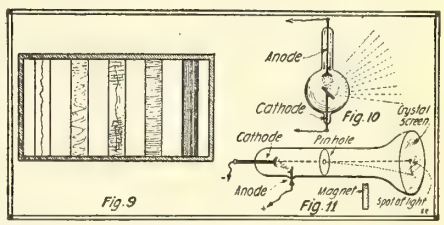


Fig. 9. Rack of Vacuum Tubes of Varying Degrees of Vacuum Used by Prof. Webster to Illustrate Change of Discharge According to Vacuum. Fig. 11. Special Vacuum Tube Used by Prof. Webster to Show That the X-Rays May Be Repelled or Attracted by a Magnet.

Radium Production

During the period of the war, with no carnotite exports, the greatest part of the world's radium supply has been produced in the United States. The following table shows the radium output of the Standard Chemical Company, of Pittsburg, Pa., since 1913, at which time radium was first produced in the United States.

	Radium Element, Grams.
1913	2.1
1914	9.6
1915	1.7
1916	5.0
1917	7.0
1918	13.6
	39.0

It is estimated that the total radium production in the United States to 1919 approximates 55 grams of radium element, and this represents, probably, more than half of all the radium produced in the world.

There has been some discussion lately by members of the Bureau of Mines as to the amount of radium that can be produced from the carnotite fields, as well as suggestions that *mesothorium*, a by-product from monazite, should replace radium in the luminous material which has found extensive use in the war on airplane and ship instrument dials, compasses, and many indicating devices, and which will find extensive use on watches and clocks, etc.

The estimates of Dr. Moore, of the Bureau of Mines, are based on a very inadequate study of the carnotite region made prior to the war and before the fields had been developed to any great extent. The carnotite holdings of the Standard Chemical Company, which are the largest under the control of a single company or individual and comprising about 350 claims, have been carefully studied—in part by systematic diamond drilling—and this work has been the basis for an estimate that at the least 500 grams of radium should be produced from carnotite. This is five times greater than Dr. Moore's estimate.

There is much speculation rife, however, as to the total radium supply available in the United States, and owing to the rapid production of the precious substance lately it is thought that our supply may soon be exhausted, or at least markedly reduced.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

Of the U. S. Naval Observatory

Double and Multiple Stars

THE plan of the solar system, which is that of a central sun encircled by satellites that are far inferior to their luminary in size, and that move about it in orbits that are almost perfect circles, is not the only, nor in fact even the most general one that prevails thruout the Universe.

Sweeping the heavens with powerful telescopes one is astonished to find that myriads of stars can be separated into two or more physically connected suns that are often, moreover, of exquisitely tinted and contrasting hues. Green and red, orange and blue, white and golden or white and blue pairs exist in profusion, and strange to say there are well-authenticated instances of color changes taking place temporarily within the same system. A pair of white stars has been known to change within a few decades, first to golden yellow and bluish green and then to orange and green. The famous pair catalogued as "95 Herculis" was noted to change from green and red to a paleish yellow and back to the original strongly contrasting hues within the course of a single year, while at another time they shone as a perfectly white pair. At the present time both of these stars are strongly yellowish in color. Such changes in hue are probably due to temporary disturbances in the atmospheres of the stars, possibly of an electrical nature or due to sudden or unusual outbursts of activity, concerning the origin of which we are as much in doubt as we are of the cause of the sunspot cycle and periodic variation in the intensity of radiation of our own sun. Temporary changes in the color of the components of double star systems sometimes take place when the two stars approach their "periastron" or point of nearest approach. Owing to the great eccentricity of the orbits of double stars, such stars are anywhere from twice to nineteen times as near to each other at periastron as they are at "apastron," or point of greatest departure. Such pronounced changes in the relative distances of two physically connected suns would produce marked changes in the intensity of the tides raised upon each of them by their mutual gravitational attraction and unusual outbursts of gases or electrical excitement in the atmospheres of the stars might cause very noticeable changes in the color of these stars as they drew nearer to each other, which would subside as they receded toward apastron.

In addition to "visual" double or multiple stars, there exists a very extensive class of stars known as "spectroscopic binaries," in which the two components are so close to each other *that even the most powerful telescopes cannot divide them!* It is only from the shifting of the lines of their overlapping spectra, caused by their alternate motion toward and from the earth as they revolve about their common center of gravity, that their *duplex* nature is revealed to us.

In some instances one member of the system is so faint that its spectrum is not visible and its presence is disclosed only by the shifting of the lines of the bright star.

According to Doppler's Law, when a star is approaching the earth the lines of its spectrum shift toward the blue end of the spectrum, and when the star is receding from the earth the lines are shifted toward the red end of the spectrum. The amount



We Are So Used to Our Sun That It Never Occurs to Us That There Are Other Worlds Which Have Multiple Suns. As a Matter of Fact, the Solar System May Be Called an Exception as We Find Thruout the Stellar Universe That There Are Many Star Systems Having Two or More Suns. Herewith Is an Illustration How a Planet of Such a Double Star System Looks to the Inhabitants,—if Any—on Such a World. The Two Suns, Due to the Tremendous Mutual Gravitation Attraction Are Pulled Into Elliptical Shape as Shown. Tremendous Tidal Effects Will Be Created on the Planet, Providing, of Course, This Planet Has Water as Our Earth Has. The Two Suns Also Give Rise to Peculiar Shadow Effects Whereby Every Object Throws Two Shadows Instead of One.



Here We See a Repetition of the Planet Shown in Our Other Illustration With the Difference That the Two Suns Have Now Drawn Apart for a Considerable Distance. The Two Suns Rotating Around Each Other Sometimes Come Within a Few Million Miles Together and at Other Times Draw Apart for a Considerably Greater Distance. The Planet Attached to One of the Suns Consequently Will Have the Peculiar Phenomenon of Having Two Suns Close Together in the Skies as Shown in the Other Illustration and at Other Times the Suns Will Be Quite Far Apart, as Shown in the Above Illustration. These Two Suns Give Tremendous Tidal Effects Upon the Planet and Life if It Exists on Such a Planet Will Be Anything But Safe on Such a World.

of this shift can be very accurately measured; and gives the relative velocities of the stars in their orbits directly in miles per second. Knowing in addition, by observation, the period of mutual revolution of the stars, it is possible to find the dimensions of these spectroscopic binary systems compared to our own solar system, and also the masses of the stars compared to the mass of our own sun. If the spectrum of the fainter star is not visible, only the velocity of the brighter star with respect to the center of gravity of the system can be found and the mass found for the system comes out too small. In such cases we can obtain only a lower limit for the mass of the system. Then, too, it must be remembered that these systems of stars lie at all angles with reference to our line of sight, and so we rarely see the orbits in their true form. The *measured* velocities are as a result smaller than the *true* velocities, and on the average amount to only sixty per cent of the true orbital velocities. The calculated masses of spectroscopic binary stars are, therefore, in general only about sixty per cent of the true masses. Strange to say, it has been found from calculating the masses of a number of binary systems, that the combined masses of the stars in these systems do not differ very greatly among themselves, nor as compared to our own sun, tho in *light-giving power* stars may differ hundreds, thousands, even millions of times. For instance, there are stars that give only *one ten-thousandth part* of the light of our own sun, and other stars that give *ten thousand times as much* light as the sun. Still stranger, there are many instances of physically-connected stars differing *thousands* of times in luminosity, tho in mass, or quantity of matter found in the stars, they differ only *two or three* times. Why this is so remains one of the great mysteries of the heavens, and makes it extremely difficult to give any satisfactory theory of the origin of double-star systems. No theory so far advanced has explained satisfactorily why of two suns physically connected and, therefore, presumably originating at the same time, one should be radiating with maximum intensity, while the other is practically an extinct sun, tho *the quantity of matter* in the two bodies differs but slightly.

In a few systems the plane in which the stars revolve passes so nearly thru the earth that the two stars temporarily eclipse one another during each revolution. Such systems are referred to as *eclipsing binaries.* To such a system belongs the famous *Algol.* Its light waxes and wanes periodically with the greatest punctuality in a period of $2^{d}\ 20^{h}\ 48.9^{m}$, owing to its temporary eclipse by a very large but extremely faint attendant sun. The diameter of the faint star is slightly greater than the diameter of the bright star which has a value of about one million miles. The distance between the *centers* of the stars is only about three million miles, which brings their *surfaces* within two million miles of each other. The masses of the two stars are in the ratio of two to one, the brighter and more massive star being about half as heavy as our own sun, tho its density is only about *two-tenths* that of the sun. The density of the fainter star is still less, being only about half that of the brighter star. Very low density for both components and extreme faintness of one member compared to the other, appears to be a very general characteristic of closely associated eclipsing and spectroscopic binaries. Among the extremely hot and brilliant helium and hydrogen stars, spectroscopic binaries exist in great numbers. In fact, among these types there appear to be as many binary and multiple systems as there are systems of isolated suns. Sometimes these close binary stars are egg-shaped or oval and revolve rapidly almost in contact about their common center of gravity. Inhabitants of satellites of such a system would see in their heavens the, to us, strange and startling phenomenon of *two* suns, each equal to our own or even greater in size, whirling rapidly about each other and separated by a space comparable in extent to their own diameters. Eclipses in such a system would be of daily occurrence, and, if one star were dark, would produce for the satellite world the same effect of alternate day and night that results from axial rotation of a satellite. The two hemispheres of the faint companion sun would be very unequally illuminated owing to the fact that the side turned toward the brilliant sun would always reflect its neighbor's brightness in addition to shining with its own comparatively feeble inherent light, while the opposite hemisphere would shine only by its own dim light, and would, therefore, be in comparative darkness.

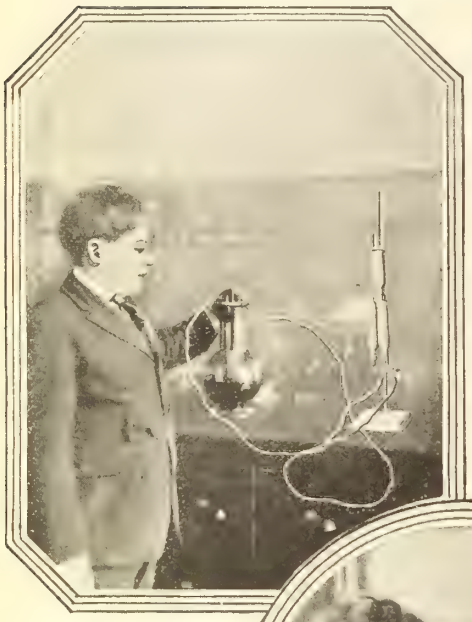
The spectroscopic binaries generally revolve closely and rapidly about their common center of gravity; there are to be found, on the other hand, among the wider *visual* doubles, many systems wherein the components are separated by distances comparable to the distances of the outer planets, Saturn, Uranus and Neptune, from the sun. It is evident that the individual components of such binary systems could not possibly be encircled by any such extensive system of satellites as attends our own sun, tho satellites such as our own planet Earth, or the inferior planets Mercury and Venus, might conceivably encircle the individual components of such binary systems at distances not greater than that of the earth from the sun. No planet could safely exist at a much greater distance from one of these suns without being subject to most dangerous perturbations and disruptive tidal forces arising from the vicinity of the second sun. Granted that planets might encircle one of these suns at a distance approximating that of Venus or our own planet from the sun, the inhabitants of such worlds would behold the strange phenomenon of *two* suns in the heavens, not always almost in contact as in spectroscopic binary systems, but at one time comparatively near and again in opposite portions of the heavens as is the case with the sun and moon in our own heavens. As the planet advanced in its orbit about

(*Continued on page* 419)

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

CHEMICAL EFFECTS OF THE ELECTRIC CURRENT



Electrolysis of Sodium Sulfate Solution, Using the Bichromate Cell as a Source of Current.



Charging a Simple Storage Cell, Consisting of Two Lead Strips in Dilute Sulfuric Acid.

SINCE Sir Humphrey Davy, working in the laboratory of the Royal Institution in London, more than a century ago, first used the electric current for chemical purposes, the application of electricity to the solution of chemical problems has revolutionized the science and introduced a host of new processes. In this article we shall take up some of the chemical applications of the electric current which can be carried out in the "Home Laboratory."

Source of Current: The electric current itself was chemical in its origin and is even yet for a myriad of purposes. When Luigi Galvani late in the eighteenth century caused the twitching of the frog's legs in his now historic experiment, altho he did not know it, the production of the current that caused the twitching was due to chemical action. Alexander Volta soon after made the first electric cell, and from that day to this the world has not been without these highly important cogs in the machinery of modern industry. For nearly a century *dynamic* electricity was unknown and the only source was batteries.

In your own laboratory you may be fortunate enough to have direct current from your house-lighting circuit of a voltage suitable for experimental work. If the current is alternating, however, it is unavailable and, even if direct, for most experiments a considerable resistance will have to be connected in series with it. Therefore, it will be to your advantage to know how to make a battery of cells that will give you sufficient voltage and current for most work.

The Bichromate Cell: This cell gives the highest voltage of any of them and is best for home laboratory work. If you prefer, the containers, carbons and zincs for these cells can be purchased but if not, then secure a half dozen fruit jars for the containers. Then dissect some old worn out dry cells and remove the carbons leaving the binding posts intact. Secure strips of heavy zinc equal in length to the carbons and about an inch and a half or two inches wide. To each zinc solder a binding post. In each jar place 710 cubic centimeters (about a pint and a half) of water and dissolve in it 80 grams of chromic acid. Then slowly add with constant stirring 45 cubic centimeters of concentrated sulfuric acid. Provide a holding clamp for each electrode and place the zinc and carbon in the jar. The clamps may be made from two strips of wood with bolts and thumb screws at each end. See Fig. 1. A half dozen of these cells connected in series, i. e., with the carbon of one joined to the zinc of the next, will give sufficient voltage for a large number of experiments. When these cells are not in use the zincs must be removed from the jar or they will soon be eaten away and this action destroys the acid, too.

Electrolysis: This term covers a large number of applications of the electric current but we shall consider first the determination of what substances are electrolytes and what ones are non-electrolytes. An electrolyte is a compound that in solution in water will conduct the current.



Producing Hydrogen and Oxygen by the Electrolysis of Water.

For this work a simple electrolysis apparatus will be necessary and it will be fully as cheap and much more satisfactory to buy one of the simpler pieces from an apparatus company than to attempt to make one. In an apparatus such as that shown in Figure 2 place some distilled water and connect with your battery of cells. Note whether bubbles appear about either of the platinum electrodes. If not, the water is a non-conductor and as the chemist says does not *ionize,* or break up in solution into small *positively* and *negatively* charged particles called ions.

If you have direct current in your laboratory of 110 volts, connect this with your electrolysis apparatus, having in series with it a 40-watt lamp. Then, whenever you have an electrolyte which ionizes to any great extent, *enough current will pass to light the lamp.*

Next place in your apparatus a little alcohol (denatured will be satisfactory) and pass the current. Is it an electrolyte? Repeat using a little glycerin dissolved in water. Result? Rinse out the apparatus and place in it solution of sugar. Determine whether this conducts the current. Prepare a solution of acetic acid and water, or vinegar and water, and try to pass the current. You will have better success in this case but still there will not be much evidence of action. These substances are all organic and one of the distinguishing characteristics of such compounds is that they are *non-electrolytes.*

Now rinse out the apparatus several times and try the action of the current on tap water or spigot. If you see bubbles, it will be due to the presence of mineral matter in the water. Indeed, by the quantity of current that passes considerable can be told as to the amount of mineral matter in the water.

In dilute sulfuric acid (1 of acid to 10 of water, always pouring the acid into the water) you will find a real electrolyte. This time close the pinchcocks on the rubber tubing at the top of the collecting tubes and allow the current to flow until a considerable quantity of gas has collected in each. Note that there is about twice as much gas in one tube as in the other. Over this one invert a test tube and carefully open the pinchcock, allowing the gas to rise into it. Quickly bring the mouth of the test tube to the flame of a Bunsen burner and a sharp explosion will follow. This gas is *hydrogen.* Over the other pinchcock bring a glowing

Making an Electrotype With a Single Storage Cell as the Source of Current.



splint and very slowly allow the gas to escape. The splint will be kindled into a flame showing the gas to be *oxygen.*

Electrolysis of Sodium Sulfate Solution: Prepare a strong solution of sodium sulfate

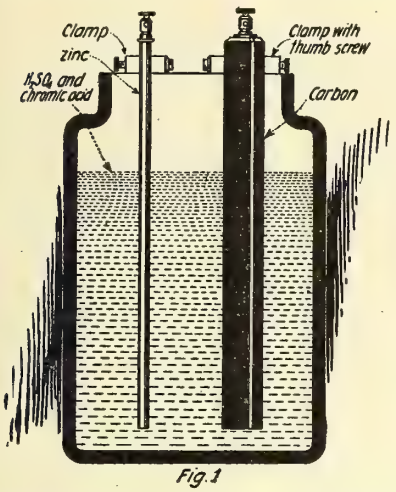


Fig. 1

The Students' Bichromate or Chromic Acid Battery Cell. Easy to Make and Yielding a High Voltage.

and in it place enough blue litmus solution to color it distinctly. Pour some of it into the apparatus used in the previous experiments and connect with your battery or direct current. Bubbles will at once appear copiously at each electrode and very shortly the liquid in one of the tubes will turn red while that in the other will become a deeper blue. Reverse the connections and in a few moments the color changes will also reverse. This is due to the fact that at the cathode, or negative electrode, sodium hydroxid, a base, forms, while at the anode, or positive electrode, sulfuric acid forms.

Other compounds may also be tested in the apparatus but do not attempt to electrolyze sodium chloride, for the chlorine liberated will attack the platinum and ruin it.

Making an Electrotype: Where a large number of copies of any publication are to be printed the soft type metal is not durable enough to give clean-cut impressions. Therefore copper electrotypes are made and the plates become permanent.

On a strip of lead 3 inches by 4 inches place lumps of beeswax and melt them over a small Bunsen flame. Allow the beeswax to run evenly over the sheet of lead and harden into a layer about ⅛ of an inch thick.

When the wax is hard rub it over thoroly with powdered grafite, using a soft cloth. Dust the object you wish to electrotype—example, some metallic souvenir stamped with an inscription and figure—and press it firmly into the wax until a deep clean-cut impression is made. Fig. 3 A. Now dust this impression again with grafite and rub to a smooth shiny surface. Attach a wire to a hole in the top of the lead strip and be sure the grafite extends onto the lead so as to make a continuous conducting surface.

Then prepare a copper plating bath. An oblong glass jar similar to that shown in Figure 3 is best. Fill this two thirds full of a saturated solution of copper sulfate, prepared by shaking the pulverized crystals into a two liter bottle of water at frequent intervals for a considerable period. At one end of the jar, as shown in Fig. 3, hang the lead plate and at the other a sheet of copper having the same area as the lead. Connect these plates with two gravity cells or one storage cell, being sure that the lead plate is joined to the negative pole. Allow the current to flow for at least 24 hours, and 48 will be better. A small steady current for a long period of time will give a firm, evenly deposited layer of copper on the grafite surface.

At the end of the period remove the lead plate and very carefully strip off the layer of copper, having first immersed it in hot water to loosen it from the wax. To make the electrotype permanent it will require backing with melted tin. To do this make a small form from molding clay of the exact size of the electrotype and about a quarter of an inch in depth. Make the bottom perfectly smooth and horizontal. Place the electrotype face down in this form being careful to have the edges fit tight up to the sides. Place the form in an oven and bring the temperature about as high as it is possible to get it. In an iron dish melt some tin over a Bunsen burner and carefully pour it into the mold until the electrotype has been covered to a depth of ⅛ of an inch. Turn off the gas under the oven and allow it to cool. When cold remove the molding clay and your electrotype will be ready for use.

Ink the electro and take off a copy on white paper.

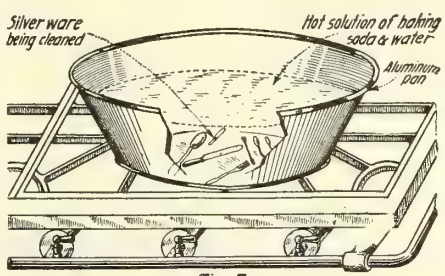
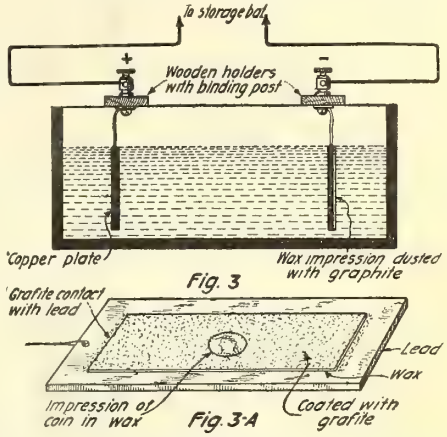


Fig. 5

A Peculiar and Very Practical Stunt for the Home—Cleaning Silverware in an Aluminum Pan.

The Storage Cell: There is no more important application of the chemical effects of the current than that of the *storage cell.* Of course this cell *does not store up electricity,* as many unthinking people suppose, but chemical energy which can be converted again into electrical energy.

A simple storage cell which will enable you to study at first-hand the chemical action and principle of it may be very easily made. A small battery jar, two lead strips, a battery stand and a 1 to 8 solution of sulfuric acid will be required. First scour the lead strips until they are perfectly bright. Then immerse them in the jar of sulfuric acid mounted on the battery stand and connect to its terminals two bichromate cells. Allow the current to pass for 5 to 10 minutes. Disconnect the charging cells and in place of them insert an electric bell, which you will find rings vigorously. Then remove the lead strips and you will find that the positive one is covered with a chocolate colored deposit. This is lead peroxid. The other plate remains unaffected. Now when these plates are connected in external circuit as they were when ringing the bell, there exist the exact conditions necessary for a simple cell, i. e., two dissimilar substances immersed in an electrolyte that will act on one of them and not on the other, or will act upon the two of them in such a way as to set up a difference of potential. On discharge both plates are changed to lead sulfate and on the charge again back to lead peroxid and lead.



One of the Most Interesting Electro-Chemical Experiments—that of "Electrotyping." Even the Pages of This Magazine Are Electrotyped.

If you wish to make a *real storage cell,* similar to the one shown in Fig. 4, obtain two *lead grids* and a container from a storage battery supply house. Make a stiff paste by mixing together litharge (lead oxid), dilute sulfuric acid and glycerin. With a small spatula or wooden paddle press this paste into the perforations in the two lead grids. Insulate the two plates from each other by placing between them pieces of heavy rubber tubing held firmly in place by large rubber bands at top and bottom. In the container place a 1 to 8 solution of sulfuric acid and immerse in it the prepared plates. To charge the cell a pressure of about 3 volts should be maintained across it for several hours. It would cost but very little to have the cell charged for 24 hours at a charging station. Such a cell will serve for a multitude of laboratory purposes and a number of them will make a very efficient and reliable battery indeed.

Polarization of an Electric Cell: One of the most troublesome features of most cells is their rapid polarization, i. e., the decline of the current owing to the accumulation of bubbles of hydrogen gas on the negative plate. Unless these bubbles are removed they will increase the resist-

(*Continued on page* 424)

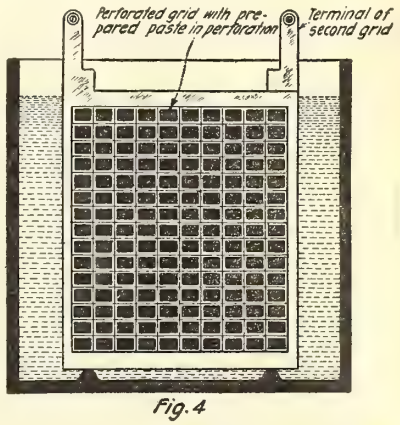


Fig. 4

The Storage Cell Represents the Storage of Electrical Energy in Chemical Form. The Energy Stored is Really Therefore "Chemical Energy"—But Transforms Into Electrical Energy Upon Discharge.

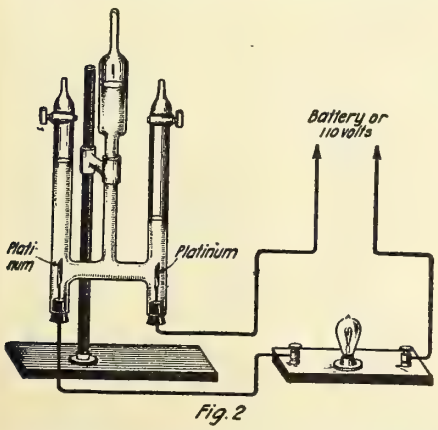


Fig. 2

Electrolysis Apparatus—to Be Used Either with a Half Dozen Cells or on a 110-Volt Circuit (D. C.) with a Lamp in Series.

Electricity from Water Power

By H. Winfield Secor

PART II—(*Conclusion*)

SOME PRACTICAL ASPECTS OF WATER POWER DEVELOPMENT.

REFERRING to Fig. 2 several interesting considerations are outlined when it comes to installing water-wheels and turbines (small or large). At Fig. 2-A we see a case met with now and then in actual practise where a water-wheel is sometimes located at a considerable distance from the lake or impounding reservoir dam. In this instance the penstock or flume has to be closed and it may be built square or other shape, of wood, but is preferably composed of riveted steel pipe. At first glance this arrangement looks very odd, but it will be evident that the water will rise without undue loss of pressure to the same height in the gate box over the water-wheel as that in the lake.

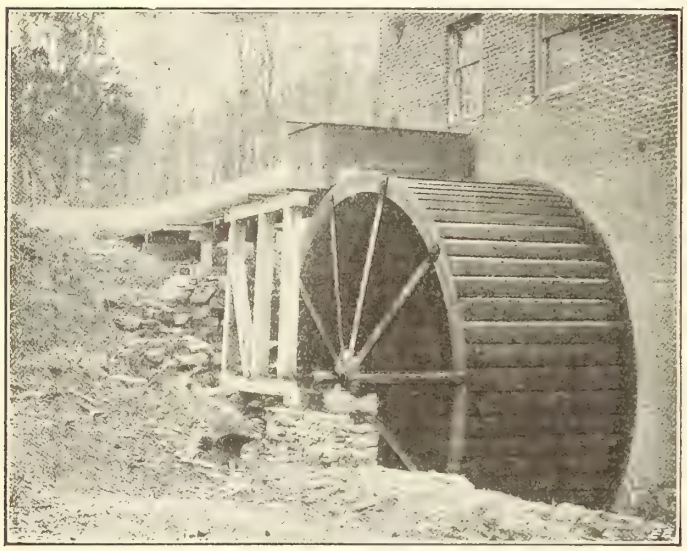
This arrangement has the advantage that the penstock can be laid along on the ground or very close to it at small expense while realizing the full head of the water in the lake or impounding reservoir.

At Fig. 2-B the usual method is shown of carrying the water from a lake or reservoir to an overshot water-wheel. Here the penstock, which may be constructed of wood and open at the top, or else of steel pipe, is carried along on wood or concrete piers until the point is reached where the desired head of water is obtained. It will be seen in looking at this figure that we have gained considerable head, even tho the penstock has usually to be carried down to the water-wheel at a slight taper, as the stream would have reached the point X, without having developt any static head outside of its velocity head.

Fig. 2-C shows a plan view of a typical installation of a water turbine. For small, low-head or lower pressure turbines no very elaborate penstock arrangement such as here outlined is used, the turbine being simply set on the bottom of a short flume pit up near the dam. In some cases these turbines operate under a head of but a few feet, especially those of large diameter, and where but a small head is available. This is in contradistinction to the plan of building large dams in order to impound a large quantity of water at a high level or running extra long penstocks in order to carry the water to a point where it could be discharged with a maximum head as is done

How to Compute the Horsepower of Streams and Build Water-Wheels

in many of the wonderful hydro-electric plants in the western part of the United States.



The Accompanying Illustration Shows the Latest Idea In Overshot Water Wheels Which, as Can Be Readily Seen, Is Built of Steel, and Is, Further, Much Superior to the Cumbersome, Heavy-Running Wooden Wheels of the Older Type. As May Be Surmised, These New Steel Water Wheels, no Matter Whether of the Overshot, Breast or Undershot Type, Realize a Much Higher Efficiency Than Ever Was Possible with the Older Wooden Wheel—an Efficiency of 85 Per Cent Being Claimed for the Steel Wheel. The Water Is Brought to the Wheel in a "D"-Shaped Steel Flume.

It is really wonderful to study some of these water power plant developments, and many of us have undoubtedly witnest some of these in the "movies" where one can often see the iron or wooden penstock running along over the hills and valleys for miles like giant snakes. But eventually the engineers' triumph comes to sight and the long winding penstocks finally lead to a precipice or steep embankment, down which they shoot at an angle of possibly 30 to 60 degrees for a distance of anywhere from 100 to 700 feet. The engineers have taken care of the pressure required to force the water thru the horizontal section of the penstock up in the hills by forming a sufficiently large and highly elevated impounding reservoir which feeds the pipe line. But a mighty "pressure head" is developt once the water starts falling thru the angular pipes going down over the hillsides and into the hydroelectric generating station as shown in Fig. 2-D.

In any case it is the best practise to place a good *head gate* or valve near the lake or reservoir where the water passes thru the screens into the penstock and practically all water-wheels and turbines have valves or gates located near or on them in order to cut them into or out of service whenever desired.

Unless the water pressure is very even and the water-wheel very evenly balanced, trouble is frequently experienced in driving electric lighting generators by fluctuations in the speed and consequently in the voltage. There are several electrical methods of overcoming this, but the major portion of these irregularities in speed can be overcome in the prime mover and its interconnecting gearing if a little care is taken.

At Fig. 3 a typical overshot water-wheel electric plant is shown in plan view. To the main shaft of the water-wheel a large master gear is fastened. This may drive one or two pinions as shown, one of these driving a pump or other machinery thru a cut-off clutch, while the other pinion drives a countershaft carrying a second large gear. Meshing with this gear is a second pinion fastened to a countershaft on which a belt pulley is mounted. From here a belt drives the dynamo, and in the best arrangements a second belt pulley on this countershaft drives an automatic fly-ball governor connecting to the water-wheel machinery. Water-wheel companies supply these where necessary or desirable. Usually this automatic governor is geared by means of a chain or otherwise to the controlling mechanism of the gate or valve.

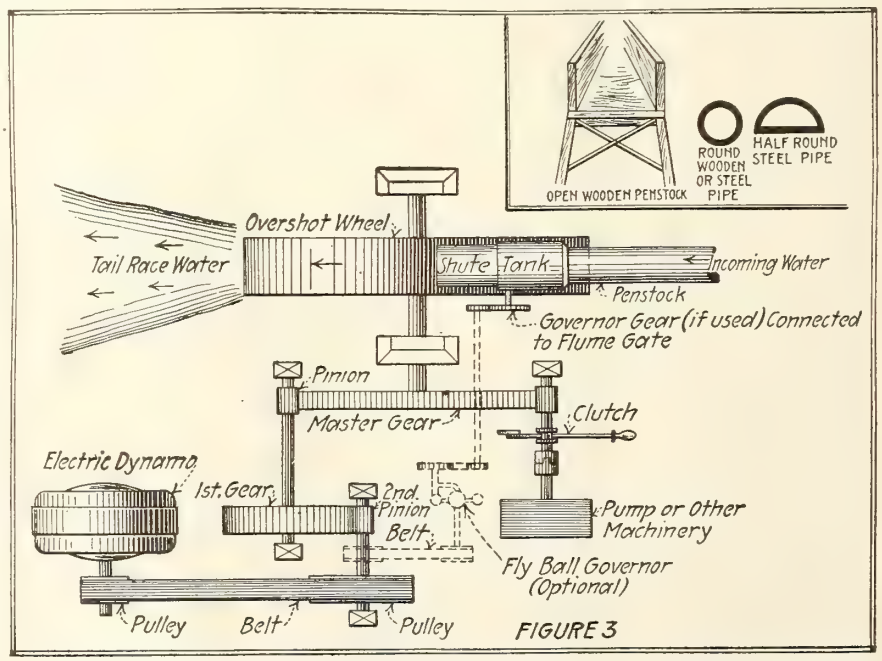


Fig. 3. This Shows How an Automatic Fly-Ball Governor Can Be Belted to the Main Driving Gears of the Water-Wheel so as to Control the Opening in the Flume Gate and Thus Automatically Regulate the Speed of the Water-Wheel in Proportion to the Load. This Is Especially Desirable in Driving Electric Lighting Dynamos.

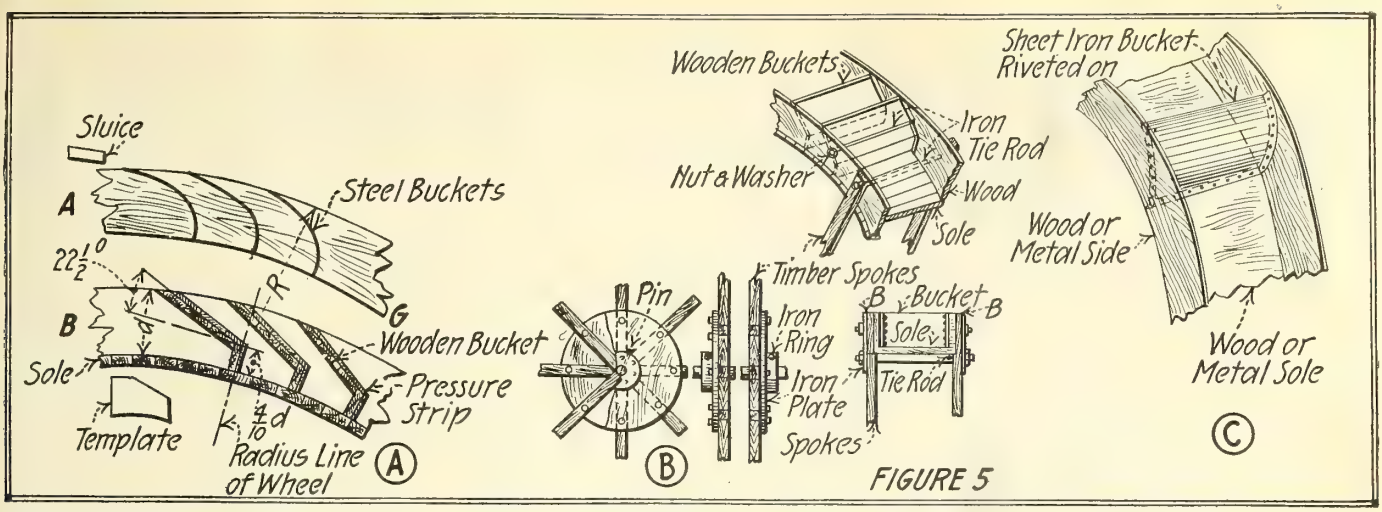


Fig. 5. This Illustration Shows the Various Practical Details Which, Altho Simple, Should Be Very Carefully Watched in Building Home-Made Water-Wheels, as Upon These Factors Will Depend the Tightness and Leakage Factor of the Wheel, the Efficiency With Which the Water Will Leave the Buckets, and Also the Rigidity of the Complete Wheel.

Thus as the wheel speeds up, indicating too much water, the governor automatically changes the size of the gate opening slightly, compensating for the over-speed by reducing the amount of water and vice versa. Many of these water-wheel electric plants develop a sufficiently steady current from the dynamo for lighting purposes, so that no storage battery floating across the line is necessary.

Where the plant, however, causes fluctuation in the voltage and thus flickering in the lights, which cannot be gotten rid of by changes in the driving machinery proper, one of the best solutions is to float a storage battery across the line. Of course where a storage battery is to be used, the dynamo must deliver *direct current.*

While on the subject of water-wheel dynamos, two or three important points should be mentioned. One of these is that for small dynamos, where the rotating member such as an armature and pulley do not have any decided weight, so as to give them a good momentum and thus help to keep the speed steady in driving from a water-wheel, it is very good policy to fit the dynamo with a flywheel type of pulley, such as those supplied on a number of dynamos used in gasoline engine outfits now on the market. The heavy flywheel pulley made of cast iron or steel develops such a momentum or "live inertia" that it absorbs any slight irregularities or pulsations in speed in a well-known manner, and the voltage delivered by the dynamo is in consequence much steadier than otherwise.

In many cases, especially where the dynamo is a small one, say of a fractional horsepower, the voltage employed is frequently 32 or some other value below 110 volts, the standard potential for all lighting service. Owing to the lower losses in the line, such as drop of voltage, etc., and also to the fact that a smaller wire could be used, 110 or 220 volt dynamos are preferable, especially where the current is to be carried over any appreciable distance. Reference to any good wiring hand-book, such as *Cushing's Wiring Manual,* will at once make this clearly evident. Where a low voltage is used, such as 32 volts and higher, there is available on the market today a great variety of electrical apparatus operating on this potential such as electric fans, sad irons, water heaters, curling irons, lamps, toasters, motors, etc.

TYPES OF WATER-WHEELS.

At Fig. 4 there are shown the three principal types of water-wheels, viz.: undershot, breast wheel and overshot wheel. The undershot wheel is frequently used for development of small power such as in brooks, etc., but it is the lowest in efficiency of the three. The breast wheel is employed in some cases where a medium head only is available and the overshot wheel is probably the most efficient of any type now in use. This becomes evident from the fact that practically one-half of the buckets on the overshot wheel are constantly in use, altho not all of them are full of water. In the breast wheel only about one-quarter of the buckets are in use and probably not two-thirds of these efficiently, while in the undershot wheel only about one-eighth to one-tenth the total number of buckets are in use at any time.

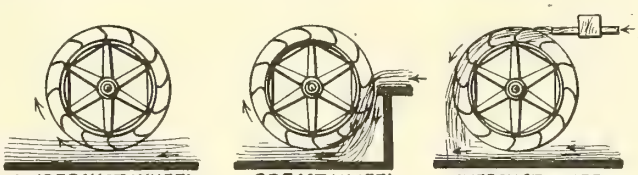
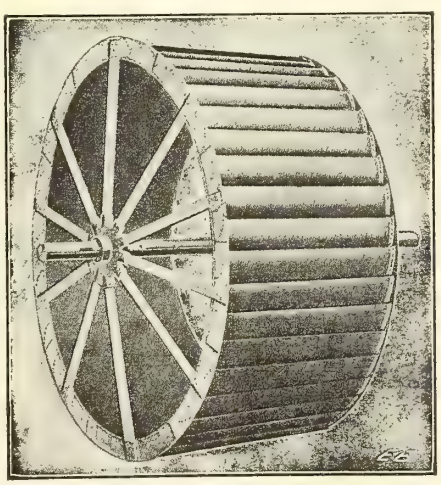


Fig. 4. This Diagram Shows the Three Principal Types of Water-Wheels—the Undershot Type, Breast Wheel, and Overshot Type. The Overshot Wheel Is the Most Efficient, and Should Be Used Wherever Possible.

For the water turbine which is invariably made of steel with two or more sets of vanes, arranged one within the other, very high efficiencies are claimed and elaborate tests have shown them to possess very marked operating conditions under full head of water, but it seems from some other tests made on the latest type of balanced all-steel overshot water-wheels that these wheels can realize an efficiency at full gate, even surpassing that of the turbine, at least on heads up to 100 feet. Moreover, it appears that the overshot water-wheel of the type just mentioned can show a very high efficiency under reduced gate openings, which is not the case with the water turbine. The turbines fall off very rapidly in efficiency and lose about one-half their efficiency in converting the horsepower of the water into mechanical power on the shaft, when the water supply fed to it is reduced to about one-half.



Close-up View of Latest Type Riveted Steel Water-Wheel. The Amateur Water-Wheel Constructor Can Build a Very Effective Wheel from Thin Sheet Iron or Steel by Following the Idea Here Shown, Together With the Instructions Given.

BUILDING YOUR OWN WATER-WHEEL.

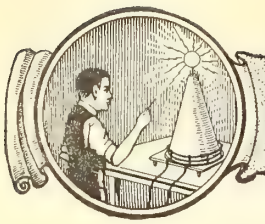
Fig. 5 gives a number of practical details in constructing water-wheels especially of the home-made type. There are roughly two types of wheels which can be built—the wooden and the metal type. A third style might comprise a combination of steel and wood. The shape of the buckets both metal and wood are shown at Fig. 5-A, and the careful design and preparation of these parts spells the difference between low and high efficiency in the production of power by this means. Full details for laying out the proper curves of the buckets were given with all mathematical formulæ in the article by the writer which appeared in the July, 1916, number of this journal and which space forbids repeating here.

At Fig. 5-B several practical hints are outlined for the construction of the spokes, the wooden buckets, as well as the rims. For one thing the buckets should always be very evenly spaced around the wheel and they should also be of similar pitch, otherwise equal quantities of water will not be carried over by the respective buckets causing unbalancing and vibrating of the wheel.

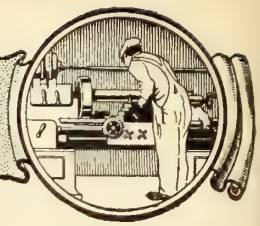
At Fig. 5-C there is shown a steel or sheet iron bucket riveted on to wooden or metal rims and a wooden or metal *sole,* as the inner ring of the wheel is called. For ordinary requirements, especially on small wheels, the shape of the buckets can be approximated from the illustration here given, and in laying out either the wooden or metal buckets time will be saved in making a template of the exact shape of the bucket, which can be laid along the side rims of the wheel and the exact outline of the bucket outlined by pencil or otherwise.

With a little ingenuity the sheet iron buckets can be readily curved by hammer-

(*Continued on page* 430)

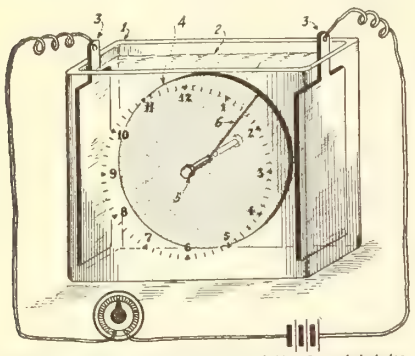


THE CONSTRUCTOR



THE TESLA CLOCK

THERE is always something extremely novel and interesting in the duplication of Dr. Tesla's experiments, but it seems that at times such attempt is rather difficult. However, that may be due to the particular care exercised by Dr. Tesla in having his experiments exact to the minutest point, a feature which amateurs generally glide over. In the case given here, however, there will be no such difficulty in the making of a clock of this nature.



1-glass tank 6"x7"x5". 2-copper sulphate solution. 3-metal plates. 4-balanced copper disc. 5-jewel bearings 6-glass thread pointer

Dr. Tesla Has Given to the Amateur Construction "Bug," a Simple Idea Which He Used Some Years Ago, In Building an Electric Clock. The Clock Is Simplicity Itself and Comprises a Well-Balanced Copper or Silver Disc, Mounted So as to Rotate In Two Jewel Bearings. Two Metal Electrodes are Placed on Either Side of the Revoluble Disc and When Current Is Applied, the Disc Rotates Very Slowly.

Not only is the clock unique in design, but rather serviceable if a constant E.M.F. is available. It makes an adorable clock for the amateur, even tho it varies slightly from correct time. This, of course, depends entirely on the regulation of the resistance in the controlling circuit.

A clear walled glass jar or celluloid jar is employed, a well balanced metal disc of copper or silver mounted in such a way that it is free to rotate in the centers of two jewelled bearings. These may be obtained from a clock and easily inserted by drilling a hole thru the glass or celluloid jar and securely mounting them therein with a copper washer on each side to prevent any escape of liquid.

On each side and equi-distant from the periphery of this metal disc are placed two metal electrodes similar in nature to the metal *disc*, i. e., either silver or copper. On the disc itself is fastened a thin glass thread pointer or a thin annealed iron wire, the latter being preferred.

The jar now is filled with a solution of silver nitrate if a silver disc has been used, or copper sulfate if a copper disc and copper electrodes have been used. (Electrodes can be copper strips.) If a magnet is now placed in front of the dial so that its action will take place upon the thin annealed iron wire, the disc inside can be rotated to any desired position. Current from several storage cells is now turned on.

The result is that an electrolytic action takes place, metal being deposited on one side of the movable disc while it is taken off on the other side slowly and with remarkable regularity. This causes the disc to rotate slowly, due to a gravitational action, and if carefully regulated a clever timepiece is the result.

The bluish color of the copper sulfate solution makes a very pleasing aspect in a home or library, the experiment itself being one of the least difficult to reproduce. The disc is about three inches in diameter and the electrodes at each end about ½ inch wide and 4 inches long. About three volts E.M.F. will be sufficient if the amperage is quite constant.

According to Dr. Tesla, a slow deposit is more desirable and for this reason a very narrow plate will answer the purpose. If a wider plate should have been used and the disc rotate too rapidly when current is applied to the terminals, the electrodes of both sides may be coated with paraffin so that but a thin space which is cleaned of this paraffin will be effective.

The plate should be slightly wider than the thickness of the disc itself. The disc could likewise be used as one electrode and instead of the two end strips only one would be employed.

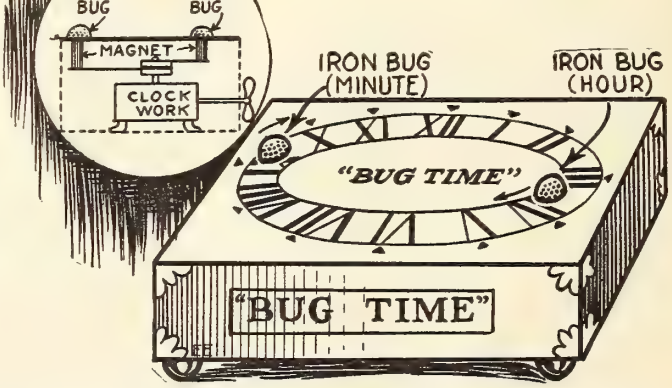
Another essential is that the bearings should be made non-corrosive and at the same time it would be better to lubricate them with a small drop of watch oil. Then when the jar is filled with the electrolyte, the oil will be retained in the bearing zone preventing a deposition of metal upon this zone and corrosion to a great extent.

THIS CLOCK TELLS "BUG" TIME

We recently noted in a jeweller's show window an interesting clock which was labelled with the startling sign, "This Clock Tells 'Bug' Time!" and while the idea involved is almost as old as Methuselah, the action of the device is very novel and pleasing.

No doubt some of our readers have seen similar clocks in their home towns and cities. The clock in question comprises a regular clock work movement mounted in a wooden cabinet, about 12 inches square by 8 inches high. The top of the cabinet was closed by an aluminum dial plate, or this might be brass, or any other non-magnetic metal or material. The clock may be mounted on a sheet of glass suspended on cords or wires well in the foreground, so as to show that no electrical or other form of energy is connected with the clock. Under the aluminum dial plate on the top of the clock the hands of the movement revolve in their usual procession. The hands in this case may have to be made a little stronger than usual, as on the outer end of each there is mounted a small steel magnet. These magnets act on the two iron "bugs" which tell the time. As will be seen from the illustration, the "minute bug" moves around on the outer circle of the dial, while the "hour bug" moves around on the inner circle of the dial. The aluminum of the dial can be as thin as 1/64 of an inch if necessary, but in any case, the thickness of this material will have no more effect on weakening the magnetism than the same thickness of air.

This clock has proven a great attraction in store windows, and can be used in practically every business, such as drug stores, jeweller's stores, etc. The people like to watch the little "minute bug" as he slides along from minute to minute, and besides they—the people, not the bugs—almost forget to eat their lunch in arguing as to how the bugs move over the dial. In five minutes you can hear about 14,000½ explanations of how the bugs tell the time,—including "psychical force"!*?!!



Thomas Reed Used to Tell Us Long and Lustily About His Clocks, — Electrical, Mechanical and Otherwise, But One of the Simplest and Most Novel Clocks Which the Average Electro-Mechanical "Bug" Will Probably Like to Build, Is This Real "Bug Clock" That Tells "Bug Time." As the Detailed Diagram Shows, an Ordinary Clock-Work, One From an Alarm Clock Will Do, Is Used, on the Outer Hands of Which Two Fairly Strong Steel Magnets are Placed. The Two Iron Bugs Can Be Easily Made and Colored.

Well, here is your chance to do a little fooling of your own. Undoubtedly you can find many improvements which will make the action of the "Bug Time" clock more smooth, such as placing little rollers in the miniature iron bugs, etc.

Why the Telephone Howls

By Prof. LINDLEY PYLE

Professor of Physics, Washington University, St. Louis, Mo.

FEW telephone users are unfamiliar with the fact that when the mouthpiece of the transmitter is held against the telephone receiver, in the position usually assumed by the human ear, a piercingly shrill musical note is usually

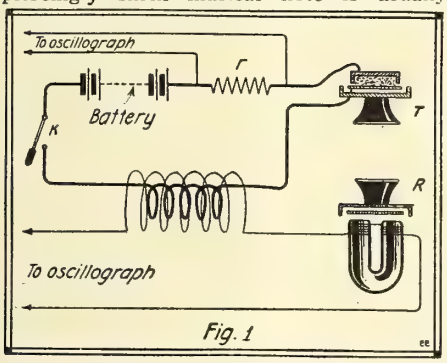


Fig. 1. Circuits Used in Laboratory Test of "Telephonic Howler."

emitted—quick action generally following a slight tap of the receiver against the transmitter.

The phenomenon is easily explained. Fig. 1 shows the essential parts of the telephone system. The transmitter is represented by *T*, the receiver by *R*. Suppose the battery is delivering a current thru the transmitter, the primary of the indicated transformer, and the closed key *k*. Suppose the receiver is on a closed circuit with the secondary of the transformer—no battery included. If the resistance of the carbon contacts in the transmitter be altered by a slight blow against the transmitter case the current in the primary will be altered, which will induce a current flow in the secondary. This induced current sets up a vibration of the receiver diafram which sends an air disturbance over against the transmitter diafram. The resulting

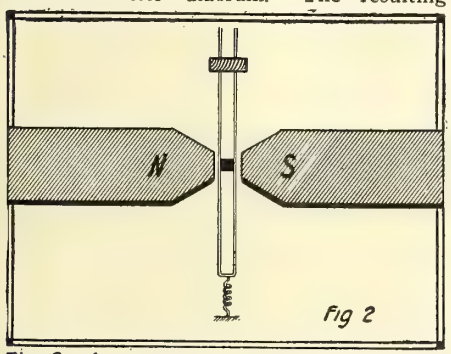


Fig. 2. Arrangement of Oscillograph Mirror Between Two Poles of Powerful Field Magnet. The Mirror is Mounted On the Two Wires Carrying Current from the Test Circuit—These Wires Tend to Twist and Swing the Mirror Beam Over a Scale.

varying pressure on the carbon granules alters the resistance of the transmitter circuit, and the whole sequence of events just described is repeated, the two diaframs maintaining a to-and-fro vibration under their mutual excitation.

The current in the transmitter circuit never changes its direction of flow; it merely strengthens and weakens, or pulsates. The induced current in the receiver circuit is an *alternating* current reversing its direction of flow in accordance with the rising and falling of the current in the primary of the transformer. The writer has used an *oscillograph* to study the way in which these currents vary. The current to be studied is past thru a loop of wire stretched between the poles of a powerful magnet. As the current varies in strength the loop twists to and fro, and a tiny mirror attached to it waves a reflected beam of light to and fro on a photographic film or plate that is moving rapidly at right angles to the direction of motion of the light-spot on the plate. Upon developing the film, or plate, one obtains a wavy line whose shape registers the change in strength of the current in the loop of the oscillograph. See Fig. 2.

Fig. 3 is an oscillogram of the high frequency alternating current in the receiver circuit. A second loop in the oscillograph made it possible to take on the same film a simultaneous record of the current from an alternating dynamo yielding 57 cycles per second. The superposition of these two records makes it clearly evident that the higher frequency in the receiver is 1,270 per second. The current strength in the receiver circuit is zero, as the wave record crosses the middle of the broad straight line running thru the middle of the record.

In order to obtain an oscillogram showing the nature of the current traversing the transmitter, the oscillograph was connected to the terminals of the non-inductive resistance, *r* (Fig. 1). Figure 4 is the interesting record obtained. The striking feature is the wide range of fluctuation in the unidirectional current. Whereas a Weston direct current ammeter in the transmitter circuit registers 0.50 of an ampere, the minimum values of the current (as reckoned from the straight line of zero current) are only eight per cent of the maximum values. The ammeter registers a sort of *average* current. The current falls almost to zero as the diafram of the transmitter swings outward, and then as an air wave pushes it in against the carbon granules the current rises to a value 12½ times larger. Corresponding to the 1,270 cycles per second of the receiver circuit, there are 1,270 pulsations per second in the transmitter circuit. That is, the current in the transmitter rises from its least value to its greatest value in about 1/2500 of a second, and in the next 1/2500 of a second falls to its original small value. To the uninitiated it may appear marvelous that our electrical devices permit us to study what transpires in a few ten-thousandths of a second.

The "howling" will continue even with as much as 80,000 ohms in the receiver circuit. The human body itself may be introduced across a gap in the receiver circuit and the "howling" may be induced without painful physiological results, altho the voltage is considerable. As measured on a sensitive

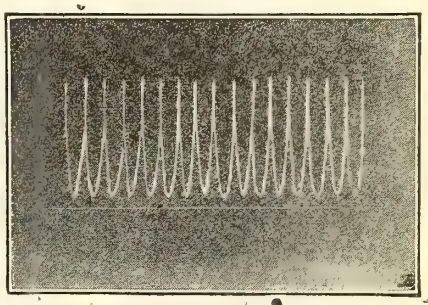


Fig. 3. This is An Oscillogram of the High Frequency Current in the Telephone Receiver Circuit.

alternating current ammeter the current strength in the receiver circuit, with no resistance other than the receiver and the transformer secondary present, is about 1/200 of an ampere. There are then present 2,000 ohms resistance and considerable inductance.

These results should prove interesting to those who wish to use the device as a generator of high frequency currents where the usual type of sinusoidal current is not necessary.

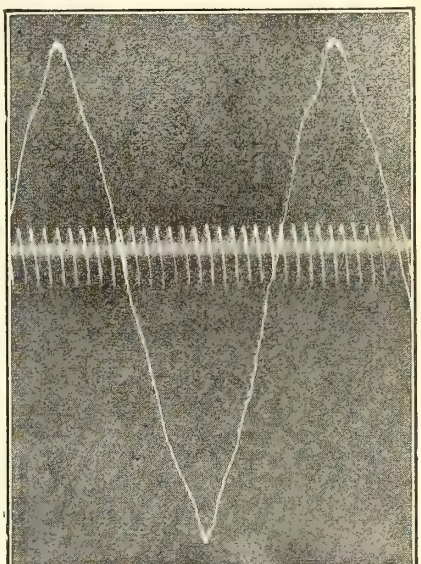


Fig. 4. In This Oscillogram a 57-Cycle, Large Curve, Alternating Current is Shown Superimposed On the Record of the Telephone Receiver Current, Demonstrating That the Latter Has a Frequency of 1,270 Cycles Per Second.

Trees Make Good Batteries

While reading the editorial in the June ELECTRICAL EXPERIMENTER on "Tree Wireless", the thought came to me: Why not use trees for batteries, as they probably have electrical currents in them the same as the human body? So, acting under this impression, I proceeded to make experiments which would possibly prove my suspicions correct.

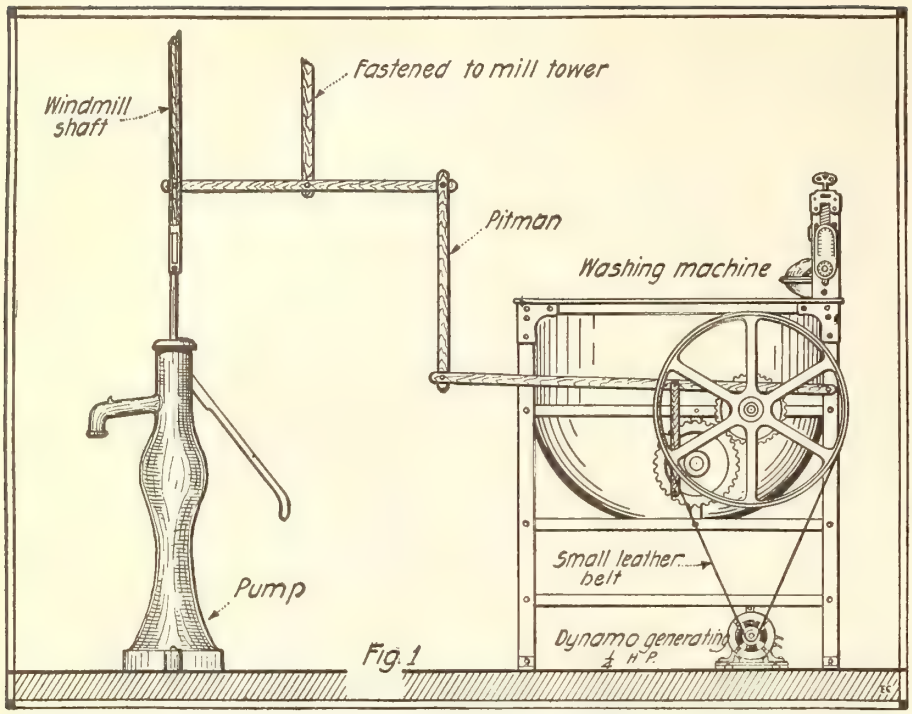
I found by driving a nail in the trunk of a tree four or five feet above the ground (however, this makes no difference as to height), and placing a rod in the ground for the other pole, I could get a comparatively strong current.

I first connected my wireless receivers in series with the nail and ground rod, and finding the current so strong, I tried placing a transmitter in the circuit. I found I could hear sounds surprisingly well, the transmitter working as well as if it had the customary dry cells. I then tried placing an induction coil in the circuit, but this seemed to decrease rather than increase the sound, the best results being attained by utilizing the transmitter and receivers in series with the nail in the tree and the ground rod. I also found that carbon block microphones worked extremely well with this source of current, proving very sensitive.

A galena detector placed in series with the "tree cell" and the phones is extremely sensitive to jars.

If a tree is used which has a large decayed cavity in the trunk the current is made much stronger by placing the ground rod in this.

Contributed by ORAN McILVAINE.



A Very Clever Idea Showing How the Reciprocating or Vertical Up-and-Down Motion Obtained from a Windmill Could Be Converted Into Continuous Rotary Motion for Driving a Small Dynamo. An Old Washing Machine Gear-Motion Does the Trick.

Windmill Pump Runs Dynamo

A farmer lad, with a general liking for things mechanical and more or less of an experimenter and inventor, rigged his mother's old washing machine to the windmill in a novel way to run his small electric generator. The dynamo required a bit more power to run at top speed than the lad cared to exert for any length of time thru his home-made device.

So on a temporary platform next to the pump the washing machine, of the type shown, was moved and the handle connected to the mill shaft by an upright pitman and the rocker cross-arm long enough to reach across the intervening space.

The dynamo was fastened to the platform with lag screws, just under the flywheel of the washing machine, and belted to the same with a small flat leather belt. The original wheel on the dynamo was too small for the purpose and another of the right size to produce the best results at the average speed of the windmill, put on in its place.

When this was connected up, the pump was disconnected, and the mill allowed to run for several hours at a time. The electricity thus generated charged a storage battery, consisting of several cells, located in the shop nearby, and furnished a constant and dependable current of electricity.

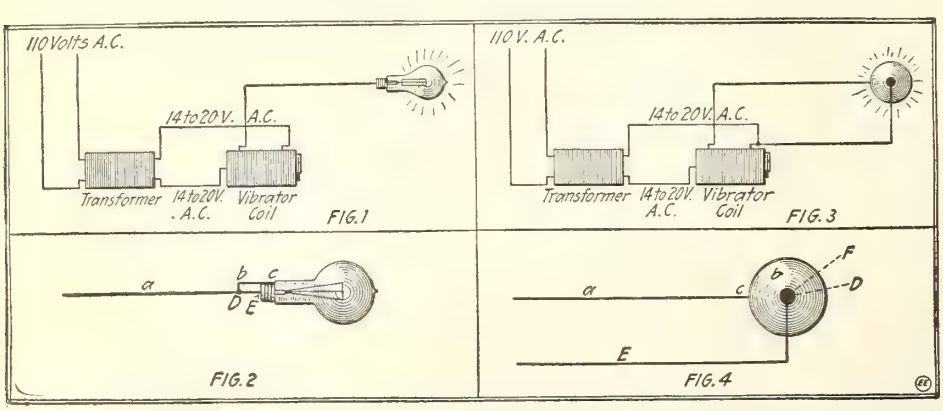
Contributed by DALE R. VAN HORN.

Spark Coil Experiments

Herewith are instructions for making Experiment No. 1. Procure a 110-volt reducing transformer which will step down the current to about 14 volts to operate a spark coil. An old ignition coil from a Ford car will do. Connect it up to the transformer as shown in drawing. Now get a piece of heavily insulated wire, reinforced cord will do, and connect this to the coil as per drawing. If Ford coil is used, binding posts must be soldered to contacts and then turning to Fig. 2 solder wire C to A at D, then solder wire C to the base of a 75 or 100 watt lamp (which is burnt out) at C. Next solder wire A to base of lamp at E. Tape well and when the current is turned on you have a Violet-Ray outfit.

Directions for Experiment No. 2:—The transformer and spark coil are the same as in Experiment No. 1. Just a word about Fig. 2. B is a flashlight reflector and F is a burnt out flashlight bulb. The wire A is soldered to reflector B at C. The wire E is soldered to back of bulb F at D. When the current is turned on, the bulb will light up with a purple light.

Contributed by C. S. WEBB, JR.



The Accompanying Diagrams Show Some Interesting Experiments with Spark Coils and Burned-Out Incandescent Bulbs, All of Which Are To Be Found in Every Experimenter's Laboratory.

POCKET SHOCKING COIL.

A screw-cap shaving stick tin is cut thru the middle, the halves separated ½" as shown at A, Fig. 1, and the gap is bridged by a 1" length of fibre tube that fits tightly over the two halves of the tin. These two portions, insulated from each other, form the *handles* for taking the shock.

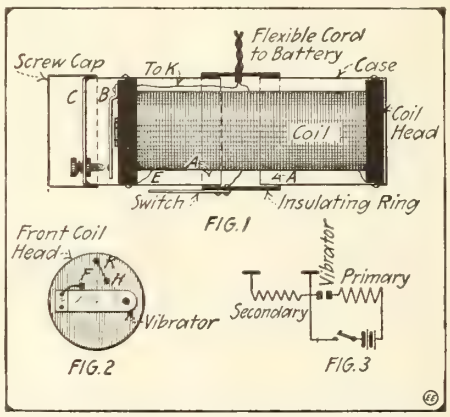
The coil heads are ¼" thick hard wood, paraffin waxt, and make a snug fit inside the tin. A ⅜" hole is bored thru the center of each for the core and the front head has holes made and the vibrator fixt on as shown in Fig. 3. The other coil head requires a small hole for the start of the secondary to pass out thru.

The vibrator is a 1¼" length of spring from an alarm clock with a silver contact soldered or riveted on as shown. Bend a ⅜" x ⅝" piece of sheet iron over the vibrator for the core to pull on. Hammer it tight so it does not shift.

The core is formed of a bundle of soft iron wires 3" long and ⅜" in diameter. The space between the coil heads is 2 7/16".

After fitting the heads tightly on the core, wrap three or four layers of shellacked brown paper around it and wind on the two layers of No. 24 S. C. C. wire for the primary coil. The start of the primary winding is brought thru hole F, Fig. 2, and fixt to the vibrator; the end of the winding is taken thru hole H and then back thru K.

Over the primary wind three layers of shellacked paper and then put on the secondary which consists of eleven layers of No. 36 enameled wire, covering this again with a further wrapping of shellacked paper.



This Shocking Coil, Built Into a Metal Shaving Stick Container, Will Afford Lots of Fun for You and Your Friends. You Will See the Point More Quickly Than They, However! The Two Handles Are Formed by Dividing the Metal Case Into Two Pieces, by Means of a Fiber Ring or Sleeve.

Next bore a hole thru the fibre ring for the flexible cord from the battery and rivet a piece of springy brass strip about ¼" wide and 1¼" long diametrically opposite this hole, fixing one wire of the flexible cord thereto. This strip acts as a push button and controls the battery current.

Twist the bared ends of the secondary winding over the coil head at each end so that they will make contact with each half of the container when in position. Smear some cement (a kind that will stick glass or iron) on the inside surface of the fibre ring and push in the ends of the container leaving about half an inch space between them.

Finally solder inside the tin the stiff brass strip, C, which acts as a contact pillar, having previously attached a nut for the screw to work in as shown. A fairly stiff spiral spring made of brass wire and placed under the screw head will prevent it slacking back when in use and is more convenient than a lock nut.

To make it real "hot" wind on more layers of finer wire or use more battery voltage.

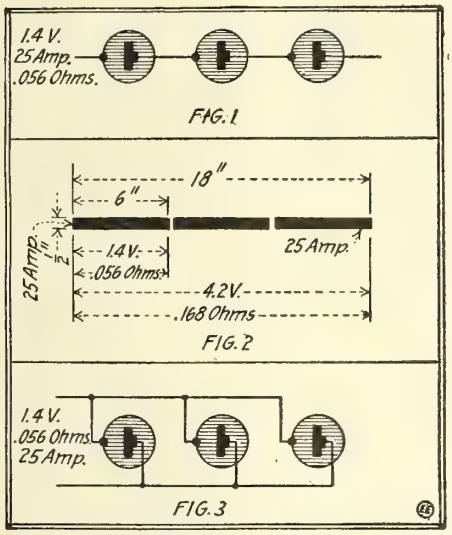
Contributed by K. McLEAN.

A Simple Explanation of Ohm's Law

By W. F. PERRY

In Regard to Series, Parallel and Series, Parallel Battery Connections

In explaining the differences (in voltage and current output as well as the difference in internal resistance of cells connected in any of the above named combinations) to my classes, I make use of three or four small sticks each six inches in length and one inch square.



One of the Best Ideas We Have Seen in Some Time Is That Suggested by Mr. Perry, Who in His Class-Room Work, Makes Use of Small Wooden Sticks, Each of Which Illustrates One Unit of a Battery, With a Given Voltage, Resistance and Current Available. By Placing the Sticks in Various Formations, the Relations in Different Battery Hook-Ups Are Evident at a Glance.

Naturally, I first consider the *Series* connection, and draw a simple sketch of three cells thus connected, giving the data pertaining to one of the cells, (assuming that the others have the same characteristics).

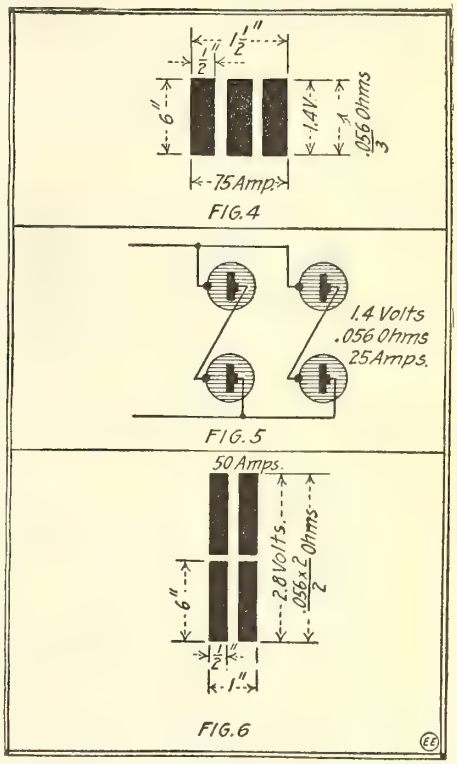
Having made the sketch and given the data I asked the question—What is the total voltage and current output of these three cells? Of course there appears to be some uncertainty on the part of the boys, as can well be expected when they really do not know—but such a question as this is perfectly proper because it causes the boys to think, and thinking is good for them. I now produce the three sticks and give them the dimensions of one of them. By placing the sticks end to end, I ask "What is the entire length of these three sticks?" Everybody answers, because everybody knows. "What is the width of this long stick." Exactly the same width as one stick of course. Having thus got the boys interested, it is a very simple matter to explain to them that the length of one stick will demonstrate the voltage of the single cell and also the internal resistance, while the ampere or current output is represented by the width; having thus related these things, the sticks are placed end to end, and thinking in the terms of volts, current and resistance, the boys thus can easily figure out the output of three series connected cells. Now that the boys can very well figure out what the output of any number of these cells may be, we move on to the next step—*Parallel* Connection.

The connecting lines in Fig. 1 are erased and lines drawn which represent the three cells as connected in *parallel*, the same data being used. To represent this connection the three sticks are placed side by side. It will be seen that the length of the sticks remains the same as one stick—that the width increases three times and that the resistance remains as the length of a single stick, therefore the voltage output of a parallel combination is the same as any of the single cells; that the current output is three times as great and by formula the internal resistance is the resistance of one cell divided by the number of cells.

Several lessons are given to examples or problems of this type and when it has been thoroly mastered the third and last type is given attention.

The sketch 5, the *series-parallel* combination is placed on the board as above and the same data applied. The boys then take a few moments for consideration of the problem after which they are asked what their opinions of the total output are. The answers are often surprising and the great majority, much out of the way. The sticks again come into play at this point—there being four of them instead of three, as in Fig. 6.

By relating the lengths and widths of the sticks with the voltage-current and internal resistance, the solution of the problem is very simple. The total length is twice that of one of the sticks—the total width is twice that of one of the sticks—therefore the total voltage output is twice that of one cell—the total current output becomes twice that of one cell, while the total internal resistance of the combination becomes by formula



Several of the Wooden Stick Combinations Used by Mr. Perry to Teach His Students "Ohm's Law" in Connection With Battery Circuits, are Here Illustrated. This Idea Could Be Used Very Nicely for "Home Study" as Well.

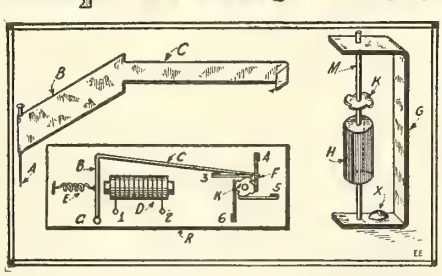
$R = \frac{r\,n}{n_1}$; where R = Unknown Resistance, r = resistance of one cell, n = number of cells in series and n_1 = the number of cells or groups of cells in parallel. It may be that this is an old method with some of your readers—if not, and you have ever the opportunity to teach any one the methods of calculating outputs and resistances of combinations of cells—just try it.

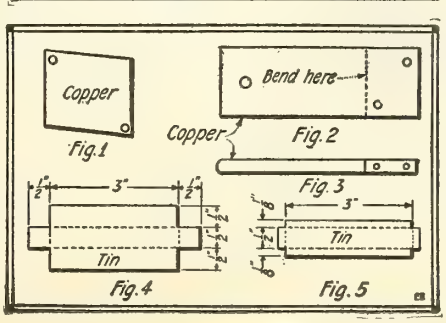
A Cheap Relay Reverser

The following is a description of a relay reverser that will work on A.C. or D.C. Referring to the diagrams, base R should be a block of wood 2" x 3" x ½". Armature B, arm C, and catch F, are all one piece, cut from soft tin and bent as shown,

This Simply Made "Relay Reverser" Will Appeal to All Experimenters and Particularly to Those Working Out Problems in Miniature Electrical Railway Train Control. The Reverser May Be Placed in the Engine or Coal Car, So That the Train Can Be Stopt and Reversed By Closing, Opening, and Closing Again,—Quickly,—the Main Supply Switch. Each Impluse Turns the Switch Drum a Quarter of a Turn.

with the free end of B bent around nail A, which is driven into the base R. The ratchet wheel K, which is cut from tin, should be ½" in dia., and soldered to axle M. Below K is a two-section commutator H, also secured on axle M. The tin piece G, bent as shown and fastened to the base by screw X, which serves to hold M ver-





tically. The brushes 3, 4, 5 and 6 all bear at right angles upon H. D is a low resistance electro-magnet which attracts B. Thus when posts 1 and 2 are connected to a circuit, D attracts B which moves arm C and catch F. When the circuit to D is opened, the spring E pulls back B and F turns H one-fourth of a revolution.

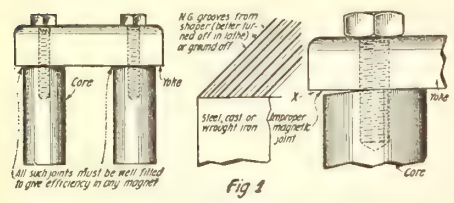
To control the direction of an electric train place the relay reverser in the engine or coal car. Connect post 2 with brush 3. Then remove the wires that run to the brushes of the motor and connect one to post 1, and the other to brush 5. Next connect the motor brushes to brushes 4 and 6. To stop the train and then make it continue in the same direction, the supply switch must be quickly closed, opened, and then closed again. To control lights from a great number of places, and thus be rid of forty-'leven-way complications, connect a small battery to D, using push buttons to close the circuit and brushes 5 and 6 in series with the lights. The brushes make no connection whatsoever with the ratchet-wheel. Contributed by PAUL R. GROVE

The Electrical Machinist

By H. WINFIELD SECOR

NO. 10—POINTERS ON IRON MAGNETIC CIRCUITS.

THE electrical machinist naturally meets with many problems in his daily work concerned with the building and repair of dynamos, motors, electric lifting magnets and various other magnetic or electro-magnetic mechanisms. The writer has thought that some pointers on the accuracy and general arrangement and construction of magnetic parts, such as the cores and yokes of dynamos, motors, etc., would be welcome.



All Iron Core Faces Should Be Machined or Filed Perfectly Smooth to Prevent Undue Magnetic Loss at Such Joints.

Referring to Fig. 1, we see one of the simplest cases met with in electrical machine shop work, that comprising the alinement of two magnet cores with their connecting yoke. On small dynamos such as fractional horse-power machines, etc., it does not matter so much as on larger machines, in some ways, as to whether or not the ends of the cores are very finely smoothed off, as well as the abutting surface on the yoke. Strictly speaking, however, on the small machine the magnetic losses are comparatively greater for a given size of air gap or space between the abutting surface.

On all good commercial makes of dynamos and motors, however, the abutting surfaces of cores and yokes, pole-pieces, pole-shoes, etc., are very accurately fitted, as even a 1/64th" air gap will mean a considerable loss in the magnetic power of the circuit owing to the extra magnetizing energy required in the coils to force the full quota of flux lines across the air gap. Probably this can be better realized when it is known that for a given size of iron core, say at the point "X" (see Fig. 1) where the core abutts the yoke member, that for a one inch length of the iron only 31.2 ampere-turns are required in the magnetizing field coil, let us say. For the same dimension core and if perchance, the core did not abutt tightly and make a perfect fit against the iron yoke member, but left a 1/64th inch *air gap* between them, then the ampere-turns required to force the flux called for in the design of the machine across this air gap would be 12.5 times that required for one inch length of iron core, or 370 ampere-turns. For a one inch air gap, 800 times as great a magnetizing force in A. T. would be required. In the case cited, for forcing 80,000 lines thru annealed wrought iron, 31.2 A. T. are required per inch of length of iron core. For one inch of air core or gap, 24,960 A. T. would be necessitated.

That is, a greater amount of ampere-turns or magnetizing energy is required in the coil to force the total magnetic flux across an air gap as short as 1/16th", as is required to force the total magnetic flux thru the whole iron magnet frame. In assembling the cast or wrought iron, or cast steel, cores and yokes of magnet frames, steel machine screws or bolts are invariably used, and never brass ones, of course, except under special conditions to be described in connection with Fig. 2.

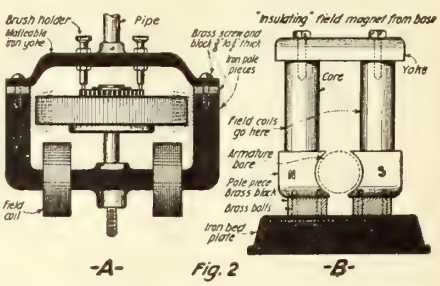
Referring once more to Fig. 1, it is often found in practise on dissembling a dynamo or other magnet frame that the abutting surfaces of the magnet members have been finisht off on a *shaper,* leaving a fine series of tool lines or grooves across the surface which is intended or at least, was intended by the designer to form a *perfect magnetic juncture* with the abutting surface. Of course such a rough finish as this is improper and it is much better, when permissible, to mount the part in the lathe and turn it down with a round nosed tool so as to be as smooth as possible, and finally finish it off with a fine file or a good square block and some very fine emery paper. Or again, the surface to be finally finisht may be very smoothly milled down in a milling machine or vertical boring mill, using a radial milling cutter of the finishing type. Where small magnet members are to be closely fitted and no machine is available, they can be filed very carefully, finishing with a fine single cut file and testing the flatness and squareness of the surface with a small steel square from time to time.

HOW TO "INSULATE" MAGNET FRAMES.

Taking up the diagrams at Fig. 2-A and B, we see two interesting cases where the auxiliary iron members of motors and dynamos had to be *insulated,* in the parlance of the electrical machinist. Of course, as we well know, there is no insulator of magnetism and the only way to prevent the magnetic flux from shunting around the auxiliary iron bars or brackets which may happen to abutt salient field poles, is to space these members away from the active poles by means of brass, fiber, zinc or gun metal blocks in the manner shown, both at Figs. 2-A and B.

In the case illustrated at Fig. 2-A, this was a fan motor of which many thousands were built in a shop, with which the writer was connected at one time. The field frame was ingeniously molded of cast iron with four pole-pieces, but only two are shown here, for simplicity. The field coils were wound on forms, taped and slipt over the pole-pieces, then thoroly shellacked and painted; finally, with a little pounding into shape with a wooden mallet, they formed themselves so as to hold tightly in place on the field cores, in the position shown.

The armature was of the ring type and rotated vertically, the ceiling fan blades being screwed on to the bottom of the threaded shaft. The iron supporting yoke, which carried the ceiling support pipe or tube, also carried the insulated brush holders. It will be noted that under each foot of the malleable iron supporting yoke there is placed a one-half inch brass block, of the same shape as the pole-piece, and measuring about two inches by three quarters of an inch, mean dimensions. A ⅜" brass machine screw, having 16 threads to the inch, was threaded 1½" into the pole-pieces on either side, as shown. These were tightened up with a large screw driver formed by grinding the end of a large discarded file to the proper shape, so that with the aid of a monkey wrench, these screws could be tightened up with plenty of pressure, as if they ever vibrated loose, the field frame might drop and kill someone. To prevent the brass blocks from turning, they were pinned with a brass pin on one side of the machine screw.



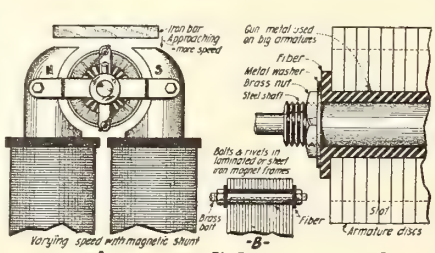
Showing How Zinc or Brass Blocks Are Placed Between Iron Magnet Frames and Bases, Etc., to Prevent "Shunting" the Magnetic Flux.

The theory of this arrangement is that the active field flux or the major portion of it, will pass into the armature coils and thru the armature core, and that very little of it will leak up and thru the brass blocks, and thus shunt around thru the iron yoke. Of course, a brass support yoke would have been a very good idea here, and in fact at one time brass yokes were used, but this material became so expensive, and for several other reasons, that it was finally discarded and the malleable iron yoke adopted as the standard.

These fan motors are still being built in large quantities, and the motor is rated at about one-eighth horse-power.

Referring to Fig. 2-B, we here come into the realm of both large and small dynamos and motors, many of which type are still in use now. Primarily, this is the old Edison type of dynamo and the electrical machinist will run into many machines of this type on repair jobs, but very few, if any of this form, are being built today, owing to the large magnetic leakage inherent in this design.

In these machines, even in such large sizes as several hundred horse-power, where the pole-pieces are on the base, then it has been necessary to place large zinc or brass blocks under the pole-pieces and between the latter and the base plate, for the purpose of preventing the shunting of a goodly part of the field magnet flux thru the iron base. The writer remembers one of these machines rated at about 100 K.W. where the zinc blocks were 3½" thick and about 8 by 10 inches in size. Of course on small machines, the measurements of the blocks are less in proportion. In some machines of this larger type, the builders have taken a chance and have used steel bolts, but it is apparent that brass screws should be used to fasten the poles to the base frame.



Controlling Speed of Motor by Magnetic Shunt and "Insulating" Tie Rods and Shafts of Laminated Iron Magnet Frames.

(*Continued on page* 439)

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; Second Prize, $3.00; Third Prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

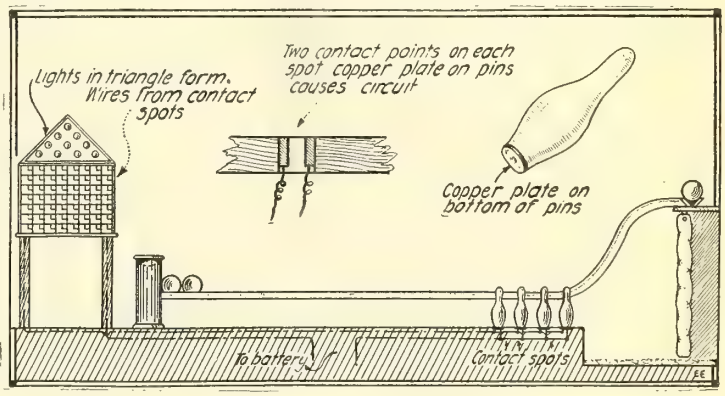
Electric Bowling Alley Signal

FIRST PRIZE, $5.00

Herewith find drawing of an electric bowling alley; my idea is to fasten small copper plates to the bottoms of the wooden pins as shown. And having two contact points to each spot, so when the pin is set on the spot the copper plate will close a circuit, lighting up the corresponding light; all the lamps being attached to a board in triangle form so as to duplicate the way in which the pins are set up. Should two of the ten pins not be directly on the spot the bowler will know instantly, as two of the ten lights on the triangle will be out. The bowler can then tell the careless pin setter just what pins are not on the spot which otherwise he could not do; as it is not a very easy matter to see whether all the pins are directly on the spots or not. The triangle with the ten lights set up on a board right where the bowler can easily see them.

An Ingenious Idea for Making an Electric Bowling Alley Signal, Which Can Be Used in the Home Alley.

Contributed by T. SHEEHAN.



Dynamo Bicycle Light

SECOND PRIZE, $3.00

I herewith submit to you a diagram of a "Dynamo Bicycle Light." It is easily constructed for a few dollars; any old battery case will do, providing it is large enough to accommodate a small dynamo, besides extra battery.

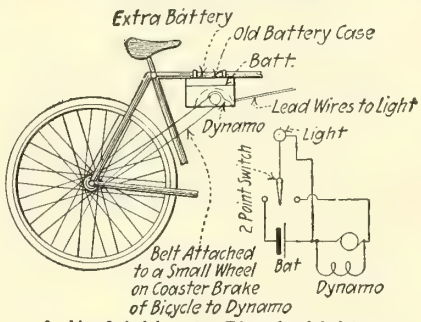
A small wheel is fastened by bolts on to the hub of the rear wheel between the two bars, and a small leather belt runs from this wheel to a small 4 to 6 volt dynamo.

The dynamo should furnish about four to six volts. A small switch is attached on the case to control the current by either battery power or dynamo; the battery comes in handy when pedaling up a hill and the wheel does not go fast.

The current then flows thru the lead wires to your light.

Therefore, I claim that this mode of lighting bicycle lamps is very efficient because it saves its owner a large sum of money that he would spend for batteries.

Contributed by FRANCIS LIEGLER.



A Useful Idea in Bicycle Lights.

Electric Heaters—Build Your Own

THIRD PRIZE, $2.00

I am sending you a drawing of an electric heater that I have tried out by experiment to heat an ordinary-sized room, and it will do it! It comprises an old coffee can, square preferably, a socket, an insulator or lead in tube, an attachment plug, cord, a nitrogen bulb, and a stand which can be cut out of sheet iron or tin. See Fig. 1. To make one of those new-fangled reflector heaters (see Fig. 2), procure a bright tin wash basin at the ten-cent store. A good size headlight reflector, or else a hammered copper reflector, will serve the purpose admirably. Next we need the heating coil. Old fan speed regulator resistance coils are useful, after you have cut out some of the wire to find out just how much will be needed to become red hot when connected to the line. A porcelain tube is imperative, and it can be wound with several yards of some resistance wire, such as No. 24 to 26 "Climax," German silver, Driver-Harris No. 193 alloy, and especially "Calido," a very good wire which will not oxidize even with a temperature in air of 2,000 degrees Fahrenheit.

Home-made Electric Heaters Are One of the Simplest Devices to Make, But They Must Be Built Right If They Are to Be Satisfactory, and Especially Fire-proof. These Heating Devices Get Pretty Hot and They Should Always Be So Designed as to Be Rigidly Supported Away from All Combustible Materials. Electric Lamp Heaters Have Been Adopted in Many Instances, and for Those Who Prefer This Form of Heater There Are Special Forms of Frosted "Heater" Lamps for Radiant Heaters Available on the Market.

Contributed by RAYMOND MATCHUN.

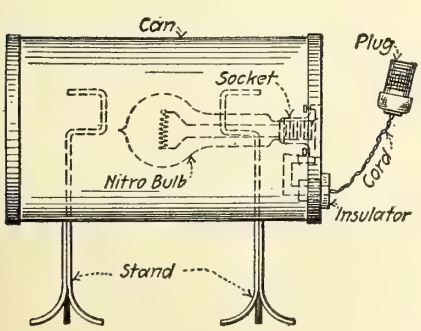


FIG. 1

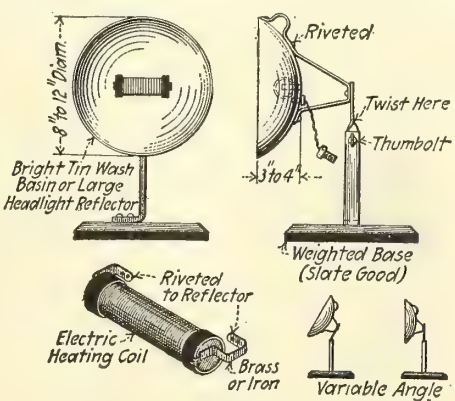


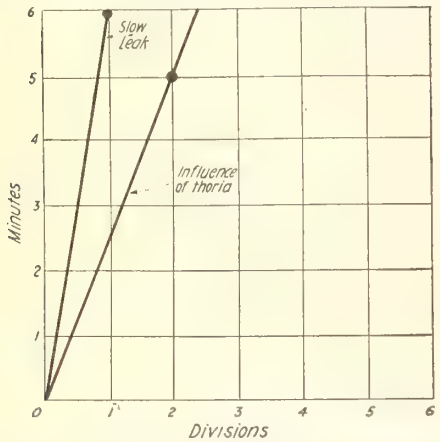
FIG. 2



SIMPLE EXPERIMENTS WITH AN ELECTROSCOPE AND THORIUM.

Many experimenters in radio activity find it hard to buy material for experiments in this interesting branch of science. Below are some experiments with substances which are cheap and found in every laboratory.

Obtain a new gas mantle from your dealer, or a broken one from home. This



Simple Graphic Chart, Showing the Decreased Time Required for Discharging a Gold-leaf Electroscope, When Some Radio-active Substance Such as Thorium is Brought Into Proximity to the Charged Members.

mantle is made up of ninety-nine per cent thoria, oxid of thorium, and one per cent ceria, oxid of cerium. Grind the mantle into a powder.

Calculate the slow leak of your electroscope by timing its fall over two or three divisions. Place some thoria on a piece of paper under your electroscope. Now, notice how long it takes the gold leaf to fall two or three divisions. A very interesting graph of this experiment may be made as follows: Suppose the slow leak of the electroscope is one division in six minutes. Place this on the graph. Now under the influence of thoria's ionizing power, suppose it falls two divisions in five minutes. Place this on the graph and a very neat comparison may be made between the slow leak with and without thoria.

Thoria is decomposed easily by treating it with sulfuric acid. Thorium sulfate cannot be obtained from this solution because the sulfate is very deliquescent. However, we may obtain the white hydroxid of thorium, $Th(HO)_4$ by evaporating nearly all the acid, diluting with water and adding ammonium sulfid. This hydroxid is insoluble in excess of the reagent.

Filter the hydroxid and dry the residue on the filter paper. Then test its radio-activity and chart your results as you did for thoria.

Now precipitate thorium carbonat from the thorium sulfate solution, by adding sodium or ammonium carbonat. This is soluble in excess but is precipitated on heating and allowing to stand. Filter this solution and dry the residue on filter paper. Then test and chart the radio-activity as before.

These three charts may be compared and if the experiments were conducted carefully, they will be almost in the same ratio.

Contributed by R. K. INNES.

MULTIPLYING FEET AND INCHES.

Contributed by Dr. W. A. Ballou, Pratt Institute, Dept. of Mathematics.

You were doubtless told by your school teachers that it could not be done. However, the only thing that is necessary is the use of a third unit of square measure that we shall call a strip. A strip is an area 1″ × 12″, and so contains 12 square inches or one-twelfth of a square foot.

3 ft. 6 in.
8 ft. 4 in.

sq. ft.	str.	sq. in.
24	48	24
	12	
24	60	24

That is, 3 ft. × 8 ft. = 24 sq. ft.; 8 ft. × 6 in. = 48 strips; 3 ft. × 4 in. = 12 strips; and 6 in. × 4 in. = 24 sq. in. But 12 strips make one square foot, so 60 strips will make 5 square feet to be added to the 24 square feet, making 3 ft. 6 in. × 8 ft. 4 in. = 29 sq. ft. 24 sq. in.

We shall now consider an example in which the number of strips is not an even multiple of 12.

2 ft. 5 in.
8 ft. 2 in.

sq. ft.	str.	sq. in.
16	40	10
	4	
16	44	10

In this case the 44 strips are divided by 12, as before, giving 3 square feet to be added to the 16 square feet. The remaining 8 strips are multiplied by 12, thus reducing them to square inches. The 96 square inches so obtained are added to the 10 square inches making 106 square inches in all. 2 ft. 5 in. × 8 ft. 2 in. = 19 sq. ft. 106 sq. in.

After a little practise by this method, feet and inches may be multiplied mentally. For example, the area of a table top 3′ 4″ × 5′ 10″ = 19 sq. ft. 64 sq. in.

CHEMICAL ORNAMENT.

Put three inches of sand in the bottom of a vessel such as a small glass globe, and on the sand place some pieces of the copper, aluminum and iron sulfates. Over this pour a solution of one part sodium silicate to three parts water. Let it remain quiet for 7 to 10 days, after which a dense growth of the silicates will have taken place, in many colors. Then place a rubber tube in the globe and let a stream of clear water pass thru the solution until all the cloudiness has been cleared away.

Fire from Water: Put a small piece of metal potassium in cold water and it catches fire, it darts about and splutters and when near an end it explodes with a sharp detonation. In a dark room trace with a camel's-hair brush your name, with water, trace this on paper and put the paper on a piece of tin, then place a piece of the potassium on the wet line and it will write the name.

A little piece of phosphuret of lime placed in water produces effects somewhat the same as the above. It takes fire snappishly, and rises in gas bubbles to surface, exploding on contact with the air and ascending in wreaths of smoke.

Saturate a lump of sugar with phosphorized ether, and placing it in warm water it will become luminous in a darkened room, and by blowing upon it brilliant and beautiful waves of light will be seen.

Fire under Water: In a small tumbler of water, at 140 degrees, drop two pieces of phosphorus about the size of peas. Then take a bladder containing oxygen, to which is attached a long thin tube, with a stop-cock. Press the bladder gently and as the gas reaches the phosphorus will take fire, filling the glass with brilliant flashes of light darting here and there in the water.

Silver Tree: Place a soft amalgam of silver into six parts of a solution of nitrate of silver, and four parts of a solution of nitrate of mercury. A beautiful precipitation in a tree-like form is the result.

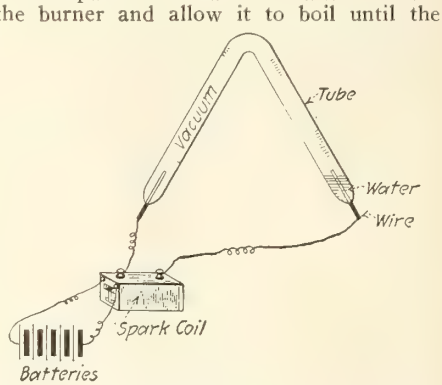
Contributed by EXWYZED.

HOME-MADE GEISSLER TUBES.

Owing to the war, the price of Geissler tubes has advanced beyond the means of most amateurs and the following device is a simple substitute for the same.

A copper wire—or, much better, platinum—is fused in one end of a glass tube which has been bent as shown in illustration and whose dimensions are about 8 inches long by ⅜ inch in diameter. Next pour about a half or a full teaspoon of water in the open end and manipulate the tube until the water is in the closed end and then rotate the other end in a bunsen burner until the open end gets quite small; in fact, so small that the wire which is finally to be placed there will just slip in and out.

Next put the end with the water in over the burner and allow it to boil until the



The Price of Geissler Tubes, as is Well Known, is at Present Almost Prohibitive—and the Present Article Dealing With a Home-made Vacuum Tube for Illumination on Spark Coils, Etc., Comes at an Opportune Time.

water is most gone, then quickly insert the wire and fuse it there. Now then as the tube cools the steam which filled the entire tube will condense, leaving a vacuum in the tube, and the result if the directions are carefully carried out is a serviceable Geissler tube.

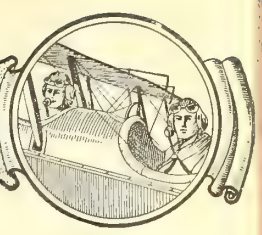
However, the tube must be kept in a triangle shaped condition or the water will short-circuit the high tension current.

Another much more commendable way is to use kerosene, gasoline, etc., instead of water, as the remaining liquid is an insulator and consequently the tube may be put in any position.

Contributed by LAWRENCE O. DENIO.



RADIO DEPARTMENT



Latest Radio News

NEW YORK UNIVERSITY FIELD RADIO.

THE photograph here reproduced shows the great interest manifested by members and visitors in the New York Universitiy Reserve Officers Training Corps, members of which are hereby seen operating a field wireless set during the recent drills held at that institution in New York City.

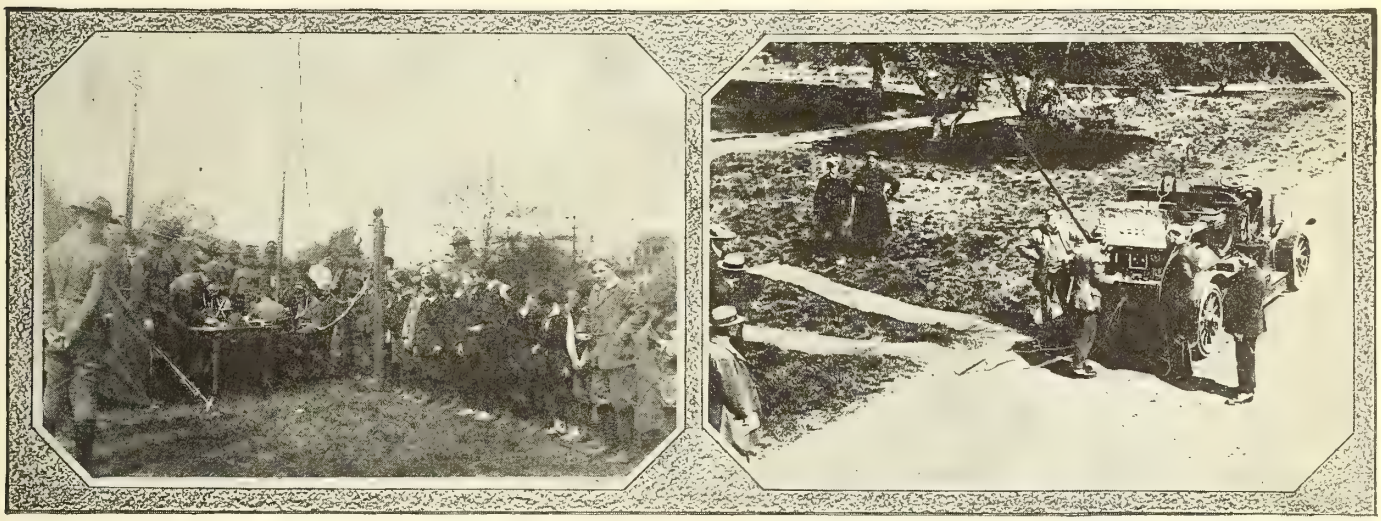
The accompanying photograph shows a wireless telephone used as an aid to "fire fighters." A demonstration was recently given in England showing how wireless telephony can be used in connection with fire fighting. Communication can immediately be establisht between the scene of the fire and headquarters, and additional equipment, ambulances, doctors, etc., called at once. This photo shows a member of the crew talking with headquarters seven miles away. A very good test, indeed.

Thanks to the high sensitivity and reliability of the multiple stage Audion detectors and amplifiers now available in the radio field, such work as this can be readily carried on without the huge antenna spreads of a decade ago, elevated to considerable heights. During the World War, it was frequently demonstrated that radio-communication over a distance of 25 to 100 miles could be carried on accurately by wireless, even when transmitted and received from an antenna supported by a 15 to 20 foot mast on a radio motor truck.

Of course, the higher the antenna the better the results obtained, generally speaking. It is interesting to note in the accompanying photo, how the ground connection is made—this as will be seen, was formed of two large wire masts, such as fine mesh, or other metal wire mesh which is placed on damp ground, or on grass or other vegetation, whenever possible.

It is also interesting to recollect that very excellent results were obtained some time ago by American radio engineers who made tests with aerial wires laid on the ground, which worked particularly well laid on grass, owing to the fact that a first class connection with the earth was then established. In using the antenna wires laid on the ground, the regular earth connection was generally employed, the ground wire being connected to an iron stake driven into the earth, or else to some earthed pipes system. Messages were transmitted over short distances successfully in this manner, using no elevated antenna whatever, and reception was carried on over distances of several hundred miles.

Later improvements, as carried out by Dr. James Harris Rogers and other radio investigators have brought to light the fact that ground antennae—either those laid on the ground or else buried under the ground—will do equally as good work, and in some cases give even better results, than the aerial elevated at a great height. One of the big outstanding features of the ground antenna, whether of the surface or buried type, is that radio reception may be carried on thru a very severe static and in fact in thunder-storms, which is practically impossible with other radio antennae.



Photos from Underwood & Underwood

New York University's Field Wireless—Members of New York University Reserve Officers Training Corps Operating a Field Wireless Set During the Competition Drills Held There Recently.

A Demonstration Was Given in England Showing How Wireless Telephony Can Be Used in Connection With Fire Fighting. This Photo Shows a Member of the Crew Talking With Headquarters Seven Miles Away.

It is to be hoped that every educational institution in the United States will for many years to come, follow the movement started since the end of the World War, and see to it that the young men which they are training and will train in the engineering and other lines, which are so extremely valuable to our army or navy in wartime, are thoroly acquainted with the military requirements of their government.

We do not believe that the military training given to members of the university and other officers reserve corps will lead to any undue aspirations as was the case in the past 40 years in Germany. The spirit of unabated Militarism apparently there reached its maximum, but under the conditions in which we find our own country, and in which way we DID find it, much to our dismay when we had to declare war, it is nothing short of criminal and foolhardiness to look the facts in the face and not train our own manhood so that they know how to handle a gun, what a Radio Set looks like, how submarines may be detected and located by a simple telephonic device, how to aim a gun so as to hit an enemy even beyond a mountain, the target never being seen by the gunner, etc., on down thru the list of military tactics and maneuvres which every army and navy man must have some knowledge of to fulfil his duties properly. And every one of us knows that these men cannot be trained in a day, nor a month or even six months.

Articles In August "Radio News"

Anti Capacity Winding vs. Coil Efficiency — *By Oscar C. Roos*

Japanese Radio Apparatus

A Trans-Oceanic Receiver — *By F. J. Rumford*

The Simplest Hook-Up—By Thos. W. Benson and Chas. S. Wolfe

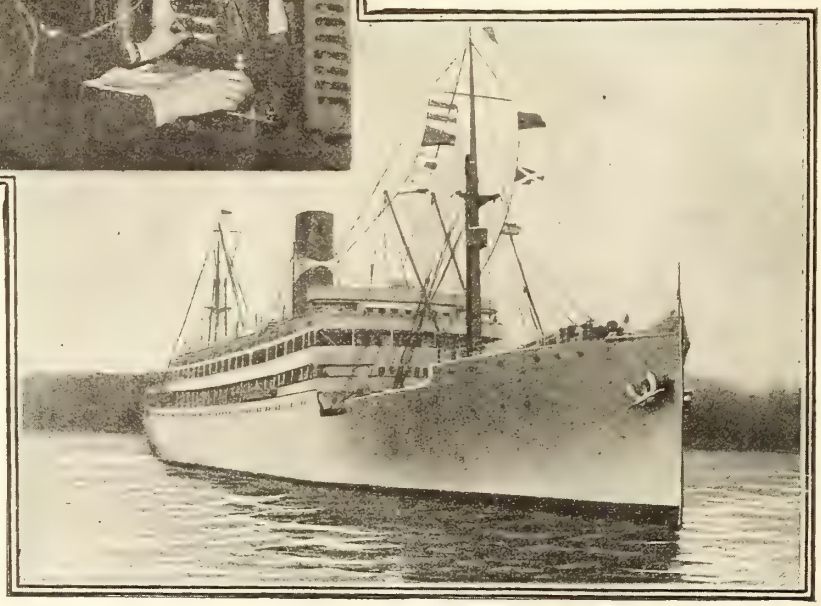
The Radiophone on Roller Chairs — *By Harold Warren*

Design of a Radio Receiver—Part 2 — *By L. M. Clement*

Static Defeated! — *By Arthur H. Lynch*

Wireless Telephony on Shipboard





The Wireless Telephone on the S. S. "Ulua" Proved of Great Use to Her Passengers. One of the Splendid Features of the S. S. "Ulua," of the United Fruit Line, the Floating Palace of the Great White Fleet, Which Arrived in New York Harbor Recently on Its Maiden Voyage from Glasgow, Scotland, is Its Wireless Telephone Service. The Photo at Top Shows One of the Passengers While Out at Sea, Connected With His New York Office by Means of the "Wireless Telephone." Photo at Right Shows the S. S. "Ulua," the Wireless Antenna Showing Clearly Between the Mast Heads. The Currents Received on the Antenna Are Carried Down to the Radio Room by Means of a Heavy Cable.

A FEW years ago, the wireless telephone was thought to be merely a delicate laboratory apparatus, requiring the very finest operating conditions for its successful operation, but the accompanying photographs show to what an extent the practicability of the radiophone has been carried.

The first picture shows a recent arrival in the United States, the S. S. *Ulua* of the United Fruit Line, often called the "Floating Palace" of the Great White Fleet,—which recently arrived in New York Harbor on its maiden voyage, equipt with the new wireless telephone shown in one of the accompanying photographs.

The photo showing the radio telephone apparatus installed in the wireless cabin on shipboard, shows one of the passengers while out at sea, talking to his New York office, by means of the wireless telephone.

RADIO SET THAT SENT PRESIDENT'S EPOCHAL MESSAGE.

A wireless set which for the first time made telephoning from sea possible and which sent President Wilson's historic message across the water to Washington is now in the research laboratory of the General Electric Company at Schenectady where it was developed by J. H. Payne, Jr., a 26-year old radio expert who was called from college to help the company to serve the government during the war. The laboratory group with which he worked did much toward making wireless telephony possible between aircraft, by cutting the size and weight of the equipment in half.

In February 1919, he devoted his attention to perfecting a wireless telephone transmitting apparatus with powerful generating tubes for ocean use.

His tests were made from the presidential liner *George Washington*. Payne took the set on two round trips during which not only was the set improved to meet varying weather but it was duplexed with a pair of antennas on board ship and a similar pair at the naval radio station in New Brunswick, so that messages could be sent and received just as they are over an ordinary telephone without switching, as had previously been necessary.

On the return lap of the first round trip, Mr. Payne, over a distance of 500 miles on May 4, 1919, sent the first commercial message ever forwarded by radiophone. It read: "From U. S. S. George Washington via Otter Cliffs, Me. 4. To Perkins, 242 W. 72d, N. Y. Expect to see you Monday night. Love. Signed, Ted. 3:30 p.m." On the following day Secretary of War Baker who was aboard, put on the headset and talked from a point 200 miles out of New York, to Asst. Secretary of War Franklin D. Roosevelt in Washington. Payne's log says the conversation proceeded "as easily as over an ordinary telephone."

Mr. Payne and the outfit returned to France with the ship to bring President Wilson home from the peace conference. The *George Washington* left Brest June 29. When the ship was 1,000 miles from Bar Harbor, Me., the set transmitted phonograph music so distinctly that sailors in Bar Harbor danced to it.

However, on July 8, just as the Atlantic fleet was greeting the *George Washington* off New York, the epoch marking official conversation was successfully held with Secretary Roosevelt in Washington and the President "Was delighted."

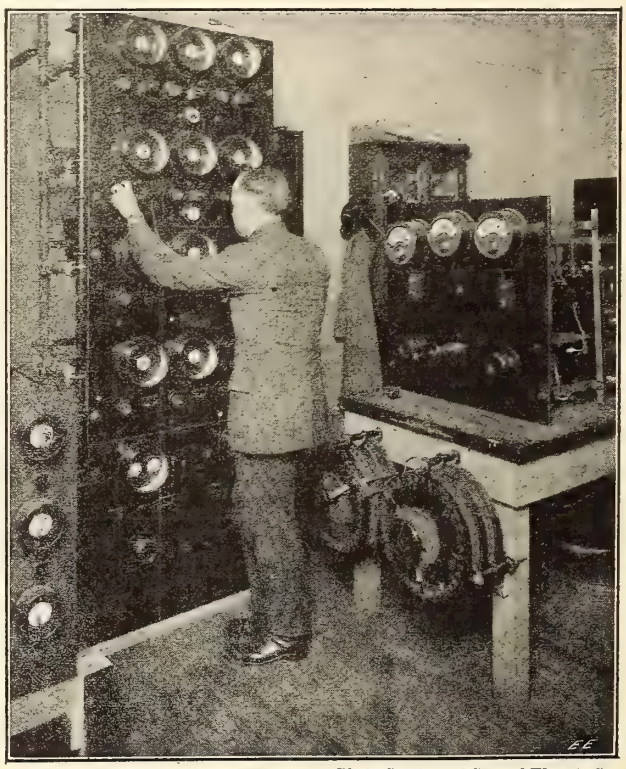


Photo in Lower Right Position Shows the Wireless Telephone Installation on the S. S. "George Washington," by Means of Which President Wilson Was Enabled to Talk Across the Atlantic Ocean to Washington, D. C. When the "George Washington" was 1,000 Miles from Bar Harbor, Me., Homeward Bound, This Set Successfully Transmitted Phonograph Music so Distinctly That Sailors in Bar Harbor Danced to It. The Set Included a Large Bank of "Plioton" Vacuum Tubes, Which, When Connected Together, Enable a Large Amount of Energy to be Easily Controlled by the Voice.

Photo Courtesy of General Electric Co.

AUDION POEM AWARDS

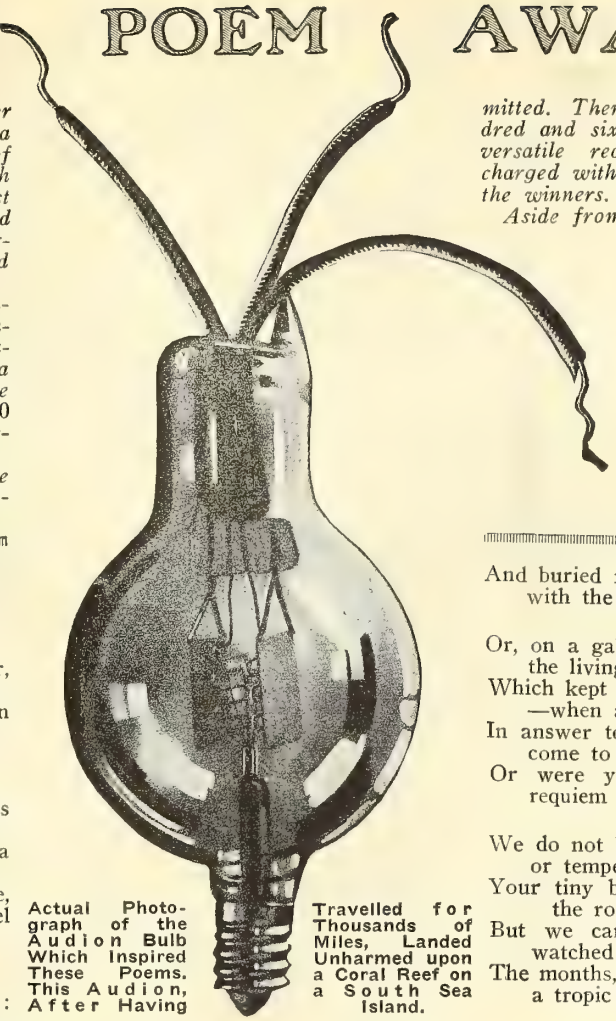
IN our March issue we publisht a letter from Dr. Lee de Forest, as well as a communication from R. A. Travers of Washington Island, which is in the South Seas. Mr. Travers had sent Dr. de Forest an audion bulb which had been washed ashore after bobbing over a coral reef, terminating its voyage of many thousand miles.

Dr. de Forest was so imprest by the wonderful pilgrimage of this little world wanderer that he suggested to us that the occasion should be duly commemorated by a fitting poem to the little adventurer. He accordingly thought the sum of $25.00 would be small indeed as the price of a befitting monument to our endearing hero.

But we were indeed surprised as to the quality and quantity of the poems submitted. There were no less than four hundred and sixty—a glowing tribute to our versatile readers. Dr. de Forest was charged with the arduous task of picking the winners.

Aside from being one of our great inventors, Dr. de Forest is also a poet of no mean accomplishments; his selections printed herewith prove this sufficiently.

We can, of course, not print all of the really good poems submitted—but we are making room for the nine best ones. The balance will appear in the September number. We know you will enjoy them.
—EDITOR.



Actual Photograph of the Audion Bulb Which Inspired These Poems. This Audion, After Having Travelled for Thousands of Miles, Landed Unharmed upon a Coral Reef on a South Sea Island.

$25.00 *Prize Winning Audion Poem*

FLOTSAM.

"Where should this music be? I' the air,
or the earth?
It sounds no more—and sure it waits upon
Some god of the island."
—*The Tempest, I, ii.*

WAVE-borne, a fragile thing of glass and wire,
Past the grim reefs that guard a lonely land,
The Audion drifted. Balked of its desire,
The spent sea washed it on the level sand.

The island took it to her warm embrace;
The palm-trees looked and wondered: "Hail, shipmate!
What wanderer are thou that the swift sea-race
Brings to our isle, sun-lit and desolate?"

The power that laughs at space was vibrant there;
Around the wanderer grew the wires again;
Answer came in the song of upper air—
The new-born Aerial of space-conq'ring men:

"My thin-faced master was a god to me,
Intent, deft-fingered, author of my breath
And my quick hearing—yet the ruthless sea
Took him, and tost me to a life in death.

Wrenched from my place, deaf, blinded, flung aside,
Wondering ever as I drifted why
I could not have gone down at that same tide
When my god sank—to die as captains die.

Still at their post—dying before reply
Could reach us sinking!—Now for me the while
No hope, save of escape from memory,
Beached on this murmurous, fair Pacific isle."

Composed by Kemper Hammond Broadus.

Special Honorable Mention

TO AN AUDION WASHED ASHORE.

Only a wanderer washed ashore, on the beach of a white sand key,
Where the warm night wind comes softly in from off the booming sea.
Only a wanderer stranded, where the ghostly palm trees sway,
But under the spell of the Southern Cross I heard the wanderer say:—

"I thrilled to the touch of my master's hands, and the tidings that came from afar,
While the old tramp steamer throbbed along, 'neath the cloud-dimmed Northern Star.
I hearked to the battle cruisers speak to their lean destroyer pack,
Where the thudding depth bombs marked the end of a cornered U-boat's track.
I heard the dreadnaughts' steel-tight towers, where the static glimmers clung,
While the hurricane droned thru the phosphor-bronze with the lay that the storm-god sung.
And I heard my masters call relief, ere I sunk in the surging brine
On the black, black day that we flung our bow on the horns of a floating mine.
The swirling maelstrom sent me free when the bursting boilers blew,
And I went a thousand weary leagues, ere I wandered here to you.
Ah, me, my masters wander still, where the cold ooze currents stream,
And the dead men go their silent ways, where the ghost-fire fishes gleam.
And thus I speak, while the moon is white, and the Southern Cross is high,
That the world may know that my masters died as the Wireless Men can die!"

Composed by Walter W. Stephen.

2nd Honorable Mention

THE WANDERER.

O little Audion, that sailed across the mighty sea,
A wondrous tale of wandering, you could reveal to me;
It may be by some careless hand that you were cast aside—
And buried in the sands until, you drifted with the tide.

Or, on a gallant ship, perhaps, yours was the living glow
Which kept men's hearts aflame with hope—when all around was woe!
In answer to their "S O S" did someone come to save?
Or were you left, alone, to chant—the requiem of the brave?

We do not know, nor can we tell, if tide or tempest bore
Your tiny bulb, so far from home, upon the rock-bound shore;
But we can fancy countless days, you watched the ships go by—
The months, in idle drifting spent, beneath a tropic sky.

You often found a shining path, made by the moonbeam, bright—
You loved the silver stars that gleamed, all thru the dreary night;
They seemed to be like comrades, there, up yonder, in the blue—
Who shared the hours of loneliness, and longed to comfort you!

Sometimes, by angry billows tost, in moments fraught with fear—
You trembled at the thunder crash, and deemed the end was near.
You mirrored every lightning flash, that rent black clouds in twain,
And wondered if your fragile bark, would stand the awful strain!

Yet, spite of storm and sore distress, your courage did not fail;
The sunshine always came again, and you forgot the gale.
Urged on by strange, resistless force, you westward sailed, to where
Three thousand miles, or more away, the coral reefs, lie bare.

O weary little wanderer, your journey, now is o'er.
Your message from that distant isle, sounds clearer than before.
You tell of power, unseen, unknown, a watchfulness Divine—
For all the world, a code, a creed. A tender loving sign.

That, whereso'er our paths may lead, though veiled in mystery—
The end will find us, safe at last; the voyage—memory.
Beyond the wind, and waves, we rest, content, because—we know
The Master's touch, will bring the thrill, the Light of Long Ago!

Composed by Emily Metcalf.

(*Continued on page* 456)

A War-Time Radio Detective

Part IV

By PIERRE H. BOUCHERON

FINAL RECITAL OF A MOBILE SPY SIGNALING OUTFIT

Down at the office of the L. C. D. they will tell you of the many startling cases which involved enemy spy systems having a strong radio background. Some may even rant about the baffling exploits of the "three musketeer spies" who had devised a system where, from several vantage points close to the huge Sperry Gyroscope Plant, strong magnetic waves had been "focused" upon the building in such a manner as to disable delicate testing instruments, thus effectively curtailing the production of much needed war apparatus. They will also tell you about many other strange and equally fantastic incidents. But I have it from very good authority that these wild and woolly impossibilities were in many instances the product of fertile imaginations.

As a matter of fact the most interesting cases entailing considerable time and expense in their solving, and which secured the most official notice, turned out to be some of the simplest and harmless happenings which were either coincidences or absolute false alarms. Judging purely from a matter of interest and narration, however, these proved to be the ones most worthy of recital for they involved the many characteristics which go toward making human nature the greatest of all scientific study and observation.

For that reason I might go on and rave indefinitely about innumerable cases, every one of them distinct from each other in its make-up and origin. Then, possibly, after the BORING point had been reached, the tables might be turned on me whereby the pursuer would become the pursued and countless numbers of otherwise genteel readers would track me to my lair, destroy my trusty typewriter and thus effectively put an end to these yarns. As I have no wish that this occur, I respectfully invite your attention to the following wind-up story:



"... Suddenly and Without the Slightest Warning, the Spy's Right Foot Shot Out and Landed Squarely on the Chest of the Lawyer ... Knocking Him Down ... a Few Seconds Later the Purr of the Motor Was Heard and the Car Went Speeding Down the Road."

THE RADIO MYSTERY STARTS.

ONE day, a middle-aged and much excited gentleman dashed into the office, and for more than an hour was closeted with our chief. He had no sooner left when a colleague and myself were called in and a hurried conference held concerning the following very strange and interesting case.

The gentleman, who by the way was a very prominent lawyer of New York City, had been visiting friends in Long Island by automobile and upon returning had stopt at a roadhouse near Babylon for some refreshment. He gave his order to the waiter and in a short time this worthy returned and was in the act of arranging things on the table when another waiter came up to him rather hurriedly and speaking in a low tone said in French, *"La voiture vient de retourner,"* meaning, "the carriage has returned." The first waiter thereupon turned rather quickly and said, *"Très bien"* (very well), then, as if an afterthought had struck him, remarked, *Faisez attention, je vous ait déja dit que vous parlez trop fort"* (be careful, I have already told you that you speak too loud).

Now it happened that altho the above conversation had been carried on in monotones, the lawyer, who had spent the early part of his youth in France and who later on in life had made frequent visits there, was therefore well conversant with the French language and readily heard and understood what had been said. Incidentally he noted a decided Teutonic accent in the speech of the would-be French waiters. The lawyer had kept up a bantering talk with his companion while the incident had taken place and now purposely continued to do so in the hope that the waiters would say more. Nothing further was said, however, and the two waiters departed towards the back part of the room.

Ordinarily, an incident of this kind might have past unnoticed, particularly in a public restaurant, as it is a well-known fact that many waiters in metropolitan districts speak French and German as well as English. In fact, many will proudly tell you that in their European travels they have waited upon this and that prime minister, General So- and So and even King Whosthis. But in this case the lawyer wondered why these two individuals had used French when they were so evidently of German origin. Was it that English was not secretive enough and could have been too readily understood by chance persons sitting nearby, or was it that French had been employed because it offered less possibility of its being understood and at the same time could be heard by other persons without exciting suspicion? It would seem logical, of course, not to resort to German during the general suspicion of war-time, which is a language recognizable even by persons not able to speak or understand it. These things, coupled with the rather unusual remarks of the two waiters, caused the lawyer to decide that here was something going on which was evidently not meant or planned as an event to be heralded from nearby housetops.

He spoke to his companion about the matter and explained to him what had been said, whereupon they decided to call for the waiter in order to observe him at close range. The headwaiter dispatched someone to the internal regions and after a considerable period of time a strange and entirely new servant came who made haste to explain that our first waiter had "gone off watch" and that he would be pleased to attend to their further wants. In view of what had gone on this sounded exceedingly unconvincing and unsatisfactory, to say the least. When waiter number three had been sent for two additional highballs (alas, reader, this all happened before July, 1919!) it occurred to the lawyer that it might not be a bad idea to stroll outdoors and endeavor to obtain a close view of the "carriage," if such it be, referred to by the two pseudo-Frenchmen.

THE RADIO TRUCK DISCOVERED.

Outdoors, however, nothing unusual seemed to be going on. There was, of course, a considerable number of automobiles parked within the immediate vicinity, for that particular roadhouse happened to be a rather popular one, but none of them seemed particularly interesting. The lawyer walked about the place for a while, then finally decided to explore what appeared to be a small driveway leading to the back of the inn and which seemed to reach out toward considerable shrubbery and trees. After walking for a short space he suddenly heard the *chug chug* of an automobile motor and upon nearing the direction from which the sound came saw a large motor truck with canvas cover similar to the huge army motor-lorries. From the top of the machine and reaching thru the canvas covering was evidently a collapsible mast of several sections. Upon approaching nearer he noticed one of the canvas flaps had been opened which gave a fairly good view of what was going on inside. A considerable number of bulky instruments and a small table or shelf could easily be seen, over which sat two men intently interested in a certain piece of machinery. The whir of a high-speed motor could now also be plainly heard above the roar of the auto engine and intermingled with this whir were intermittent hissing noises which sounded very much like escaping steam. The lawyer thought these activities rather unusual in this section, for the outfit, which evidently was a portable or transient radio signaling unit, could hardly be connected with the army signal corps or any other authorized and official organization, particularly in view of the fact that the two men were not drest in uniform of any kind, being

clothed in rather unkempt civilian attire. From his point of vantage he continued to observe the strange couple and their activities, being at this point a considerable distance from the main road. For the time being he did not know just what to do in order to confirm his suspicions. To go back to his friend and explain the situation with a view of further investigation would have meant that by the time he would return, the traveling plant might have decampt to parts unknown. On the other hand, the outfit might possibly be part of a Government signal unit operated by civilians for the purpose of test communication or research work, and it would be placing himself in a ridiculous position to attempt to report it or interfere should this prove to be the case.

The best plan, therefore, was to walk up to the two men and under the guise of a curious inn guest wandering about for some fresh air, nonchalantly step up and ask questions. He shortly reached the rear part of the auto truck but the men having their backs to him did not become aware of his presence immediately and this fact gave him the opportunity to better observe and study the contents of the car and its occupants. A small portable drop lamp of the storage battery type hung from the top of the car and thus by its fairly bright light could be seen the entire interior. Altho the lawyer was not well versed in radio matters, his general knowledge of the subject, however, enabled him to recognize the installation and its purpose with reasonable certainty.

Judging from the general arrangement of the car, it had evidently been designed for extended trips and constant travel. On one side was a settee or couch, the base of which probably contained storage cells and tools. One of the men was making some sort of adjustment to one of the running pieces of apparatus while the other was sitting on a camp stool and, with the familiar head telephones common to radio signaling outfits, seemed to be "listening in." Finally the noise of the machine must have been too much for him for he reached over and stopt the motor. It was at this moment that the nearest man slowly turned his head as if sensing the immediate presence of some one. The lawyer was somewhat startled for the man was no other than the late versatile waiter. He looked surprised for a moment then rather abruptly asked what was wanted.

"Nothing," replied the lawyer, "just walking around for a little air. What kind of an outfit is this you have here?"

The man had gotten up from his position and slowly walked to the end of the car and stood up above the lawyer looking down at him and studying his face when suddenly, and without the slightest warning, his right foot shot out from its elevated position and landed squarely on the chest of the lawyer with great force knocking him down and for the moment stunning him out of his wits. A few seconds later, the purr of the motor was heard once more, the canvas flap was drawn down tightly, thereby excluding all light, the car lurched forward and in less time than it takes to tell was speeding down the by-road at a considerable rate of speed where it was soon lost in the darkness.

After recovering from his surprise and astonishment the lawyer got up and since pursuit was out of the question, slowly walked back to the inn. He had not thought it wise to make a hullabaloo of the incident to any one in the place, but instead went directly to his friend who had been patiently waiting for him. The lawyer sat down and related what had just occurred, whereupon the two decided that to attempt to report or phone the matter from this locality would probably not be a wise step. One thing was certain, the first strange conversation of the two waiters, the motor lorrie and its paraphernalia coupled with the rather impromptu way of the versatile waiter in disposing of curious onlookers, proved beyond a doubt that the car and its occupants were engaged in an illegal activity having to do with some sort of spy communication system. Under the circumstances the most logical thing to do was to personally report the matter to the Government officials directly interested in investigations of this nature.

That was the substance of the story which the lawyer had related to our chief and which we two were now familiar with. The case was gone over very carefully and it was finally decided that enemy agencies were engaged in seeking and transmitting information to possible submarines lurking off the coast of Long Island, and that in order to do this in a way which would be hard to detect, they had resorted to the novel use of the traveling radio installation previously described. Moreover, this fact was shortly confirmed when upon inquiry it was learned that neither the Army nor Navy had any portable units of this type operating in that vicinity under circumstances as previously related.

SUSPICIOUS RADIO SIGNALS

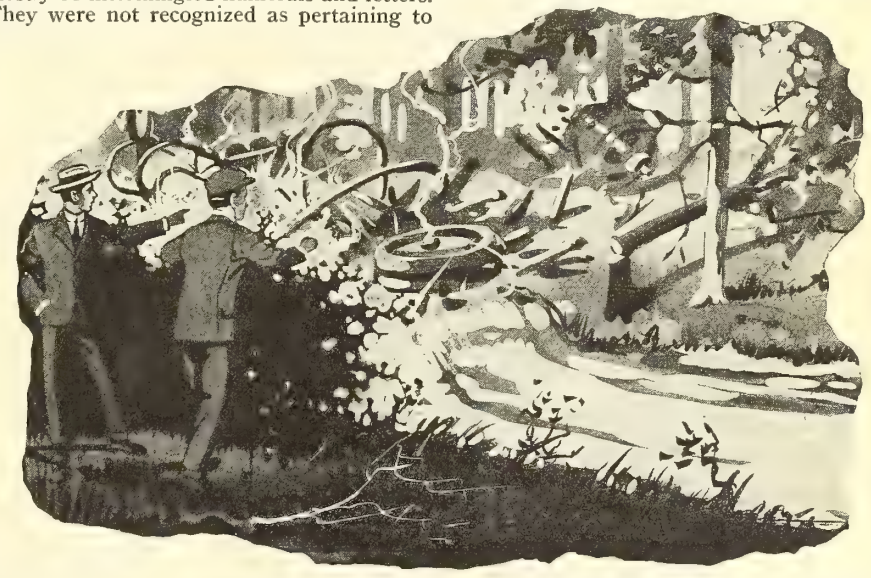
Incidentally, it was recalled that several of the Government radio stations on Long Island as well as those in Brooklyn had recently heard signals which sounded rather suspicious. These operated on a wavelength slightly above 700 meters, with a constantly fluctuating frequency, that is to say, gave the impression of emanating from a portable motor-generator unit, similar to those employed by the Army Signal Corps. Some types have hand-operated motor-generators whereupon as soon as the operator presses the key of the transmitting circuit the beginning of a dash will have a frequency somewhere around 800 cycles but will immediately drop down to perhaps 400. This characteristic will give a somewhat fantastic sound to long series of dots and dashes. It was also recalled that these particular signals had no real sequence, being composed mostly of intermingled numerals and letters. They were not recognized as pertaining to any Army or Navy signal codes or ciphers.

It was, therefore, very logical to infer that these strange and suspicious signals probably originated with the traveling radio station. This fact had been confirmed by resultant radio compass bearings which gave greatly varying positions every time they were intercepted. The regular means of investigating signals of unknown origin decidedly could not be employed in this instance, for it was recognized that we were dealing with persons who had made a close study of American communication systems, and that they were experts in the art of eluding detection. This case would therefore entail a different procedure and would necessitate the employment of many men as compared with the usual cases which could easily be covered by one or two investigators. The plan decided upon, therefore, was to erect several radio compass listening-in stations in the vicinity of Bay Shore, Babylon, Amityville and other points further east on the island. These stations were to maintain a constant "watch" and immediately upon securing approximate bearings of any unrecognizable or suspicious signals, report them to another body of men furnished with automobiles whose duty it would be to immediately dash out to the suspected spots and endeavor to corral the strange acting motor truck. This was the substance of the proposed operations. Incidentally, we were told to "work fast," for, since there were many military and naval establishments on Long Island it would not do to have their activities ascertained and reported to enemy intelligence systems for any length of time without resulting in possible dangerous consequences.

Naval intelligence men were accordingly dispatched to their individual points of vantage and the above-mentioned portable radio compasses were set up at the most advantageous sections. My good friend and coworker J. T. H. and myself sallied forth to win recognition and fame on this latest exploit which certainly did promise interesting developments.

A MERRY CHASE

Days rolled by, then weeks which were filled with some most breathless and intense moments. Excitement was the order of the day. At any hour of the day and night our radio compass operators would report bearings on suspicious signals whereupon we would spurt to the given spots only to find our birds had flown. This was to be expected, of course, for the very act of the radio spies in using the traveling outfit was designed to evade all possible detection by means of the radio compass. We hoped, however, that we would eventually run across the motor lorrie, for our system was such that with the great number of men now working on the case such a large truck could not evade us much longer. Not only that, but we were working in connection with the Army so that possible disguise or camouflage on the part of the truck could have been readily detected. The great disadvantage was that our activities might



". . . Lo and Behold, There in the Center of the Cleared Space Was a Large Mass of Twisted Steel and Charred Wood. . . . Was This the Spy Radio Truck Discovered at Last—But Too Late?"

(*Continued on page* 457)

MAGNAVOX BOOSTS RADIO SIGNALS

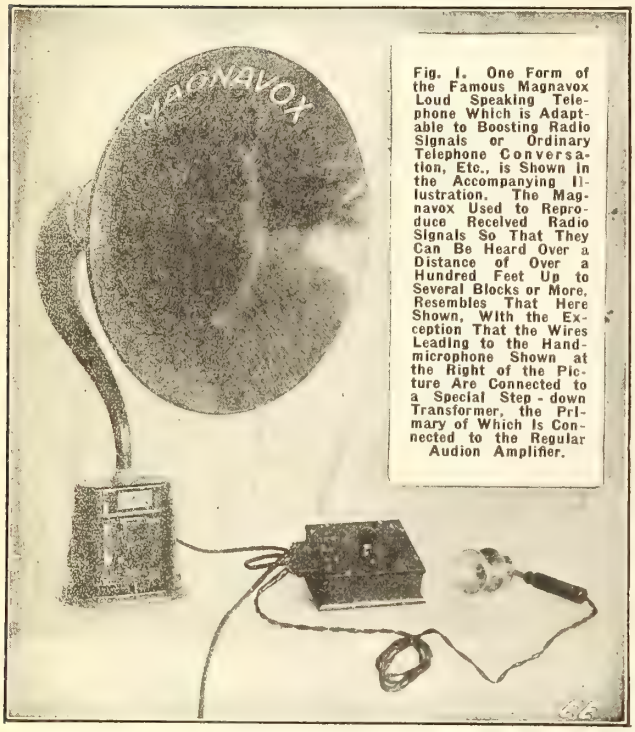


Fig. 1. One Form of the Famous Magnavox Loud Speaking Telephone Which is Adaptable to Boosting Radio Signals or Ordinary Telephone Conversation, Etc., is Shown in the Accompanying Illustration. The Magnavox Used to Reproduce Received Radio Signals So That They Can Be Heard Over a Distance of Over a Hundred Feet Up to Several Blocks or More, Resembles That Here Shown, With the Exception That the Wires Leading to the Hand-microphone Shown at the Right of the Picture Are Connected to a Special Step-down Transformer, the Primary of Which Is Connected to the Regular Audion Amplifier.

IT was by means of Magnavox telemegafones that Lieut. Herbert E. Metcalf, 3,000 feet overhead, startled the city of Washington on April 21, 1919, by reading, via radio, President Wilson's Victory Loan message from an airplane in flight. The voice was distinctly heard by 20,000 people below. This feat was accomplisht thru the installation of Magnavox sound-amplifying apparatus in front of the Treasury Department Building. Every word uttered by the army officer in his radio-telephone was caught and swelled in volume by the telemegafones below, until persons blocks away could hear the message plainly.

Now comes the complete Radio Telemegafone, which enables radio operators to do without their head-sets and hear every ordinary signal easily by means of a telemegafone standing on the receiving table.

There are at present manufactured two forms of sound-amplifying apparatus. These are: The radio telemegafone, Type R-1 or R-2, as described below, and the voice and music telemegafone, MV-1, illustrated at Fig. 1, herewith.

The radio telemegafone, equipt with both head-set and horn, is designed particularly for use by the following: Commercial stations, ships, technical schools and colleges, experimental radio stations, radio amateurs, radio-apparatus manufacturers. This type of telemegafone will appeal strongly to radio engineers, operators and manufacturers, because:

With the telemegafone standing on the receiving table, an operator can read signals as plainly as he can those that ordinarily come thru head-receivers. With the Magnavox telemegafone's head-set attached he can easily read weak signals. The gain in comfort to the operator by using the telemegafone for ordinary signals is self-evident.

By using proper current-amplifying apparatus, any signals can be amplified and reproduced thru the telemegafone to a volume too great to be adequately measured or even estimated. In fact, *signals can be heard thousands of feet from the horn!*

When extremely loud reproduction is desired, the radio telemegafone type R-2 is recommended, with its wooden horn having a mouth 22 inches in diameter. This type is identical with the R-1, save in this feature. It gives the maximum clearness for distributing sound to outdoor audiences or in a large auditorium. Either the type R-1 or type R-2 may be used with a one- or two-stage audion amplifier of the type used with most radio receiving sets, or it may be used with more elaborate amplifying apparatus according to the degree of loudness desired. The makers of the Magnavox supply when desired a three-stage audio frequency amplifier with two tubes in each stage.

This amplifier is particularly adapted for use in connection with Magnavox telemegafones.

This type radio set consists of: One telemegafone, one metal horn, 17 inches long with mouth 6 inches in diameter, one listening tube headset, one special step-down induction coil and battery switch, mounted on base with telemegafone.

A six-volt storage battery is required to furnish current to energize the powerful electro-magnet of the telemegafone. The leads from the battery are connected to terminals marked B-B in Fig. 3, which in turn are connected to the field coil of the telemegafone.

The *electro-dynamic* principle has in the past superseded the *electro-magnetic* principle in almost every form of electrical apparatus employed for the transformation of electrical energy into mechanical energy.

The startling results obtained with Magnavox dynamic receivers indicate that this type is destined rapidly to supersede the commonly used electro-magnetic or Bell type of receiver.

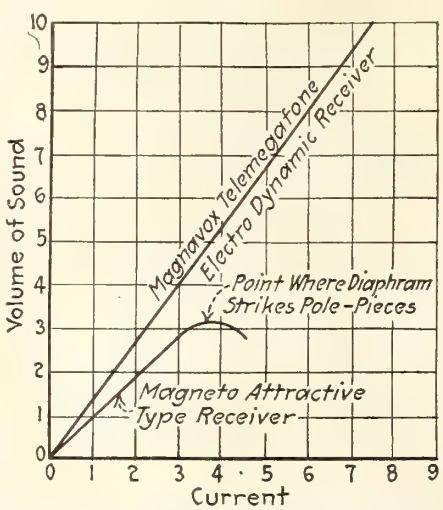


Fig. 2. Graphic Curves Which Show Clearly the Wonderful Range of the Magnavox Telemegafone, or "Electro-Dynamic" Receiver, as Compared to the Standard Type of Magneto-Attraction Telephone Receiver. Note That at Slightly More Than Three Units of Sound Volume, the Diafram Strikes the Pole-pieces in the Usual Form of Receiver.

The telemegafone (distant megaphone), which is the name given the Magnavox electro-dynamic loud-speaking receiver, consists of an ironclad electro-magnet provided with a narrow circular airgap in which exists a dense magnetic field. A circular-shaped, light, movable coil is suspended in this airgap and is firmly attached to the diafram enclosed in the sound box. When the variable currents flow thru the movable diafram coil it will move in accordance with the characteristics of the incoming variable currents. The diafram, being firmly attached to the coil, will reproduce the signals. (See Fig. 3.)

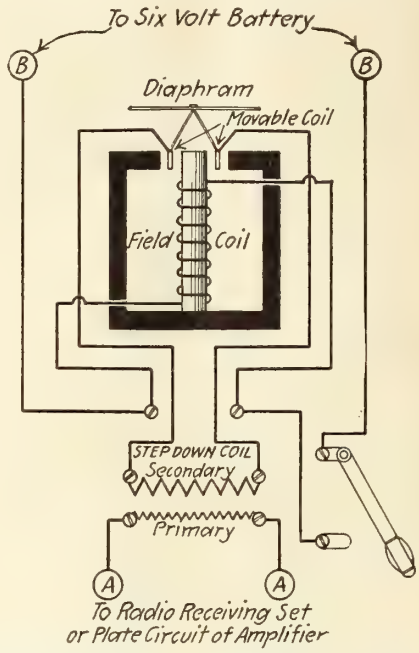


Fig. 3. Hook-up of Magnavox Telemegafone with Special Step-down Transformer, Switch, Etc., to Radio Receiving Set.

The construction of the electro-dynamic receiver permits the diafram to move as far as the natural resiliency of its material will permit. (German silver or phosphor bronze diaframs are suitable.)

The diafram in an electro-magnet or Bell type of receiver can vibrate only up to the point where it will begin to strike the pole-pieces. If the pole-pieces are removed further from the diafram the receiver will rapidly lose in sensitiveness. (See curve, Fig. 2.)

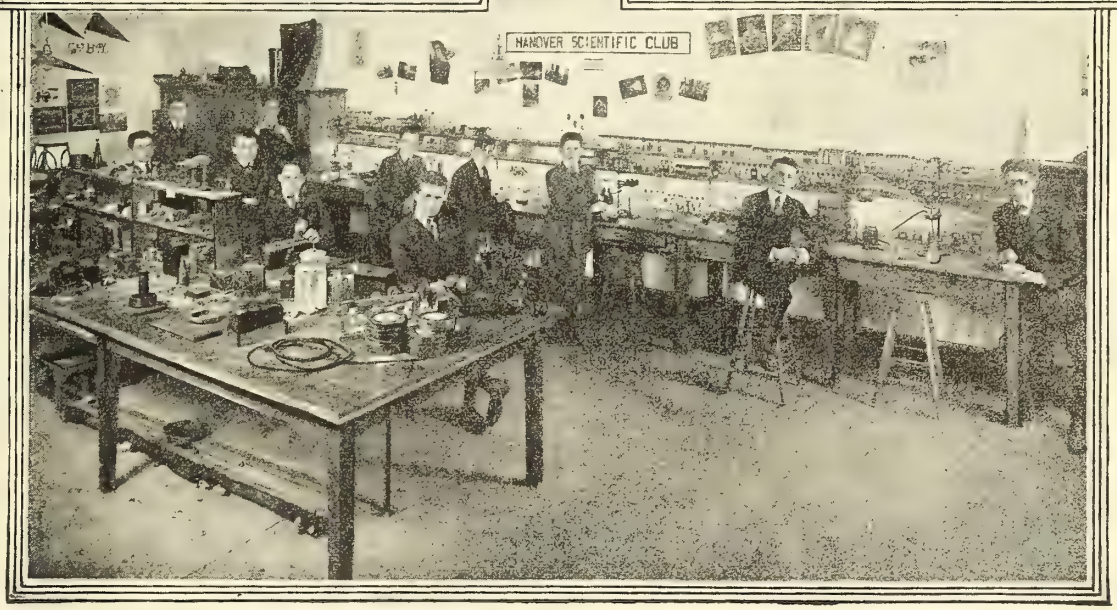
The receiving coil of the telemegafone is wound so as to have a direct-current resistance of about ten ohms. This necessitates the use of a special step-down transformer or induction coil. The step-down coil, which is used in the R-1 or R-2 set in connection with a type LS-2 telemegafone, is wound in sections to decrease the capacity effect of the coil. The primary winding, which is connected to the terminals marked A-A in Fig. 3, and from there connected to the radio-receiving apparatus, is wound with about 1500 ohms, direct-current resistance, of No. 35 B. & S. gauge insulated copper wire, wound in nine sections.

The secondary winding is connected to the light movable coil of the telemegafone and is comparatively short. It is wound with No. 22 wire in six sections. The length of the secondary winding is such that maximum effect is obtained in the telemegafone. The instrument shown at Fig. 1 is intended for amplifying the spoken voice or phonograph music, but resembles identically in principle the radio type.



Large Photograph Below Shows General Experimental Room of the Hanover Scientific Club.





In the Rear Left - Hand Corner of the Photo Above, Appears the Wireless Table of the Hanover Scientific Club, With Its Long Wave Tuning Coils and Loose Couplers. In the Extreme End of This View, Appears a Reading Table and Library Room Which Is Formed by Drawing the Curtains Together. Many Text Books and Magazines Are Available at All Times to the Members.

At the Right-Hand Side of the Photo Above, May Be Seen the Vapor Hood Used by the Electro-Chemical Students of the Hanover Scientific Club, in Making Gas Experiments. The Sink is Equipt With Hot and Cold Water and Gas, and a Large Basin For Draining the Water.

The Hanover Scientific Club

HEREWITH we, members of the *Hanover (Pennsylvania) Scientific Club,* submit a brief description of our club and experimental laboratory. Our laboratory is in the largest building and in the heart of Hanover, Pa. We have ample room for all of our members which at present number nine active and three honorary.

In the large photograph can be seen some of the members engaged in experimental research. On the right-hand side are work benches, which are occupied by members studying chemistry. Each bench is furnisht with a gas and electric outlet and a large drawer in which their smaller apparatus and miscellaneous parts are kept. Each member also has a separate locker to keep his larger apparatus and belongings in. In the center is a table which is used by those members experimenting in electricity. The small motion-picture machine on the left-hand corner of the table, with its films, is used for lecture work and general amusement. The antenna under the table is in readiness to be strung between the two large towers on the roof of the five-story building. On the table can be seen Oudin coils, Leyden jars, interrupters, spark coils and transformers, storage batteries, wireless parts, magnetos, generators and everything a live experimenter needs. The table is also equipt with drawers in which the usual "junk" is kept. In the rear left-hand corner of the second photo is the wireless table with its long tuning coils and transformers and couplers. In the extreme end of this view appears the reading table and library room, which is formed by drawing the curtains together. Text-books of many descriptions are found on the shelves just above the table. The ELECTRICAL EXPERIMENTER (Science and Invention) and the *Radio News* are among the most popular magazines.

In the third photo, on the right-hand side, is the vapor hood used by the electro-chemical students in gas experiments. This sink is equipt with hot and cold water and gas and a large basin for draining the water. In front of the fireproof door stands the president (right) and the vice-president (left). The switchboard along the wall controls all current in the laboratory, both alternating and direct 110 and 220 volts. On the window in the rear is a motor-generator used for special direct current work and battery charging. The shelves on the left contains any kind of electrical junk from a binding post to a polarized relay, and such raw material as zinc, copper, iron, lead and aluminum sheets. Meetings are held every Thursday, all chartered members have keys and entrance can be had at any time. The students in chemistry are under the supervision of a college professor and regular progressive lessons are given. A Wireless Class has recently been formed.

The plan of effecting the organization in every town and city of all the scientifically inclined young men, is a most commendable one and one that merits and invariably does receive, the full support of the local officers of the municipal and town governments. Among the many other features resulting from the banding together of a number of young men interested in similar ideas, we find the following:

In the first place, a club such as this can always purchase material and instruments when necessary beyond the reach of the average experimenter, and which apparatus is frequently very necessary and important, in order to carry out certain research problems.

But aside from this, there are many other educational and intellectual features connected with any whole-hearted organization where each one of the students strives to do his best and the utmost to build up a solid feeling of brotherhood.

Any reader wishing to communicate with the club should address E. J. J. Gobrecht, President, Hanover Scientific Club, Boys' Club Bldg., Hanover, Pa.

SPECIAL LABORATORY PRIZE CONTEST.

As announced some months ago, we stated that for special experimental laboratory photos and descriptions an extra inducement or special prize would be offered. This month, we have pleasure in presenting an exceptionally fine experimental laboratory group, THE HANOVER SCIENTIFIC CLUB. We hope to receive more of these complete laboratory write-ups every month, and shall offer a cash prize of $10.00 for the best description, accompanied by photos, submitted.

Send photos and descriptions to Editor of "Special Laboratory Prize Contest."

WITH the AMATEURS

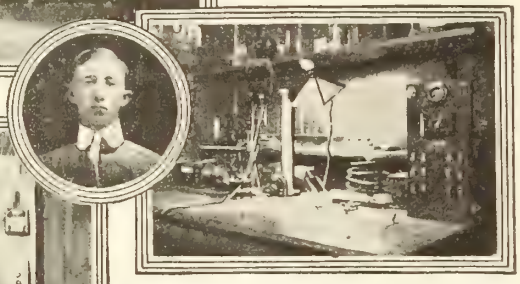
Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

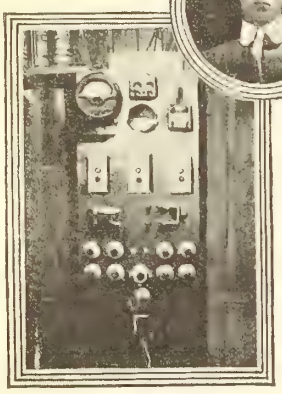
"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER—

EARL H. FURMAN







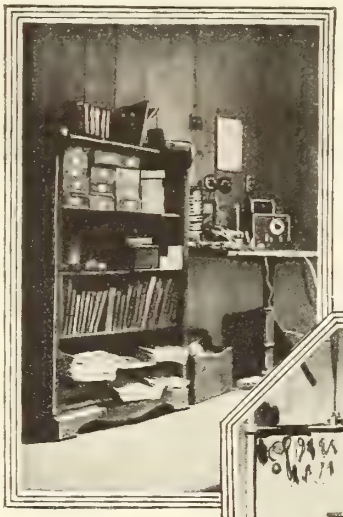
HERE are several pictures of my "Electrical Lab." My wireless receiving set consists of an Audion bulb detector, loose-coupler, Murdock variable condenser, fixt variable condenser, a pair of Murdock receivers, and various loading coils made by myself. The sending set is very simple, consisting only of a spark coil, condenser, spark gap, and key. See photos at left.

My aerial comprises four wires about 200 feet long and 50 feet high.

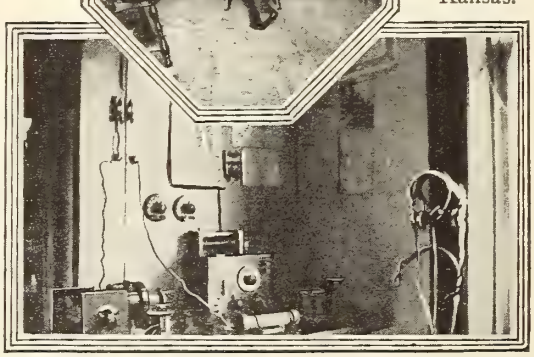
At the left of the wireless table is a small telephone which is hooked on with our house 'phone. On the right of the wireless table is a small transformer-switchboard with ammeter, fuses, small electric light and twelve binding posts, enabling a person to obtain any voltage from two to twenty. The large switchboard is over five feet high. It has on it the meter, fuses and switches to all lights in the "lab." It also carries the door bell, binding posts and receptacles for 110 volts, and a bell-ringing transformer. Another photo shows a miniature thrashing machine and separator. The engine is run by a small motor inside the boiler. The street car is run by a motor and reverses automatically. I also have a small farm yard consisting of an electrically lighted house, windmill, barn and other buildings.

Everything shown on this table was made by myself. One of the photos shows the work table and tools, which need no explanation.

Mr. Earl H. Furman, Box 112, Norcatur, Kansas.







HONORABLE MENTION—
EDWARD SLEPIAN
$2.00 PRIZE

I PRESENT herewith photos of my laboratory. My electrical workshop consists of a small table, a vise, and my tools which are situated above it. I have two receiving sets. The first consists of a double slide tuner, a detector which is home-made, an E. I. Co. fixt condenser, and an 85 ohm phone. My second set is composed of an 800 meter loose coupler, fixt condenser, Murdock variable condenser, two loading coils of 5,000 meters each, and a home-made loading coil of 15,000 meters. I also have a home-made Audion panel detector set. Among my electrical apparatus I have a 6-volt magneto and an assortment of switches, lamps, bulbs and nineteen cigar boxes full of "junk."

My transmitting set consists of a Ford spark coil, key, helix and a Leyden jar of one pint capacity. For "juice" I have ten Red Seal dry cells.

My chemical laboratory is built up from fifty-two chemicals, glassware and a zinc aspirator which I use in experimenting with chlorin, etc. I also have a large supply of copper wire, including some small pieces of platinum, German silver wire and nickel wire.

Hanging from the ceiling are two airplanes, one of which is three feet long and another of seven feet long with a wing spread of eight feet. Also a model dirigible which is under course of construction.

The photos of my laboratory shown at the right, do not do it justice, as I have a great deal more material and apparatus than is here visible. I have among other things an excellent collection of text books of electrical and chemical subjects, and find it very interesting to spend my spare moments in trying out new experiments and researches in chemical, electrical and radio work. One of the first things that the average experimenter needs badly is a good collection of tools. These do not have to be expensive tools, but they should be selected when you buy them so as to be of fairly good quality, and also adapted to all of the different work which you can think of. You will also need a good nest of screw drivers, from the smallest to the largest, and from four to eight sizes, form a very good set. In the plier family one will always find use for a liberal assortment.

I also receive regularly an assortment of five magazines among which are the ELECTRICAL EXPERIMENTER (Science and Invention) and *Radio News*.—Edward Slepian, 5007 Sixth Ave., Brooklyn, N. Y.

What To Invent

By JAY G. HOBSON

BOLL WEEVIL ERADICATOR.

TWENTY-EIGHT years ago in the year of 1892, some little fly-like bugs flew over the Rio Grande from Mexico and settled themselves down in the Texas cotton fields nearest the border. For several years thereafter they



Find a Good Means of Destroying the Cotton Boll Weevil, and Reap a Fortune.

were content in raising a few million children on the valued cotton plants, but as their flock of descendants increased faster than even they first dared to anticipate, new and larger fields of cotton became necessary to maintain them, so every year thereafter a few million children moved further North until today they are a very serious pest all over the Southern cotton growing states.

Under favorable conditions it is about one dozen days from egg to mature weevil. In a season, which is about three summer months, one pair of weevils can give birth to over 10,000,000. They can go six months without food if necessary. The weevil is one-fourth inch long and has wings like the familiar house-fly. The female weevil lays eggs in the fruit of the cotton plant. She bores a small hole in the pod or flower of the plant with her nose, then reverses ends and deposits an egg in the hole. This egg hatches into a little worm in about three days. This worm or infant weevil eats the delicate cotton boll, which is not matured, and here is where the great damage to the valuable crop is done.

Millions of dollars worth of cotton is destroyed each year by these parasites, and strange as it may seem, even our greatest scientists have been unable to cope with them. Numerous schemes for their elimination have been offered without success. This year they promise to prove more destructive than ever. Recently the United States Department of Agriculture announced years of experiments have shown that dusting the fields with "calcium arsenate" is the only way to stop the weevil. The Government says that "calcium arsenate" is the only means by which to poison them. However, this preparation is not successful in preventing over ten per cent of the weevils' destruction of the cotton.

Some other plan or device must be forthcoming soon or within a few years cotton growing will be impossible—and this means a calamity.

The peculiar feeding habits of the weevil makes it difficult to reach his vital spot with poisons. The punctures the female weevil makes in the square and boll of the cotton plant to eat the tender tissues therein and to lay eggs, kills the plant.

Because this tender part of the plant is covered with tougher tissues which the weevil don't eat, it is impossible to inject the poison into the pod, or flower, without spoiling the cotton at maturity.

One important thing the Government learned was that the weevil drinks lots of water. Dew drops and other water on the leaves supply his aqua pura. Working with this in mind, scientists began to experiment with spraying poisons in powder form over the plants which would mix with the moistures. When the weevil drank the liquid the poison would kill them. But so far this method has failed to produce the desired result because the poison employed is not the preparation required to eradicate the pest. Some other means must be found very soon to save the cotton.

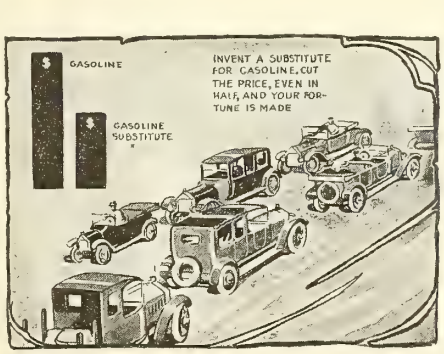
The inventor who can bring forth a reasonable preparation, a plan, a device or process that will eliminate the weevil can soon enjoy world-wide fame and fortune. Most any of the cotton growing states would gladly pay one million dollars for a sure eradication, because many times more than this amount is lost yearly from the ravages of the weevil.

To be sure, it is a tremendous achievement, but I am confident before long some American inventor will solve the problem. It appears to me the logical plan to follow is for some proper chemical, rather than mechanical, as the weevils are not attracted at night by bright lights, like other insects, and they are too small to be caught in a mechanical device, unless it could embrace some preparation sufficiently enticing to draw them to it.

A SUBSTITUTE FOR GASOLINE.

Quoting from the Washington, D. C., *Post*, the importance of a gasoline substitute for automobiles is absolutely necessary if the indispensable power wagon is to be continued. We read as follows:

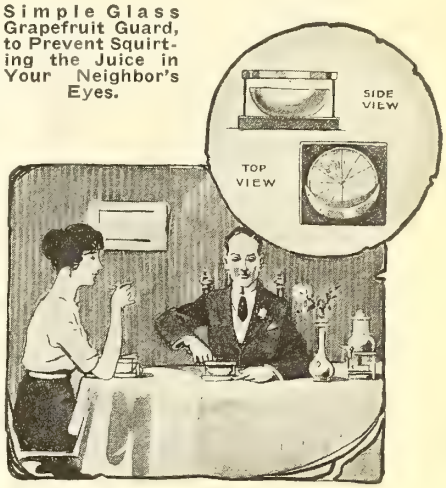
"A substitute for gasoline as a motor fuel obviously must be found, and scientists should be encouraged to work for that end. The public should not be left at the mercy of the oil producers and speculators, nor should it be compelled to pay unreasonable prices for its fuel. Long since the automobile ceased to be a luxury, and past into the necessity class. It now ranks with the telephone in the ordinary affairs of life. Within a few years, if road building continues and if the motor truck becomes the factor in transportation which is predicted for it, the automobile will pass on into a higher class and rank with the railroads as a public utility of vital necessity to the public.



What a Fortune Awaits the Genius Who Gives Us a "Real" and Cheap Gasoline Substitute!

Therefore the high price of gasoline is not merely a question affecting the activities of joy riders. It is a matter of serious concern to the people."

We all can recall several newspaper accounts of discoveries that were going to bring the price of gasoline



Simple Glass Grapefruit Guard, to Prevent Squirting the Juice in Your Neighbor's Eyes.

down to a few cents per gallon, or drive it into oblivion altogether. But King Gasoline is still on deck, more domineering and "exclusive" than ever. No practical substitute has been found, which leaves us exactly where we were years ago, *when eleven cents a gallon for gas was considered high.* Comparing eleven cents then with thirty-five cents now, makes a fellow feel that we did not know when we were well off. But the present high figure is a fact, and not a theory, which brings us face to face with the importance of a gasoline substitute.

Undoubtedly there is a practical substitute for Nature's power-juice. What and Where, of course, is the question, but I am confident it will be found within a few years, for anything under the sun is possible, except perpetual motion, and it wouldn't surprise me to learn that that, too, had appeared.

Down in Texas, where they miss oil sometimes and find gas, there has been developed a practical process of extracting gasoline from natural gas. Known as "casing-head gasoline," gasoline secured from the natural gas as it flows thru the casing or pipe. Evidently some automatic process of liquidation takes place in the gas as it travels thru the metal pipes.

It appears to me feasible to construct a device that will so compress natural and artificial gas that the hydrogen or gasoline liquid contents of same can be collected and stored for use in driving automobiles.

A device in the form of a powerful compressor so constructed that it will take natural gas from the well, turning it into a liquid form to be used as gasoline is used today.

There are millions of automobiles used daily, depending upon gasoline for fuel. This great army of consumers would gladly buy a practical gasoline substitute, and the inventor who succeeds in discovering one that will give satisfaction in power, and cost less, will be handsomely rewarded both with fame and with fortune.

(*Continued on page* 440)

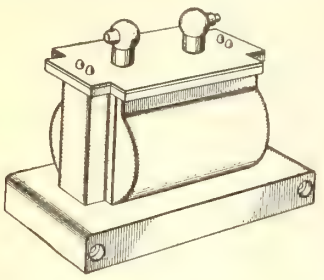
Copyrighted by Jay G. Hobson, 1920.

LATEST PATENTS

X-Ray Transformer.

(No. 1,337,885, issued to William D. Coolidge.)

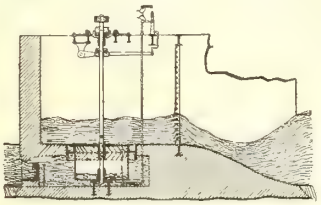
This invention relates to casings for portable transformers which are adapted for use in connection with X-ray work and its specific object is to produce a casing which is small and light having but little internal clearance and hence, follows the form of the core and windings closely. In this manner, but a small quantity of oil is necessary to completely insulate the windings, and keep the transformer cool. The top is made large to provide for ample radiation and the middle of the secondary winding is so arranged so that a milli-ammeter can be inserted in the proper position viz—between the windings.



Wave or Tide Motor.

(No. 1,338,326, issued to Frederick G. Peck.)

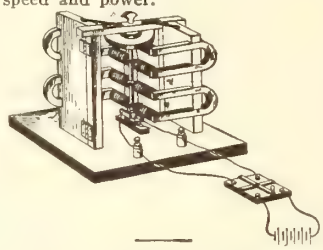
This tide motor is located in a peculiar shaped recess made of concrete so that waves coming toward the shore will be concentrated into a small area. These dash thru flap-gates, making the water within the chamber considerably higher than the surrounding water when, the crest of the wave falls. A very large turbine using but a small head of water is operated by the water thus caught. A novel method of keeping a constant water-head is employed, in that the turbine itself is buoyed up by a large air chamber. Whenever the water rises higher within the confining compartment, the weight upon the turbine becomes greater and immediately the turbine sinks. This actuates a valve-like mechanism which forces air into the buoying chamber raising the turbine back to normal. Should the water-head above fall, another valve allows for the escape of air, lowering the turbine. A basin in back of the chamber takes up the used water.



Electric Motor.

No. 1,337,686, issued to Solomon Boardman.)

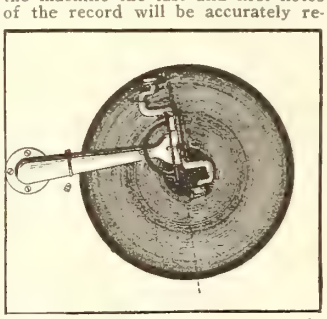
This invention relates to a new type electric motor whereby a regulation as to the speed and power is made by a unique manner. Permanent magnets of the horse-shoe type are mounted upon a frame. In the center part is a series of electro-magnets in an upright position and rotatably mounted in this frame. When current is applied, it enters thru the commutator at the base and energizes the magnets which are so arranged so as to be of alternate polation and cause the motor to rotate by reason of repulsive and attractive effects, between the electro-magnets and the permanent magnets. The latter are mounted upon hinged sections so that the armature can either be approached or receded from, in this way regulating the speed and power.



Repeating Attachment for Talking Machines.

No. 1,339,199, issued to Joseph C. Hitchner.)

This invention consists of a very novel constructural arrangement of two sound reproducing mechanisms attached to one tone-arm and with tripping apparatus which enables the record to be repeated over and over again. A telescopic sleeve to which each tone-arm is mounted allows for the adjustment of one sound box at the start of the record. The other sound box will be placed at the end of the record. When the right-hand tone-arm has completely traveled toward the end of the record, a set of cams and levers are operated which raise the tone-arm, and simultaneously lowering the one at the opposite end and the record continues to play with the other sound box operating. Upon coming back to the original position, the same effect is reproduced. By careful adjustment of the stabilizer on the machine the last and first notes of the record will be accurately re-

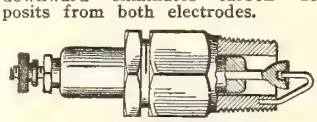


produced in order, one after the other, so that there is apparently no break between the end of the song and its beginning. It can be employed with the hill and dale records and also those having a laterally arranged impression or groove.

Spark Plug.

(No. 1,336,914, issued to Harry J. Munster.)

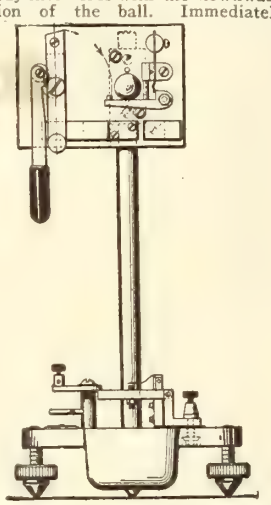
This invention for which a U. S. letters patent has recently been granted has for its principal object, an upper electrode, the terminal of which extends beyond the lower electrode and having a dome-shaped inverted cup arrangement in which a recess is cut. This allows any oil to flow downward without interfering with the spark, at the same time the spark commences in the upper portion of the recess and traveling downward eliminates carbon deposits from both electrodes.



Timing Apparatus.

(No. 1,337,335, issued to Irving B. Smith.)

A very ingenious idea is the subject of a recent patent issued to this Pennsylvanian, which enables accurate analysis of time, either making and breaking a contact or breaking first and making later, in accordance with the binding posts used. It consists of a hammer which is made to rotate rapidly which can be released by a lever-like handle projecting below the upper part of the instrument. In the course of its revolution the hammer strikes upon a pin which releases a metallic ball from a scaffold-like platform. This platform moves away much more rapidly from the descending ball so that it in no way interferes with the downward motion of the ball. Immediately

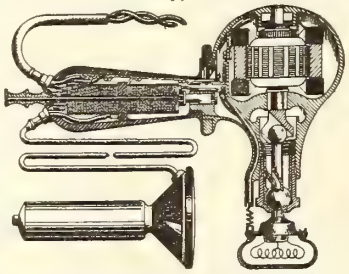


upon release of this platform, contact is made thru an electric circuit or broken just as desired, and when the ball has dropt it again closes the contact thru a tongue-like piece of metal dropping into a trough likewise. This contact at the lower end can be either made or broken in accordance with the binding posts in use and the method desired.

Combination Faradic & Vibratory Massage Implement.

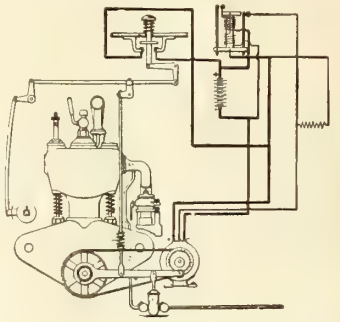
(No. 1,338,020, Issued to Edward Masayoshi Kojima.)

This invention possesses so many novel features, that it promises to be accepted universally as soon as placed on the market. It comprises a vibratory massage apparatus, a means for producing and supplying both heat and light, and also faradic current with the regulations for each. Essentially, it consists of a



motor in the dome shaped portion, into the socket of which is a ball element. This ball actuates the oscillator and can be regulated to give a greater or smaller amount of vibration as desired. A push button in the handle is provided for its operation. The vibrator element itself is an applicator bulb provided with a glass body wherein is embodied the electrode filament which gives both heat and light. The control of the same being obtained thru a set of carbon diaframs or other high resistance discs. The resistance is increased or diminished by varying the pressure upon them. Another set of these discs operates the faradic appliance in regard to increasing or diminishing the current. Both sets of discs are operated by a duplex screw in the handle of the implement.

(No. 1,335,153, issued to William L. Bliss.)

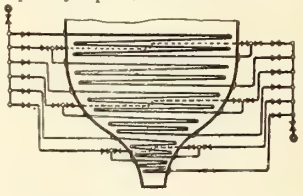


The motor itself has a pulley placed upon its shaft provided with a ratchet like arm acting in this manner as a one-way clutch. Upon the motor another similar ratchet clutch is placed. The shaft is provided at its extremity with an eccentric pulley, and the motor turned over by a ratchet pipe-wrench action. When the gasolene motor is operating as such, it is disengaged from the rocker arm.

Indirect Boiling Apparatus.

(No. 1,337,704, issued to Rolf Harald Hult.)

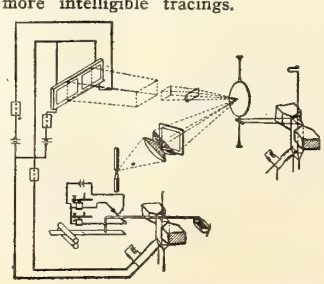
A method whereby steam is conserved in indirect boiling apparata, due to the fact that the pipes can be arranged in either parallel or series; the latter arrangement when the liquid is quite hot. This allows the full energy of the steam to be completely spent.



Telegraphy Amplified.

(No. 1,339,551, issued to Thomas Bullitt-Dixon.)

Heretofore, signals being transmitted across submarine cables have been greatly retarded at the receiving end, and the dots and dashes which are recorded on tape by siphon recorders. The recorders are actuated by sensitive galvanometers which in turn operate the pen, the latter being a siphon tube. The tracing thus produced is a wavy line, on one side of an imaginary center for the dashes and on the other side for the dots. At low speed they are transmitted clearly, but at a higher rate of speed become indistinct. The inventor employs a galvanometer fitted with a mirror. A powerful ray of light is concentrated upon the mirror on the galvanometer. This is caused to oscillate due to electric current fluctuations. Light is then reflected upon selenium or other photo-electric cells and accordingly operates the siphon pen thru relays and the heavier currents now available become an asset in bringing forth better and more intelligible tracings.



Scientific Humor

FIRST PRIZE $3.00

He Could Swim In His Bathing Suit. FIRST OPERATOR TELEGRAPHING—"Can't come down—washout on line."

SECOND OPERATOR, ANSWERING—"Borrow a shirt and come anyway."—*V. J. Sandors.*

Quite So.—TEACHER—"Every day we breathe oxygen. Willie, what do we breathe at night?"

WILLIE—"*Nit*rogen."—*Frank Simpson.*

So That's His "Attraction."—"They say that Paderewski has fascinating manners."

"Yeah, one of those *magnetic Poles,* I s'pose."—*Frank Simpson.*

Some Thinkers Resemble Cuckoos!—When does a hen resemble a thinker?

When she is in earnest.—*Mrs. W. E. Claycomb.*



Easy Pickings.—Seeing an Irish laborer pick up an electric cable, an electrician cautioned him not to handle wires because they might carry a high voltage and kill him.

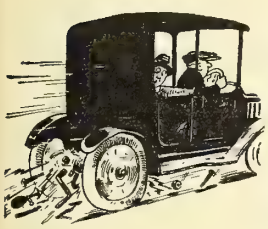
The Irishman replied, "Sure, Oi thought of that, but Oi felt it all over before Oi picked it up!"—*Clarence A. June.*

How Many Revolutions Per Minute?—From an engineering standpoint, Mexico seems to be the greatest country in the world, for there, they get the maximum number of *revolutions* with the minimum amount of *power.—Thomas L. Barker.*

"Within The Law."—SON—"Say, pop, what is Newton's law of gravitation?"

POP—"It is—let's see. Hem! Newton's law of gravitation is—What is it now? (Suddenly relieved) That's a foolish question, son. There's no such thing anymore since Professor Einstein's discovery.

—*Loyd Hutchens.*



A True Genius.—"That man is one of our great inventive geniuses."

"How's that?"

"He magnetizes the rear axle of his Ford so he can pick up the parts as they drop off."—*Leonard E. Himler, Jr.*

The Plate Was "Over-Developed."—WATT—"How was that snapshot of Mabel in her bathing suit?"

KNOT—"Not good."

WATT—"What was the matter?"

KNOT—"Too much exposure."—*Earl Keiser.*

And Both "Charge" You Plenty!—"What is the difference between an electrician and a huckster?"

"One *produces Storage Cells,* and the other *sells Storage Produce.*"—*Geo. M. Harrer.*

An Alarming Situation.—JONES—"Did your Electric Burglar Alarm prove its worth?"

SMITH—"I suppose so. It was stolen the first night I tried it out!"—*L. Snipes.*



Bought It C. O. D. (Current Oozed Down).—IRATE CUSTOMER—"I just bought this battery and I can't get any current out of it."

SALESMAN—"Did you have it charged?"

I. C.—"No, I paid cash for it!"—*V. H. Todd.*

Is This a "Phoney" Patent.—BELL—"I am going to invest some money in the new automatic telephone."

CELL—"What! In such a phoney proposition."—*George Spector.*

No, They "Rubber" Too Much!—SON—"Papa, we get electric current from city electric plants; why is it we cannot get electricity from rubber plants?"

PAPA—"Because they are insulators, my son!"—*H. W. Roces.*

ALL jokes accepted and publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

Must Have Been Deli-Kate!

There lived an unhappy lass,
Her tragic name was Kate,
She drank an ounce of water glass,
Oh, wasn't that a *silicate?*

—*J. M. Kindall.*

Of Interest to Ladies.—NERVOUS OLD LADY—"Constable, is it dangerous to put my foot on the trolley car rail?"

P. C. MURPHY—"No, mum; not widout ye put yer other fut on the overhead woire."

—*R. Peaker.*

How Impo-Light.—INQUISITIVE CUSTOMER—"What kind of lights do you use in this store?

"Three kinds, Madam; electric lights, gas lights, and israelites," replied the little Hebrew clerk in his most suave manner.—*J. W. Schoonmaker.*



Wives—Take Notice.—DOCTOR—"You said you were hit with a flatiron. You do seem to be suffering from shock."

PATIENT—"Yes; it was an *electric iron!*"

S. S. Medeiros.

Shake Before Taking!—TOMMY TO AVIATOR—"What is the most deadly poison known?"

AVIATOR—"Aviation Poison."

TOMMY—"How much does it take to kill a person?"

AVIATOR—"One drop!"—*Ronald Merritt.*

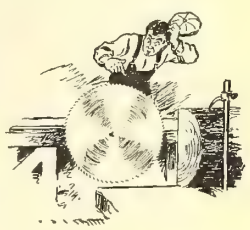
He Never "Misses" Evidently.—SPARK—"How is your boss now?"

PLUG—"He is still firing."—*R. I. Pernell.*

Electric Shops Will Take Notice.—Now that we have prohibition, no doubt we shall have to use only *"dry"* batteries.—

—*John Dowden.*

Convincing.—A sign posted up in a Wisconsin saw mill, reads: "The saws *are* running—no use to touch them to convince yourself."—*A. R. Albro.*



Some Nerve.—DOCTOR—"You are suffering from nerve exhaustion, and I can cure you by electric treatment for the small sum of $200.

PATIENT—"And then will my nerve be as good as yours?"—*Rose Harris.*

He Needs An Electrician.—"I've been reading an article on electricity, William," said his wife, as she laid down the technical magazine, "and it appears that before long we shall get pretty near everything we want by just touching a button."

"It will not pay here!" said friend husband. "You will never be able to get anything that way."

"Why not, William?"

"Because nothing would ever make you touch a button. *Look at my shirt."—Frank Becker.*

Maybe He Needed a Cleaning.—"Mrs. Gadlots is terribly upset over the loss of her pet poodle."



"Yes, it was very sad. After they had hunted for him all day, they found that one of the maids had accidentally pick him up with the vacuum cleaner."—*C. A. Butterworth.*

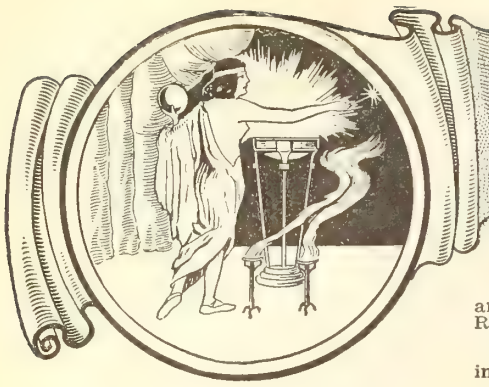
Not As Advertised.—YOUNG MAN ON TELEPHONE—"Hello, is this the weather bureau? How about that shower tonight?"

WEATHER BUREAU—"Don't ask us. If you need one, take it.—*Henry F. Robbins.*

A "Hot" One.—PROFESSOR—"Name one of the tropics."

PUPIL—"Can't, sir!"

PROFESSOR—"That's right. Tropic of Cancer."—*V. K. French.*



THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

MONEL METAL FOR BOAT HULLS.

(1052) John Smith, New York, N. Y., inquires:

Q. 1. The writer has been much interested in some recent reports on monel metal, and if he recollects correctly, it was used in building a large yacht, the *"Sea Call,"* a 214 foot craft, several years ago, which, soon after it was built, disintegrated. Can you tell me anything about this?

A. 1. You are correct, and the palatial yacht, the *Sea Call,* was built almost entirely of monel metal placed on the hull, below the water line. The idea of the owner and builders in employing monel metal in constructing this boat, was that the well-known resistance of the metal to corrosion would protect against the fouling of the hull by marine growths.

Monel metal, is as you probably know, about 68 per cent nickel and 32 per cent copper, and was invented by Ambrose Monell.

Three months after the yacht had been launched, she was taken from the water and broken up for scrap—the builders and owner having apparently decided that the monel metal had proven a failure owing to the fact that the steel parts of the boat which had been in connection with the monel metal, had been so severely corroded by electro-galvanic action that they were practically destroyed. This is now thought to have been an erroneous conclusion, and that it was not the fault of the monel metal that the vessel disintegrated so quickly, but that the blame for the disintegration of the yacht, should have been placed on the manner of construction and the arrangement of the various metals used.

The action was electrolytic, and the most severe corrosion took place on the thin steel rib which formed the outer frame of the rudder, and also on the steel stem of the vessel. The monel metal plates themselves, showed not the slightest evidence of corrosion in any way, as a report in *Engineering News* at the time, showed.

Before this craft was built of the monel metal plates, extensive experiments were carried on with sensitive electrical meters and various metal plates such as steel, etc., placed in proximity to monel metal plates, but no electrical activity worth mentioning, was noted; it was therefore considered safe to proceed with the building of the vessel.

It is now thought that the engineers were fooled eventually, owing to the fact that the vessel was of entirely different shape and of much larger submerged area than any of the small metal pieces tested in salt water at the ship yard before starting to build the boat; and also because the area of monel metal exposed to the sea water on the hull of the vessel was so very large in comparison to the area of steel exposed, which caused the corrosion of the steel to be concentrated and greatly intensified.

It seems indeed strange that some such action should not have been foreseen in view of the large amount of experience on record as to the effect of galvanic action between steel and some of the copper alloys when immersed in sea water. Monel metal, we are informed, is almost identical with manganese bronze in its electrical relation to steel when connected as a galvanic couple. In ships which use manganese-bronze propellers it has become common practise to attach plates of zinc to the hull. As the zinc is more electro-positive than the steel, the corrosion due to the galvanic action with the manganese-bronze propeller is concentrated upon the zinc and the steel is protected.

WANTED!!!

"ODD PHOTOS" AT $1.00 EACH

Here's what we want! What have you got?

ELECTRICAL PHOTOS—
New photos of Lightning; new and unusual Electrical Apparatus and Machinery; Electric Signs; Electric Autos; Electric Clocks.

SCIENTIFIC PHOTOS—
New Scientific Apparatus; Results; Effects; Motion Pictures; Stunts.

OPTICAL PHOTOS—
Peculiar stunts obtained with various lens arrangements; odd film effects caused by unusual conditions; novel micro-photographic subjects.

ASTRONOMICAL PHOTOS—
New eclipse photos; star and moon effects caught by the camera; comets; shooting stars; progressive moon studies.

FREAK PHOTOS—
Odd double and triple exposure effects; novel and striking effects due to unusual exposures.

MECHANICAL PHOTOS—
Electrical and Mechanical apparatus of unusual news interest.

RADIO PHOTOS—
New stations, both commercial, government, and private. Owners of private or amateur stations will find a special contest for these photos on another page of this issue. And don't send us plate or film "negatives"; send unmounted or mounted "prints" preferably a light and dark one. Enclose stamps if photos are to be returned.

Address photos to—Editor "Odd Photos", Science & Invention, 233 Fulton Street, New York City.

THERMO-ELECTRIC EFFECTS.

(1053) Edward O'Connell, Philadelphia, Pa., writes:

Q. 1. Asking about various thermo-electric effects.

A. 1. So far, it is yet not quite determined as to what really causes the Thermo-electric effect when two dissimilar materials are connected together.

The Thermo-electric series is as follows and any of the materials will be positive toward those after it in the following table:

Bismuth, Nickel, German Silver, Lead Platinum, Copper, Zinc, Iron, Antimony, Tellurium, Selenium.

Powerful Thermo-electric batteries have been made by Clamond, Noe, and others. Such batteries actuated by a large furnace were extremely difficult to maintain in constant operation, owing perhaps to a permanent molecular change at the junctions.

You can purchase these materials from any large chemical supply house.

GOOD TO LEAVE HIGH SCHOOL FOR COLLEGE?

(1054) Harry Batastini, Brookville, Pa., writes:

Q. 1. I am a reader of the ELECTRICAL EXPERIMENTER and needless to say it is a "great" magazine.

The purpose of this letter is to ask advice. I am a student in a local High School and have three more years before I graduate, and I would like to know if it would be advisable for me to drop my High School work and take up a course in electrical engineering in a school in Washington, D. C. Of course, it would be better to finish my High School course and then take up engineering, but that is where the hitch comes in, if I finish my course in High School I am not certain of being able to attend an engineering school for financial reasons, but if I take up engineering now I am sure of seeing my course (in engineering) thru.

A. I. We have carefully considered your query, and to begin with, we would not care to say one way or the other, whether or not it would be preferable for you to continue with your High School work before taking up electrical engineering in the Washington school, as you suggest; or to stop your High School work now and at once take up the electrical engineering course.

Speaking from personal experience and observation, the editor of this column would, he thinks, prefer to give up the High School and at once take up the electrical engineering course, provided you pass the entrance examinations for the latter course.

It might be that you would have to work quite hard or even go so far as to hire a tutor to brush you up a little on mathematics, etc., so that you could take the examinations for entering the electrical engineering course, but under the circumstances which you describe, it would seem a feasible policy to do this. However, it is of course, up to you in the final analysis.



Which would you rather carry?

IT'S no trouble to carry a can of **Johnson's Radiator Cement** in your car and it may save you a very unpleasant experience on the road. JOHNSON'S RADIATOR CEMENT is the easiest and quickest way to repair leaks in radiators, pumps, water jackets, hose connections, etc. It will stop leaks immediately without laying up the car. It requires no experience to use this product—all you have to do is remove the cap and pour **Johnson's Radiator Cement** into the radiator.

JOHNSON'S Car Savers

Start today to reduce the depreciation of your automobile. An hour or two a month and JOHNSON'S CAR SAVERS will do the trick. There's a JOHNSON CAR SAVER for every purpose. No experience is necessary for their use—they can all be applied by the average motorist with perfect results.

Johnson's Carbon Remover—use it every 500 miles as a carbon preventative. You can easily do it yourself in ten minutes—without even soiling your hands—and the cost is trifling. Half-pints—75c in U. S. East of Rockies.

Johnson's Stop Squeak Oil—penetrates between the spring leaves thoroughly lubricating them. Half-pints—35c in U. S. East of Rockies.

Johnson's Auto-Lak—an automobile body varnish that amateurs can use successfully. You can finish your car one day and drive it the next. Pints—$1.00 in U. S. East of Rockies.

Johnson's Black-Lac—the perfect top dressing. Easy to apply—dries in fifteen minutes—is permanent, water-proof and inexpensive. Half-pints—75c in U. S. East of Rockies.

Johnson's Cleaner—for body, hood and fenders. Removes stains, road oil, grease and body scratches. ½ lb. cans—45c in U. S. East of Rockies.

Johnson's Prepared Wax Liquid—the dustless automobile polish. Sheds water like a duck's back. Half-pints—50c in U. S. East of Rockies.

Write for our folder on Keeping Cars Young—it's free.

S. C. JOHNSON & SON *Dept. E. E. 8* **Racine, Wisconsin, U. S. A.**

Canadian Branch—Brantford, Ont.

BE AN EXPERT



Auto and Tractor Mechanic Earn $100 to $400 a Month

Young man, are you mechanically inclined? Come to the Sweeney School. Learn to be an expert. I teach with tools not books. Do the work yourself, that's the secret of the

SWEENEY SYSTEM

of practical training by which 5,000 soldiers were trained for U. S. Government and over 20,000 expert mechanics. Learn in a few weeks; no previous experience necessary.

FREE Write today for illustrated free catalog showing hundreds of pictures men working in new Million Dollar Trade School.

LEARN A TRADE

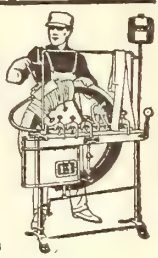
Sweeney

SCHOOL OF AUTO-TRACTOR-AVIATION
66 SWEENEY BLDG. KANSAS CITY, MO.

AN EASY WAY TO MAKE MONEY Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $600 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

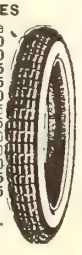
"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2207 Fourth St. Waupun, Wisconsin

STANDARD MAKE TIRES

DEMONSTRATING TIRES AT GREATLY REDUCED PRICES

Size	Price	Guaran. Tube
30x3	$5.50	$1.90
30x3½	6.75	2.00
32x3½	7.00	2.25
31x4	8.50	2.75
32x4	10.00	3.00
33x4	11.00	3.35
34x4	12.00	3.55
34x4½	13.50	3.90
35x4½	16.75	4.50
36x4½	18.00	4.50
37x4½	18.50	4.75
37x5	18.50	5.25



Specify Straight Side or Clincher.
Send $2.00 deposit. Balance upon examination. 5% discount if fully paid.

FULTON TIRE CO., Dept. 44
1518 S. Michigan Avenue Chicago, Ill.

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. Guarantee Bond for 8000 Miles. (No seconds). Shipped prepaid on approval. Sample sections furnished. Donot buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.
901 Oak St. Kansas City, Mo.

Learn Autos and Tractors



Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O.

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 769 Bogue Bldg., Indianapolis

Man-Made Rubies

By O. IVAN LEE, B. Sc.

(*Continued from page* 359)

periodically taps on this magazine and jars a little powder into the oxygen stream. Beneath the flame of the blow-pipe is fixt an upright rod or candle of incombustible material. At first, the flame is not hot enough to thoroly fuse the oxid but just enough to make it sticky. Consequently, the powder gradually builds up a little cone of rather porous aluminum oxid. When a suitable base has thus been provided, the heat is increased by adjusting the gas supply until the tip of the cone fuses to an incipient head. Now the flame is made yet more intense and it "mushrooms" out and envelops the top of the *pear, boule* or *brut* as it is called. Tiny molten droplets of aluminum oxid brought to the fluid state by their passage thru the fiery zone above spatter on the top of the pear, literally plastered by the force of the blast, and gradually increase its size to almost any that may be desired.

When hot, this *boule* is clear and free from flaws; but on cooling, it cracks down the center by reason of an internal strain similar to that which resides in the well known Prince Rupert drops. Indeed, the early rubies made by this method on a wide base, had a disconcerting habit of breaking into a multitude of particles, but those formed as described on a narrow neck, simply split in two, each half then being used by the cutter.

The aluminum oxid may be prepared from ammonium alum. This is dissolved in water and ammonia added, producing a gelatinous white precipitate of aluminum hydroxid which is washed repeatedly by decantation. On ignition, this substance loses water and becomes pure aluminum oxid which is ground and sifted. In practise, the materials used must be of great purity for the merest trace of certain substances will ruin the color and transparency of the gems, the white saffire being particularly sensitive.

If it is desired to make a ruby red, a very small percentage of chromic oxid is introduced by mixing a bit of chrome alum (those violet crystals which deposit in old bichromate plunge batteries) with the ammonium alum solution. If a blue saffire is wanted, a little iron and titanium in the correct proportion will duplicate the color of transparent blue corundum exactly, and other tints and colors may be produced by adding traces of other metals. Incidentally, it is interesting to note that it took a year of very patient, painstaking and expensive research to find out *just what makes a saffire blue!*

Since the raw materials are very cheap, labor and overhead are the chief items of expense in a "Ruby Factory." The cutting, too, requires great skill and experience, but notwithstanding, genuine synthetic rubies may be had *for less than ten dollars a carat.*

SYNTHETIC RUBY AT $10.00 A CARAT—RIVALS NATURAL STONE.

So far as the physical and chemical properties go, synthetic rubies are identical in every respect with the gems obtained from mines. They are as much alike as artificial (synthetic) ice and that taken from frozen ponds. They are composed of the same material, owe their colors to the same impurities, are of equal hardness, and have the same optical properties, such as refraction. Under a high-power microscope, however, the minute flaws of a natural ruby are seen to have flat sides, while those of the synthetic stone are rounded; also, the flaws of the mined stone are arranged in parallel plane layers, those of the synthetic stone lie along slightly curved layers like those of an onion. These differences are very slight and cannot be infallibly detected even by experts, so that practically speaking, the differences between the product wrought thru eons of time in the underground laboratory of Dame Nature and that evolved in a few minutes by the skill of the chemist, are negligible. It is only a question of decades when he will also manufacture diamonds commercially. He has already produced minute ones, but like the first synthetic rubies, they were useless to the lapidary. One wonders, tho, if the discoverer of a feasible process will possess a dangerous secret; and if people will prize diamonds so highly *when they are retailing for five dollars a carat!*

Book Review.

SCHOOL OF PRACTICAL ELECTRICITY—BOOK I. Fundamentals of Electricity and Wiring. Fully illustrated. Cloth covers, size 7 by 10 inches. Publisht by School of Engineering of Milwaukee, Milwaukee, Wis.

Of recognized aid in the teaching of the fundamentals of electricity and wiring is Book I of the text book series "School of Practical Electricity." Written by Oscar Werwath, E.E. President of the School of Engineering of Milwaukee in collaboration with several members of the faculty of that school.

Dry technicalities are avoided but the subject matter is presented in an interesting way that permits the student to firmly grip and retain what he reads.

Profusely illustrated not only with diagrams but interesting halftones, the book contains in the short space of 60 pages all the essentials and fundamental principles of electricity.

Installation of bells and annunciators with their respective circuits, the telegraph system and the use of various codes, sources of current and the types of connections and circuits, as well as the historical aspect of electricity are logically and exhaustively treated. The telephone system is thoroly explained covering the elements of the telephone set, such as transmitter, hook and receiver, and many laboratory experiments are given. Of much importance to the practising electrician as well as to the electrical student are the definitions of electrical terms, examples of estimates and contracts and a series of "don'ts" to be observed in installations of all kinds. The contents of the tool kit and points on electrical workmanship are also described. As a manual for the electrical laboratory the book is also of value on account of the wide variety of experiments outlined.

DYKE'S AUTOMOBILE ENCYCLOPEDIA. By A. L. Dyke, E.E. Tenth edition. 960 pages, 3,362 illustrations, 6,000 lines of index. Publisht by the author, St. Louis, Mo.

This remarkable book has again been revised and greatly improved. It could appropriately be termed a "Repairman's Guide." In addition to its mass of information on automobiles, covering every detail from the construction and repair of the axle to the repair of radiator and top, many new subjects have been added. For instance, how to make electric tests of the starting motor, generator, battery, coils, magnetos, etc. In fact, the subjects are dealt with in such a simplified manner that one can almost understand by a mere glance at the numerous illustrations.

The storage battery subject is profusely illustrated, and anyone who can read plain English can soon learn how to diagnose trouble, disassemble, repair, assemble and recharge batteries. A feature of this instruction is a simplified explanation of the "Cadmium Test" of a storage battery. One naturally thinks of a very technical and complicated subject, but after reading this subject and a glance at the numerous illustrations the 'tech" part becomes perfectly clear.

The tire subject is very interesting. One learns the difference between the "molded" tire and "wrapped tread" tire. The difference between the "fabric" tire and the "cord" tire and the advantage and disadvantage of each. Such subjects as blow-outs, stone bruises, loose treads, etc., are thoroly treated with an explanation of the cause and how to repair.

Water--The Elixir of Life

By WILLIAM M. BUTTERFIELD

(*Continued from page* 370)

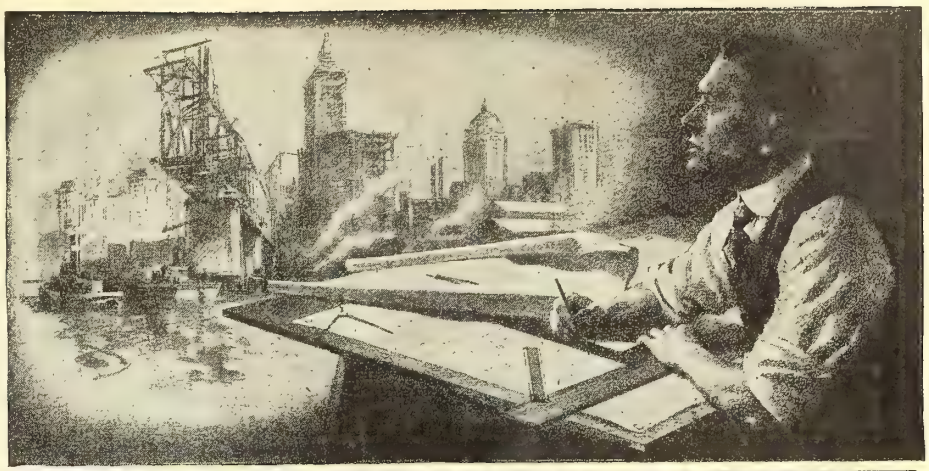
is made possible by the amount of moisture each has absorbed from the air. The average percentage of water in animals—man included—is about 80, and in vegetables over 90, thus giving a very large predominance of the liquid over what is known as the body or solid part.

The atmosphere, or air a man breathes, is also saturated with water in variable degrees, the dryest being composed of 4/10,000 part of this fluid. It is for this reason that no object exposed to the air is entirely free from it. The stick he carries, his hat, gloves, tie, handkerchief, shoes and clothing are liberally irrigated. Every conceivable thing that surrounds him at home or in his office; even his watch, scarf-pin, ring, quarters and half-dollars are saturated with water as surely as his body. Geologists tell us it forms ¾ of the earth's surface in the form of oceans, lakes and rivers; forms 1/3 of the soil, and penetrates into every crevice and invisible opening in the rocks and minerals. We see, after a little consideration, that water is a very vital substance to man, to the vegetable and animal kingdoms and to the world they live upon.

It is not vital because it forms nearly 80 per cent. of the materials on the earth's surface, but really because it alone makes possible that unknown something called "Life." First, water in some one of its three forms (solid, liquid or gaseous) makes the blue in our atmosphere, the clouds, fog, dew, rain, snow and ice. Deposited in the form of rain, snow or ice at the tops of lofty mountains, it causes by its presence extreme contraction in the rocks, thus causing them to break into particles, many of which, each time this breaking action is repeated, are seized to be quickly pushed or carried away by the water, as it forms into streams and rivers, to the lakes or oceans. Here the particles are subjected to the action of the waves and ultimately rounded into boulders, gravel, sand and finally into the kind of particles that form the soil. The enormous quantities of water upon the earth undergoing changes of this nature cause an increase or a lowering of temperature, thus expanding or contracting the atmosphere. This action produces the winds which in time operate the waves. In fact, water is wholly responsible for those changing conditions which we call "weather."

Water never occurs absolutely pure, for it is our most efficient solvent and contains in solution, more or less of the constituents of the strata thru which it has past. For instance, rain water, the purest known natural water, after passing thru the atmosphere contains such substances as ammonia, nitrate of ammonia, carbonic acid, and nitrous and sulfurous acids. Spring water, or that from hydrants, always contains a larger percentage of dissolved substances than rain water.

Water is the common carrier of Creation. It dissolves the elements of the soil, and, laden with them, climbs as sap thru the cells and capillaries of every individual plant, thus conveying the substances of rivers, lakes, and oceans. It also forms one-third of the soil; fills to some extent every opening and tiny crevice in the rocks and minerals; it occurs in combination with many mineral substances; forms from 80 to 90 per cent. of all organic bodies, such as animals and plants; and is the most efficient of all solvents, few substances not being to some extent affected by it. It is because of this that it never occurs absolutely pure, but contains in solution, more or less of the constituents of the strata thru which it has past.



Learn Draftsmanship

Send Coupon Now

A great profession is open to you. No matter where you live or what you are doing, you can become a master draftsman by spare time study at home. Send the coupon below and get information about this. Learn how other men have risen to big jobs and large salaries through the same Chicago "Tech" courses that you can take. You get the free lesson and catalog which explains everything—just for the asking. Send now—today.

Big Demand for Trained Men

Not enough draftsmen to go around—is the cry of thousands of employers. Construction work all over the country, postponed during the war, must now be done. Expanding businesses need draftsmen. Factories, architects, electrical plants, contractors, sheet metal works, map publishers, engineering concerns are all searching for trained men. This is your chance. Take advantage of the advantageous conditions. Learn draftsmanship.

$60 to $150 a Week

The demand for trained draftsmen has pushed the salaries up. And You can not only start at good pay but you can be in line for quick advancement to engineer, superintendent, manager. Why stay in any small pay job when you can make yourself worth $60 to $150 a week?

Learn at Home

If you can't come to Chicago to attend the college, you can get the same training at home by mail, under the same experts who would teach you here. By the Chicago "Tech" method you are trained by practical men who instruct you in exactly the methods that they themselves use on important work. They teach you to deal with the same kind of problems that are handled daily in great manufacturing plants, engineering, railroad and architects' offices and other places where technical work is done. They give you the very knowledge that is required in men who are to hold the responsible positions.

The instruction by mail is just as individual as in the class room. Every lesson is directed and every exercise examined and corrected by members of our faculty who make every point clear to you. This is the kind of training that makes you worth a large salary because you can go on to a job familiar with the requirements. And now you can get this practical knowledge thoroughly, completely in your spare time at home.

FREE TEST LESSON



This free test lesson will show you how well qualified you are for Draftsmanship and how practical the Chicago "Tech" courses are. While other schools ask you to enroll and send money first, we send the free lesson first. The only offer of its kind. Read the lesson, practice the exercises and then decide for yourself whether to take the course or not. No obligation on you for asking for this.

Drawing Outfit—No Extra Charge

FREE outfit is included with our Home Study course or credit given if you already have an outfit. These are high grade instruments, drawing board, T square, etc.—same as used by leading draftsmen.

Other Paying Courses

If you want to take up any other technical study, the coupon gives you a list of our courses. Mark the one you want information on and we will send catalogs. All Chicago "Tech" instruction is given by experts in each particular branch.

SEND Big jobs are waiting. You can make more money if you train for it, and Chicago "Tech" training puts you in the high salaried class. It makes you thorough—self confident—expert. Which course are you interested in? Mail the coupon.

Chicago Technical College
845 Chicago "Tech" Bldg.
Chicago, Ill.

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked X below:

[ ] Architectural Drafting	[ ] Auto. Engineering
[ ] Machine Drafting	[ ] Aero. Engineering
[ ] Electrical Drafting	[ ] Gas Engines
[ ] Structural Drafting	[ ] Plan Reading—Buildings
[ ] Sheet Metal Drafting	[ ] Estimating—Buildings
[ ] Topographic Drafting	[ ] Plan Reading—Machinery
[ ] Surveying	[ ] Plumbing—Estimating, etc.
[ ] Designing	[ ] Heating & Ventilating
[ ] Contracting—Buildings	[ ] Steam Engineering

Name.....

Address.....

Post Office..... State.....

Free Trial Lesson included when inquiry is for Draftsmanship or Plan Reading.



The Electric Safety razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."
A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.
Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

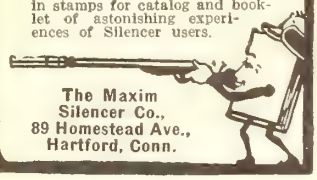
VIBRATING ELECTRIC RAZOR CO.
729-31 West Broadway, Council Bluffs, Iowa

Shoot Without Noise

Avoid disturbance, also flinching. Enjoy quiet shooting, anywhere, anytime. Use a

MAXIM SILENCER

Price, .22 cal. $7.00. Send 6c in stamps for catalog and booklet of astonishing experiences of Silencer users.



The Maxim Silencer Co.,
89 Homestead Ave.,
Hartford, Conn.



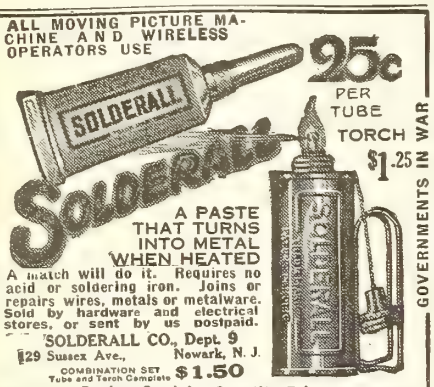
VEST POCKET BLOW TORCH $1

The handiest tool on the market. The most business-like little thing you ever saw. Instant intensive heat. Sootless flame. Useful for

**Electricians,
Machinists,
Automobilists,
Vocational Schools,
Home Tinkering.**

REO SPECIALTY CO.
**6381 Woodbine Avenue
Philadelphia, Pa.**

ALL MOVING PICTURE MACHINE AND WIRELESS OPERATORS USE



25c PER TUBE

TORCH **$1.25**

A PASTE THAT TURNS INTO METAL WHEN HEATED

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. 9
129 Sussex Ave., Newark, N. J.

COMBINATION SET Tube and Torch Complete **$1.50**

Dealers Send for Quantity Prices.

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR

You Can Save $50.00



$8.93 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

In the human body, water flows as blood or other fluids to every part of the system, also building or repairing with its solutions the "house we live in." It changes the common air that we breathe, and in its way tempers the gases of the atmosphere to our needs, whereas these gases without it would destroy us.

It is because of these combinations and their chemical action that men exhale carbonic anhydride in breathing, an animal-made gas when mixed with the atmosphere absolutely necessary to the growth and life of plants. While, on the other hand, the plants are caused by similar chemical action to throw off oxygen, without which man or any other animal, would cease to live. Water, therefore, is the medium that conveys the solid parts, in the form of solutions to the plant and animal; causes these solutions to combine and harden thru laws that are common with dissolved substances; and aids the living organism to function by aid of these natural chemical changes.

When spring water is highly charged with saline or gaseous constituents, so as to have a peculiar taste or smell, it is called mineral-water. Whether these mineral solutions are formed by natural or artificial means, they are said to have beneficial or harmful properties if used as beverages. For this reason the resorts we have named, and many natural or artificial waters are made profitable investments, the desire of mankind to obtain a "water-cure" never at any time ceasing. The fountain of youth is supposed to be a kind of supreme, or shall we call it "super-natural" water-cure. Yet it is a dangerous experiment to drink any of these super-charged waters, unless they have proven beneficial as a common beverage to large numbers of people for long periods of time, advertisements and doctors' prescriptions to the contrary notwithstanding.

As an illustration, sea-water is essentially a mineral-water and contains in solution almost every mineral substance; its saline constituents in the free ocean is about one ounce to the pound, and it is probably slowly increasing thru evaporation, yet innumerable forms of plant and animal life thrive in and upon it. Fresh water plants and animals, of which man is one, cannot exist if compelled to use it in their bodies. If it becomes charged to one-third or more of its whole weight, with saline matter, like the great Salt Lake in Utah, it becomes impossible for even the sea-water forms to live in it. On a large scale, this shows the harmful results to organic life when water not suited to each individual's requirement is used.

The real fountain of youth is found in any locality where its drinking water agrees with the physical requirements of its population as a whole. The water supply of the City of New York is likely to perform more miracles of rejuvenation and health building, if properly used, than all the health resorts or patent mineral-water concoctions imbibed while taking a "cure." The way to obtain lasting and invigorating results at this time is to exercise and feed the body in such a manner as to supply the necessary natural stimulas for a proper circulation thru the system; then, if the water contains the constituents required, perfect results will be obtained.

First Electric Welded Building

By H. B. PAYNE

(*Continued from page* 362)

The trusses were left under load forty-eight hours and readings taken showed—East support settled 15/16 inch, west support, ¾ inch, actual. Two days afterward the load was entirely removed and readings taken at this time showed all points in the trusses had returned to their original position, leaving no permanent deflection except at point No. 3 of 1/16 inch. To quote from the official report:

"From the above it is evident that electric welding is a dependable method of uniting structural members *and is stiffer than riveting, if the work is properly performed.*"

It is particularly interesting to note that this test was actually carried to the limit of elasticity of the metal used. There is no doubt that this successful demonstration will do much to further the use of electric welding in steel construction work. The many specific advantages are too important to be disregarded by engineers and contractors, particularly in these days when there is a vital demand for increased housing facilities for homes as well as for industries. It would seem almost axiomatic to say that electric arc welding is going to make substantial progress in displacing riveting in the structural steel field.

The mere fact that this test was witnest by members for all building departments in Greater New York, and as a result a permit was issued for the erection of the building, the first of its kind, should be sufficiently convincing to the skeptical, that electric welding as a means of construction is not an unknown quantity but is a certainty.

Generally speaking, electric welding can be used in all parts of steel structures. Electric welding eliminates the use of bolts, rivets and gusset plates, and in some cases connection angles and brackets.

ELECTRIC WELDING CHEAPER THAN RIVETING

Comparative figures for an estimated construction cost of a steel barge measuring 166 feet in length by 39 feet in width, by 8 feet 8 inches in depth, were made recently. The figures were based on 1917 wage rates and material prices, but of course approximately the same *ratio* between riveting and electric welding of such vessels would hold with the present labor and material prices, altho these are higher.

Figuring on the construction of the above-size steel barges, we find that for a total production cost of about $11,500 for the riveted and welded types, that with the *electric welded* type there is shown a profit of nearly $2,000, or to be exact—$1,838. On this construction cost of $11,500 there is no profit left with the riveted design. The riveted design is much more expensive, almost double in some instances, when it comes to the various details of the construction work, such as, for example, the erection and assembling—this item amounting to nearly twice as much for the riveted design as for the electrically welded barge. The chipping and caulking amounts to twice as much for the riveted design as for the electrically welded barge. The item of rivets costs $780 alone, while the punching and shearing costs amount to twice as much for the riveted design as for the electrically welded type.

In other words, unbelievable as it may seem to those familiar with the regular riveted steel structures, on this particular job—amounting to $11,500 on an estimated budget—you can have your choice of *riveting* the ship with *no* profit; or *electrically welding* it and having a profit of nearly $2,000, or 16 per cent.

Popular Astronomy

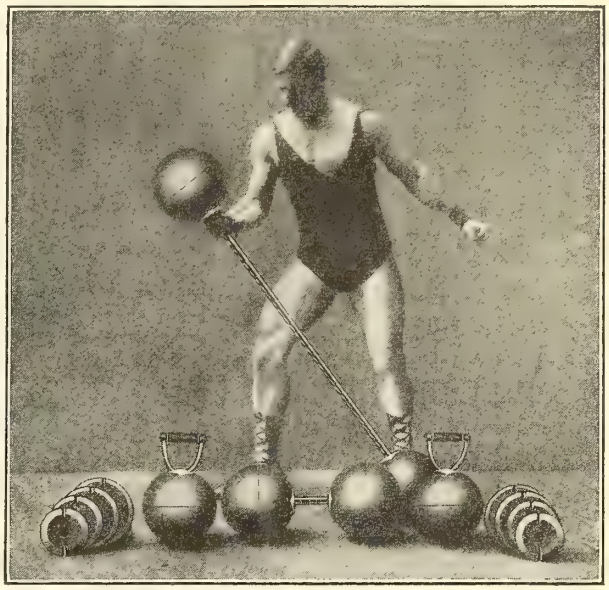
By ISABEL M. LEWIS, M.A.

(*Continued from page* 391)

the ruling sun, the secondary sun would be visible at one time by day and again by night. If, as is frequently the case, the two suns are of contrasting hues, as, for instance, green and red, there might appear in the nearby heavens at a distance of one hundred million miles or so a magnificent sun of deep reddish hue, equal to or surpassing our own in splendor, while in a far distant part of the sky, at a distance as great as lies between us and the planet Saturn, might appear a rival sun of greenish hue, smaller and fainter, but nevertheless, hot and brilliant and capable of exerting thru its great gravitational power a most disturbing effect upon the motion of the planet of its neighbor. At times the rays of the two suns, *red and green,* would combine to produce a day characterized by terrific heat and intense illumination. Again the green orb would rise in the east as the red sun set in the west and night would be turned into a weird, dimly-lighted day by the greenish rays of the secondary sun. Compared to the wonders and beauties of the heavens in such a system, our own well-regulated and orderly planet family, undisturbed by the exciting proximity of a rival sun, might seem to pale into insignificance. Yet we have every good reason to be content with the ordering of affairs within our own solar system, and to feel relief rather than regret at the absence of a secondary sun. In a planet world revolving about one member of a double star system, we can well imagine the dread rather than pleasure with which the periodic near-approach of a rival sun would be hailed, and even the possible hurried migration from exposed to sheltered portions of the planetary world to escape the rapidly increasing heat and intensity of light from the approaching sun. In such systems of suns the coming and going of the seasons might well be a matter of life and death to the inhabitants of satellite worlds, while to keep track of the perturbations and tidal disturbances produced by the nearness of such a powerfully attractive mass as a secondary sun, would drive the astronomers of such a planet world to distraction, unless they were more successful than ourselves in mastering the intricacies of that most distressing mathematical problem of the motion of three bodies that still evades the skill of the greatest mathematicians of our own world.

Within our solar system the masses of the planets are practically negligible compared to the mass of the sun, and it is for this reason that they appear to revolve about the *center* of the sun. As a matter of fact, no body in the universe revolves about the *exact geometrical center* of another body, but two mutually attracting bodies revolve in orbits about their common center of gravity, which always lies between the two bodies on the line connecting them and at a distance from each of them that is in inverse proportion to the mass of the body. The moon does not revolve about the *center of the earth,* but about the *center of gravity* of the earth and moon, which lies on the line connecting the two bodies and at a distance from the earth's center that is one eighty-first of the distance from the center of the earth to the center of the moon, as this represents the ratio of the masses of the two bodies. The center of gravity of the earth and moon, therefore, lies about two thousand miles from the earth's center, and about this point both

What Is a Bar-Bell?



A bar-bell is simply a long handled dumb-bell, and is used for developing exercises. It can be made light enough to suit the needs of any beginner, and heavy enough to provide exercise for the strongest men. It is intended for home exercising, and can be used in your bedroom, no matter how small it is.

To be of any advantage, a bar-bell must be adjustable, in order that you may begin exercising with a moderate weight, and gradually increase that weight as your strength increases. Used in connection with kettle bells and dumb-bells, it is the most efficient exercising apparatus ever devised, and produces real health and strength in a remarkably short time. The bar-bell is used by men in every walk of life as a means of keeping in good health, and it has developed all the professional strong men of the country.

A Real Strength Builder

Why is it that the man who exercises with bar-bells can perform feats of strength far beyond the combined power of two or three ordinary men? Not alone because his arms are twice as strong, but because his back, hips and legs are four to five times as strong as those of the average man who uses a system of light exercise. Just having strong arms will not keep you in perfect health. You must be strong in all parts of the body.

Bar-bell exercises bring into play all the muscles of the body. That is why bar-bell users develop perfect health and phenomenal strength. They devote less time to exercises than the average physical culturist, but they get real results.

Rebuild Yourself

A bar-bell will help you to become the man you ought to be, the man you want to be. The reason so many people are weak and sickly is because they do not exercise all parts of the body, regularly. If you are troubled with indigestion, constipation, etc., it will not help you any to merely exercise your arms. You must exercise the entire body with sufficient muscular resistance, gradually increasing the resistance as your strength increases.

We are interested in you and can help you. Send for our illustrated Catalog and Folder No. 18, describing our system of exercising. Both Free.

STRENGTH

STRENGTH is primarily a man's magazine, and is all that the name implies. Are you interested in good health and the best methods of obtaining it? STRENGTH will show you the way.

Beginning September first, STRENGTH will be published every month, and the subscription price will be $1.50 per year. This is your last chance to get STRENGTH for $1.00 per year. A dollar invested in STRENGTH will bring you a fortune in good health. Send in your subscription ***TO-DAY.***

THE MILO BAR-BELL CO.

Physical culture specialists and the largest manufacturers and distributors of bar-bells, dumb-bells and kettle bells in the world.

Diamond and Third Streets

Dept. 7 Philadelphia, Pa.

This Coupon good only until Sept. 1st

SUBSCRIPTION BLANK

Date.....

MILO BAR-BELL CO.
Diamond & Third Sts.
Dept. 7, Philadelphia, Pa.

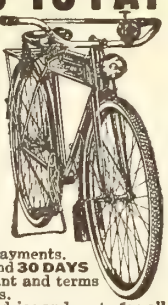
I herewith enclose one dollar ($1.00) in payment for one year's subscription to "STRENGTH." ($1.25 Canada and $1.50 foreign countries.)

Name.....

Street Address.....

City or Town..... State.....

NINE MONTHS TO PAY



Immediate possession on our liberal **Easy Monthly Payment** plan—the most liberal terms ever offered on a high grade bicycle.

FACTORY TO RIDER prices save you money. We make our bicycles in our own **new model factory** and sell direct to you. We put real quality in them and our bicycles **must** satisfy you.

44 STYLES, colors, and sizes to choose from in our famous **RANGER** line. Send for big beautiful catalog.

Many parents advance the first payment and energetic boys by odd jobs—paper routes, delivery for stores, etc., **make the bicycle earn money** to meet the small monthly Payments.

DELIVERED FREE on Approval and **30 DAYS TRIAL.** Select the bicycle you want and terms that suit you—cash or easy payments.

TIRES lamps, horns, wheels, sundries and parts for all bicycles—at half usual prices. **SEND NO MONEY** but write today for the big new catalog, prices and terms.

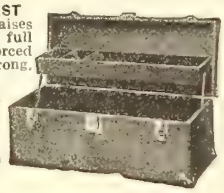
MEAD CYCLE COMPANY Dept. W-107 Chicago

STALWART

You'll appreciate this Union Utility Chest if you love fine tools—and every good workman does. Made of Solid Oak, with lock cornered joints—the strongest known. Top and bottom rabbeted in, glued, and nailed. Beautifully finished—golden oak or imitation leather.

UNION UTILITY CHEST

Note handy tray that raises and lowers with top, full nickeled hardware, reinforced corners. Handle is very strong, steel cored.



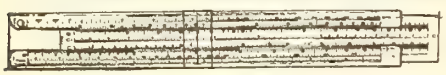
WRITE FOR CATALOG prices, and name of dealer. Sold on "Satisfaction or Money-Back" Guarantee.

Union Tool Chests are made in 24 styles and sizes.

UNION TOOL CHEST CO., Inc., 36 Mill St., Rochester, N. Y.

UNION TOOL CHESTS

RICHARDSON'S POLYPHASE SLIDE RULE



has the regular A, B, C, and D Scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book which teaches all there is to know about slide rules, is sent with each order.

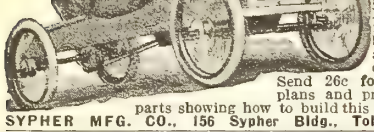
Price of the Richardson's Polyphase Slide Rule, in case with 100 page Instruction Book $2.00.

An ideal Slide Rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10. each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO. NILES, MICH.

Oh Boy! Build This Car.



This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 26c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO., 156 Sypher Bldg., Toledo, Ohio

Every Bicycle A Motor Cycle

by using a STEFFEY ATTACHMENT.



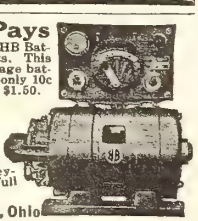
Thoroughly **PRACTICAL** and **SUCCESSFUL,** In use over 20 years. Fits double-bar, Arch or diamond frame.

Send stamp for circulars.

STEFFEY MFG. COMPANY

Dept. E 5025 Brown St. Phila., Pa.

Battery Charging Pays



$100 to $200 extra profit every month in HB Battery Charging. You can make big profits. This HB Charger will recharge 1 to 8 auto storage batteries at one time, with a current cost of only 10c to 16c per battery. Autoist pays 75c to $1.50. Figure your profits.

Small Cash Payment Puts This Money-Maker In Your Garage

Balance in easy monthly payments which earnings should easily pay, with good profits besides. No risk. Absolute money-back Guarantee. Write TODAY for full particulars.

HOBART BROS. CO., Box 82E, Troy, Ohio

"The Ellis Music Master Reproducer"

made for all phonographs. Pleases the most exacting music lover. Eliminates twang. Perfect harmony of accompaniments, individuality of artists, voices and instruments reproduced from records in life like reanimation. It sells on its merits. Send 10c for booklets E, "Hints to Music Lovers" and "Music Masters." Agents wanted

J. H. ELLIS, P. O. Box 882, Milwaukee, Wisconsin

earth and moon perform orbits of revolution that are identical in form and differ only in size. In the same way each of the planets of the solar system revolves about the center of gravity of itself and the sun, but the mass of the sun is so far in excess of the combined masses of all the planets that we may consider, for all practical purposes, that the planets revolve about the sun's center, the center of gravity of the system being *within the* sun.

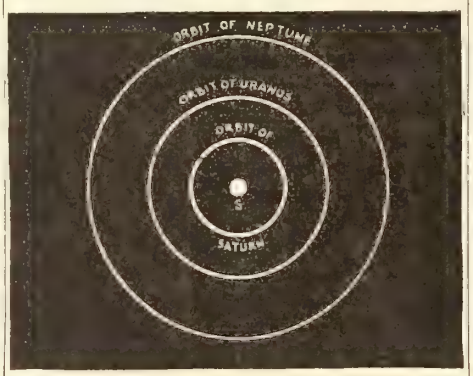


Fig. 1. Plan of Solar System. The Inner Circle Represents the Orbit of Saturn About the Sun, S. The Next Circle is the Orbit of Uranus and the Outer Circle the Orbit of Neptune. The Orbit of the Earth on this Scale Is About the Size of the Solid Circle S at the Center. The Distances of the Planets from the Sun In Terms of the Astronomical Unit (93,000,000 Miles Distance of Earth from Sun) Are Mercury 0.4, Venus 0.7, Earth 1.0, Mars 1.5, Jupiter 5.2, Saturn 9.5, Uranus 19.2, Neptune 30.1.

Prof. T. J. J. See found from the investigation of forty binary star orbits that the average eccentricity of double star orbits is twelve times as great as the average eccentricity of a planetary orbit, and that the masses of the component suns are always comparable to each other in size. The center of gravity of a binary system, therefore, lies at a great distance from the centers of the stars, and about this point, as a focus, the stars move in orbits that are exactly similar in form but differ in size in inverse proportion to the ratio of the masses. Since the orbits of binaries are, moreover, very highly eccentric, the two suns are anywhere from two to nineteen times nearer to each other at periastron, than they are at "apastron."

We have spoken so far only of systems of *two* associated suns, but many systems exist in which three or more sun-like

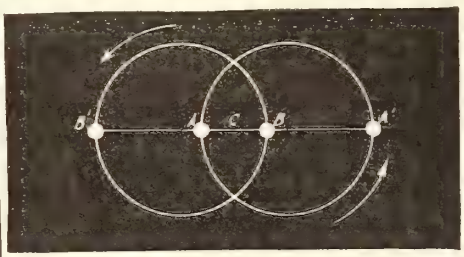
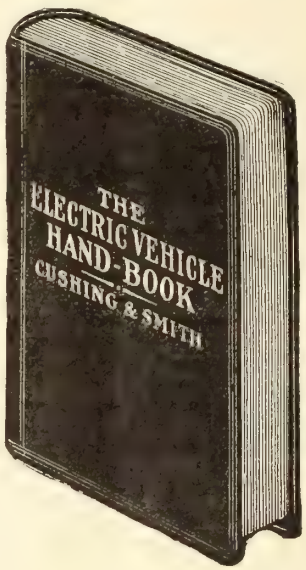


Fig. 2. Here the Distance AB=930,000,000 Miles (Ten Times Distance of the Earth From the Sun). Plan of the Double Star Systems—Alpha Centauri. The Two Suns That Belong to This System Are the Nearest of All Stars to the Solar System. They Are Nearly Equal in Mass, Tho One Emits Only One-Third As Much Light As the Other, and Is a Much Deeper Yellow in Color. The Brighter Star Is Almost an Exact Duplicate of Our Own Sun in Every Way. The Combined Mass of the Two Stars Is Twice That of the Sun. They Revolve About Their Common Center of Gravity at C, in a Period of Eighty Years. As they Are Equally Massive the Center of Gravity Always Lies Just Half Way Between Them and They Are Always at Opposite Extremities of a Straight Line Passing Thru the Center of Gravity. At Periastron They Are Separated by the Distance AB Which Is, As in the Sirian System, About Ten Times the Distance of the Earth From the Sun. Their Distance at Apastron When They Are In the Position A'B' Is Three Times Greater Than When They Are at Periastron.

WHAT EDISON SAYS ABOUT THE Electric Vehicle Hand-Book

"CONGRATULATIONS ON YOUR ELECTRIC VEHICLE HAND-BOOK. THE INDUSTRY HAS NEEDED JUST THE INFORMATION CONTAINED IN ITS PAGES."

THOMAS A. EDISON.



CONTENTS

It tells you all about every leading make of storage battery of both the lead and Edison types. How to install them, care for them, charge and discharge them and how to get the best service out of them.

Charging overnight, boosting, electrolyte inspection, etc.

The most complete and accurate treatise on the storage battery published.

All about charging apparatus for both direct and alternating current. Rectifiers and Rotary converters.

Measuring instruments, meters and ampere hour meters, how to install and use them.

All about motors and their controllers, how constructed, installed and operated.

All about wheels, tires, rims, their construction and care.

The chassis and transmission gears and their care.

All the leading types of commercial, industrial and passenger electric vehicles.

The Only Book on the Electric Vehicle Published

350 Pages, 216 Illustrations. Leatherette Cover. Pocket Size.

Sent on receipt of $3.00

H. C. CUSHING, JR.

8 West 40th St., New York, N. Y.

bodies are in revolution about a common center of gravity. Frequently two fairly close suns are in revolution about a common center of gravity, in a period, say, of fifty or sixty years, while a third sun revolves at a comparatively great distance about the center of gravity of itself and the first pair in a period of several hundred years. Or possibly the third sun also possesses a close attendant and the two pairs revolve in a period of great duration about a common center of gravity.

Such are the systems of *Zeta Cancri* and *Epsilon Lyrae*. In the former system the closer components revolve rapidly in a period of about sixty years, while the remote companion shows irregularities in its motion that appear to indicate that it is revolving about a dark body in a period of seventeen and a half years, while the two together are revolving very slowly in a period of six or seven centuries, about the center of gravity of the first pair in a retrograde direction.

The wider pair of *Epsilon Lyrae* is a naked-eye double for it can be seen as a double star by a keen eye, while even a three-inch telescope will separate each of the components into a double star. So extensive is this system that the periods of revolution of the closer components occupy several centuries, one pair appearing to revolve about twice as rapidly as the other, while the period of revolution of the two pairs about a common center is probably a matter of thousands of years. The gap that separates the two pairs may be so great that light would require months or possibly several years to cross it.

These multiple systems are by no means exceptional. They are to be found in profusion among the brilliant *Orion* stars. They have been referred to as "knots" of stars and it has been suggested that they may have originated as local condensations in one vast nebulous tract. A system of only two components appears to be the exception rather than the rule, groups of several connected suns being more numerous than single pairs.

In all of these double and multiple systems there exists the possibility of minute satellites, such as our own Earth, in attendance upon some component of the system, tho these tiny bodies shining only by reflected light from a nearby brilliant sun would be hopelessly invisible in the most powerful telescope.

We can only assume that it is far more reasonable to believe in than to disprove the existence of such satellites.

Our own solar system, we may say, then, represents neither in its mechanical nor physical features, the only possibilities for the maintenance of life; neither can it be considered a unique form, nor the most generally prevalent form in the universe.

Jules Verne — The World's Greatest Prophet

By CHARLES I. HORNE, Ph.D.

(*Continued from page* 368)

the Probable, indeed in the light of his success we might almost call it the Inevitable. The sureness with which time is accomplishing each serious prophecy of Verne, tempts us to look with even greater confidence to the completion of such of his visions as still belong to the future.

In other words, Verne is not wholly a past issue. The man of today may still read his books with something of that tingling eagerness to go forth and attempt their marvels which inspired readers of fifty years ago. How much, I wonder, of the scientific progress of today do we really owe to Verne? Our country can almost claim him as more American than French. Where and when shall we erect to him a fitting monument?

LEARN DRAFTING

At Home—In Spare Time
as you would in actual practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed, by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher, especially qualifies him to give you the training you need to become a successful Draftsman.









Draftsmen Get $35 to $100 a Week

Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field paying as high as $50,000 a year.

Become a Specialist

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.

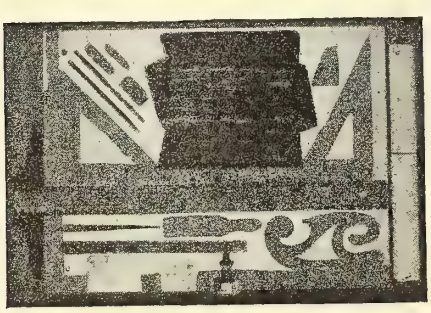
Draftsmen are needed in greater numbers, and receive better salaries than ever before.

How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions now open. Here is what "Columbia" training is doing for some of our graduates: Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.

This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



Big Concerns Employ "Columbia" Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them.

Send This Coupon Today

Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write today to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1151, 14th & T Sts., N. W., Washington, D. C.

COLUMBIA SCHOOL OF DRAFTING,
Roy C. Claflin, President
Dept. 1151, 14th & T Sts., N. W.
Washington, D. C.

I am interested in your practical training in Mechanical Drafting. Please send me Free, your illustrated book of particulars, testimonials, terms, etc. I am also interested in the special post-graduate course checked below:
(Mechanical Drafting, or Machine Drafting is the foundation course and is complete in itself.)

Architectural Drafting...	Ship Drafting .....
Automobile Drafting.....	Statistical Drafting .....
Electrical Drafting	Radio Drafting .....
Aeroplane Drafting	Automotive Drafting .....
Special Machinery Drafting	Hydrographic Drafting...
Sheet Metal Drafting....	Machine Design .....
Structural Drafting	Tool Design .....
Highway Drafting	Shop Mathematics .....
Patent Drafting	Builders' Course .....
Topographical Drafting..	

Name.....
Address.....
City.....State.....



"You've Gone Way Past Me, Jim!"

"Today good old Wright came to my office. All day the boys had been dropping in to congratulate me on my promotion. But with Wright it was different.

"When I had to give up school to go to work I came to the plant seeking any kind of a job. They put me on the pay-roll and turned me over to Wright, an assistant foreman then as now.

"Well, I soon realized that to get ahead I must not only do my work well, but prepare for something better. So I wrote to Scranton and found I could get exactly the course I needed to learn our business. I took it up and began studying an hour or two each evening.

"Why, in just a little while my work took on a whole new meaning. Wright began giving me the most particular jobs—and asking *my* advice. Next thing I knew I was made assistant foreman of a new department. I kept right on studying because I could see results. Then there was a change and I was promoted to foreman—at good money, too.

"And now the first big goal is reached—I am superintendent, with an income that means independence and all those things that make life worth living.

"Wright is still at the same job, an example of the tragedy of lack of training. What a truth he spoke when he said today, 'You've gone 'way past me, Jim,—and you deserve to. Heads win—every time!'"

The International Correspondence Schools have helped more than two million men and women to know the joy of getting ahead in business and in life.

You, too, can have the position you want in the work of your choice, with an income that will make possible money in the bank, a home of your own, the comforts and luxuries you would like to provide your family.

All we ask is the chance to prove it—without obligation on your part or a penny of cost. That's fair, isn't it? Then mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6245, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE — Spanish
Sheet Metal Worker	Poultry Raising — French
Navigator	Automobiles — Italian

Name_____

Present Occupation_____ 7-28-19

Street and No._____

City_____ State_____

The Seneca MOTOR CAR — Built for the Owner — $1185



Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. Comfortable E-Z riding

4 cyl. - 27 H. P. 108 in. wheel base

Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. Write or Wire NOW.

THE SENECA MOTORCAR CO., 48 Seneca Factory, FOSTORIA, OHIO

Book on Law Free



Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.

Write Today—now while we are making a special reduced price offer.

American Correspondence School of Law
744C Manhattan Bldg. Chicago, Illinois

Marvels of the Ear

By JOSEPH H. KRAUS.

(*Continued from page* 365)

We now must take into consideration the multiplying factor due to the two membranes. Inasmuch as the ear drum or tympanic membrane is twenty times the size of the oval window membrane upon which it acts, any force applying to the former will be amplified twenty times in the latter, if directly connected just the same as for instance in two pumps, one with an area of twenty units and another with an area of one unit. We naturally get an amplification factor of twenty. The lever systems of bones again amplify this one and a half times, but reduce the motion. As a result we find that a movement of the drum is accompanied by a similar movement of the oval window but increased in force fully thirty times.

Communicating with the middle ear is a tube connecting to the mouth which opens upon swallowing. This serves a very important function in allowing the ear to maintain the same pressure on both sides of the tympanic membrane. This function, if destroyed thru disease of the tube, will cause partial deafness because this chamber will have its air absorbed on the inner side, causing extreme pressure from the outside. The bones will then press the oval window inward to a greater extent.

THE "END ORGANS" OF HEARING.

We now come to the end organs of the ear which are the most important of all. Here we have a vestibule to which are added several important structures. Three of these are the *semi-circular canals*, which have to do the work of notifying our brain when our body is right side up. The other important structure which we will now look into is the *cochlea*. This consists of two portions, a bony part which is shell-like in appearance, winding upward in a spiral direction to an apex. This is divided internally into three portions. Two of them bony, more or less, and a third membranous. These partitions can be clearly seen in the accompanying drawing where it will be noted that one lies below the other with the intermediate membranous chamber laterally and seemingly split between the other two.

The *oval window* which we have described before and the membrane covering which is actuated by the last of the bony lever system in the middle ear communicates directly with the upper chamber. All three chambers are filled with a liquid called *perilymph*. The latter fills two chambers, the upper and the lower, while another liquid, *endolymph*, fills the membranous lateral chamber. When, therefore, a vibration causes the oval window to be forced inward, the liquid is immediately comprest in the upper chamber (vestibular). This pressure wave passes along to the top of the cochlea, where the chamber communicates with the lower or tympanic chamber, and the pressure wave passes downward to the end of the lower chamber (tympanic), where the wave terminates at another window called the *round window* because of its shape. Here a bulging of the window membrane can clearly be seen whenever pressure is applied to the oval window.

During the course of the pressure wave, however, it has past along on two long thin sheaves of tissue which encircle the *membranous scala*, causing these membranes to approach each other due to external pressure. Naturally, compression is going to take place in this closed spiral which has no exit except thru a small tube leading into a sack, and in this way acting as a safety valve for pressures which may be

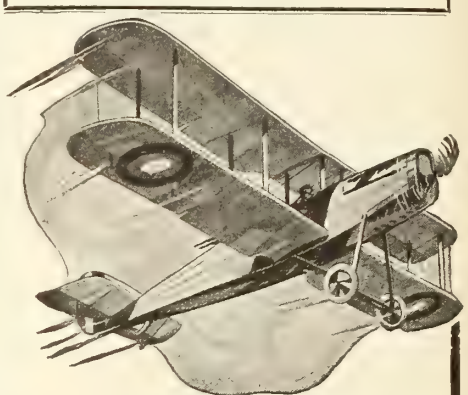
Take a Dollar Bill

fill out the attached coupon, send both to the Electro Importing Company, 231 Fulton St., New York City, and by return mail you will receive your



SKINDERVIKEN TRANSMITTER BUTTON

Electro Importing Co.,
231 Fulton St., New York.
Gentlemen:—Enclosed please find One Dollar. Ship *at once* one Skinderviken Transmitter Button to
Name .....
Address .....



Build and Fly A Model Aeroplane This Summer!

Build a real, flying model of any of the famous Aeroplanes listed below. IDEAL Scale Drawings and Building and Flying Instructions show how you can build 3-ft. models of real 'planes.

Send now for drawings and instructions for the one you want to build.

Curtiss JN4D-2 Training 'Plane (Just Out)
NC-4 Naval Seaplane
DeHaviland Battle 'plane

35c EACH POSTPAID

Curtiss Military Tractor
Bleriot Monoplane
Nieuport Monoplane
Taube Monoplane

Catalogue of IDEAL Model Aeroplanes and Supplies 5c, if you write at once; regular price 10c.

Ideal Airplane & Supply Company
Making Model Aeroplanes since 1911
159-161 Wooster St., Cor. West Houston St. New York City

RAZOR BLADES AT WHOLESALE PRICES

25 GUARANTEED Blades to fit Gem, Ever-Ready and Star Razors. Sent post-paid by manufacturer direct on receipt of $1. More and better shaves at less cost. Satisfaction or money back cheerfully.

SHAVING UTILITIES CO.,
750 Summer Ave., Dept. E.E.
Newark, N. J.





DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my sworn statement of how I recovered my hearing.

A. O. LEONARD
Suite 369, 70 5th Avenue -- New York City

too great. This *scala* has two membranes, as can be seen from the illustration, causing it to assume a triangular shape. The one on the bottom is called the *basal membrane* or basilar membrane.

This membrane is built like a harp made up of a large number of strings, and it is believed that the vibration of these strings cause the end organs of the auditory nerves, which are mounted upon them, to vibrate and by thus being stimulated, the sense of some distinct sound is immediately transmitted to the auditory centers (cells) of the brain. The basal membrane is widest at the top and narrowest at the bottom and contains 24,000 fibers. Upon these fibers are mounted the end organs of hearing which are small cell-like structures having numerous hairs at the top. Stretching over these is a sort of *soft pedal* arrangement, which in the event of the cells vibrating too much comes down and dampens their action. The auditory nerve itself has 14,000 terminal fibers.

The action in the ear, therefore, appears to be as follows: A sound is transmitted from some position causing a wave disturbance in the air. This disturbance impinges on the drum causing the drum to vibrate, which in turn communicates its vibrations to the oval window, after amplifying them thirty times thru the intermediary of the bones, altho the motion itself is considerably decreased. This pumps a liquid up to the top of the shell-like structure in one compartment and down the other to the bottom again, causing a pressure effect all along the length, but not a flow. This pressure is felt in a flexible chamber, also containing a liquid and having a membrane of strings capable of vibrating. On each string is a specially sensitized cell which, if stimulated, will communicate with the brain, giving indication of sound.

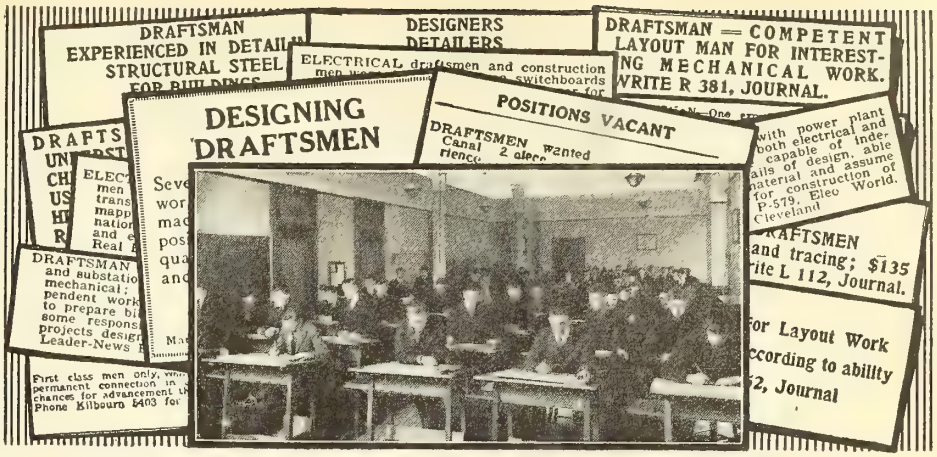
A good musician can distinguish between two notes, one sixty-fourth of a semitone apart. This means that there is more than one fiber, but less than two of the nerve for each note in the auditory scale. The basilar membrane itself has more than two fibers, but less than three for each note, and the peculiar rod-shaped structures, which are shown in the diagram, are more than one in number for each note.

It has been found that in diseases involving the basilar membrane, that the membrane destroyed at the apex or the wider portion of the membrane, means the complete loss of perception of the sounds low in the musical scale, while those destroyed at the base or narrow portion of the membranous scale destroyed the ability to realize the high notes in the musical scale. In birds, altho the distinction between the notes is much more delicate, the scale is greatly limited. The *telephone theory* is different from the above, which is called the *piano theory* of hearing.

THE TELEPHONE THEORY OF HEARING.

This theory relegates the whole work of analysis to the central nervous system to the brain, but gives us no clue as to how such an act of analysis may take place. The idea advanced is that when a bow of a violin is drawn across a plate which has previously been sprinkled with some fine powder such as lycopodium, the plate assumes a complicated pattern having nodal points. It is thought that perhaps the entire basilar membrane vibrates as a whole, but various nodal points will not vibrate as much as the internodal points, and since the hair cells vibrate, with the membrane, and are affected by the dampening membrane on top, a pressure pattern is formed, which pattern is communicated to the brain.

Animal experiments have not completely borne out this theory. Animals such as guinea pigs, etc., have been subjected to a stress of one continuous sound from a pipe organ. The animal when killed, has shown that one certain or definite portion of the basilar membrane, together with the rod cells, has practically disintegrated.



Learn Drafting!

Mechanical — Electrical — Architectural — Structural

TODAY everything is built by plan. In the factories, large and small, no new product is made, not even a change is made in an old design, but that a new sketch, worked out to the finest detail is first prepared. New buildings are constructed according to the architect's cleverly-drawn plans. Great bridges, tunnels, reclamation projects are first schemed out on paper—by draftsmen! So we find every industry, in every land throughout the world in great need of skilled draftsmen. These men must be trained to take plans in the rough and draft them into workable, accurate graphs to guide the workmen. For this work handsome salaries are paid. But the men who earn the really big pay are the men who have been properly trained in the principles and practice of advanced draftsmanship.

Every Industry Needs Draftsmen

Railroads, steel mills, factories, ship yards, electrical concerns, contractors, construction engineers and companies, car shops, architects and hundreds of other concerns need and must have skilled draftsmen. In every industry thousands of draftsmen are daily required. The services of the man who is properly trained in this important work are always in great demand. Why don't you get into this fascinating profession?

Become an Expert in Six Months

Practical Men Prepare You

Come to the School of Engineering of Milwaukee to learn *right* the science of *Drafting*. You will learn quickly and thoroughly here, from men who are recognized experts. No special ability or "drawing talent" is necessary. With the desire to learn and the will to win you can here quickly qualify for a responsible well-paying position in this fascinating field of work. Here you learn in large, airy, well-lighted drafting rooms. Skilled instructors, who are practical experts, train you step by step. Working models, machine parts, intricate electrical apparatus—the most thorough complete equipment for learning every phase of drafting is provided by School of Engineering. With this wonderful training you can become an expert Draftsman in six months.

Earn While You Learn

By our special system you may earn your way while learning. Our Employment Department will secure you a position to which you may devote a part of each day spending the remainder at the school. This plan both solves the students' financial problems and provides splendid experience at the same time. One week of practical employment and one week in the drawing room permit you finishing this full course in one year. Low tuition fee and Fraternity House for all students who wish to secure board and room at cost.

Earn $150 to $400 a Month

In this fascinating profession each man is paid according to his skill and worth. Expert Draftsmen with specialized training such as School of Engineering offers can easily earn $150 to $400 a month. Expert Designers who have had drafting experience enjoy incomes up to $10,000 a year and more. Salaries of over $5,000 are often paid to Chief Draftsmen and Engineers. Train now for one of these splendid positions. With six months of special, intense instruction here, you will be started with a good work that will quickly put you into the big-pay class.

SEND FOR NEW FREE BOOK

NEXT TERM BEGINS SEPT. 1st

Mail the coupon now and get full information so that you will be ready to start your training on September 1st. It is the ideal time to come to School of Engineering of Milwaukee. Here, on this breeze-swept shore of Lake Michigan, you will enjoy cool weather while you are learning. And there is every facility for recreation. The school is located in the heart of Milwaukee, a large up-to-date city with the added attraction of bathing and boating on beautiful Lake Michigan and other lakes in the surrounding country. Our students engage in baseball and other sports. You will enjoy your training at School of Engineering and your time here will pay you golden dividends all the rest of your life in increased earning power and bigger opportunities. It will mean thousands of dollars to you to mail the coupon **NOW.**

School of Engineering of Milwaukee

15th Successful Year Begins Sept. 1st

1-HA-373 Broadway, Milwaukee, Wis.

School of Engineering of Milwaukee

1-HA-373 Broadway, Milwaukee, Wis.

I want full details and new catalog of the Electrical & Mechanical DRAFTING Course FREE!

Name.....

Address.....

Age.....Education.....

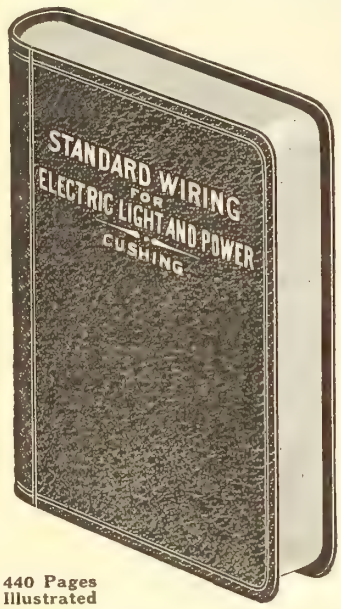
LEARN TO BE A

WIREMAN

AND EARN

$75 a Week

This year's Edition will make you an Expert



440 Pages Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. Electrical Units and their Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve your wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges. Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.

12 W. 40th Street New York

Electrocuting Sharks

By H. GERNSBACK

(*Continued from page* 364)

The cable itself may be sealed into the bamboo pole by means of a high grade insulating compound. A sort of switch now becomes necessary to turn on and turn off the current for reasons mentioned above. If no such switch were used, it would never be possible to bring the pole with its live point anywhere near the shark, for he would feel the effects of the current several feet away, and would swim out of the danger zone. So a sort of telescopic switch as shown in our third illustration is used, and this may be made to work automatically. In other words, as soon as the pole point is stuck into the shark, the force of the thrust will close the telescopic switch automatically, as can be readily seen. Instantly the current shoots into the shark's body, electrocuting him, providing there is a good contact.

It is however, not always necessary to electrocute the shark, and indeed it is not absolutely necessary. In order to protect the pearl or sponge divers, two or three men armed with electrified poles can take stations around the working divers, while the latter work on unmolested. If a shark comes within sight, the electrified poles will readily ward off the pest, altho it may never be necessary to actually stab him. In other words, the effect of the current will be sufficient to frighten off the sharks should they come anywhere near the electrified zone.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page* 393)

ance of the cell, decrease its voltage and therefore its current. There are a number of ways to diminish this action but the following one is a very effective one, and it is not found in the text-books on the subject:

In a fruit jar make up a strong solution of sal-ammoniac. From an old dry cell remove the carbon and secure a zinc rod or heavy strip of zinc. Now immerse the carbon in a dilute solution of nitric acid. Then heat it in the oxidizing flame of a Bunsen burner. Repeat this a number of times after which place the carbon and zinc in the jar of sal-ammoniac. You will find that this cell, unlike the ordinary sal-ammoniac cell, will give a strong current for a long time and when it does begin to polarize give the carbon the same treatment again. Of course fresh sal-ammoniac must be added from time to time.

Local Action: The chemistry of local action is a much more important matter than is commonly supposed. By local action is meant the wasting away of the zinc on both open and closed circuit owing to the presence of little particles of impurity, chiefly carbon. When these impurities are present little batteries are set up between them and adjacent particles of zinc and a vigorous chemical action results, accompanied by the solution of the zinc, the wasting of the acid and the liberation of large quantities of hydrogen gas.

In a tumbler of dilute sulfuric acid place a strip of ordinary sheet zinc and you will immediately observe a myriad of bubbles rising about it. These are due to local action. Remove the strip and dip the end of it in a little mercury. Rub the mercury and it will quickly spread over the entire surface. Now put it in the tumbler of acid and no bubbles will appear. You have covered up the particles of carbon and the tiny electric cells have disappeared. A strip of chemically pure zinc will also show no signs of local action.

One important application of this action is in the generation of hydrogen. Perhaps, sometime you have been absolutely unable to make your hydrogen generator work. Its failure to act *is due to the use of too pure zinc.* Unless there are impurities present to set up little cells the zinc will not go into solution. If, however, you will add 2 or 3 cc. of a solution of copper sulfate an immediate and vigorous action will begin. The zinc drives the copper from the copper sulfate solution and the tiny particles of it collect over the surface of the zinc and at once the electrolytic action and the consequent liberation of hydrogen begin.

Cleaning Silver-Ware: One very unique and useful application of local action is to be found in a new method of cleaning silver-ware. The silver is placed in an *aluminum* kettle or pan and a solution containing 5 teaspoonfuls of baking soda (sodium bicarbonate) to a gallon of water is poured on it. Or the solution may be prepared first in the kettle and the silver immersed in it. Then place the kettle on the stove and heat it nearly to boiling. The soda forms a mildly alkaline solution which will attack the aluminum but not the silver. We have then the exact conditions for an *electric cell* with the result that the hydrogen liberated by the action of the alkali on the aluminum is driven over to the silver where it unites with the sulfur on the latter and quickly removes it. The silver can then be polished with a chamois skin. The amount of aluminum going into solution is not great enough to injure the vessel.

An interesting illustration of local action was recently observed on a splendid new yacht built for salt water. Copper sheeting was put together with rivets containing iron. As a result local action set in and the sheeting quickly fell apart.

One of the most important applications of the electric current is to be found in the electrolytic refining of copper, electroplating and the electrolytic analysis of alloys. The principle of all of these processes, however, is exactly the same as that of electrotyping. Had it not been for the necessity of having a very expensive platinum dish for the electrolytic determination of copper in brass, I should have been glad to describe the practical method of doing this. Silver plating was described in considerable detail by the writer in the *January* issue of the ELECTRICAL EXPERIMENTER.

In addition to these processes there is a host of chemical industries that employ the electric current and are made possible by it. Among these are the extraction of aluminum, the separation of the alkali metals, the preparation of the caustic alkalis, the production of hydrogen, oxygen and chlorine, the metallurgy of steel, the making of nitric acid from the air and many more.

Learn Electricity



In the Great Shops of COYNE IN 3½ MONTHS

Thousands of Electrical experts are needed to help rebuild the world. Come to Chicago to the great shops of Coyne and let us train you quickly by our sure, practical way, backed by twenty years of success. Hundreds of our graduates have become experts in less than four months. *You* can do the same. *Now* is your big opportunity. Come—no previous education necessary.

Earn $150 to $400 a Month

In the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position.

Become an Expert in 3½ Months

No need of taking from 1 to 4 years to become an expert, we have proved this in thousands of cases. The Coyne method of practical training eliminates all books, useless theory and other non-essentials and trains you in just what you need to know to become an expert.

Earn Your Way

Don't tell yourself you haven't got the money to come to Coyne. If you have ambition and the nerve of a real man, that's all you need. Hundreds of our students every year work in their spare time and earn their living expenses. Hundreds of others work in the day time, earn all their expense and attend our evening school. Our employment department will help you without charge.

Day or Evening Courses

Don't worry about the money. Anyone with ambition can learn here. Our tuition is low with small easy payments if desired. All tools and equipment furnished free. Our students live in comfortable homes in the best section in Chicago—on the lake—just a few minutes' walk from our school.

Electricity, Drafting Motion Picture Operating

We teach these professions quickly and in such a thorough, practical way that when finished you are ready to step right into a position of responsibility and big pay.

Send Today for Big Free Book

Write today, *now*, for the book. It tells what Coyne graduates have done. What you can do. Fill in the coupon, check the trade you are most interested in or send a postal card, do it *now*.

Learn Drafting

The country is crying for skilled draftsmen in all lines. Thousands of positions open with princely salaries. We give you the advantage of our big shops. No other school can do this. Now is the time to get into this big field. Experts train you under practical working conditions, no books and theory go here. Check drafting on the coupon below and mail it *at once* for full particulars.

BENNETT W. COOKE, *President*
COYNE TRADE AND ENGINEERING SCHOOLS
Dept. 28 39-51 E. Illinois Street, Chicago, Ill.

COYNE TRADE AND ENGINEERING SCHOOLS
Bennett W. Cooke, President
Dept. 28, 39-51 E. Illinois St., Chicago, Ill.
Please send at once your big Free Book—I am interested in
[ ] Electricity [ ] Drafting
[ ] Motion Picture Operating
(*Check trade interested in*)

Name.....

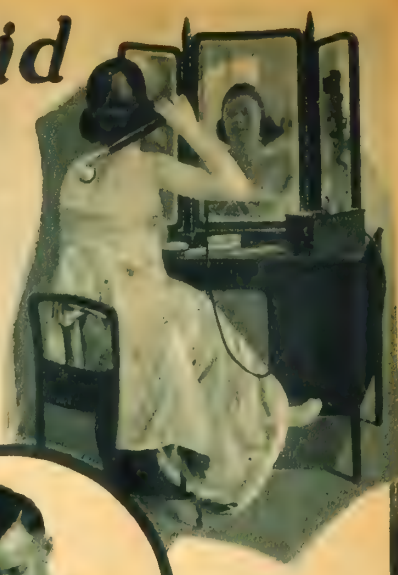
Address.....

MAIL THIS COUPON NOW!

Use Nature's Greatest Aid

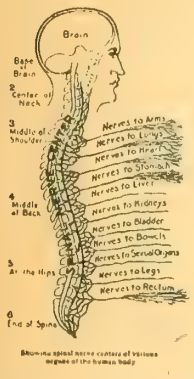
Renulife VIOLET RAY

To Health and Beauty



Treat yourself at home with *Renulife Violet Ray*—affording the marvelous curative forces of electricity in their most pleasant and effective form. This *High Frequency* electric current is shockless and painless—can do injury—yet is most powerful in helping Nature to restore normal conditions. You should know just what it will do for you. Send for full information, mailed free. Write at once.

Treatment at Nerve Centers



Showing spinal nerve centers of various organs of the human body

For Chronic Functional Disorders And for Nerves, Blood and Circulation

You treat locally as well as the great nerve centers. You saturate the system with revitalizing, health-bringing forces. Circulation is brought to parts treated—the glow and warmth of a fresh blood supply brings relief and permanent benefit. Aches, pains, sluggish organic functioning of liver, bowels, etc., respond remarkably to this powerful, purifying administration. you feel a sense of relief as you gently and surely aid Nature to put back in order her vital machinery. Assimilation and elimination are improved.

Send for Book Telling All

Don't delay getting our book telling all about the Violet Ray—its many uses, its wonderful accomplishments and how you, yourself can employ this 20th Century, scientific mode of treatment.

Mail the Coupon



Every Woman and Man should have a *Renulife* at hand to keep *100% Fit*



Every beauty parlor uses a Violet Ray for hair, scalp and skin treatments. The secret of its success is that it brings about a healthy, natural circulation stimulating natural processes—and thus hair growth is promoted or the complexion given the attractive charm of rosy health; wrinkles and blemishes disappear. Health is the foundation of beauty as it is also the source of strength and success. Nothing has ever been discovered that wou'd act both as a stimulant or as a sedative—as does the Violet Ray—with no harmful after effects—only permanent beneficial results. Find out just how these results are accomplished.



Thousands in Use

Many thousand people in all parts of the United States and the World are using *Renulife Generators*—and some of the most astonishing results—approaching the miraculous—have been reported to us. Thousands testify to their satisfactory use. We are confident that you or anyone seeking improved health or relief from ailments that have not yielded to other methods—will find it well worth while to investigate. We ship on a MOST LIBERAL TRIAL PLAN—giving you ample opportunity to determine what you could expect in your own case. Send for particulars.

Health *via* Violet Ray

That's the title of the Book—telling how the Violet Ray is really atomized electricity—sprayed into the body—penetrating every tissue and cell—carrying an invigorating and refreshing stimulation. Nothing else reaches in the same way the hidden cause, or removes the painful or annoying symptoms. Learn how you may now use this irresistible, revitalizing force for any ailment listed on coupon. Send for Book.

Inhaling Ozone

The Violet Ray produces Ozone, the greatest purifying element. Tissues absorb it from external application. An attachment is also provided for inhalation. Breathing Ozone is unequalled for Catarrh, Hay Fever, etc., and for Anemia.

RENULIFE ELECTRIC CO. 1208 Marquette Bldg. Detroit, Mich.

New York City 27 Warren St. | Chicago 123 West Madison St. | Toronto 384 Yonge St.

Sales Distributors

If you are in position to handle a territory in a big way as a local agency, write for proposition.

COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO.,
1208 Marquette Bldg., Detroit, Mich.

Please send without obligation, your book "Health," explaining Violet Ray treatments with Renulife Generators; also give full particulars as to its application for ailments checked below.

TREATS SUCCESSFULLY

..Abscesses	..Facial Neuralgia	..Obesity
..Anemia	..Falling Hair	..Pain in Abdomen and chest
..Asthma	..Female Complaints	..Paralysis
..Arteriosclerosis	..Goitre	..Piles
..Baldness	..Gout	..Pimples
..Blackheads	..Haemorrhoids	..Pyorrhea
..Brain Fag	..Hay Fever	..Rheumatism
..Bronchitis	..Infantile Paralysis	..Scars
..Bunions	..Insomnia	..Sciatica
..Bruises	..Lameness	..Skin Diseases
..Catarrh	..Locomotor Ataxia	..Sore Throat and Throat Diseases
..Colds	..Lumbago	..Sprains
..Chilblains	..Nervous Affections	..Toothache
..Dandruff	..Neuralgia	..Weak Eyes
..Deafness and Ear Diseases	..Neuritis	..Wrinkles
..Eczema		..Warts and Moles
..Enlarged Prostate		

Name .....

Address .....

.....



Made in Several Models—Most Effective, Least Expensive—Violet Outfits



Don't Waste Time

Learn Electricity —the New Way

IT'S no longer necessary to go to school or serve an apprenticeship to learn electricity. With this new library of APPLIED PRACTICAL ELECTRICITY you learn right at home—in your spare time without interfering with your present work.

Any big job that you want in the electrical field is yours if you will train yourself to fill it. It only takes an hour or two a day with these books.

This is the 1920 edition—new from cover to cover—chuck full of the latest methods and most recent discoveries in this fascinating field. Everything is written in plain, good old U. S. language by 27 of the greatest experts in the business. The eight volumes with 3800 pages make up a complete course in electrical engineering. It's a home study course for the beginner and a handy reference guide for the expert combined.

Big Pay for Trained Men Jobs paying $1500.00 to $5000.00 a year are waiting for men who can qualify as Electrical Engineers—Substation Operators—Troublemen—Switchboard Operators—Dynamo Tenders—Electricians. Electricity is the greatest force in the world and it is growing bigger and bigger every day. More and more men are needed all the time. Why don't you get into this big paying field now?

Good Jobs Are Waiting If you are trained in some branch of electricity you will never have to look for a job. The job and the big pay will be looking for you. You can't dodge a good job if you have the "know how" under your hat. Let these 27 great engineers help you to the best kind of job with their books.

Send the coupon below and get them for FREE examination. See our free offer below.

What the Books Teach Elements of Electricity—Electrical Measurements—Electric Wiring—Underwriter's Electrical Requirements—Theory, Calculation, Design and Construction of Direct Current Generators and Motors—Types of Generators and Motors—Management of Electrical Machinery—Electric Lighting—Alternating Current Machinery—Power Transmission—Electric Railways—Self-Propelled Railway Cars—Trackless Trolley—Power Stations—Switchboards and Switching—Storage Batteries—Applied Electro-chemistry—Electric Elevators—Electric Welding and Heating—Wireless Telegraphy and Telephony—Land and Submarine Telegraphy.

Free Service With every set of these great electrical books we give a one year membership in this society. This entitles you to consult our engineers and experts on any electrical problem. Write as often as you like. Ask as many question as you like for one year.

The World's Greatest Electrical Books LOANED to YOU FREE

We will lend you this wonderful library to use in your own home or shop a whole week FREE. It won't cost you one cent. DON'T SEND ANY MONEY. Just fill out and mail the coupon today and the set of eight volumes will come to you by express collect. You be the judge and find out for yourself what the books will do for you. Use them as you please. Show them to your friends and get their opinion. Then if you have any doubt as to their value send them back at our expense and you won't owe us anything.

Only 7 Cents a Day

If you like the books after a week's examination you pay us only $2.80 and $2.00 each month until $29.80 is paid. This is only 50 cents a week—7 cents a day. You can't afford to pass up a better job on these easy terms. MAIL THE COUPON NOW.

American Technical Society
Dept. E-25-C CHICAGO

Coupon is All You Need— Send it Now

American Technical Society
Dept. E-25C
Chicago, U. S. A.

Please send me the 8-volume set of Electrical Engineering for 7 days' examination, shipping charges collect. If I decide to buy I will send $2.80 within 7 days and balance at the rate of $2.00 a month until $29.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine and fully paid for. If I want to get along without the books, I will return them, after 7 days, at your expense.

Name.....

Address.....

Reference.....

Chemical Laboratory



$6.00

No. 4889

We present herewith to our friends our **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform real chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

DESCRIPTION OF THE OUTFIT:

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The Instruction book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the Elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English System and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the **100 Experiments** are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and Smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make Chemical Colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

Price $6.00. Shipping Weight 10 lbs. (Can be shipped by Express only.)
Immediate Shipment

The Boy's Electric Toys

"THE BOY'S ELECTRIC TOYS" contains enough material TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

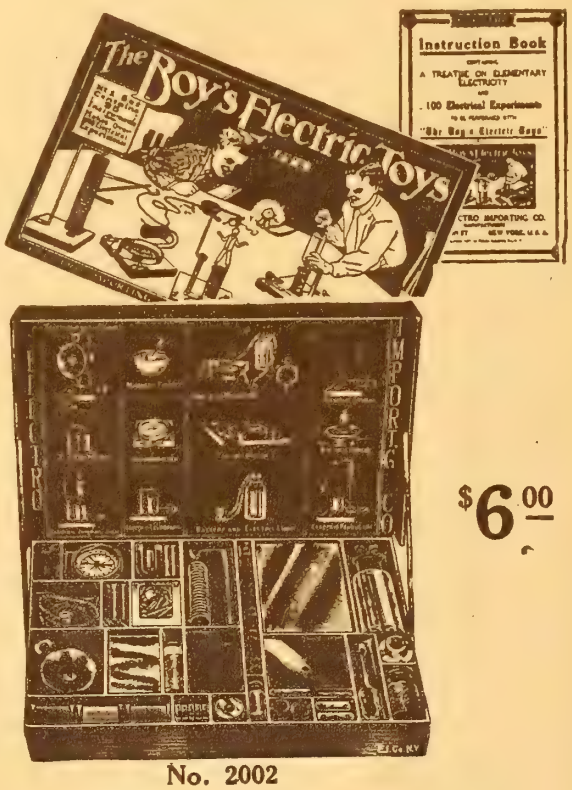
Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size over all of the outfit is 14 x 9 x 2¾. Shipping weight, 8 lbs.

No. 2002 "The Boy's Electric Toys," outfit as described.....$6.00

IMMEDIATE SHIPMENTS



$6.00

No. 2002

"The Livest Catalog in America"

IN this cyclopedia you will find all about radio. One of the greatest catalogs of its kind in print.

You will find in it dozens of wireless instruments of the famous E. I. Co. make.

Other things you will find listed in this catalog: Electrolytic Interrupters, Bulldog Spark Coils, Chemical Outfits, Code Practice Sets, Primary Batteries, Storage Batteries, Hydrometers, Volt and Ammeters, Batterymeters, Electrolytic Rectifiers, Rheostats, Tesla Coils, Microphones, Loud Talkers, Electro-magnets, X-ray Tubes, Telephones, Magnetos, Low Tension Transformers, Books, etc., etc. IN A WORD THE MOST COMPLETE CATALOG IN PRINT.

FREE with this wonderful cyclopedia —20 coupons for our 160 page Wireless Course in 20 lessons. 350 illustrations, 30 tables. Catalog explains how you can get this Course absolutely free.

The Electro Importing Co.,

231 Fulton Street **New York**

"Everything for the Experimenter"

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

I enclose herewith 6 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 22 as described.

NAME .....

ADDRESS .....

STATE.....S.&I. 8-20

Movies of the Unseen

By JEROME LACKENBRUCH

(*Continued from page* 361)

ground is used for several pictures and consequently time is saved in making the drawings, as the entire hook-up need only be drawn once. Lines that are to appear in another drawing are never repeated. Only when the action to be shown necessitates a change in part of the drawing is a new plate or background used. In diagram 3, it will be seen that a celluloid composition plate has been superimposed over the background, *and the current is seen to be flowing.* This particular plate shows only the lines represented by the white and black dashes. But when they are placed on top of the background, they fit perfectly into place and are so photographed. This is the action that is evident to the eye. But behind this we know that an electro-magnetic field has been built up and has reached out to include the iron ball and magnetized it so that the end nearest the bar is of different potentiality than the end of the bar to which it is attracted. The theory that unlike poles attract is now flashed on the screen to explain the action; and finally a view of the magnetic field about the iron bar is shown; stage four. Diagram 4, which consists of a background and one plate photographed together, shows the lines of force about the bar that has been magnetized by an electric current being past thru a wire wound about it. Figures 5 and 6, at bottom of strip, show the iron ball attracted partly at first, and then drawn up against the pole. Here we have a fundamental electro-magnet in action.

THE DYNAMO BARES ITS SECRET.

Now that we know the interrelation between magnetism and electricity, the animated drawing proceeds to tell that when magnetic lines of force are cut by a closed loop of wire, an electric current is induced in the wire. The second strip of diagrams show two permanent magnets with magnetic lines of force running from the North pole of one to the South pole of the other. The drawings for this series of animated technical drawings which develop the principle behind the action of an alternating current generator were made by Mr. S. A. Marti of the Bray Studios. The fundamental background for these drawings is an outline of the magnets. The lines of force mentioned above are drawn on a celluloid plate and photographed together with the background.

The next step involves the removal of the lines of force drawing and the substitution of a drawing of an armature (rotating) a loop together with lines of force. This shows the introduction of the simplest form of armature between the magnets. Another drawing shows only the brushes, which connect with the collector rings that draw off the current, when it has been generated by the revolving of the loop in the magnetic field. In other words, diagram 4 is made by photographing together a background, and two plates, one consisting of the loop, collector rings and magnetic field, and the other, of the brushes, the one plate superimposed above the other; and both upon the background.

The electrical action that now takes place is as follows. Assuming that the loop is revolved in the opposite direction of the hands of a clock; that is, up on the side toward the S magnet and down on the side near the one marked N, the current induced will vary in strength during the course of one revolution. If the loop were PARALLEL to the lines of force, there would be no space within the rectangle of the loop circuit to enclose the



"—that's why I say he knows his trade.

"Look at his tools spread out on that planer bed. Every one's got the Starrett trade mark on it. It's a pretty safe guess that a man with Starrett Tools, knows how to use 'em."

"Guess you're right. I've worked around considerable, and everywhere I've been, I've noticed that the high-class men use Starrett Tools. It's easy to see why. You've simply got to have good tools for first-rate work."

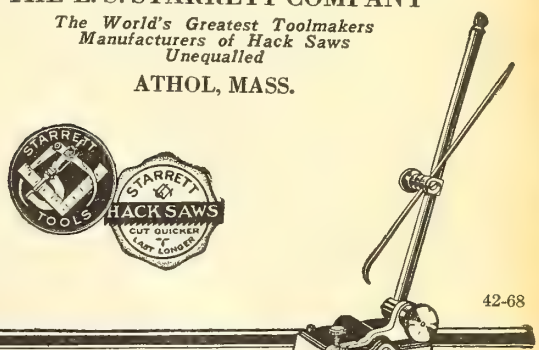
"Starrett's name on a tool is enough for me. I've been using them since I was an apprentice, and I know I can depend on 'em. When I'm on a high-grade job—or just an ordinary one, for that matter—give me a Starrett Tool."

THE L. S. STARRETT COMPANY

The World's Greatest Toolmakers
Manufacturers of Hack Saws
Unequalled

ATHOL, MASS.

There are 2100 tools listed in the Starrett Catalog—tools of the highest quality. Write for Catalog No. 21 "LE."

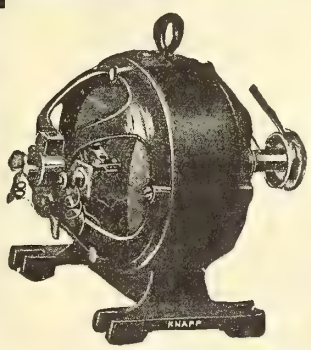


42-68

Starrett Tools

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

Motors, Electrical Toys and Specialties Are Best



Knapp Goods have stood the test for 29 years. No detail in construction has been spared to make them the best that money can buy. The complete Knapp line includes Toy and Power Motors, Generators and Dynamos. Specialties and Novelties that amuse and instruct. Fans, Rheostats, Compasses, etc. And Knapp prices are always lowest. Always insist on Knapp Goods.

KNAPP "LEARNELECTRICS"

A complete Electrical Laboratory, including a very valuable instruction book by H. P. Gorman, A.I.E.E. Covers all subjects clearly and concisely.



KNAPP DYNAMO MOTOR

Will electroplate, charge storage batteries, run lamps, motors, train of cars, induction coils,—in fact, the number of experiments it can be used for is unlimited. Runs on 4 to 6 Volts or can be connected to run on 110 Volts through a transformer.

Price, Complete, $9.00

Price, Complete, $4.00

Order to-day. Or your dealer can secure them for you. DESCRIPTIVE CIRCULAR and CATALOG of celebrated **KNAPP MOTORS** *and Electrical Specialties from 10c up mailed FREE on request.*

KNAPP ELECTRIC & NOVELTY CO., 523 West 51st Street, New York City



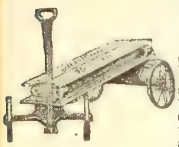
King of 'em all

Auto-Wheel Roadster

WE BUILT IT for fellows who want something new and better. We found a way to give you two wagons in one. When you want to haul, you need a box wagon. The **Auto-Wheel Convertible Roadster** is ready. Swing sides outward and there's a roomy wagon bed that will carry 1,000 lbs.



Fold the sides toward the center and there's the new model roadster—long, low and built for a race. The only one of its kind made.



Auto-Wheel Coaster Roadster

has the same chassis as the **Auto-Wheel Coaster**—the old stand-by. On both these **Auto-Wheel** models you'll find the same smooth-running roller-bearings and the same substantial steel tires and axles that have made **Auto-Wheels** the standard for boys.



Get *"Auto-Wheel* Spokesman"

A monthly magazine that tells all about Auto-Wheel wagons. Gives details of the Auto-Wheel Prize Contests (they are worth entering.) Send names of three coaster dealers telling which handle the wagon with the name "Auto-Wheel" on sides. We'll put your name on mailing list.

In Canada: Preston, Ont.

Export Office: 365 W. 23rd St., New York City.

The Buffalo Sled Co.,

163 Schenck Street,

N. TONAWANDA, N. Y.

lines of force passing between the magnets. But, if the rectangular loop were turned to a vertical position with respect to the lines of force, the *maximum* number of lines of force would pass THRU the space enclosed by the loop. Now, by turning the loop (armature), the lines of force are cut; and this cutting results in a current being induced in the loop; forcibly illustrating the basis of action in all dynamos.

It is clear that when the loop is in a vertical position, and it is revolved about its own axis, it will move almost parallel (for an instant) to the lines of force it is cutting. Gradually, however, as the loop moves toward the horizontal position, more and more lines of force are cut at right angles, and consequently an increasingly stronger current is induced in the loop. From the horizontal to the vertical position, the loop cuts fewer and fewer lines of force at right angles until it is again in a position parallel to them. From this we may conclude that as the loop makes one revolution, the current increases as the loop moves from 0 to 90 degrees, decreases from 90 to 180 degrees, and then repeats this progression and declination from 180 degrees to 360 degrees.

WHY CURRENT ALTERNATES.

The principle on which electric current alternates is this: An increase in the number of lines of force embraced by a circuit induces a current in a certain direction, depending upon the direction in which the conductor cuts the lines of force. (In the accompanying diagram 5, it would be away from the observer, on the left side of the loop and toward him on the right side.) And a decrease in the number of lines of force embraced within the circuit induces a current in the same direction in which the hands of a clock move. Applying this to the diagram, we may say that when the loop moves down 90 degrees from a vertical position, on the side marked N, and up on the side marked S, the number of lines of force embraced within the rectangular loop gradually decreases, and consequently the current induced will be in the direction in which the hands of a clock move. In this case, it will be away from the observer on the side toward S and toward him on the side N. Now, as the loop changes its position with respect to the number of lines of force it cuts at right angles, the direction of the current induced changes.

It will be observed that each end of the loop is attached to a ring, known as a *collector ring.* These rings revolve with the loop and draw off the current in alternating directions, positive thru one-half revolution of the loop, and negative thru the second half of the revolution.

The next step in building up the action of the generator on the screen, is to remove the drawings of the loop and brushes from the background and to lay other celluloid plates upon it. One of these (figure 5) is a view of an "H" armature; the second (figure 6) is a view of the loop, and the third (figure 7) is the "H" armature containing many loops wound in the form of a coil. The action previously outlined takes place in greatly increased measure within the armature shown in diagram 7. By removing the single black loop and substituting a cross-sectional view of the interior of the armature, an idea may be obtained of the mass of wire within it. As the strength of a current depends upon the number of wires cutting the lines of force, it is evident that the desirable condition is obtained when a great number of wires are wound closely together in the armature. Figure 8, the lower and final stage here shown, shows the current being taken off by means of brushes and slip rings.

Electricity from Water Power

By H. WINFIELD SECOR

(*Continued from page* 395)

ing with a wooden mallet over a mandrel of the proper shape, and the securing tabs or bent over ribs also formed. These securing tabs may be drilled for rivet holes before being bent over if desired.

POWER OF WATER MOTORS

(Extracts from Kent's Handbook)

Size inches	Head in ft.	Pressure lbs.	Spouting Velocity ft. per M.	Revolutions per M.	H. P.
6	20	8.66	2151.97	684	.05
6	30	12.70	2635.62	837	.10
6	40	17.32	3043.39	969	.15
6	50	21.65	3402.61	1038	.21
6	60	25.98	3727.37	1185	.28
6	70	30.31	4026.	1281	.35
6	80	34.64	4303.99	1368	.43
6	90	38.97	4565.04	1452	.51
6	100	43.30	4812.	1530	.60
6	120	51.96	5271.30	1677	.79
6	140	60.62	5693.65	1812	.99
6	180	77.94	6455.97	2049	1.45
12	80	34.64	4303.99	684	1.00
12	140	60.62	5693.65	906	2.33
12	180	77.94	6455.67	1024	3.39

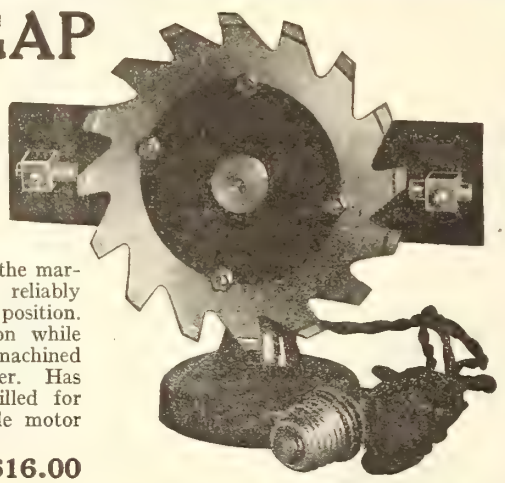
12-INCH REGULAR TURBINE WHEEL (JONVAL TYPE)

This wheel uses eighteen square inches of water.

Head in ft.	Cubic ft. Discharged per M.	Revolutions per M.	H. P.
6	147.0	368	1.25
10	190.2	451	2.70
15	232.8	558	4.96
20	268.8	644	7.65
22	282.0	673	8.81
25	300.6	711	10.67
28	317.4	747	12.62
30	329.4	768	14.03

ROTARY GAP

Cat. No. YM1



A new development in the rotary line has been made expressly for Young & McCombs. Improvements on the well known saw tooth rotary wheel, make this gap the equal in tone and efficiency to any selling for twice the money. It is the only gap on the market which will run smoothly and reliably in either a horizontal or vertical position. Can be run in a vertical position while screwed to the wall. Rotor is machined cast aluminum with formica center. Has liberal sparking space and is drilled for either 1-4 or 3-16 shaft. Variable motor speed switch in base.

Price, complete - $16.00

ROTORS ONLY

YM1a—Rotor and standards only.....$7.00
YM1b—Standards with base and binding posts 2.50

ROTORS AND STANDARDS

YM2—Plain rotor, as illustrated.....$4.50
YM3—Saw-tooth rotor, designed for Harmonic Chord tone..... 4.75

Send 4c in stamps for 50-page Catalog

Young & McCombs

L. P. BEST PRES.

ROCK ISLAND, ILL.

Address Orders to Dept. 67

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.

Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. Guaranteed by the maker. Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.

EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.

FREE TO PHOTOPLAY WRITERS

A wonderful book, illustrated with 100 potographs, of stars, directors, producers, scenes in the filming, studio interiors and exteriors. Literally takes you on tour of the great Motion Picture Studios.

It tells how Adrian Johnson, author of 300 produced photoplays by formulating a simple, practical, followable system of screen writing, has brought this fascinating profitable profession to your very door.

It is a system for persons of average intelligence. You need not be a "genius" to master it.

Send no money. Get this beautiful souvenir book today, for the asking.

The Adrian Johnson Photoplay System
111 American Theatre Building, New York, N. Y.



Navigation
Taught by Mail

Be a ship officer in merchant marine—earn big money — see the world. Captain Warren Sheppard's Course on Ocean, Coast and Lakes Navigation ready. Officially adopted by the U. S. Navy. Endorsed by Merchant Marine. Merchant ship officers earn up to

$412 per month and expenses

Whether you are on the sea or intend to go, enroll now. Send today for valuable illustrated booklet, "Your Future is on the Seven Seas." It is free.

WORLD TECHNICAL INSTITUTE
Dept. "E", Fuller Building, Jersey City, N. J.

You Can Have Strong Arms



POWERFUL BACK, CHEST, MILITARY SHOULDERS, SHAPELY LEGS, and a HEALTHY STOMACH.

All of the above can be obtained by following the instructions in my book, Strong Arms, which contains a complete course in physical culture that will develop all parts of your body to perfect proportion. The exercises are illustrated with 20 full page half tone cuts and require no apparatus. Send 25c in coin.

300,000 COPIES SOLD

Send your order today before you forget.

Prof. ANTHONY BARKER, D. C.
Studio 562
127 West 42d Street, New York City

What 15 Cents Will Bring You From the Nation's Capital

The little matter of **15 cts.** in stamps or coin will bring you the Pathfinder **13** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for the Nation; a paper that prints all the news of the world and tells the truth and only the truth; now in its **27th** year. This paper fills the bill without emptying the purse; it costs but **$1** a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, briefly—here it is. Send **15c** to show that you might like such a paper, and we will send the Pathfinder on probation 13 weeks. The 15c does not repay us, but we are glad to invest in new friends.

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, Box 1176 Washington, D. C.

LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries —thousands needed today. We give you personal and thorough training—practical, technical courses 3 months to 2 years under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. **Not a trade school.** Training is condensed—if your time is limited, come to the **Finlay Engineering College**—only one of its kind in the West. Day and night sessions—enroll anytime. Write for **FREE** catalog, a post card will do.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.



SAVE 25% to 60%
on slightly used
GRAFLEX-KODAKS

Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 10 days' Free Trial. Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.

CENTRAL CAMERA CO., Dept. 118 124 S. Wabash, Chicago

THE "MASTER KEY"

By CHARLES S. WOLFE.

(*Continued from page* 374)

marvelous happenings of fiction. The dispute grew rather hotter than either of us liked, and—well, we ended in a bet.

"Fair offered to bet me five thousand dollars that he personally could demonstrate to a selected committee that the mysterious entrance or exit from a room as described in this book was quite possible. I accepted the wager.

"The committee was selected, and the conditions agreed on. He was to enter a room from which no unaided exit could apparently be made. He was to be allowed the entire night in which to effect his escape. If he succeeded, I agreed to find him within 48 hours, and to explain how he got away or forfeit the wager.

"The arrangements were made, and he entered the selected room at eight last evening. This morning we forced an entrance to that room. He has disappeared!"

Fenner made no effort to conceal his grin. "Put one over, eh? Any idea how he managed it?"

"Not the slightest," confest Watson, dejectedly. "Apparently it is impossible. Yet he is gone. My forty-eight hours are slipping away rapidly, and it seems as if I am slated to lose. I don't mind the money at all, you understand. I would give the little devil that much if he asked for it. It is the idea of having the young jackanapod hoodwink me in this fashion that makes me determined to find him if I can. Yet I haven't an idea where to begin. Now I am making you this offer. Solve this riddle for me, and the money I win you may have. Of course, I rely on you to keep secret the fact that you aided me."

"That's a pretty stiff condition," objected Fenner, "for how I am to get a look at the scene of this mysterious disappearance without someone noting my presence there, and how I am to trace the movements of Fair without following any trail he may have left without seeing it is more than I can imagine."

"That you can easily do," returned Watson. "The selected room was in the Commercial House. This morning we forced the door, doing some little damage. I told the proprietor that I would send workmen around to make the necessary repairs. You may represent yourselves as locksmiths without arousing any suspicion."

"Right," Fenner agreed, cheerfully, "and now, Mr. Watson, give me a concise account of Fair's last movements."

"We finally chose a room on the twelfth floor. Fair accepted this room without comment, and it suited me. It opens onto a long corridor, which leads to the elevator. It is much like the other rooms on that floor. The reason that it appealed to me was that it was situated quite a distance from the fire escape. In fact, it is inconceivable that Fair past out thru the windows of the room."

"Granting that he had the nerve to venture out over the abyss, couldn't he reach the roof?" queried Fenner, quietly.

"Watson shook his head in negation. "Three stories above, and the out jutting cornice, you know. Practically no hand or footholds on the surface of the wall. I don't imagine a cat could make it. I think we can eliminate the windows. The hotel proprietor assures me that there are no secret passages, spaces between the walls or anything of that sort in the building. I take his word for it. Now as to the doors. There are two. The one leading into the room from the corridor by which Fair entered, and one within the room in the left wall, leading into an adjoining room, which also has a door opening into the corridor.



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This Course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years.* You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

TAKE 10 LESSONS FREE So that you may see for yourself how thorough and complete our training is. We invite you to take *ten lessons* in the High School Course—or any Course of specialized training in the Coupon below—before deciding whether you wish to continue. If you are not then satisfied you are not out one cent. *We absolutely guarantee satisfaction.* On that basis you owe it to yourself to make this test.

Check and mail the coupon NOW for full particulars and Free Bulletin.

AMERICAN SCHOOL
OF CORRESPONDENCE
Dept. H. C. 26, Chicago, Illinois

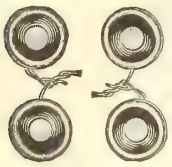
TRAINING—THE KEY TO SUCCESS

Please explain how I can qualify for the position marked X

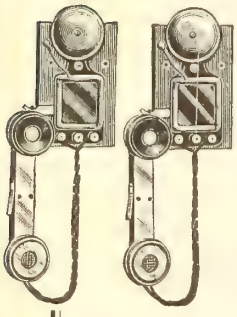
..High School Graduate	..Lawyer
..Electrical Engineer	..Business Manager
..Elec. Light & Pr. Supt.	..Certified Pub. Accoun't.
..Hydroelectric Engineer	..Accountant & Auditor
..Telephone Engineer	..Bookkeeper
..Telegraph Engineer	..Stenographer
..Wireless Operator	..Fire Insurance Expert
..Architect	..Sanitary Engineer
..Building Contractor	..Master Plumber
..Civil Engineer	..Heating & Vent. Eng.
	..Automobile Eng.
..Structural Engineer	..Automobile Repairman
..Shop Superintendent	..Airplane Mechanic
..Steam Engineer	..General Edu'n Course
..Draftsman & Designer	..Common School Br'ch's
..Photoplay Writer	..Employment Manager

Foreman's Training Course

ORIGINAL TRADE-MARK MECANEL ELECTRIC TELEPHONES







SET NO. 1—This set is a very desirable outfit for the experimenter. Contains carbon transmitters and mono-coil receivers. Can be taken apart and reassembled without affecting instruments. For connecting, use bell-wire and two batteries for distances up to 200 ft., for further distances add additional batteries. The instruments are 2½" x 1" and ruggedly made. **PRICE $1.00.**

SET NO. 2—A highly developed set, similar to those used by the Signal Corps of the U. S. Army during the recent war. Can be put up in a few moments practically ANYWHERE. This set is proving very popular amongst the BOY-SCOUTS both in the United States and Canada. In connecting, it only requires two wires or one wire and a ground. **SIMPLE DIAGRAMS AND DIRECTIONS WITH EACH SET. PRICE $1.50.**

SET NO. 3—This is a real SIGNALLING TELEPHONE SET and not a cigar-box contraption as the ordinary run of low-priced telephones prove to be and is the result of long and costly experimenting and is the only one made whereby you can TALK AND RING OVER ONLY TWO WIRES or one wire and a ground. A special constructed CUT-OUT-HOOK-BELL does the trick. When making a call, simply lift telephone off hook, you will then hear a buzzing sound in your receiver which indicates that a BELL is ringing at the other end and which will continue to ring until someone answers by lifting their telephone off the hook, presses his switch and you both are now ready to talk. Can be put up in about 15 minutes with bell wire and batteries. Saves many a step and lots of walking for it can be used over distances of several hundred feet. Requires no special skill in installing. **SIMPLE DIAGRAMS AND DIRECTIONS WITH EACH SET. PRICE $5.00.**

WE GUARANTEE these telephones to work satisfactorily or money refunded.

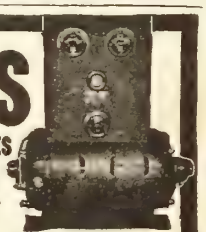
If your dealer does not handle MECANEL TELEPHONES write us direct enclosing CASH, CHECK or MONEY-ORDER and we will ship postpaid.

INLAND SPECIALTY CO.
1562 N. Robey St. Chicago, Ill.



NEW MOTORS

FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES



Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle 1800 R. P. M. with pulley

1/4	H. P., 110 volts, induction, full load start	$28.50
1/2	H. P., 110-220 volts, induction, full load start	$38.50
1/2	H. P., 110-220 volts, repulsion, for compressor	$52.50
1	H. P., 110-220 volts, repulsion, with sliding base	$76.50
2	H. P., 110-220 volts, repulsion, sliding base	$116.50
3	H. P., 110-220 volts, repulsion, sliding base	$142.50
5	H. P., 110-220 volts, repulsion, sliding base	$184.50

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

6 volts, 10 amp.	$19.50
16 volts, 10 amp.	$24.50
40 volts, 6 amp.	$31.50
110 v. 2½ amp.	$31.50
110 volts, 5 amp.	$46.50
40 volts, 30 amp.	$78.50
110 volts, 10 amp.	$106.50
110 volts, 16 amp.	$146.50
Moving Picture Arc Generator 60 v., 35 a.	$106.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60c., 1750 R.P.M., complete with base and pulley.

½ H. P.	$46.50
1 H. P.	$64.00
2 H. P.	$81.00
3 H. P.	$96.00
5 H. P.	$112.00
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only	$36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase. Voltage as specified.

110-220 v., A.C., 150 watts, 15 v., with switchboard	$68.50
110-220 v., A.C., 150 watts, 30 v., with switchboard	$68.50
110-220 v., A.C., 175 watts, 24 volts, with switchboard	$68.50
110-220 v., A.C., 250 watts, 50 volts, with switchboard	$88.50
220 volts, 2 phase, 600 watts, 24 v., without switchboard	$75.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS



1/4 H.P. SPECIAL 110 volts A.C., 60 c S. P., 1750 R.P.M. Complete, cord, plug and pulley



WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. **$22.75 Each** Reg. Val. $32.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 12, West End, Pittsburgh, Pa.

WIRELESS TELEPHONE COURSE

Covering Theory and Practice of Electricity—Radio—Blue Print Reading and Wireless Telephony. 4 in 1 Course. Our easy payment plan places this course within reach of anyone who wishes to better themselves. Immediate action will assure you of a good future. Don't delay.

FREE Audion tube, experimental electrical outfit, and other apparatus furnished each student, FREE. Write TODAY to

CHICAGO ELECTRICAL ENGINEERING CO.

Dept. W. 1000 Diversey Parkway Chicago, Ill.

"Both these doors have ordinary locks, not dead latches. For this reason, I suppose, they have also bolts. There is a bolt on the inside of the door which opens on the corridor, and a bolt on the door within the room. There is a bolt on the other side of that door, by the way, within the adjoining room. I looked this morning. And for the occasion we put a bolt on the outside of the corridor door.

"When Fair entered the room we shot this outside bolt. He shot the one on the inside. That's why we had to force our way in this morning. That bolt on the inside was still in place. So also were both bolts on the other door. And there you are."

Fenner arose. "Your description of the conditions is good, Mr. Watson," he said, "and now Bill and I will become locksmiths and go down and see if we can do anything for you. If I am able to help you out, I'll call Davidson on the 'phone."

"Do that," agreed Watson, "and remember, the money is all yours if you can successfully unravel this mystery."

Fenner nodded, and we past out, leaving Watson seated at the table. As we past thru the outer office, Davidson favored us with a wink and a grimace to which Fenner replied by forming with his hands a very creditable imitation of the long ears of a mule.

We made our way to Fenner's house, attired ourselves in working clothes, took a few tools, and caught a downtown car. As we rode I ventured to question Fenner, hoping that he might have a possible solution to the riddle. He proved non-committal.

"Wait, Bill," he said, "until we have had a first-hand look at the scene of this fourth-dimensional chap's activities. Let us form no theories until we know all that is to be known about the case."

"Watson's description was quite lucid," I replied, "and if things are just as he described them, the trick seems impossible to me. Fair couldn't have flown, you know."

"No matter how impossible it may seem," rejoined Fenner, "you are face to face with the fact that when they broke into the room this morning Fair was gone. That, I take it, is proof enough that it is quite possible. Here we are."

On stating our errand to the manager, we had no trouble in securing admission to the room, and the departing bell hop left us alone in the room from which Fair had contrived to find an exit.

The damage to the door was trivial and Fenner set about making the few necessary repairs. "You search carefully, Bill," he said, as he applied himself to the task of replacing the torn off bolt and its keeper, "and make sure that our young friend is not here, disguised as a bed or a clothes tree."

Ignoring the banter I did make a thoro examination of the room, having come to the conclusion on the way down that Fair might just possibly have remained in the room, avoiding detection by some clever expedient.

My efforts were fruitless, however, for a search convinced me that he could not possibly be in hiding within the room.

Conditions were just as described by Watson, there being no disorder or sign of unusual physical effort to suggest a possible answer to the enigma. A glance out of the window assured me that Watson had spoken the truth. Just to fancy a human being clinging to the surface of that wall at that height was sickening, and I felt convinced that Fair had not made the fire escape. Yet the bolted doors seemed proof that he had not past thru either of them, for it is possible to lock a door after you, but hardly so to bolt one on the other side of a closed door. Also the fact that there were bolts on the outside of each of these

doors made it look like a rather difficult proposition for him to have opened them at all, let alone bolting them behind him.

The ceiling, examined from the vantage point of a chair, was as fruitless of clues as the previously scrutinized floor.

"And now," said Fenner, after these details had been attended to, "we will take a leaf from Watson's book, and have a look at the adjoining room."

By means of an ordinary skeleton key we readily got into this chamber thru the corridor door. I prepared myself for another thoro search, but Fenner stayed me, "No use, Bill," he said; "let's go."

Mystified, and a little rebellious, I followed him from the room, and we made our way to the street.

As we walked along, Fenner hummed softly under his breath.

"It wouldn't have done any harm to have taken a look around that room," I grumbled, "on the off chance. While he's not likely there, we might have made sure."

"Nor would it have done us any good. Ah! there's a telephone booth. Wait here until I get Davidson and kiss that five thousand good-bye."

"Are you giving it up?" I demanded, amazed and hurt. "Let's go back and have another try."

"Not on your life," said Fenner, grimly. "Lead us not into temptation. If I go back there I may be tempted to collect that money."

"You'll never collect it this way," I demurred.

"My boy, I don't want to collect it," retorted Fenner. "I don't need money that bad. Watson's a short sport, or he would have seen this thing thru himself, and not asked to buy the brains which he apparently lacks. Fair on the other hand has proved himself the possessor of some real gray matter. Get me? I'm going to be something of a good sport myself and not give him away."

I laughed, shortly. "Give him away," I echoed. "I hardly think you will!"

Fenner stopt short in his tracks, nettled. "Say, you ass," he said, sharply, "you don't think I'm stumpt, do you? Let me tell you something, fellow. I know where that lad is at this very moment."

"You do?" I yelled. "Then where in blazes is he?"

"In that room that I wouldn't let you search, my boy," rejoined Fenner, complacently, gratified by my startled expression. "That's why I literally dragged you out. I didn't want you to flush the poor lad and spoil it for him. He was in that big closet, sticking out his forty-eight hours."

"He was?" I demanded, in amazement. "How did he get thru that bolted door?"

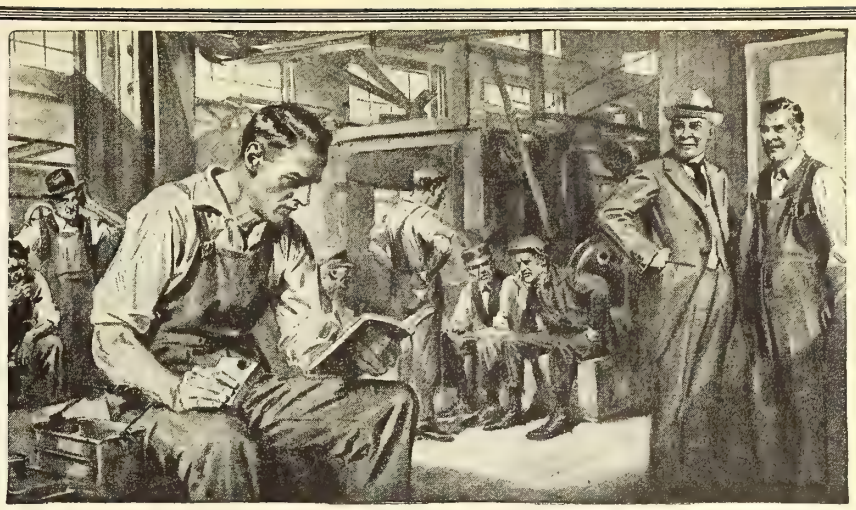
"Easiest thing in the world," chuckled Fenner. "A cinch. He had the MASTER KEY."

"A master key for a bolt?" I demanded, incredulously.

"A master key for a bolt," Fenner said quietly. *"A nice little electro-magnet and some lamp cord.* Simple, wasn't it. Hook right into the lamp socket and shoot the bolts about at will. He figured, and rightly enough, that the fact that all those bolts were found safely in their keepers would ward off all suspicion that he merely stept into the adjoining room. He was right when he told Watson that things happen in every day life that are stranger than fiction. Maybe that worthy will believe him now."

"Good night!" I murmured, dazedly. "I never thought of that method—never suspected the trick."

"I did," replied Fenner, "and just the moment that I saw those bolts were of steel and not brass ones, I knew that I was right. Gee! Couldn't we have rigged up some station with those five thousand iron men!"



"Keep Your Eye on Jim!"

"It's not alone what a man does *during* working hours, but *outside* of working hours—that determines his future. There are plenty of men who do a good job while they're at it, but who work with one eye on the clock and one ear cocked for the whistle. They long for that loaf at noon and for that evening hour in the bowling alley. They are good workers and they'll always be just that—ten years from now they are likely to be right where they are today.

"But when you see a man putting in his noon hour learning more about his work, you see a man that won't stay down. His job today is just a stepping-stone to something better. He'll never be satisfied until he hits the top. And he'll get there, because he's the kind of man we want in this firm's responsible positions. You can always depend on a man like Jim.

"Every important man in this plant won out in the same way. Our treasurer used to be a bookkeeper. The sales manager started in a branch office up state. The factory superintendent was at a lathe a few years ago. The chief designer rose from the bottom in the drafting room. The traffic manager was a clerk.

"All these men won their advancements through spare time study with the International Correspondence Schools. Today they are earning four or five times—yes, some of them *ten* times as much money as when they came with us.

"That's why I say that Jim there is one of our future executives. Keep your eye on him. Give him every chance—he'll make good!"

Employers everywhere are looking for men who really want to get ahead. If *you* want to make more money, show your employer that you're trying to be *worth* more money. If you want more responsibility, show him you're willing to *prepare* yourself for it.

For 29 years the International Correspondence Schools have been training men and women right in their own homes after supper, or whenever they had a little time to spare. More than two million have stepped up in just this way. Over 110,000 are studying now. Ten thousand are starting every month. Can you afford to let another priceless hour pass without making *your* start toward something better? Here is all we ask—without cost, without obligation, mark and mail this coupon. It's a little thing that takes but a moment, but it's the most important thing you can do today. Do it now!

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6242, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Car Running	☐ Outdoor Sign Painter
☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ BOOKKEEPER
☐ Mechanical Draftsman	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Ship Draftsman	☐ Traffic Management
☐ Machine Shop Practice	☐ Commercial Law
☐ Gas Engineer	☐ GOOD ENGLISH
☐ CIVIL ENGINEER	☐ Common School Subjects
☐ Surveying and Mapping	☐ CIVIL SERVICE
☐ MINE FOREM'N OR ENG'R	☐ Railway Mail Clerk
☐ ARCHITECT	☐ STATIONARY ENGINEER
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

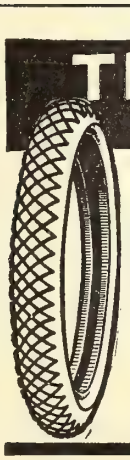
Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

TIRE PRICES CUT
FROM OUR FACTORY TO YOU
6000 MILES GUARANTEE

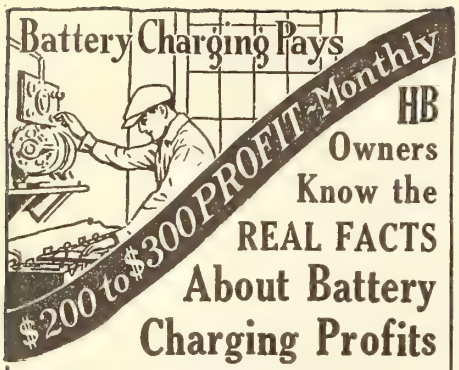


Our double tread reconstructed tires save you time, energy and money and do away with tire troubles. Our tires cannot be compared with ordinary double tread or triple fabric tires of inferior make. Our reputation and success is due to the fact that we spare no time or money to make our tires excel in quality and durability. Our tires are used from Coast to Coast. Ask your banker about us. Reliner Free with every Tire. Tubes are guaranteed fresh stock.

Size	Tires	Tubes	Size	Tires	Tubes	Size	Tires	Tubes
30x3	$6.00	$1.75	32x4	$8.75	$2.60	36x4½	$12.00	$3.40
30x3½	7.00	2.00	33x4	9.00	2.75	35x5	13.00	3.60
31x3½	7.25	2.10	34x4	9.25	2.85	36x5	13.25	3.70
32x3½	7.50	2.25	34x4½	10.50	3.00	37x5	13.50	3.75
31x4	8.50	2.50	35x4½	11.50	3.15			

Send $2 deposit for each tire and $1 for each tube ordered, balance C. O. D. Tires shipped subject to your examination. State whether S. S., C. L. (Q. D.) plain or N. S. is desired. All same price.

NATIONAL GOOD-WEAR TIRE CO., 1113 Washington Blvd., Dept. 220, CHICAGO



HB Owners Know the REAL FACTS About Battery Charging Profits

Letters from all parts of the country tell us about BIG PROFITS with HB Equipment, running from $100 a month as high as $300. Many make even more.

YOU, too, can have BIG PROFITS just like these

With an HB Charger, it costs you 10c to 15c each to charge batteries. Customer pays 75c to $1.50. Think of that for BIG PROFITS! HB Chargers have no delicate parts to wear out, no burn outs or expensive renewals. Built for hard, steady, money-making service. HB Equipment will be running long after less efficient chargers have been discarded.

Small Cash Payment Starts this Big Business

HB Charges are sold on long, easy terms extending over almost a year's time, and you can have one by making a small cash payment. The profits from your battery charging should easily pay the balance. If you find that your HB Charger is not suited to your needs you can return it any time within ten days and get your money back.

Choose the Size You Need USE THE COUPON!

There is an HB Charger to suit any size battery business. Pick the size you need and mark a cross on the picture in the coupon. Then tear out and mail. Remember you run no risk. Send the coupon TODAY.

TEAR HERE

HOBART BROTHERS COMPANY
Box 87E, Troy, Ohio

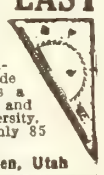
Send me complete information about the HB Charger marked (X), also details of your Easy Payment Plan.



Name .....

Address..... State.....

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only 85 cents Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah

Become a Specialist in Accountancy

Write today for particulars of the most unusual course of its kind in existence. Learn how you may get a thorough training in this remarkably profitable profession and besides become a specialist in any branch you may elect. C. P. A. instructors of highest standing. **FREE BOOK** tells just what you want to know. Address—

International Accountants Society, Inc.
Dept. 821 2626 S. Michigan Ave. Chicago, Ill.



$4 AND $5 WILL BUY
a month
A Beautifully Reconstructed TYPEWRITER
With Every Modern Writing Convenience

WRITE TODAY FOR ILLUSTRATED CIRCULAR Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER OVERLAND, MO.

Electric Sand-Hog to Salvage Ships

By ERIC A. DIME

(*Continued from page* 357)

tion of the machine contains an electric motor and the mechanism used for guiding the device while in operation. All the machinery is enclosed in a watertight metal casing. The burrowing apparatus is connected by means of a cable to the wrecking tug above. The cable contains the feed wire for the motor and other wires employed for controlling the speed and direction of the device, as it is digging its way.

LOCATING THE WRECKED SHIP.

Operations begin with the location of the wreck. Various methods may be employed for this purpose. If the ship rests at a depth of a hundred feet or less, it can be located by means of an airplane. Cases are on record where aviators have located wrecks because these appear like a dark shadow to the men flying at heights of from 500 to 1,000 feet. Should it happen that the vessels lie at depths of more than a hundred feet, they may be located by means of a drag-line attached between two tug boats. The boats may be separated to a distance of from 1,000 feet to a quarter of a mile, and the wide sweep of the line would be caught in the wreck and the latter thus located. Still another method of finding the resting place of an ill-fated ship is by means of an electrical detector. This consists of a coil of wire attached to the end of a cable dragged along the bottom of the sea, as suggested by Dr. Alexander Graham Bell. When the coil approaches the metal of the ship or some other metal part, it will change the electrical inductance in a telephone circuit connected with it.*

When the ship has been found, the burrowing machine is lowered close to the wreck and a diver is despatched from the wrecking tug. If the vessel is in shallow water, the diver may be equipt with an ordinary diving suit. On the other hand, if the wreck is at such a depth that the water pressure is too great for a diving suit made of fabric, a metal diving suit is employed. There is so little work for the diver to do that the necessary movements with the arms can be done, even if heavy water pressure should interfere with the action of the joints in the arms and legs of suit. Mr. Saliger has designed a metal diving suit which, he claims, has more freedom of action than those in use today.

The diver places the burrowing machine in the right position for the first hole or passage and then signal by means of a telephone to the men on the tug to start the motor in the machine. When the latter has dug in, the diver is raised to the surface to wait until the *mechanical mole* has finished its course under the hull of the ship. Then the diver is lowered again and he attaches a cable from a derrick on the wrecking tug to the nose of the burrowing machine which is hoisted to the surface.

An ingenious feature of this sub-sea mole is the mechanism by which its course can be controlled by the operator on the tug above. The position or angle, which the device holds as it burrows away, is automatically registered by means of small electric lights with colored bulbs on a control board in front of the operator. For example, when the nose of the machine is pointing downward at, say, an angle of 45°, this position is registered by one set of colored lights, white, for instance. Should the machine move on an even keel, this would be indicated by blue lights, and when the nose points upward, as it must when emerging on the opposite side of the ship, red lights would be the signal for this.

*See article on detecting submerged ships in our October 1919 issue.

REBUILT ELECTRIC MOTORS

General Electric
Westinghouse
Crocker-Wheeler
Emerson
Century
Wagner
etc.



All Motors Guaranteed For One Year

Motors bought, exchanged and repaired
ELECTRICAL SUPPLIES
Wholesale Prices
Sockets, wire, tape, loom, fuses, switches, cut outs, etc. New illustrated catalogue free. Satisfaction guaranteed or money refunded.
HYRE ELECTRIC CO.
631 S. Dearborn St. Chicago, Ill.

Handwriting Tells You Secrets

Be successful. Find out what holds you back. Send us an ink specimen of your handwriting and $1.00. Our expert Graphologists will tell you your faults, virtues, talents, etc. Your $1.00 back if you are not satisfied.

ROBERT R. ROSS, 110 West 40th St., N. Y.

Sanity in Sex By WILLIAM J. FIELDING

Price $1.75, postpaid
A popular presentation of the vital problems of sex. Intensely interesting. Gripping. Frank. Convincing. Descriptive circular free on request.

DODD, MEAD & COMPANY
445 Fourth Avenue New York

YOUR FUTURE

depends upon the use you make of present opportunities. Write now for literature explaining our day and evening courses in Chiropractic, the greatest science of the age. Hurry for prices advance soon. New classes forming now.

The New York College of Chiropractic
1416 Broadway, New York City

You can be a DRUGLESS PHYSICIAN

A well-paid profession is open to you. The field beckons to both men and women. Combined home study and college course. Heal without drugs. Free catalog. International College of Drugless Physicians, Dept. F.E.8 4200 Grand Blvd., Chicago.

Chicago Medical School

Offers Accredited
DAY AND EVENING COURSES
in medicine and surgery leading to the degree of DOCTOR OF MEDICINE. Also offers through its affiliated college opportunity to complete premedical credits. WORK YOUR WAY PLAN.
Address **REGISTRAR**
3832 RHODES AVE. Dept. 7 CHICAGO

MEN

Intensely interesting booklet free.
Wonderful results.

Winslow H. Chase, Washington, D. C.

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
DEPT. 774C 431 So. Dearborn St. CHICAGO

TELEGRAPHY

(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.

DODGE'S INSTITUTE A Street, Valparaiso, Ind.

STAMMER NO MORE

Kill the *fear* of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Order a copy today. **THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago, Illinois**

Electrical Engineering In One Year

men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete



Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 28th year opens Sept. 29, 1920
BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

The ROGERS
Violet Ray, High Frequency Generator
Does not burn out. No sparking—therefore all shocks are eliminated. An ideal outfit, fully guaranteed as to material and workmanship.
PRICE COMPLETE With One Surface Applicator $25.00
Send for free descriptive Booklet
The Rogers Electric Laboratories Co.
Dept. B, 2056 E. 4th St., Cleveland, Ohio

Small Steam Engines and Boilers



Gas and Gasoline Engines, ⅛ H. P. up; Tanks, Pumps, Gears, Model Maker's Supplies. Get our Big Catalogue sent postpaid for 15c (coin preferred) or stamps. Refunded first order. 192 Pages—over 200 Illustrations.
MODERN ENGINE & SUPPLY CO. 346 Monadnock Block, CHICAGO.



Phonograph Owners, Attention—The Ear-O-Phone when placed over the ear, collects a musical tone and brings it to the ear in an intensified form, clarifying it so that it sounds more natural with increased volume. You get a strong overtone too. Only 3 by 2 inches in size. (State for which ear it is intended.) Made in Oak, Walnut and Mahogany, price $3.50 postpaid. Send P. O. or Exp. money order. Address
THE EAR-O-PHONE
1413 North Broadway
Los Angeles, Calif.

Learn Autos & Tractors Earn $100 to $400 Per Month
Qualify right away for a good paying job and bright future in the Auto and Tractor field. At our great school, under expert instruction, you can learn to operate, adjust and repair all makes of Autos, Tractors, Trucks and Gas Engines. Including complete automotive electricity. Low tuition now. Work with actual tools. Write at once for particulars.



FREE A fine kit of 29 tools given to everyone who enrolls now. Send for free book. Get full information.
MILWAUKEE MOTOR SCHOOL, Dept. 1168
555 Downer Ave., Milwaukee, Wisconsin

"Lighting Fixtures"
Ready to Hang
(Direct from Manufacturers)
Completely wired, including glassware. New designs.
Send for catalogue No. 18
ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

Send for a Complete Catalog of
MASONIC BOOKS
Jewelry and Goods
REDDING & CO.
Publishers and Manufacturers
Dept. 5 200 Fifth Avenue, N. Y.

Fun, Magic and Mystery!
56 Feats in Magic, 250 New Jokes, 21 Puzzles, 1 Fortune Telling Tablet, 52 Money-Making Secrets, 15 Card Tricks, 71 Toasts, 58 Verses in Comic Poetry, 10 Funny Readings, 41 Epitaphs, and 11 Parlor Pastimes. You get all the above-mentioned and our big illustrated Catalog of 125 Magic Tricks for only 10 cents. Write today.
DETROIT TRICK & NOVELTY CO.
454-456 Dix Avenue Detroit, Mich.

SELENIUM CELLS
Made by entirely new process. Highly sensitive and quick-acting. Suitable for all experiments. From $5 up.
Write for Catalog
Selenium Laboratories
Good Ground, Long Island, N. Y.

Should it happen that one propeller would cut its way thru the ground faster than the other, due to a possible difference of material thru which the device must burrow, thus diverting the machine from its correct course, the operator on the tug can correct this by increasing the speed of one propeller and slowing down the other. The distance covered by the machine thru the sand is determined by the number of feet paid out by the cable attached to the apparatus.

When the device has completed its course, under the hull of the ship, the diver must locate the machine. Under ordinary circumstances this would not be an easy matter. It is obvious that in the darkness prevailing at the ship's depth and that the nose of the machine is barely above—or flush with—the surface of the ocean's bottom, it would be difficult for the diver to pick out the particular spot, where it is to be found. This difficulty has also been overcome in a clever manner by the inventor. He has installed a little hammer, operated electrically, in the mechanism of the machine, and by pushing a button on the control board above, the hammer gives a series of sharp knocks by striking metal. By the noise thus produced, the diver is able to locate the burrowing device.

A CATERPILLAR TRACTOR HELPS THE SALVAGING WORK.

In addition to the burrowing machine, Mr. Saliger has invented a caterpillar tractor combined with hydraulic sluicing. This tractor is designed to take the place of the burrowing device, where the sea bed is of such a nature that the latter would not work.

This tractor resembles very much an armored tank, altho of miniature size. Its dimensions are four feet wide, three feet high and five feet long over all. It has caterpillar belts on top as well as below, the two sets being essential for propulsion where a tunnel is dug. The front of the tractor has hydraulic nozzles thru which water is forced at great pressure.

When all lifting cables have been placed under the wreck, everything is ready for attaching the pontoons. These are resilient and collapsible. They are made of rubber and strong fabric and when inflated have the shape of a gigantic football. A network of ropes surrounds the pontoons, thus helping the fabric, when inflated, to withstand the air pressure and at the same time serving as the support for the lifting cables.

The rigid wood or steel pontoons, which are universally used at the present time, have certain drawbacks. In the first place, they require a heavy hoisting and hauling equipment. Furthermore, they are impractical save in sheltered waters, because the slightest storm may wreck both the ship and the surrounding pontoons by pounding and grinding them together.

FLEXIBLE NON-DAMAGEABLE PONTOONS RAISE SHIPS.

In order to overcome these difficulties, Mr. Saliger devised his collapsible pontoons which require only one tugboat and its ordinary equipment. The secret of success of these pontoons is found in their construction and in the mechanical devices used in connection with them. Each pontoon has a lifting capacity of 25 tons. They are attached to the lifting cables under water in a deflated condition and the number required, of course, depends on the size of the ship. The pontoons may entirely encircle the hull, or, if necessary, surround it in rows of two or three deep. When they are once in position, the wrecking outfit above pumps air into all the units simultaneously. When all are fully inflated, it is evident that the ship must rise, thus obeying one of the immutable laws of nature.

Upon reaching the surface, the pontoon becomes a factor of protection instead of a menace to the prize. It acts as a buffer, protecting the ship from storms and shocks.



THE HEART OF THE HAMMOND
Interchangeable Type

One of the Greatest Achievements of Science and Invention.

Hammond MULTIPLEX

"Many Typewriters In One"

For the Mathematician, Engineer, Chemist, Astronomer, Surveyor, Navigator—there is no typewriter like the Multiplex Hammond! The Multiplex does many things that *no other typewriter* can do!

The Mathematical Multiplex contains the characters and signs used for writing in higher and lower mathematics, and for engineering, mechanics, etc., as well as for all the ordinary work that can be done on any typewriter. Just note these fine styles of Multiplex type—

TWO STYLES OF TYPE, or *two to five different languages,* carried on the machine AT ONCE. "JUST TURN THE KNOB" and change *instantly* from Roman Type, to *Italics,* or Miniature Roman, or our Beautiful Script Type, or from English to Greek, Russian, German, French, etc. *Any other type or language can be substituted in a few seconds.*

The above gives a slight idea of the versatility of the Multiplex which has literally revolutionized typewriting—has changed it from monotonous commercial work to the beauty of fine printing and engraving.

SEND FOR FREE BOOKLET showing the many languages and type sets of the Multiplex—Chinese Phonetic and Japanese Kata Kana—the latest in languages to be added to the many already available on the Multiplex.

Fill out the Coupon and mail to us *now*—before you turn this page and possibly forget. You incur no obligation.



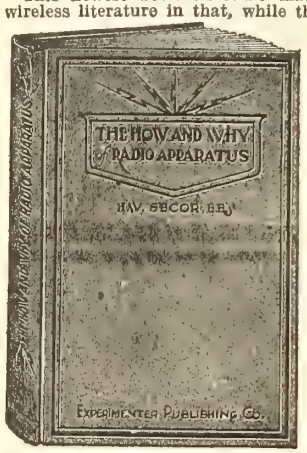
Also—an Aluminum PORTABLE Model
For Traveling—for home. Weighs about 11 lbs. Full capacity. Ask for special folder.

THE HAMMOND TYPEWRITER CO.
589 East 69th Street New York City
Name .....
Address .....
.....
Please write your occupation below.

NEW AND POPULAR BOOKS

The How and Why of Radio Apparatus
By H. W. SECOR, E. E.

This newest book on radio matters fulfills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathematics as possible, it at the same time, incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as teachers and students of the subject in general.



A very broad field has been covered by the author, at the same time giving a great deal of information not found in other text-books. If you are engaged in any branch of the Radio or allied arts at all, you will surely need this latest contribution to radio literature, which is destined to be found on every radio man's book shelf before long.

A glance at the following list of chapters gives but a very scant idea of the extensive and useful radio knowledge provided in its text:

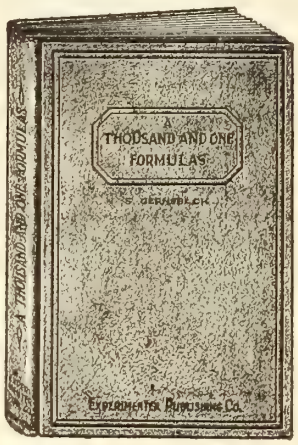
The Induction Coil; The Alternating Current Transformer; Radio Transmitting Condensers; The Spark-Gaps; Radio-Transmitting Inductances; Radio Receiving Tuners; Radio Receiving Condensers; Detectors; Telephone Receivers; Radio Amplifiers; Construction of a Direct Reading Wavemeter and Decremeter; Antenna Construction; The Calculation and Measurement of Inductances; Appendix containing very useful tables, covering all subjects treated in this very unusual book.

This newest of Radio Works, cloth bound in Vellum de Luxe, Gold stamped and Hand Sewed has 160 pages. Size of Book 6 x 9 inches.

The How and Why of Radio Apparatus, Postpaid.....$1.75

A Thousand and One Formulas
By S. GERNSBACK

A Laboratory Hand Book for the Experimenter and for Everybody who wants to "do things."



A Book, brimful with very important and priceless information, collected and selected for years.

The recipes and formulas are classified in such a manner as to be available at once, without long research.

Invaluable for Students, Engineers, Physicians, Experimenters, etc.

Here are some of the chapter headings:

Cements and Glues; Compositions of All Kinds; Glass and Glassworking; Inks; Leather Polishes; Metal-craft; Perfumery; Soaps and Extracts; Photography; Blue Print and other Paper; Plating; Pyrotechny; Polishes and Stains; Varnishes and Paints; Various Cleaning Formulas; Wood-craft; Chemical Laboratory Hints and Experiments; Mechanical Laboratory Hints and Experiments; Electrical Laboratory Hints and Experiments.

Besides there are a score of tables and hundreds of Illustrations and Diagrams.

Book is cloth bound in Vellum de Luxe.

Gold stamped and hand sewed.

It contains 160 pages. The paper has been especially selected to stand rough handling in laboratories.

Size 6 x 9 inches.

A Thousand and One Formulas, as described, Postpaid.....$1.75

Design and Construction of Audion Amplifying Transformers
Radio and Audio Frequency Type

This latest and important book by Mr. Edward T. Jones, late Associate Editor of *Radio News*, will be of great interest to all radio amateurs thruout the land. The transformers shown in these books have never been described in print before, and have usually been considered a manufacturer's secret. Anyone who has several vacuum tubes cannot afford to do without this book because it will enable him to build the necessary amplifying transformers very readily. The designs are very simple and rugged, and anybody can make them without trouble.

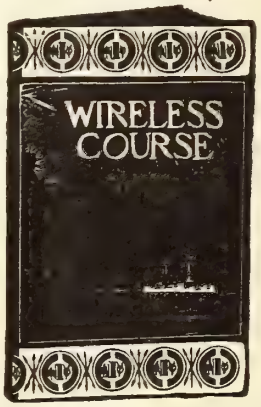


Mr. Jones, the author, is a practical man who is an experimenter himself and knows whereof he speaks. The book is printed on good paper and has an attractive cover in two colors. Paper bound. Size 5 in. x 7 in. Contains many illustrations, diagrams and working data necessary to build the transformers.

Price, Postpaid, 25c

Wireless Course in 20 Lessons
By S. Gernsback, A. Lescarboura and H. W. Secor, E.E.

A Course that tells you everything you want to know about "Wireless" starting off in lesson No. 1 by explaining the Principles of Electricity. By simple, easy stages, this wonderful Course takes you into "Wireless" by the use of such simple language so skillfully used that of necessity you must understand every word. There is a whole lesson devoted to the Theory and Mathematics of this epoch marking subject. The last lesson is devoted to a history of Wireless.



More than 50,000 of this course sold

(Eighth Edition)

Size of book is 7 x 10¼ in., 160 pages, 350 illustrations, 90 tables.

Flexible cloth cover, per copy.....75c

Stiff cloth cover, per copy...$1.25 Postpaid

Experimental Electricity Course in 20 Lessons
By S. Gernsback and H. W. Secor, E.E.



A Course on the theory and practice of Electricity for Experimenters. One of the most complete and comprehensive treatises of this special subject ever published. Written by the same authors as the famous "Wireless Course."

Every phase of experimental electricity is treated comprehensively in plain English. New Experiments are described and explained and nearly every application of Electricity in modern life is given in simple language.

The Best Electrical Text Book on the Market

Size of Book is 6 x 9 in.

The book contains 128 pages and more than 400 illustrations.

Flexible cloth cover, per copy.....75c
Stiff cloth cover, per copy.....$1.25
Postpaid

Two Remarkable Books

Book No. 1—How to make Wireless Sending Apparatus .. 35c Postpaid.



Book No. 1 contains 100 pages, size 7 x 5 in., and 88 illustrations.

Book No. 2 contains 100 pages, size 7 x 5 in., and 90 illustrations.

Written and published entirely for the wireless enthusiast who wants to make his own radio apparata. Only strictly modern instruments are described and the illustrations and descriptions are so clear and simple that no trouble will be experienced in making the instruments.

Book No. 2—How to make Wireless Receiving Apparatus ..35c Postpaid.



THE EXPERIMENTER PUBLISHING CO.

Book Dept., 233 Fulton Street **NEW YORK**



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries address to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

SPECIAL NOTICE.

Of late we have received so many letters from our correspondents regarding patent advice, that it has been quite impossible to publish all of them.

Altho printed in the smallest type possible, we cannot accommodate more than ten or twelve answers a month. At the present time we are about four months behind. Of course, if our correspondents have time, no harm is done! We would, however, advise that if a quicker answer is wanted, correspondents should avail themselves of our special service, as per the notice printed at the head of this column.

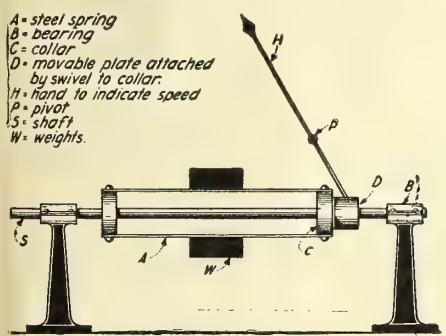
All letters are answered in turn as they come into this office, and for this reason it will be understood why it takes so long for an answer to be publisht. Will correspondents please bear this in mind?—EDITOR.

SPEEDOMETER

(396) Carroll Coleman, Muscatine, Iowa, writes: I would like to ask your advice on a speedometer of which I am enclosing a diagram.

The power would be transmitted to the end of the shaft in the ordinary way. The faster the shaft revolves the farther the weights would spread apart, causing the end with the movable plate to move closer the other end, also causing an increased movement at the other end of the hand.

A. This seems to be a good idea, and while similar schemes have been used in the past for other purposes, we have never seen it applied as a speedometer, and we think that it is possible that if the instrument would be self-contained, a patent could be obtained upon it.



INCANDESCENT LAMP.

(397) Mr. M. Maltz, Passaic, N. J., writes as follows: "I discovered a new method of lamp construction. The method does away with stem making, flare making, sealing in, and combines basing and exhausting of lamps in one operation. The base has copper lead wires soldered to sides and bottom, base is then filled with compound and filament attached. When proper degree of vacuum is obtained, bulb settles into compound, sealing itself therein."

A. The idea is highly ingenious and quite clever, but the only draw-back is that the heat of the lamp will sooner or later soften the sealing compound and get into the lamp.

Even if a compound not affected by heat were used, we doubt if a sufficiently good vacuum would result for ordinary purposes.

DRAFTING INSTRUMENTS.

(398) Mr. D. Guigue, Montreal, Can., has this to say:

Will you please give your opinion as to patentability, etc., of the following idea for improvement in drawing instruments?

Pieces 1/16" thick are glued on to triangles as indicated by sketch. Of course, instead of pieces being glued on, the angles could be formed in one piece. The advantages are: 1st—There would be no danger of the ink getting under the edge of the instrument and making blots when drawing lines. 2nd—There being a space between the pieces, the instruments could be used over wet lines.

A. The idea is a very good one, altho similar appliances are on the market today, and we doubt very much if a patent could be obtained upon the slight improvement. A design patent might be obtained, and we advise our correspondent to get in touch with a patent attorney.

RATCHET WRENCH.

(399) Johnson A. Holmes, Manchester, Kansas, submits a design of a new ratchet wrench which works on a novel principle. This wrench does away with the necessity of taking off the wrench each turn and putting it on again; hence, it saves time and also works better in a tight place.

A. A very clever idea, and we are sure a patent can be obtained upon it. There is a good demand for such a wrench on the market at the present time, and if it can be sold at a reasonable cost, we should think there would be a wide demand.

SEALED-IN DETECTOR.

(400) Albert Ruff, Superior, Wis., states: I have made several permanent crystal detectors by sealing the catwisker onto the mineral with a certain compound. I have made permanent detectors by this method that copy Arlington at a distance of 900 miles with a comparatively simple amateur outfit. The detectors remain permanent indefinitely with proper handling and require absolutely no adjustment. I am enclosing sketch on separate sheet. I would like your advice as to its patentability, etc.

A. There is nothing new contained in this invention, as many detectors of this kind have been described in this as well as other periodicals for a long time.

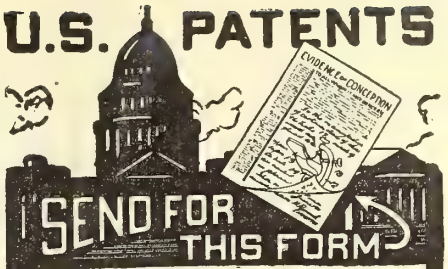
DOUBLE COAT.

(401) Newton Rhodes, Albany, N. Y., requests the following information:

I would like to know if a patent can be obtained on a "double coat"? My idea is to take a light weight overcoat and put a heavy fur lining in it, attaching it by several buttons. The coat being light weight can be worn with comfort during fall and spring and in winter can be made warmer or heavier by attaching the lining, thus making the one coat do for two. I have tried this scheme and find that it works.

A. At the present time reversible coats are on the market, but these, of course, work on a different principle, i.e., the coat can be pulled inside out without the use of the buttons mentioned by our correspondent. We should think, however, that the idea is patentable, but as a precautionary measure would advise our correspondent to have a search made in the patent office.

U.S. PATENTS



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE ON CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

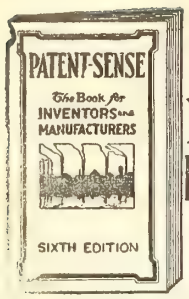
Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg. **Pittsburgh Offices: 514 Empire Bldg.** **Philadelphia Offices: 135 S. Broad St.** **San Francisco Offices: Hobart Bldg.**
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

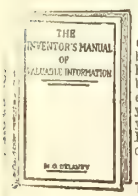
Name..... *Address*.....



"The Book for Inventors and Manufacturers"

SIXTH EDITION.

By return mail FREE. Write LACEY & LACEY Dept K. Washington, D.C.



Get This Book !

Contains first hand, practical advice by an experienced inventor. NOT on how to get your inventions patented, but how to dispose of them after patented with the greatest advantage to you; what kind of agreements protect you; contracts and offers to avoid. Full of valuable pointers; every page one of interest and advice.

$1.50 will bring you a copy of THE INVENTOR'S MANUAL OF VALUABLE INFORMATION

G. E. Perry Company, Publishers
Dept. 20 1328 Broadway New York

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?

Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.
1926 Broadway, New York

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.

OFFICES
364 University St. Montreal, Canada
919 F St., N. W. Washington, D. C.

PATENTS C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service, 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

PATENTS & TRADE-MARKS
—FREE BOOKLET ON REQUEST—
MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES —
WARNER I. CUBBERLEY, PATENT ATTORNEY
22 NATIONAL UNION BUILDING
WASHINGTON D.C.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.

MUNN & CO., 622 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 622 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

SHOE DEVICE.

(402) Herbert Skinner, Oxford, Ohio, wishes our advice on the patentability of the following:

"When the ice is on the sidewalks and streets, people find it very hard to stand up. My idea is to have a cleat put on one's heels the same way that heel plates are put on. There will be points in this plate which will stick in the ice. On the other side will be some projections which will stick in the heel and hold it on. The advantage of these over the ones which strap on is that they are invisible and they do not have to be taken off every time one goes in the house. This outfit would be much cheaper, too."

A. This is not a new idea at all, and there are many devices on the market at the present time that accomplish the same thing. We have in mind particularly, a simple article which attaches to the shoe, which can be unfolded, having on one side spikes to prevent one from slipping on the sleet or ice-covered streets. Normally the device folds back and rests between the space of the heel and the sole.

PATENTS.

(403) J. B. McClellan, Monongahela City, writes: Through your *Patent Advice* I would like to know the following:

If an inventor makes public a certain invention or has it witnessed and signed by a notary public, would a patent be allowed on the invention if the inventor has his patent attorney, whom he employs, get out his patent, act as witness, sign specifications, etc.? Could this be considered lawfully executed by the patent office?

A. As far as we know, one of the finest claims of priority is established by having the article known to as many of your friends as possible. After specifications have been written up and signed by a notary public, if desired, a duplicate copy can be placed on a large *post card* and can be mailed to yourself or a friend.

If it is then published in a magazine, it establishes a third claim of priority. The patent office also, however, rules that some attempt must be made at obtaining a patent within one year after its first publication. A very good method of establishing priority is to daily record your activities in a notebook and not forgetting to put the date on the page. At the end of the year you can have the notebook stamped by a notary public or once a month, if desired.

A patent, however, is the best, but if your funds are insufficient, publication in some magazine will constitute the next strongest claim, lasting only one year, of course. If, during that time, some manufacturer sees the practicability of your device, he will be very glad to help you in your patent.

NEW TRACTION SCHEME.

(404) O. W. Hammarlund, Rumford, R. I., writes: I am at present experimenting on an electric-gasoline system of transportation. I have spent quite a lot of money on it, and before I do much more I will have to interest capital.

I have been using a 6-cylinder engine which is rated at 31 hp., but develops 48 at 4,000 r.p.m., and been driving it at a 25-k.w. speed for an electric generator direct connected to it. This plant is set on a chassis and is to be propelled by a 5-hp. series motor, and four other chasses for either passengers or freight. Each will be propelled by 5-hp. motors and coupled mechanically and electrically together and controlled from one point.

As a 3 1/10-hp. motor is used on two-ton electric trucks to propel combined weight of vehicle and load of 12,000 pounds at a speed of 8 to 12 miles per hour, a 5-hp. motor should propel my cars at faster speed. The engine will run all the time except on long stops and the units can be made up of 2, 3 or 4 cars, just as the traffic demands. I think I will have very little trouble with the control of the system.

The power plant at the load is a logical answer to the street car question, as a 34-000-pound vehicle to transport less than 6,000 pounds is a very inefficient idea where miles and miles of copper and steel, with their losses and cost of maintenance, are also needed, without which they are dead.

The old 50-ton locomotive will pull more, and the need of its weight is because this is required for traction, where if an electric motor was put on each coach or car far better results would be obtained and using a turbo generator to drive them.

A. Your idea is surely feasible and very practical as far as its mechanical possibility is concerned. As yet no one has thought of using a gasoline engine in connection with a series of cars such as you explain and no difficulty should be experienced at all with the control system.

Furthermore, you would experience very little difficulty with operating on railroad track, as only 16 pounds of energy is required to move one ton of stock on wheels, provided the same is on a railroad track, and we believe its speed, as high as 25 to 30 miles, could be obtained with little difficulty. It is quite possible, however, that if your gasoline engine were coupled directly by coercion to the wheels of the car, you would get a greater horsepower.

On the other hand, it would seem that a more even distribution of the power along a train of cars tends to cause safer and smoother operation. Whether the device is going to be a commercial asset and can be adopted to a very great extent is hard to say, as no patent could really be secured on the same, inasmuch as gasoline engines, motors and generators have often been coupled together, unless you can secure some intrinsic patents on the controlling method.

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.
225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c.

"I Would Not Part with it for $10,000"

So writes an enthusiastic, grateful customer. In like manner testify over 100,000 people who have worn it. Conserve your body and life *first*.



The Natural Body Brace

Overcomes WEAKNESS and ORGANIC AILMENTS of WOMEN AND MEN. Develops erect, graceful figure.

Brings restful relief, comfort, ability to do things, health and strength.

Wear It 30 Days Free at Our Expense

For Children Also

Does away with the strain and pain of standing and walking; replaces and supports misplaced internal organs; reduces enlarged abdomen; straightens and strengthens the back; corrects stooping shoulders; develops lungs, chest and bust; relieves backache, curvatures, nervousness, ruptures, constipation. Comfortable and easy to wear.

Keep Yourself Fit

Write today for illustrated booklet, measurement blank, etc., and read our very liberal proposition.

HOWARD C. RASH, Pres. Natural Body Brace Co.
286 Rash Building SALINA, KANSAS



SAVE! DOCTOR BILLS

With this Book of Over 1000 Pages

Description of Diseases, treatment and prevention. One remedy worth cost. Saves hundreds of dollars a year. Board binding. $1.00 POSTPAID.

THE F. ADAMIK CO.
Dept. 6, 2040 Carver Street Chicago, Ill.



WHAT EVERY GIRL SHOULD KNOW

SENT PREPAID FOR ONLY 50c

This book is written by Margaret Sanger, the great birth control advocate and contains information never before published. Anyone reading this book cannot help but be benefited. It is highly endorsed by eminent physicians. Send us your order at once. Don't delay.

Truth Pub. Co., Dept. B. T., 1402 B'way, N. Y.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

The Electrical Machinist

By H. WINFIELD SECOR

(*Continued from page* 400)

MISCELLANEOUS ASPECTS ON MAGNET FRAME CONSTRUCTION.

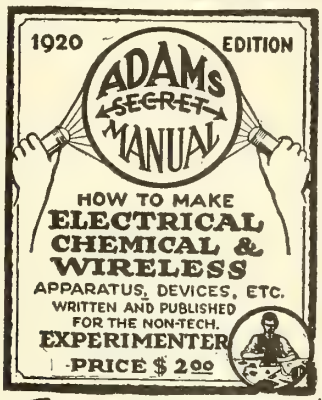
Before going further, an interesting experiment which was performed accidently one time, and which came under the writer's observation, will be mentioned, as it happens to show vividly, the important effect of shunting even a part of the magnetic flux from the field-poles of a dynamo or motor. At Fig. 3-A, the experiment in question, is illustrated. One of the men in the shop happened to have in his hand a large wrench, and was testing a motor which had just been rewound, rated at about ½ horse-power. The motor was of the vertical bi-polar type as illustrated, and unthinkingly, or else in a spirit of experimentation, he approached the wrench toward the top of the two salient field-poles. Before he could catch his breath, the powerful magnetic flux acted on the wrench and slammed it out of his hands and down on the poles. The next minute the armature of the motor, due to the shunting of a great part of the field flux thru the wrench, and the consequent weakening of the active field, started to fairly whistle as its speed mounted skyward. This is an important thing to know, for several reasons. One of them is that you can regulate the speed of a motor or the voltage of a dynamo, by a simple iron shunt arrangement, which may be strongly built so as to be controlled by a wheel or gear, acting in the manner just described. As you approach the iron shunt bar towards the field-poles, the field acting on the armature is weakened, and the motor speed raised or the voltage of a dynamo lowered.

As the iron shunt member recedes from the field-poles, the motor speed approaches normal or the voltage of the dynamo will increase toward normal.

In the Stow variable speed motor, the field pole-shoes are caused to recede from or approach the armature by means of a special gearing arrangement, which simultaneously moves all the pole-shoes whenever a gear wheel on the exterior of the machine is turned. This, as will be seen on reflection effects the same results; that is, it weakens the field or raises the armature speed, whenever the pole-shoes are moved away from the armature owing to the larger air gap and consequent higher reluctance offered to the magnetic flux. As the pole-shoes are approached to the armature, the air gaps are reduced in length, the magnetic reluctance is also lowered, and the armature reduces to its normal speed.

As the field flux lowers on the motor armature in any case, the rotating member will tend to increase its speed in an effort to generate its usual quota of counter electro-motive-force. As this counter emf., is dependent upon the number of armature conductors, the speed of rotation and the magnetic field flux in maxwells per square inch, it is evident that if we reduce any one of these quantities then one or more of the others must be increased. Therefore, as the field flux is reduced, the speed will tend to increase as the number of armature conductors is already fixt, and in order to generate the proper counter emf., the armature will rotate faster and faster as the field flux is weakened to try and produce sufficient emf. to buck the line voltage applied to the motor, in order to keep the armature current down to the proper value. It is this important fact which accounts for the rush of current when a D.C. motor is started, and the reduction of the current consumption as the motor speeds up; in other words

ADAMS GREAT SECRET MANUAL



The GREATEST BOOK Ever Issued for Making Electrical, Chemical Wireless Apparatus, Supplies, etc., at little cost

TELLS HOW TO MAKE

Print-O-Graph for 50c prints circulars, letterheads, signs, etc., in one or more colors. Print labels, stickers and envelopes at 25c a thousand.
Wireless Telephone without aerials, easy to make. Materials required are receiver, transmitter, battery and wire. Transmits clearly at any distance.
Burglar Alarm, closed circuit for $1.00. Bell rings automatically when wire or tinfoil is broken. Without relays, electro magnets, buttons, springs, etc.
New Electric Battery for 50c. Charge it at home. Without electricity, wet or dry batteries. This battery produces 12 volts.
Wireless Set for $1.00. No! Will not send 1,000 miles, but is an efficient wireless apparatus that will operate anywhere if instruments are carefully made.
Aeroplane Photography—photograph your town, and make the picture look as if photographed from an aeroplane; tell them you were up and made a snapshot.
Liquid Pocket Flashlight for 25c gives steady light for six weeks with one charge without matches, oil, wicks, batteries, etc., handy and safe as a flashlight.
Hypnotism made easy with this chemical method—anyone can easily be hypnotized; results guaranteed. No high brow language, but plain, simple instructions.
Telegraph electricity free. You can get 7 volts of earth electricity free, anywhere, anytime; never runs down; this electricity operates lines up to 2½ miles.
New Electric Telephone—With only one ordinary receiver at each end of the line you can receive and also transmit with it at any distance.
Catch Fish Quickly—By hundreds or dozens; when this chemical is placed in the water all fish will come to the top intoxicated ready to pick up.
Old coins made visible. Unreadable impressions on any old coins can be made readable again without cost. This secret is indeed valuable.
Midget Ice Plant for 50c. Freezes a daily supply of pure cold ice for a few cents in any season and in any part of the world.
Self Lighting Gas, an inexpensive chemical. Once applied to any gas mantel or burner. Lights the gas instantly, when turned on.
400-Mile Condenser for 25c. Will operate satisfactorily up to that distance. This variable condenser is very simple and easy to make.
Wireless Set without Aerials—How to send and receive messages anywhere, anytime, without aerials, wires, coils, etc.
New Process Embossing, or raised colored letters on stationery, post cards, etc., for 25c a hundred, without presses, dies, etc.
Mysterious Ball. With this homemade ball you can pitch the most peculiar curves, such as no ballplayer can catch.

Actually Tells:

How to Make any phone receive wireless calls.
How to Make genuine stamp photos at 2c a doz.
How to Make an electric walking stick.
How to Make a small hand camera for 25c.
How to Make A. C. Transformers for 10c.
How to Make a small motion picture camera.
How to Make a vest pocket wireless telegraph.
How to Make practical storage battery for 25c.
How to Make unbreakable flexible mirrors.
How to Make 16 x 20-inch photos for 10c.
How to Make rubber bands for 50c a thousand.
How to Make duplicates of old stamps at 2c dz.
How to Make a simple, sensitive radio amplifier.
How to Make a good battery rheostat for 5c.
How to Make an electric gas lighter for 10c.
How to Make an invisible aerial.
How to Make any clock run 2 yrs. with 1 winding.
How to Make or buy moving pictures at ½ c a ft.
How to Make dry batteries last 3 times as long.
How to Make an experimental battery for 5c.

MAKE A REAL SPEEDY MOTORCYCLE from any old bicycle **in a few hours** with ordinary home tools. Materials and parts are very cheap. You simply attach them to your bicycle and presto—your motorcycle is ready. The price of **Adams Secret Manual** is **$2.00,** but because it is impossible to completely describe it in the limited space available, we are willing to send it anywhere prepaid **for only a $1.00 deposit,** and as a special offer we will also send along material to make a simple, unique

SENDING AND RECEIVING SET FREE

with **key sounder, switches, detector, etc.,** absolutely **FREE.** And still more, you can return the book and material if anything is misrepresented, and your deposit will come back as quick as Uncle Sam can carry it. Otherwise remit the $1.00 balance. Can anything be fairer? **Experimenters, take advantage of this remarkable offer now**—you may never see it again. **SEND THAT $1.00 TODAY. You'll be sorry if you don't—you'll be glad if you do.**

A. E. ADAMS ELECTRIC COMPANY, CHICAGO
Address—1305 Peoria Street

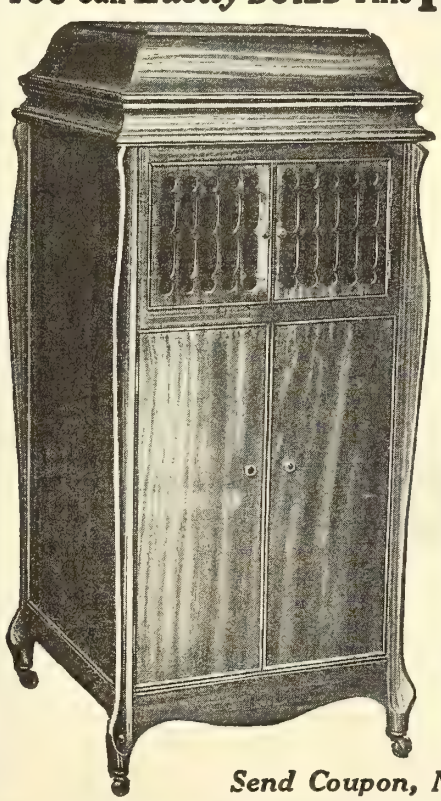
10 Per Cent Discount for Cash in Full With Order and Money Back as Guaranteed

ARE YOU BASHFUL, TIMID
Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address **The Veritas Science Institute, 1400 Broadway, New York, Desk 15.**

AUTOMATIC FIBRE LIMBS

Easy Payments—Do Nature's Work. **AGENTS WANTED** who wear leg. Good Pay. FREE Fibre Sample.
Describe Stump to
WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.

YOU can *Easily* BUILD This PHONOGRAPH



TREMENDOUS SAVING IN COST

You don't need to be a cabinet maker. We have made it an easy and a pleasant job with

Our Simplified Plans We furnish blue prints, diagrams, motor, ready-built horn, cabinet pieces and all metal parts complete. You do the assembling, **6 models to choose from.** A few hours' work, and you will have as fine a type of phonograph as any produced, and at a price away below what you would pay in a store.

KEEP THE SAVINGS IN YOUR POCKET

Machines play all records, have a wonderful tonal quality, excelled by none. No need now for any family to be without a phonograph because of the cost. THE MAKAFONE solves the problem. BUILD IT YOURSELF AT LESS THAN ONE-FOURTH REGULAR COST, but equal to the high priced cabinet machines. Free Records with each outfit. SEND TODAY FOR FREE CATALOG and full particulars of our wonderful offer. *Many a manufacturer got his start in this way. Why not you? Build machines and sell to your friends.*

Agents Attention You can make and sell these machines from our plans at a profit of $50 to $75 each. Others are selling two and three a week. Here is your opportunity to make big money and become independent. Pleasant and profitable work.

Send Coupon, Now—To-day
MODERN PHONOGRAPH SUPPLY CO.
302 Springer Bldg., 313 So. Clinton St., Chicago.

Modern Phonograph Supply Co.
302 Springer Bldg.
313 So. Clinton St., Chicago, Ill.

Gentlemen: Please send me full particulars of your Makafone proposition, without obligation to me.

Name .....



BURN LESS COAL

With an improved, all-cast pipeless furnace you can cut your coal bills in two. This efficient, basement installed heating plant heats and ventilates the entire home. It burns any grade of coal more economically than a stove. It needs no expensive piping or other equipment. Anyone can install it in a day. They are described at our wholesale prices in our Handy Man Book. Send for it.

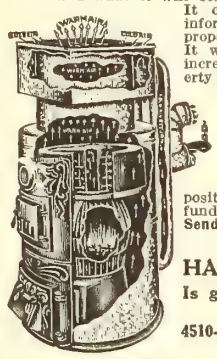


Do Your Own Plumbing and Heating by the Cut-to-Fit Method.

By our new plan anyone can install a complete plumbing or heating plant in his own home. Send us a rough sketch with measurements. Our Engineers will draw your plans, furnish information and see that the supplies you order come CUT-TO-FIT your needs. No waste of time, labor or unused material. Only a few simple tools necessary. **Send for**

The Handy Man Book

It will show you how. It will tell you just what to order and what it will cost at our wholesale prices. It contains plans and useful information for every builder, property owner or contractor. It will convince you. It will increase the value of your property 50%. You can do the work yourself.



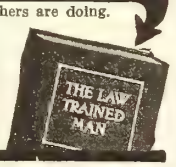
We have spared no effort or expense in the preparation of this valuable book. To keep from sending it broadcast to uninterested persons we request a temporary deposit of 25c which will be refunded with your first order. **Send for it Today.**

The Service of
HARDIN-LAVIN CO.
Is guaranteed by 40 years' business at
4510-20K Cottage Grove Avenue
CHICAGO

Free Book-LAW

Send for this Free 118 Page Book. It tells how you can gain a thorough knowledge of law in your spare time, as 40,000 others are doing. Splendid opportunities in the profession of law. Business today needs law trained men. Free book gives experiences of successful law trained men, and tells how you can read law under guidance of Ex-President Taft and 80 other eminent authorities.





BLACKSTONE INSTITUTE
Dept 340-C. 608 S. Dearborn St., Chicago

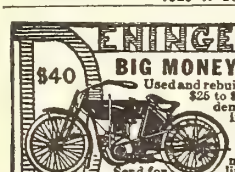
BE AN ARTIST

Earn $25 to $100 per week. Cartooning, illustrating, Designing successfully taught by mail through new instruction method. Entire outfit free to new students. Write today for beautiful new book, "HOW TO BECOME AN ARTIST" and special free offer.

Washington School of Art, Inc.
1526 H St., N.W. Washington, D. C.

ENINGER WILL SAVE
BIG MONEY SAVINGS FOR YOU

$40



Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog

Deninger Cycle Co., Rochester, N.Y.

YOU 25 TO 50 DOLLARS

Learn to Dance!

You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful Peak System of Mail Instruction.

New Diagram Method. Easily learned; no music needed: thousands taught successfully. **Write for Special Terms.** Send *today* for FREE information and surprisingly low offer.



WILLIAM CHANDLER PEAK, M. B.
Room 235, 621 Crescent Place—Chicago, Ill.

STAMMER

If you stammer attend no stammering school till you get my big new FREE book and special rate. Largest and most successful school in the world curing all forms of defective speech by advanced natural method. Write today. **North-Western School for Stammerers, Inc., 2331 Grand Ave., Milwaukee, Wis.**

the counter emf., builds up as the speed of the armature increases, and a greater emf., bucks the applied line voltage.

On a 500 volt motor, the counter emf., would be about 500—22 volts, the resistance drop in the armature, or 478 volts. The armature must therefore run at such a speed under a given strength of field, as to develop therefore 478 volts when the machine is operated at normal voltage. It is thus evident why starting resistances must be cut into the armature circuit when starting motors, particularly those of the shunt and compound type, until the armature has reached its normal speed and started to develop its regular and full value of counter emf.

At Figs. 3-B and C are shown two recommended methods of assembling and clamping laminated or sheet iron magnet frames, such as those found on motor stators and rotors. Brass bolts are best used in assembling stator frames, altho steel bolts are used considerably, and are best placed in fiber sleeves with fiber washers under the clamping nuts, to prevent the production of eddy currents. On medium and large size armatures having a steel disc assembly on a shaft, it is considered the best practise to mount these on a gun metal, fiber or brass sleeve of a thickness dependent upon the size of the armature, and not to drive the steel shaft dirctly thru the laminations; as when this is the case, there is liable to be more or less unnecessary eddy current and hysteresis loss.

(To be continued.)

What To Invent

By JAY G. HOBSON

(Continued from page 411)

LIQUID BEARD REMOVER.

Many have been the attempts to compound preparations to successfully remove the beard from the face without injuring the skin. None that I know of, has succeeded, and right here please let me record the importance of such a discovery.

How wonderful the banishment of razor slavery will be when the *liquid shave* is perfected. Just imagine the joy of shaving with the ease of washing the face. Some day this great preparation will be invented which will see millions of men gladly switch from the old hoe-method of today.

A special preparation that would quickly dissolve the hair and *not* the skin, seems to me as being the practical goal to work for. One that will be both cleansing and antiseptic will make many masculine converts shout with joy.

GRAPE FRUIT GUARD.

A few mornings ago I was piloted across the hotel dining room by the head waiter, and sat me down to a table where the garcon was already serving three *grape fruit enthusiasts.* Unfortunately I joined them as all three started to operate on their "nature squirt guns," and as I sat there patiently waiting for my half, the bombardment began! All three companions had their juice artillery pointing away from their eyes and *directly toward mine.* They were very harmonious with the eating tools it seemed, for each plunged after the "aquacitrus," with the same vim which sent a triple stream over my way inundating me almost entirely. Had it not been for my "specks"—my eyes surely would have been blinded.

After the deluge (necessity being the mother of invention), I imagined what I believe to be a practical device for every dining room; a *grape fruit guard* like the one shown in the illustration—a device made of glass and metal. The bottom or

For Homes, Offices, Factories, Farms

Complete Wall Set Magneto Telephone

Western Electric Type

$7



This is a complete commercial telephone station. They were bought from telephone exchanges who put in Central battery types. Slightly used but guaranteed to be in A1 working order. The cabinet is of polished oak, piano finish, within which is contained the powerful magneto, the 300 Ohm polarized ringer, an induction coil. The magneto is exceptionally efficient, being of the two bar type with brass gear transmission. The extra sensitive microphone, mouthpiece and two gongs are mounted on the front of the cabinet, giving the entire instrument that desirable appearance of compactness and efficiency. Guaranteed to work over 20 miles. The telephone receiver is a double poled one, and has a hard rubber case. Seven binding posts are provided for connections.

The instrument is one which we can offer with pride to our patrons at a ridiculously low price. It is unobtainable anywhere else at less than $15.00 and is an instrument unequaled in value for the price we ask. Size over all 11x10x8 in.

Long Distance Telephone Set—
One station.....$7.00
Shipping weight, 15 lbs.
Two stations
Shipping weight, 25 lbs.....**$13.00**

Send 6c in stamps for our big 160 page Wireless and Electrical Catalog No. 22.

The Electro Importing Co.
231 Fulton Street, New York

BE AN EXPERT
Penman

Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. Complete outline FREE. Write C. J. Ozment, Dept. 44, St. Louis, Mo.

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**

ALL THE PARTS AND PLANS



HERE BOYS

75cts. (No stamps.) Cloth wings, any color. 2 hours FUN making it. Flies 75 feet. Airplane Circulet 4 cts. (stamps) shows 7 other models. Money back if not satisfied.
NIFTY NOVELTY & TOY CO.
Mail Order Dept., Newark, N. J.



158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. Only 10
Finest Approval Sheets 50% to 60%. AGENTS WANTED. Big 72-p. Lists *Free.* **We Buy Stamps.** Established 25 yrs.
Hussman Stamp Co., Dept. 67, St. Louis, Mo.

RADIO APPARATUS

Distributors of Reliable Radio Apparatus for Experimenters in Every Branch of the Radio Field.

"Pittsco" the Sign of service.

PITTSCO

All we ask is a trial!

HONEY-COMB COILS

LITZENDRAHT WIRE. (While they last.)

LL-75	330-1030	meters	$1.60
LL-100	450-1460	"	1.70
LL-150	660-2200	"	2.00
LL-200	930-2850	"	2.10
LL-250	1300-4000	"	2.30
LL-300	1550-4800	"	2.50
LL-400	2050-6300	"	2.80
LL-600	4000-12000	"	3.00
LL-750	5000-15000	"	3.20
LL-1000	6200-19000	"	3.50
LL-1250	7000-21000	"	3.90

Note:—These are the genuine De Forest litz coils.

Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.

Dept. D

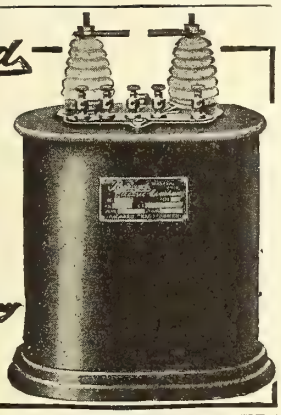
12 Park Square, Boston 11, Mass.

Packard

Wireless Transformers

cover maximum distance with small condensers.

Write for Bulletin today



The Packard Electric Company

Warren Ohio

Sales offices in all principal cities

Learn the Sign-Show Card Business

Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.

EARN $25. TO $75. WEEKLY

You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.



DETROIT SCHOOL OF LETTERING, 688 D.S.L. Bldg. Detroit, Mich.

Learn Watch Repairing

Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates.

Ask for our Free Book. It explains our system and terms.



THE DeSELMS WATCH SCHOOL
720 Perry St., ATTICA, IND.

$10 Brings This Latest Model **L. C. Smith** or a **Remington**

TYPEWRITER



Thoroughly rebuilt in our factory by the famous "Young Process." Fully guaranteed. Easy terms. No interest. FREE TRIAL. We handle all standard makes. Write for details.

YOUNG TYPEWRITER CO., Dept. 9, Chicago

Arnold **Loose Couplers**

Combination Loose Coupler Parts and accessories.

Send 3c stamp for literature which is sure to interest you.

J. F. ARNOLD **2082 Lexington Av. N.Y. Established 1910**

holder part is deprest in the center to hold the grape fruit securely. The glass is crescent shape and supported above by three metal rods. The grape fruit is placed in the metal holder and under the glass.

The glass is high enough to allow a spoon to be manipulated underneath. In operation the user holds the fruit with one hand, places the spoon in the fruit under the glass, which acts as guard in preventing the juice from getting into the eyes.

The grape fruit habit is a popular one. Every eating place serves them. A practical and attractive device for this purpose certainly would sell big and make lots of money for the inventor if properly handled.

100 H. P. Voice for Conventions

(*Continued from page* 360)

mic counting came weirdly out of the mist. But the test which counted most was the vocalizing for a vast outdoor audience in the New Jersey Velodrome, the judges' announcements of the bicycle races.

There have been various demonstrations of earlier apparatus, but beyond the tests necessary to assure complete success, the demonstration at Chicago was unprecedented in the history of the world. The first speaker addresses the delegates. The sensitive transmitter is ready at the front of the platform above the heads of the correspondents. The speaker does not have to speak into the specially sensitized transmitter, but may walk back and forth at will. The sound of his voice is carried to the amplifying apparatus. This sound has been imprest upon silent electrical waves, which are gradually stepped-up by being given greater electrical force. The force of the original wave carrying current is magnified many thousands of times before it is delivered to the loud speaking receiver and there converted into sound. The loud speaking receiver or horn and the speaker himself are perfectly synchronized and the human speech mingles with its electrical counterpart in complete unison. The nearby audience hear the speaker and the loudspeaker as if it were one voice, while the more distant audience hear only the loudspeaker.

Back out of sight is the Control Room where is located the *Deus ex machina*—the wonderful amplifying apparatus. The speaker's voice waves strike the diaphragm of the sensitive transmitter and the electrical energy generated by this transmitter is conveyed to the loud speaking control board in the Control Room, from thence passing thru the amplifiers after which it is delivered to the loud speaking receiver and there converted into sound. Before it reaches the loud speaking receivers it may be amplified many thousand times.

The transmitters, of which there are two, comprise microphone buttons mounted in highly resilient supports within the protective boxes observed in front of the speaker. The loud talking reproducers are built somewhat on the order of the Magnavox, i.e., they involve an electro-magnet of special construction acting on a crimped diaphragm of large size. The three horns are of wood, suitably braced with wooden ribs along their sides. The horns are connected on parallel.

CORRECTION NOTICE.

In the April issue there appeared an article entitled, "New York Has Ozonized Water." Thru an unfortunate oversight on the part of the editors the name of the inventor of this system of ozonizing water, Mr. A. J. Moisant, of New York City, was omitted. We are glad to call our readers' attention to this omission.



When this test comes it won't be a question of how brave or strong you are, but of whether you know how to defend yourself.

Brave but helpless

Deep down in your heart you know if you were called upon tonight to defend a loved one, you couldn't play the part. That if a bully spoke insultingly to your mother or sister you couldn't teach him a lesson. That if you were attacked on a lonely street you couldn't overcome your opponent.

You're not a coward—but you don't *know how.* When the test comes, it isn't going to be just a question of bravery, but whether you know how to box, how to disarm your opponent, how to stop the kick he launches at your stomach, etc.

Don't you see that in justice to those who look to you for protection, it is your duty not only to be *willing,* but *able* to play a man's part. Your excuse that it takes too long, or that you haven't the money to learn, no longer holds good, for boxing and self-defense are being taught successfully by mail to over 10,000 pupils—*at less than half the cost of the usual term of lessons by the old method.*

Just as scientific teaching reduced the time of learning to swim to a few lessons, so the Marshall Stillman "Shortcut" method has reduced the teaching of boxing to 5 lessons. The instruction takes place before your mirror, so that you learn the rudiments (the hit, guard, duck, feint, clinch, and footwork) before facing an opponent. Then you know how to hit, what to expect, and how to guard against it.

In a few more lessons you learn how to disarm an opponent and how to get out of dangerous holds, etc. To show how simple the lessons are, we quote instructions on how to break a strangle-hold on your throat: "If your opponent has both hands on your throat and is choking you, don't try to choke him, don't pull at his wrists and don't try to hit him. Simply reach up with your two hands and take hold of his two little fingers and give them a quick bend back; break them if necessary; he will let go."

Simple, isn't it? So are all the lessons in the course. The complete course includes:

5 lessons in boxing, the hit, guard, duck, clinch, feint, and foot-work.
1 set of daily exercises to keep you in condition.
3 rounds of shadow boxing.
8 bone-breaking or jiu-jitsu holds and releases.
8 holds in standing wrestling.
1 copy of Boxing Blows and Guards showing nearly every good blow and guard known to the ring.

Now, we suppose you are like many others—you still don't believe that boxing can be taught by mail, because you never heard of its being done before. All right! We will mail you complete course on 10-day approval. Don't send any money. Simply fill in and mail coupon below. If you keep the course, remit $5.00 in 10 days to the Marshall Stillman Assn., Suite E-8, 461 Fourth Ave., New York.

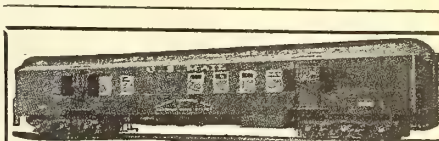
FREE TRIAL COUPON

MARSHALL STILLMAN ASSOCIATION
Suite E-8, No. 461 Fourth Ave., New York

You may send me complete Marshall Stillman course in boxing and self-defense as described above on approval. I have always been faithful in paying my obligations and I give you my pledge that you may feel safe in trusting me as agreed, and that I will return the course or remit $5 (Canada $6, foreign countries $7) within ten days.

Name .....

Address .....



WANTED-Railway Mail Clerks

$1600 FIRST YEAR

August Examinations Everywhere.

Common education sufficient

LIFE JOB

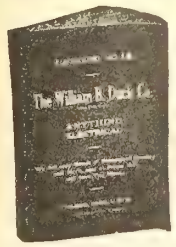
COUPON

FRANKLIN INSTITUTE
Dept. A101 Rochester, N.Y.

Sirs:—Send me at once, free of charge, Sample Railway Mail Examination questions, list of many U. S. Government positions now open and free book describing them.

Name .....

Address .....



DUCK'S

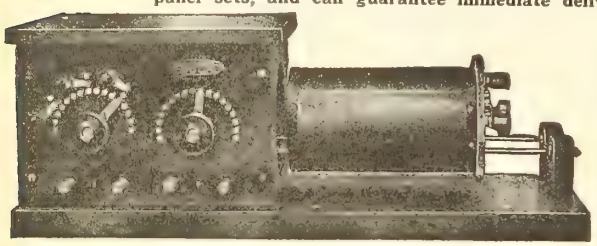
New Big 200-Page No. 14 Wireless Catalog and 100 Page Electrical Catalog

The wireless catalog mailed for 12c and the electrical catalog for 6c, either in stamps or coin, which amount you are privileged to deduct on your first order of $1.00. Catalog positively not sent otherwise.

This edition of our wireless catalog is the most complete and elaborate we have ever put out. It embraces everything in wireless worth while. As an encyclopedia of information it is invaluable. It is printed on excellent paper and with a beautiful cover. Your amateur friend will tell you that there never has been any wireless catalog to take the place of Duck's, and above all that you can absolutely rely on the quality of every instrument listed in this catalog. In a word it is all worth while catalogs in one.

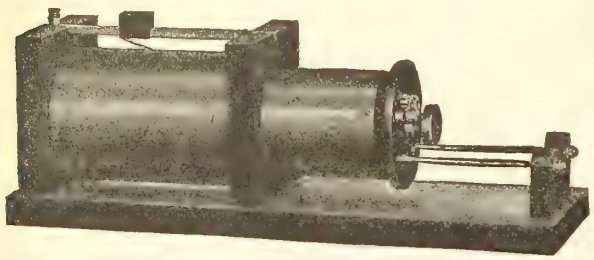
Audio Tron bulbs prepaid $6.00

We discontinued selling Audio Tron bulbs and accessories for a short time but we have again resumed their sale and also panel sets, and can guarantee immediate delivery.



NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER

A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $27.50.



OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

The secondary on our new type Arlington is divided into three sections with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type, permitting a looser coupling. It is a beautifully finished instrument.

Price only $15.00

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio

LEARN WIRELESS



Radio Telegraphy and Telephony Can Now Be Mastered at Home By Marvelous New Method

YOU can now learn Wireless Telegraphy and Telephony quickly and easily in your spare time at home, by mail, through the famous Home Study Course of the National Radio Institute, and with the help of the wonderful Natrometer outfit which we will send you. Then you can travel or locate in land wireless work near your home.

IS FINE NATROMETER SET TO EVERY STUDENT

send you this wonderful Natrometer while ng our Home Study Course. It becomes your onal property on completion of the course. Natrometer automatically sends you messages arying speeds, just as you would receive them distant wireless stations. This set is ated entirely without the use of "aerials."

ECIAL PRIVILEGES TO NATIONAL RADIO INSTITUTE STUDENTS

bination course in Wireless Telegraphy and Telephony for the price of one course. Post Graduate urse FREE.
plimentary Membership in the N. R. I. Relay ague with blue and gold membership pin.
dsome diploma suitable for framing.
onal help in securing position.

SEND FOR FREE BOOK

the attached coupon TODAY for free copy of our able and interesting book "Wireless The Opportunity of Today," telling how we help you win success Wireless.

NATIONAL RADIO INSTITUTE
America's First and Foremost, Established 1914
265. 14th & U Sts., N. W., Washington, D. C.

EARN BIG MONEY

Our graduates start work as Senior Operators at $125 a month with all living expenses paid. This includes board, lodging, laundry, etc., which when totalled and added to the salary amounts to $200 or more a month. Advancement to high positions with bigger pay is rapid. One of our recent graduates is getting $6,000 a year. Radio Aids receive $6 to $15 a day; Aerial Mail Service $1,500 to $2,400 a year plus a 10% bonus; Radio Inspectors $1,200 to $3,000 a year. Our graduates are guaranteed positions upon securing their official license.

Send Coupon for FREE Book

NATIONAL RADIO INSTITUTE *Write*
Dept. 265, 14th & U Sts., N. W. *Plainly*
Washington, D. C.

Send me your FREE book "Wireless The Opportunity of Today." Tell me about your famous Home Study Course in Wireless Telegraphy and Telephony—your post graduate course—membership in the N. R. I Relay League—your Special Instrument Offer.

Name .....

Age.....Address .....

City..... State.....

The "Ultimate Ray"

By RAY WHITCOMB

(*Continued from page 372*)

panting and numb for perhaps fifteen minutes while the storm raged furiously without.

Finally, as my strength slowly returned to me, I got up, shivering and miserable, and determined to find out where I was and, if possible, to obtain some dry clothes. Not thinking of where I was, I fumbled around on the wall for a switch, found it, and flooded the room with light. Even as I past the switch, however, and stood blinking in the light, I thought how unusual it was to have electricity in an out of the way spot like this.

The room in which I found myself was plainly but modernly furnisht as a library. A mission table stood in the center, chairs to match were set about and series of shelves nearly filled with books, completely occupied one wall. I took a step toward the books when a sharp click behind me caused me to whirl around.

Facing me, stood a short, stout, red faced man wearing a huge rubber apron and holding a businesslike looking automatic pistol trained squarely at me.

I stretched forth my hand and started forward—

"Stay where you are," came in quick, incisive tones, and he eyed me from head to foot with evident dissatisfaction.

So taken aback was I by this reception, that words failed me and I simply glared at him. He had evidently just cocked the revolver as a pudgy thumb still remained on the hammer. Broad, square-toed shoes peeked out from under the ridiculously large apron; his shirt sleeves were rolled up, disclosing an elaborate, tatooed design on his left arm; and a pair of immense goggles protruded from a pocket in the apron. A stubby beard of sandy color gave a ferocious aspect to him, and a thick mat of frizzley, brown hair surmounting a beefy, bloated face, was the remaining feature of this most singular person.

"Well," he snapt, at length, "I guess I've got you."

"And may I ask," I rapt back at him, "What you intend to do with me now that you have me?" My head throbbed painfully yet, and I felt decidedly out of humor at being thus treated.

"Hmpf!" he grunted, his little eyes narrowing down to slits. "Your visit is most inopportune. However," he laughed heavily, raucously, "I scarcely think the interruption need prove serious."

"See here, whoever you are," I retorted impatiently, "If this is the kind of hospitality that you offer a person who seeks refuge in your house from a violent storm, then I much prefer to remain in the storm." I took a step toward the door and stopt short as a loud report rang out and a clean hole appeared in the panel above my head.

"You will remain precisely where you are," he growled, "And if you make another move like that last one, I will reward you with a bullet between the ribs."

Not wishing to risk enraging him, for I was now about convinced that I had to do with a mad man, I shoved my hands into my wet trousers' pockets and leaned up against the door.

"Very sensible," he commented, then continued, "You came here to kill me and steal the result of my lifetime's work. Your very pretty explanation failed to impress me, and I have you just where I want you. Take that hatchet out of your belt and lay it on the floor—and be mighty careful how you do it!"

I did as he commanded, altho feeling strongly inclined to hurl the thing at his evil, sneering countenance.

"You are making a lot of trouble for yourself by this outrage," I flung at him angrily, "and I shall——"

"That will be enough from you," he cut in sharply. "You will do as I say and you will make no remarks about it either. Turn around and face the door with your hands behind you."

As I turned around, I heard him open a drawer and come up behind me. In a few moments my hands were securely tied behind my back, and making me lie down, he fastened my ankles in the same way. Then, without a word, he seized my feet and began dragging me across the floor after him. Thru a door and along a narrow hall, we went, finally going thru a second door into a brilliantly lighted room. I heard him slam the door and bolt it; then I was roughly jerked up into a sitting posture on a bench (the man must have been a physical giant from the way he handled me).

His attire together with his remark about "a lifetime's work" had rather prepared me for the sight which I saw. I was on a bench in one corner of a room fitted up as some kind of a workshop. On my right, four huge wooden vats and one of metal lined the wall, all having wires running to them from two well insulated mains that completely circled the room, starting from a large panel switchboard upon which were several meters, rheostat controls and circuit breakers. Next to the switchboard was a sink and a large electric furnace of the arc type, and between the switchboard and the bench upon which I sat, was a set of large shelves on which were numerous sacks and bottles. At the further end of the room was a work bench and beneath it were several acid carboys.

The room was lighted by a small arc lamp hung in the center of the ceiling and directly beneath it was a long wooden table resting upon heavy porcelain insulators. My captor was busily engaged in adjusting a rather curious piece of apparatus which was clampt to this table.

At first I could not make it out; but finally I decided that part of it, at least, was a large searchlight. In other parts of it, I thought I recognized a rheostat, a transformer, and condenser, while some pieces offered no indication as to their nature.

Tired of watching his endless puttering and tightening of screws, I closed my eyes. My head still throbbed and the report of the pistol had left my ears ringing loudly. All at once I became conscious of the crash of thunder. The numbing effect of the revolver shot at close range had helped to make me oblivious of the storm raging. There were no windows to the room and thus I had not noticed the lightning flashes.

Now, however, as the crashing of the thunder reached my ears, harsh and fearsome, I began wondering what Victor was doing; what he had thought when I failed to return; how he was weathering the storm. For the first time, I felt a twinge of fear as I realized that I was in the absolute power of this man who evidently had some wild notion that I had come to kill him and rob him of some secret, probably having something to do with this curious machine which he was working at. I had already, in fact, begun to work at the cords at my back, when his voice broke the thread of my thoughts.

"I have no cause for bearing you good will," he was saying, as I opened my eyes, "but I have decided to give you a demonstration before I dispose of you, of the power of my invention—the invention which you sought to steal on the eve of its completion."

He was standing facing me, with one hand resting on the table and the other thrust into a pocket of the apron. As he finished he adjusted the goggles to his head

CONNECTICUT RADIO



Electrical Development ha proven that the simples way is the best.

A Short-Cut to Expert Efficiency

THE Connecticut Variable Condenser increases the efficiency of even the most skillful operator.

It is a necessity for those of average skill.

Ranging over a scale of 360 degrees, it permits far finer adjustments. Thus clear readings are secured at the extreme of the scale—an impossibility with the rotary condenser.

You may do average work with a rotary—you experience the satisfaction of an expert with a Connecticut.

An interesting brief booklet describes it completely and plainly. It's yours for a postal.

Mention Your Dealer's Name

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut

RADIO MAIL ORDER SERVICE

Our claim of "Personal Service to the Consumer" has been more than upheld. You can take advantage of this wonderful service thru our mail order department. We list a few of the more important parts below, and we assure you of prompt delivery. See other current Radio Magazines for a more complete list of parts.

Audion Control Panels

RORA	Grebe Panel	$11.00
RORH	Grebe Panel	$17.00
Radio	Craft Co.	$15.00
P 400	DeForest Unit	$12.00
P 401	Same as above, but with Oak finished cabinet	$14.25
P 402	Same, but with 40 V. B Battery	$22.00
P 500	DeForest Audion-Ultro Audion complete with cabinet and 40 V. "B" Battery	$25.00

"B" Batteries

766	AM. Eveready 22½ V., 10 Amperes	$3.50
7623	Standard 22½ V. "B" Batteries Variable.	$1.35
7625		$2.40
7650		$3.25

Sockets

156	General Radio	$1.75
550	Murdock	$1.00
	Radio Service	$1.20
R300	DeForest	$1.50

Loose Couplers

Arnold 3000 meter loose coupler	$22.50
CE F 673 3000 meter coupler	$14.00
Signal No. R 21 3000 meter coupler	$18.50

Amplifying Transformers

Acme specially mounted	$5.00
Acme unmounted	$4.50
Federal 226 W.	$7.50

Articles listed above will be sent postpaid to any part of the United States

OUR WORD OF HONOR TO YOU IS
OUR GUARANTEE. LET US PROVE IT.

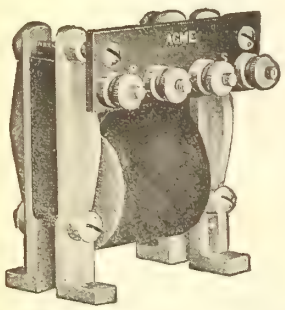
Write Dept. A1 for Literature and Price Lists

CONTINENTAL RADIO AND ELECTRIC CORP.

J. Di Blasi, Secretary—J. Stantley, Treasurer

6 Warren Street New York

OUR CONTRIBUTION TOWARDS REDUCING H. C. L.



ACME AMPLIFYING TRANSFORMER

$5.00

WITH BINDING POSTS, BAKELITE STRIP, AND CASTINGS

FORMERLY WITH CASTINGS ONLY

ACME APPARATUS COMPANY 28 Windsor Street Cambridge 39, Mass.

TRANSFORMER AND RADIO ENGINEERS AND MANUFACTURERS

DEALERS

We shall be pleased to send our revised schedule of prices and discounts on request. Delivery on our standard equipment can be made immediately from stock, subject to prior sale.

WIRELESS SPECIALTY APPARATUS CO.

Engineers, Designers, Manufacturers

Boston, Mass., U. S. A.

SUCCESS OPPORTUNITY **UTTMARK'S NAUTICAL ACADEMY RADIO SCHOOL**

8 State St., New York, N.Y.

Phone Bowling Green 8079

Complete instruction in radio operating in all branches, for Merchant Marine, Ocean Steamships, Telegram Service, Aerial Mail Service, etc. Preparing for Government Examinations.

Elementary and Advanced Classes
Day and Evening Classes
Write for Circular.

and slipt on a pair of rubber gauntlets. Then, crossing over to the switchboard, he threw a huge switch and turned to me.

"No doubt you wonder how I detected your presence, as you probably figured that the storm would drown out all noise. As a matter of fact it would, and you might have succeeded in killing me, but for the fact that I happened to be standing in front of this switchboard at the time you turned on the light in the library. That was careless of you. I saw the meter fluctuate when the switch was thrown and guest the cause."

"That's a d——d lie when you say that I came here to kill you and you know it. And if you don't let me loose——"

"I should greatly deplore the necessity of gagging you, but unless you remain quiet, I shall be compelled to do so," came in his suave, harsh tones.

No reply to this was possible, so I remained quiet and glowered sullenly at him, meanwhile working continuously with the rope that bound my hands. It seemed to be giving slightly.

"And now," he went on, after a short pause, "I shall first describe the different parts of the apparatus which you see upon the table and with which you are probably familiar in a more or less degree. If I neglect to explain some point of interest, you are at liberty to question me."

The grotesque figure before me, the strange room, and the awful booming of the thunder, all combined to give me a feeling that this was unnatural, unreal,—a dream! I strove to convince myself that I was the victim of a hallucination, but to no avail.

The monstrous creature closed a switch on the table and a dim light sprang up within the cylinder which I had taken for a searchlight. Manipulating a large milled head at the back of it, he began.

"Observe the pilot light in the heat-generator. This apparatus is essentially a small searchlight in which the arc has been replaced by a filament of special alloy. Because this filament is never raised to a temperature high enough to cause it to emit visible radiations, some method of bringing to a focus the heat waves generated by the passage of the electric current is necessary; hence the pilot light which is merely a five-watt electric lamp arranged so that it can be placed in the center of the heating filament or swung out of the way by a simple lever system. We will focus the generator on the transformer by means of this screen."

Here he paused to move the so-called heat-generator forward by means of a rack and pinion movement until the image of a small lamp filament was thrown sharply on a small white screen about an inch square.

"Now by removing this screen, and the pilot light, and throwing this switch, current is past thru the heating filament and the rays or rather waves pass thru this small opening in the next apparatus and are refracted into a parallel beam about the size of a quarter by means of a plano convex lens of quartz glass especially treated so that very little heat is absorbed. I may mention that the lens in the front of the heat-generator is of the same composition and before I go any farther I shall digress for a few moments to say a few words about the theory upon which this next piece of apparatus is built. I call it my *ether vibration transformer.*"

He cleared his throat and continued, "You are aware, no doubt, that light, whether red or violet, is simply energy waves or vibrations of the so-called luminiferous ether, a postulated all-pervading medium. In the broad sense, therefore, of speaking of light as ether vibrations, it includes vibrations of all frequencies, and

(*Continued on page* 449)

$90 TO $125 PER WEEK

Earned By Burgess-Trained Men

ELECTRICITY

TAUGHT BY A PRACTICAL MAN



MORE GOOD PAYING JOBS THAN MEN TO FILL THEM

BURGESS-TRAINED MEN are not only getting $90.00 to $125.00 per week, **but they are earning it.** We do NOT promise you will do it, because a good bit depends upon you alone, but the opportunity is there and it is up to you to make the best of it. The Burgess Policy is truthfulness in advertising and to give an honest and satisfactory service. Therefore we offer **no free inducements,** but depend rather on telling just what Burgess Men are doing. This we find is one of our strongest endorsements.

Are You in Earnest?

We DO say that if you have an earnest desire to succeed we **know** our Fifty-Fifty Plan will help you. It has helped hundreds of others who have been placed in better positions, at better salaries, by BURGESS SERVICE

This is Our Plan

You make moderate monthly payments for what you get, **and you get what you pay for.** Your payments stop anytime you are not satisfied. **It's up to you.**

Burgess Service Brings Success to Men and Young Men—It is Real Service

The Burgess Service is based on the personal experience of Yorke Burgess, for nearly a quarter of a century in practical Electrical work. Starting at the bottom, himself, and finishing at the top, he **knows** the needs of the **very Beginner** as well as the experienced man. He simplifies the principles and practice of Electricity. The electrical laws, formulas, methods of calculation and the daily problems that come up in Electrical work are made **plain** and **clear.** No frills, just simple, everyday English that anyone can understand and remember. He gives you his personal and individual attention—**and he does not sign his name with a rubber stamp.**

Just a Little of Your Spare Time at Home Between You and Success

Burgess Students are in demand. Beginners get employment after taking the Burgess course a short while—over 90% now actually engaged in Electrical work.

This Man Made Good—So Can You

(Mr. Engleman, now an Electrician in one of the finest hotels in the world, was formerly a waiter in New York City).
Here are Engleman's three letters.
"Your first installment on the electrical course received, and I like the method of your instructions very well. You will find the answers to the examination questions attached to this letter. I AM OCCUPIED AS A WAITER AND WOULD BE ONLY TOO GLAD TO MOVE INTO A REAL TRADE."

From the Same Man Two Months Later

"In the book review of the Electrical Experimenter, I saw a description of the Burgess Blue Book, which I would like to possess and wish you would mail me a copy. I HAVE GIVEN UP MY POSITION AS WAITER AND AM NOW EMPLOYED AS ELECTRICIAN in the Ritz Carlton Hotel and so far like the work very much."

The Burgess Name Your Guarantee

"Your lessons together with your Blue Book received and I thank you very much, and I think it is like everything else that is connected with your name, really 'A No. 1.' MY WORK in the hotel CONSISTS OF WORK ON MOTORS, DUMB WAITERS AND ELEVATORS and from time to time I do repair work on small apparatus."
Hundreds of other letters like these from Beginners who have made good.

From Mr. Knight, Chief Electrician of a large coal company.
Dear Mr. Burgess:
I am Chief Electrician for this Company and I feel that I need the instructions in your course more today than I did when I first commenced working with electrical appliances.
If these is any electrician today who feels that he cannot gain anything by taking a BURGESS COURSE send him to me and I will soon convince him that he is wrong.
If I should live to be one hundred years old, I will continue to preach every place I go, THE BURGESS ELECTRICAL SCHOOL. I wish I could come face to face with the great number of young men of today. I believe I could convince them in a few minutes that they are missing one of the greatest opportunities by not taking this course and sticking to it.
Very sincerely yours,
J. L. KNIGHT,
Glen White, W. Va.

If you have any desire to learn all about this service that is helping so many make good in a big

Send For

"ELECTRICITY BOOK 8."

Forty-eight pages of Success in various lines of Electrical work told by Burgess Students themselves together with valuable information by Yorke Burgess. This book should be in the hands of every Beginner interested in Electricity or Experienced Men in any branch of Practical Electrical Work.
"Burgess Bulletin"—issued for the benefit of Burgess Students—contains Articles on Electricity, Problems, Diagrams, Positions open, Electrical Information, News, Advice, etc.
Fill out coupon below and these will be sent you prepaid. They cost you nothing.

BURGESS ELECTRICAL SCHOOL

(Endorsed by Electrical Experts)

WRITE YORKE BURGESS personally—Or use coupon

The Burgess Company Educational Division,
Yorke Burgess, Supt.
745 East 42nd Street, Chicago, Ill.

Please send me prepaid "ELECTRICITY BOOK 8" and the Burgess Bulletin, without cost or obligation.

Name .....

Address .....

Burgess Electrical Hand-Book

(called THE BURGESS BLUE BOOK, originally in blue-print form)

Short Cuts and Time Savers

PREPARED in pocket size especially for practical men and those taking up the study of electricity. Contains drawings and diagrams of electrical machinery—over 200 formulas for calculation and problems worked out showing how formulas are used. From the personal note book of Yorke Burgess while on all different kinds of electrical work covering a period of nearly a quarter of a century.
Electrical laws, formulas, methods of calculation, etc. Simplified and made easy to understand and remember. Easy to apply in practical work. **Many valuable stunts not to be found in any other book.** Of value to any electrical man, whether Technical Graduate, Electrical Engineer, Student or Practical Man.
Electricians all over the world are sending for this book. **The most complete and valuable book of its kind published. Nothing else like it.** If you have never seen this book it is impossible for you to realize what you have missed.

Price $1.00

Send dollar bill, money order or check. You take no chance—money back ANY TIME if not satisfactory.

THE BURGESS COMPANY

Consulting Electrical Engineers

Yorke Burgess, President.

Engineering Division (Department 108), 750 E. 42nd St. Chicago, Illinois, U. S. A.



FOR SALE AT ALL NEWS STANDS

ARTISTIC TWO COLOR COVER

"THE 100% WIRELESS MAGAZINE"

Partial CONTENTS OF AUGUST ISSUE:

Anti-Capacity Winding vs. Coil Efficiency.
By Oscar C. Roos

Japanese Radio Apparatus A Trans-Oceanic Receiver.
By F. J. Rumford

The Simplest Hook-Up.
By Thos. W. Benson and Chas.. S. Wolfe

The Radiophone on Roller Chairs.
By Harold Warren

Design of a Radio Receiver—Part 2.
By L. M. Clement

Static Defeated!
By Arthur H. Lynch

The Construction of a Cage Type Antenna.
By Lloyd C. Greene

What "Radio News" Is:

RADIO NEWS now in its second year holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO NEWS leads all other wireless magazines. The July issue has 72 pages; there are seventy-four separate purely radio articles and 107 illustrations. *Over forty thousand copies were printed and circulated.*

Each issue of RADIO NEWS contains 72 pages (or more) and an artistic cover in two colors. The illustrations average 120 every month and there are from 60 to 80 up-to-date articles, some by our greatest radio scientists, in every issue.

THIRD $100.00 RADIO PRIZE CONTEST

A new radio contest. The third one offering $100.00 in prizes began in our May issue.

20c The Copy
$2.00 A Year
Canada and Foreign $2.50 A Year

SEND 20c FOR SAMPLE COPY TODAY

72 PAGES 120 ILLUSTRATIONS

EXPERIMENTER PUB. CO., 231 Fulton St., New York City

SPECIAL OFFER

Gentlemen:
Please enter my subscription for RADIO NEWS for the term of one year for which I enclose herewith $2.00. As a special offer you will also send me for 25c extra your great Wireless Course containing 160 pages, 350 illustrations, size 6¾ x 10" with fine flexible cloth cover. I have written my name and address in margin below.

LEARN WIRELESS AT HOME

The Demand for Good Wireless Operators Far Exceeds the Supply

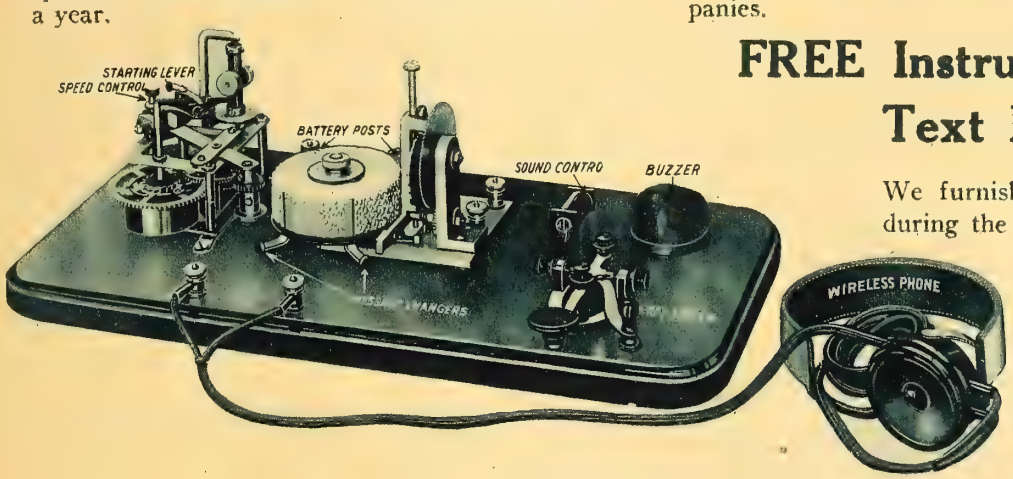
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, Chief Radio Inspector, Bureau of Navigation, N. Y. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way, will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free*, will make it as easy to learn the Code as it was to learn to talk. *All you will have to do,* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* **This set is not loaned, but given to all students completing the course.**

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph*, place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—*but do it today.*

NEW YORK WIRELESS INSTITUTE,
Dept. 12, 258 Broadway, New York City

New York Wireless Institute,
Dept. 12, 258 Broadway, New York City.

Send me free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your *Free Instrument Offer.*

Name .....

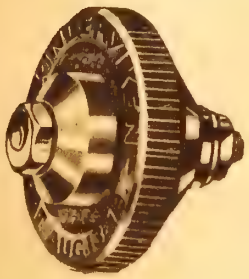
Address .....

City or Town..... State.....

Radio and Electrical Experimenters

We offer you a partial list of our products of A-1 experimental apparatus. Here you can buy anything you need. If it is not quoted below, send for it and we will do our best to fill your order. All inquiries promptly answered. Note the wonderful goods we offer at rock bottom prices.

Skinderviken Transmitter Button



This famous button made in several styles for experimenters and wireless men. Supersensitive style for detectiphone work. Sends piano, violin, and victrola music thruout the house.

Common battery style for Wireless telephone and amplifier use. Capable of passing a greater amperage than most transmitters. Price with complete instructions for use $1.00.





Transmitters

With Arm $2.00
With Arm and Button 2.50
With Button only... 2.00



Ringers

1000 Ohm ...$1.25

Receivers

Watchcase, 75 Ohm. $1.25
5 Ohm. 1.50
Single Headband ... 1.00



Receivers

Telephone $1, $1.25

MAIL THIS COUPON

J. SKINDERVIKEN
414 Broadway, New York

I enclose $..... for which please send me the following:

.....
.....
.....

Signed .....

Address .....



Mechanical Stethoscope

The latest mechanical achievement, a boon for Engineers, Mechanics, Experimenters, Automobile Mechanics, Etc. Immediate detection of all knocks or defections in running machinery of every description is made possible with the use of this instrument.

Sensitive as a detectiphone; picks up the sound of your watch. By placing point of rod on steam-pipe you can distinctly hear words spoken thruout the building.

Price $5.00 without battery. Money Order, Check, or registered currency only.

J. SKINDERVIKEN

Inventor and Sole Manufacturer — 414 BROADWAY, NEW YORK

DE FOREST

THE typical 15-panel DE FOREST Unit Receiving Set shown below consists of a Tuner with wave length range of 150 to 25,000 meters; a crystal and an audion detector, and a one-step amplifier. This Set is the most complete and efficient receiving apparatus ever put out under $175.00. Its cost is less than that; the entire set of Units shown below totalling only

$162.64

DE FOREST Unit Receiving Sets

Give You Better Apparatus at Low Cost



Simplicity, Absolute Reliability, Economy and a Broader Radio Knowledge are assured with the DeForest Unit System.

DE FOREST Unit Receiving Sets offer the most practical system of securing accurately designed and highly efficient receiving apparatus without paying for expensive factory assembly and costly cabinets. You buy the individual instruments, ready mounted on Unit panels, and assemble and wire them yourself. You can start with a few Units and then build up, always fitting new Units into the system as additions to the old, to increase your selectivity and circuit efficiency. You can even fit these Units into any system you may now have.

If you are going to take up wireless work, find out about the DeForest Unit Receiving Set before you get your apparatus. It will give you the most highly developed Radio Instruments obtainable. And if you are an Amateur, Student or Experimenter, this Unit System holds even greater possibilities because in using your own ingenuity in assembling and wiring the Units you will greatly broaden your Radio knowledge. There are many possible Unit Set combinations and you should

Send for the De Forest Radio Manual

which describes the Unit System in full and also contains much valuable general Radio material. Send 10 cents for a copy at once.

DE FOREST RADIO TELEPHONE AND TELEGRAPH COMPANY
Inventors and Manufacturers of High Grade Radio Apparatus
1403 SEDGWICK AVE. NEW YORK CITY
Lee De Forest Incorporated, 451 Third St., San Francisco, Cal.
Western Distributors — Shipments Made from San Francisco Stock

DE FOREST

The "Ultimate Ray"

(*Continued from page* 444)

hence the only difference between X-rays and heat waves is the frequency. This visible light represents vibrations varying in frequency from 430 to 740 trillions per second, while at higher frequencies the ultra violet and X-rays are produced, representing vibrations from 870 to 1500 trillions per second. In the other direction from about 430 to 20 trillions of vibrations per second the waves manifest themselves as infra-red and heat waves, while at lower frequencies than 20 trillions down to vibrations that last one second and longer are produced the electro-magnetic waves, which, within certain limits are used in radio-telegraphy.

"You will forgive me for this recital of facts with which you are probably well acquainted, as I gave it merely as a means of leading up to my next point, which is: Are we justified in concluding that X-rays are the *ultimate* rays; that is, the rays of highest frequency which it is possible to produce? Is it not possible for the ether to be made to vibrate at rates substantially in excess of 1500 trillions per second, and if so, how? Well, since there is nothing to authorize an assumption that the ether cannot be made to vibrate at higher frequencies, it is logical to look for a means of effecting such an increase in rate of vibration. To this end, I searched and searched and at last, I, Pax Marriote, have discovered the secret—have found a means to make the ether vibrate at frequencies up to as high as a million trillion of vibrations per second, which I am convinced is the highest possible rate—have finally discovered the *ultimate ray,* the "Z" ray, the long sought ray that would decompose matter utterly into energy alone, the disintegrating ray!

Becoming excited toward the last, his voice had risen to a shrill screech, indescribably horrible to hear, and now, as he paused for breath, the terrific fury of the storm once more caught my attention. The thunder crackled and boomed till it seemed the very earth around us must be splitting, and at every volley the building seemed to give a lurch as from a physical blow. Actually, I felt that I must be going mad.

After he had taken a drink at the sink, he came over and stood before me once more, inspecting the ropes that bound my wrists, and tightening them again, thus destroying my one slim hope of escape. Then returning to his position by the table, he continued—

"Concerning the reasoning that led me to finally experiment in the right direction, I may say that my first inkling as to the basic secret or principle involved came from a recollection of the fact that X-rays are produced from cathode rays when the latter are allowed to come in contact with certain substances, and that the transformation is produced because of the crystalline arrangement of the molecules in the substance employed. With that as a basic principle to work from, I carried out an elaborate series of researches with alloys, and learned some amazing facts about these substances of which modern chemistry is so ignorant.

"At length, I discovered a combination of metals which, when subjected to the influence of the X-rays, gave off a new ray, similar to the X-rays but of nearly 2000 trillions of vibrations per second. This new ray possest characteristics identical with those of X-rays but in a considerably augmented degree. It easily penetrated six-inch plates of lead and the peculiar feature of its formation was that the new rays

"ASK ANYONE WHO HAS USED IT"
USERS ARE PROVERS
"I have also asked some of my friends all of whom say, 'BRANDES? Sure, get them: They will positively pay for themselves'". (Name on request.)

BRANDES WIRELESS HEADSETS

CLEAR TONE LIGHT WEIGHT
DEPENDABLE SERVICE

Score 100% efficiency in actual use. Sharp, Unblurred, Readable Signals assured by



"Superior" Set, 2,000 ohms, $7

"BRANDES MATCHED TONE"

Exactly matching the tone of both receivers in each set and thus eliminating all confusion due to unmatched harmonics.

TRIAL OFFER *Buy a Brandes Superior Headset and use it critically for ten days. Then, if it doesn't come up to our claims or your expectations, return it and your money will be cheerfully refunded. Test it—compare with others—for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphragms toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*



"Navy" Set
3200 ohms, $14.

SEND 4c FOR CATALOGUE E

C. BRANDES, Inc.
32 Union Square
Room 814
New York City, U. S. A.
WIRELESS RECEIVER SPECIALISTS



"Transatlantic" Set
2800 ohms, $10.

Complete Line of Brandes Receivers for those in Canada. Send stamp for Pamphlet "E"
Scientific Experimenters, Ltd., 11 St. Sacrament Street, Montreal, P. Q., Canada

POWER!

O! Boy! but my car runs fine with the **ALSOP ALL-SPARK** I have no more spark-plug troubles



Cylinders Don't Miss Fire
when your car is equipped ***with the***
Alsop-All-Spark

Old, cracked, oil-soaked spark plugs give a hot, fat spark. You don't need new plugs to get every drop of power out of your gas. The Alsop-All-Spark puts new life into your old spark plugs. Just attach the handsome dial to your instrument board and connect up the plugs. **They will last indefinitely now and you will find power in your car that you never knew was there.**

Why don't you decide today to take advantage of this wonderful intensifier. You take no risk. The entire resources of the All-Spark Ignition Company are behind every Alsop-All-Spark. The guarantee of complete satisfaction for the life of the car is absolute. Your money refunded as per guarantee.

The saving in spark plugs, the relief from carbon and the increased power from your gas will pay for the All-Spark many times over. You owe it to yourself and to your car to at least try the Alsop-All-Spark.

Send in your order today. The Alsop Intensifier illustrated here (the four cylinder type) sells for $7.50. Mail the coupon with your remittance at once and you will receive your All-Spark Intensifier by return mail. It will mean an actual money saving in addition to increased pleasure from your car.

If you don't want to order now at least mail the coupon for a complete description of this wonderful intensifier and price list.

ALL-SPARK IGNITION COMPANY, Inc.
13-X Water Street New York, N. Y.



Write for Government Tests.

ALL-SPARK IGNITION COMPANY
13-X Water Street
New York, N. Y.

Gentlemen:

☐ Enclosed please find remittance for $7.50 for which please send me one Alsop-All-Spark Intensifier for a four cylinder engine.

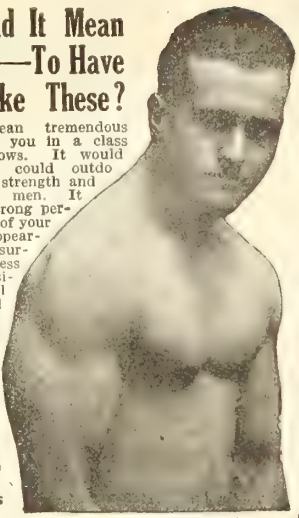
☐ Please send me circular describing the Alsop-All-Spark Intensifier at once.

Name .....

Address .....

City..... State.....

What Would It Mean —To YOU—To Have Muscles Like These?



It would mean tremendous strength, putting you in a class above your fellows. It would mean that you could outdo them in feats of strength and be a leader of men. It would mean a strong personality because of your commanding appearance, thereby assuring you of success in both the business and social world. It would mean added lung power, unlimited vitality and perfect health; removing all fears of indigestion and disorders which undermine the average man and make him old long before his time.

All These Things Are Yours

I absolutely guarantee to do all this and more for you. I have found the short cut to physical perfection and applied it on my own body, proving its results. I have personally trained many of the world's strongest men by this same method. Why waste your time and money with old-time worthless methods? If you are desirous of being a real robust man, follow the path of those who have already made a success. Come now, get busy, for every day counts.

EARLE LIEDERMAN
The Acme of Physical Perfection

Send for My New Book, "Muscular Development"

It tells the secret. Handsomely illustrated with 25 full-page photographs of myself and some of the world's best athletes whom I have trained. Also contains full particulars of my splendid offer to you. The valuable book and special offer will be sent on receipt of only 10c, stamps or coin, to cover cost of wrapping and mailing.

Don't miss this opportunity. Sit right down now and fill in the coupon. The sooner you get started on the road to health the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon to-day.

EARLE E. LIEDERMAN, Dept. 208, 309 Broadway, N. Y.

EARLE E. LIEDERMAN, Dept. 208, 309 Broadway New York City.

Dear Sir:—I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name .....

Address .....

City..... State.....

Q. S. T. *de* ACE

LET'S SING

(TUNE Battle hymn of the Republic)

Mine ears have heard the signals
From a dozen different lands,
From Greenland's icy mountains
To Sahara's burning sands,
From the land of cherry blossoms
To where Mount Sorata stands.
And I've learned a thing or two.

CHORUS

Q. R. X. I'm going to tell you,
Q. R. X. I'm going to tell you,
Q. R. X. I'm going to tell you
How you can get them too.

This spasm continued next month. Watch our ads, they are "different." So are our instruments. It's to our mutual advantage to get acquainted. "You may pay more, but you can't buy better." DEALERS. If you don't stock Ace equipment you are missing a good line.

THE PRECISION EQUIPMENT COMPANY
2437 Gilbert Ave., Dept. E. Cincinnati, Ohio.

Radio Parts Supplies

Bakelite-Dilecto sheet, rod, tubes. Hard fiber sheet, rod, tubes. Copper and brass sheets, rods and tubes, brass and iron machine screws, brass wood screws, molded knobs, switch points, and levers. Binding post, sheet aluminum. Hard rubber sheet, tuning coil cylinders, etc., etc.

Complete price list sent for 5 cents in stamps.

KEYSTONE RADIO COMPANY
Drawer 307 Greenville, Pa.
Formerly O. L. Bortz Machine Co.

were emitted from the opposite side of the alloy from that which the X-rays struck, or, in other words, the alloy seemed to act as a sort of transformer in which, by the action of light rays of one frequency on a surface of it, a molecular action was set up which produced either vibrations of a high frequency on the opposite surface.

"My second discovery was that, quite by accident, I found it possible to vary the ratio between the primary and secondary vibrations by passing a high frequency current thru or rather across the surfaces of the transformer plate. Thus, by using heat waves as the primary vibrations, I was enabled to cause the emission as secondary vibrations of light waves varying thru all the ranges of the visible and invisible spectrum and far beyond, into frequencies closely approaching a *million trillions* by simply increasing the frequency of the current alternations which past thru the alloy.

"All that remained to be done was to find the most efficient thickness for the transformer plate, and having solved that and a few other minor problems, behold the result," he paused to fondly pat the strange little box-like instrument, "my ether vibration transformer—the producer of the *ultimate ray.*"

Going over to the switchboard, after this staggering recital, he closed two switches in rapid succession and with much sparking and crashing of circuit breakers, a low humming became audible from behind the switchboard and steadily increased in volume and shrillness till it filled the room with a high-pitched, musical hum.

Again the sense of unrealness assailed me, and I felt possest with an almost overwhelming desire to laugh—to cry out; but I fought it down, silently, desperately, knowing full well that I must maintain control of myself then or never. The room was becoming insufferably close, and my wet garments clung to me clammily. Suddenly the light went out, and so high strung were my nerves that I started up, lost my balance and fell heavily to the floor. After a moment's darkness, a dim shaded light was turned on, casting a glow over the table and on the strange man who called himself—Pax Marriote. He roughly jerked me back on to the bench and returned to his work.

In a sort of stupor I sat there and watched his never-ending adjustments.

"It may interest you," a voice was saying, and the words seemed to come from a great distance, "to know that I have installed a turbine-generator at a falls in the nearby stream. This furnishes me with ample power for conducting my experiments as well as for lighting the house. Now to continue, by means of this transformer and specially constructed Tesla coil I am able to cause a current to pass over the transformer plate ranging from 100,000 oscillations per second up to several millions. I use silver plated copper tubes in the high frequency circuit."

Quickly closing a switch, he seized the rheostat control and pointed excitedly to a square white screen in front of the machine. A square about six inches on a side and of a faint red color was visible. Slowly it changed to a deep red, then began to grow brighter, taking on a cherry tinge that soon changed to a dark orange.

"You see it! *You see it!*" he cried excitedly, at the same time moving the rheostat lever ahead.

The dark orange became brighter, then changed altogether to a yellow. With eyes glued to the screen, I watched the eerie phenomenon progress—breathlessly waiting while the yellow changed to green, to blue, to violet, and then faded out altogether.

"Now watch!" His voice had risen to a scream as he gave the lever a mighty shove.

I gave a little gasp as brilliant flames began to play about the contact points of the switches and long streamers floated eerily

Radio Diagrams and Formulae in Loose Leaf Form

The publishers of the CONSOLIDATED RADIO CALL BOOK have completed the preparation of diagrams and instructions on:—

Measurement of Capacity of a Condenser. (Substitution Method.) Calibration of a Variable Condenser. Two Diagrams and Curve.....No. 1
Measurement of Inductance of a Coil or Circuit. Two Methods—Two Diagrams.....No. 2
Measurement of Distributed Capacity of an Inductance. Diagram and Curve.....No. 3
Measurement of Fundamental Wavelength of an Antenna. Three Methods. Three Diagrams.....No. 4
Measurement of Wavelength of Distant Transmitting Station. Two Methods. Calibration of a Receiving Set. Two Diagrams....No. 5
Measurement of Effective Antenna Capacity. Two Methods. Two Diagrams.....No. 6
Measurement of Inductance of Antenna and a Third Method of Measuring Effective Capacity of Antenna. One Diagram.....No. 7
Measurement of Antenna Resistance. Substitution Method.....No. 8
Schematic Wiring Diagram of Regenerative Audion Receiving Set Suitable for Receiving High Power Undamped Wave Stations. Connections shown are those used in most Navy and Commercial Receivers.....No. 50
Table giving the value of LC (Product of Inductance and Capacity) for wavelengths from 300 to 20,000 meters. Inductance in Microhenrys.....No. 100
Table same as above but with Inductance in centimeters.....No. 101
Schematic Wiring Diagram of Signal Corps Type SCR-68 Radio Telephone Transmitting and Receiving Set.....No. 51
Schematic Wiring Diagram of Type CW-936 (Navy Submarine Chaser) Radio Telephone and Telegraph Transmitter and Receiver. No. 52
Schematic Diagram of Type S.E. 1100 (Navy Flying Boat) Radio Telephone and Telegraph Transmitter.....No. 53

These diagrams and instructions are the most CLEAR, CONCISE, COMPREHENSIVE and CONVENIENT form of instruction that has ever been presented. They are printed on pages size 8½ x 11.

Complete Set of 14 Sheets as described, sent postpaid 75c

CONSOLIDATED RADIO CALL BOOK CO., Inc.
41 Park Row, New York, N. Y.

BUILD YOUR OWN WIRELESS RECEIVING SET



You can **SAVE** at least **$25.00** By buying parts and assembling yourself

Think of the pleasure and practical experience you will gain in making your own set, with wavelength range from 170 to 2,500 meters. We furnish full-sized Blueprint and complete detailed instructions for making this set and prices of parts for $1.00.

Write today and get started

K. & G. WIRELESS SUPPLY CO.
Dept. 15A, 152 Chambers Street, New York City

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 22 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 80 Big Pages, 300 illustrations, 200 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 22 measures 6" x 9". Weight ½ lb. Beautiful stiff covers.

WIRELESS

Send 6 cents in stamps or coin for which we will send our latest Cyclopedia Catalog No. 22 as described.

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

Super-Sensitive Microphone ONLY $8.00



This instrument is offered at an extremely low price. It is excellent for building your own amplifier. Can also be used in many experiments where a sensitive microphone is required.

Detectagraph, $18.00

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.



Detectagraph $18.00

Send for One To-day and Convince Yourself



THE $18.00 MICROPHO DEAF-PHONE

is a super-sensitive instrument which has been developed to meet the demands for a practical and efficient hearing device at an extremely low price. It is equal to any $35 instrument made and superior to most of them. The outfit consists of One Super-Sensitive Transmitter with cord connector; One Super-Sensitive Ear Piece with small black cord; One Black Single Headband; Black Case and Two Batteries.

Adjusted Model "B" Horn, with No. 20 High Grade Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete.



Write To-day for Free Booklet

G. BOISSONNAULT CO.

26 Cortlandt St. New York

Makers of Super-Sensitive Microphone Apparatus

MEMORIZE

CONTINENTAL CODE

ALMOST INSTANTLY

This method THE short cut to success

After September 1st FIFTY CENTS Until then

COMPLETE CHART

and full instructions TWO DIMES

C. K. DODGE

Box 300 Mamaroneck, N. Y.

AMATEURS

YOU REQUIRE SWITCH POINTS AND BINDING POSTS FOR THAT NEW SET.

SWITCH POINTS THAT ARE ACCURATE.

¼" Diameter and ¼" High, Shanks for 6-32 Nut—SIZES as below, Postpaid.

This Month Only

⅜" Shank, Nickel Plated, $1.00
½" Shank, Nickel Plated, 1.00
⅝" Shank, Nickel Plated, 1.00

Dependable Radio Equipment and Parts

See catalogue No. 9

DORON BROS. ELEC. CO.

Manufacturers, Hamilton, Ohio

The WIRELESS EQUIPMENT COMPANY, Inc.

Furnishes all kinds of reliable radio apparatus at lowest prices. Send for latest bulletin No. 146C on new apparatus.

188-190 Greenwich St. New York

about the room, producing an electrical display more magnificent than I had imagined possible. A dull violet glow covered the table and all the apparatus, while the unmistakable odor of ozone became noticeable. Then glancing at the heavy screen I beheld the beginning of the miracle!

Slowly,—very slowly,—*the screen was dissolving,*—I use the word deliberately,—was dissolving into thin air. Not the slightest noise accompanied this strange sight and I could scarcely credit my senses, as before my eyes, I saw the absolute annihilation of this very appreciable quantity of matter; it appeared to be some kind of porcelain.

"Merciful heavens!" I screamed, in a sort of unreasoning panic, "turn it off—stop it—quit! STOP IT, I say!"

The ghostly streamers, the strange blue haze covering the table, the weird figure crouched over the control lever, the uncanny disappearance of the screen, the whir of the rotors, the intermittent crash of the thunder, all combined to produce a terrible effect upon me, and outraged reason was mercifully relieved as the room swam before my face and everything went black. A momentary sensation I had of delicious rest and quiet; then I knew no more.

* * *

I regained consciousness to find myself in absolute darkness with the rain beating upon my face. I tried to move and found that I was lashed to a chair. By straining my neck I could look to one side, and by the flashes of lightning made out a jagged hole in the wall thru which the rain poured in upon me. The storm, far from abating, had grown even more violent, and the thunder seemed to be crashing and crackling directly above the building. I caught the glint of metal before me, and, by the flickering glare of lightning flash, I saw with freezing horror that I was still in the workshop of Pax Marriote, that the chair to which I was strapped had been placed directly in front of his fiendish invention!

In unspeakable terror I heard footsteps outside the door, heard a key grate in the lock, heard the door open and close, heard the bolt shot home. There was a click and the details of the room sprang out in sudden brilliancy in the bright rays of the arc-light. I sat perfectly still, my eyes riveted to the demon machine by some horrible fascination. Recalling his remarks concerning "my disposal," and considering my present location directly in the path of the dread ray, left no doubt in my mind as to the fate in store for me. I was to be annihilated, utterly wiped out of existence!

With a curious feeling of detachment from my surroundings, I became aware that he had put on his goggles, apron and gauntlets and was standing over by the switchboard. Then came the low purring of the rotors as they commenced to gain speed and a terrific peal of thunder that shook the building like a leaf. A strong sulfur smell reached my nostrils, cleared my brain, and started me to coughing violently.

I looked up and saw him drest in his unmistakable, unforgettable manner. He was regarding me curiously thru the fantastic goggles.

"Humpf!" he began. "Wide awake at last, I——"

A peal of thunder drowned out the rest of his sentence.

"Now, look here, Pax Marriote, if that is your name, you seem to have some wild

MODEL AIRPLANE SUPPLIES

Build and fly Model Airplanes ~

Send 5¢ for catalog of complete and knocked-down scale models of new machines, parts, fittings, and supplies.

Wading River Mfg. Co. 672 Broadway, Brooklyn, N.Y.

Fit YOURSELF for the Joy of Life



STRONGFORT
The Perfect Man

No one can get real happiness out of life, however much money he may have, unless he is physically FIT. What are dollars to a man who can't eat a square meal without discomfort? Where's the joy in an elegant home if constipation, dyspepsia, biliousness or any other chronic ailment makes you wake up each morning with a nasty taste in your mouth, an ache in your bones and a millstone in your chest?

The real Joy of Life comes from the possession of red-blooded health and strength PLUS sufficient money—from the ability to live as you want to live, eat what you want to eat and do the things that please you, without being reminded every hour that you have a stomach or a liver or a heart that has to be considered and coddled like an old woman.

PUT YOUR ENGINE IN ORDER

Don't try to ride through life with an engine that rattles, knocks, misses and is likely to break down in the middle of the trip. Take as good care of your human machine as you do of your car.

It's a lot easier and less expensive to do. Nature will do the repairing, promptly, efficiently, systematically, if you give her a chance. With her help you can free yourself from the chronic ailments that make your life a burden; develop your figure and muscles; strengthen all your vital organs, and get back the health, strength and vigor you used to have.

STRONGFORTISM

Strongfortism is "The Science of the Normal." It gets right down to bedrock in its treatment of human ills. It is Nature's own way of rebuilding, revitalizing and rejuvenating the human organism.

I have spent my life investigating and studying out Nature's methods. By them I built myself up into the strongest man in the world. By them I have restored health and happiness to the weak, sickly, anemic men and women in every part of the civilized world. By them I can and will build YOU up, so you are FIT to enjoy life, if you will follow my directions for a few months.

SEND FOR MY FREE BOOK

"Promotion and Conservation of Health, Strength and Mental Energy" will tell you all about the Science of Strongfortism—what it has done for others and WHAT IT WILL DO FOR *YOU,* no matter what your present condition is or what may have brought you to it.

No medicines or drugs of any kind to take; no expensive apparatus to buy, no interference with your regular occupations—just Nature's way. You can practise Strongfortism and secure its wonderful benefits by devoting to it fifteen or twenty minutes a day in the privacy of your own bedroom.

Send for the book to-day—WRITE FOR IT *NOW.* IT'S FREE, but its real VALUE to you cannot be measured in dollars. Enclose three 2c stamps for packing and postage and I will mail you a copy at once.

LIONEL STRONGFORT

Physical and Health Specialist

1344 Strongfort Institute Newark, N. J.

CUT OUT AND MAIL THIS COUPON

Mr. Lionel Strongfort, Newark, N. J.

Dear Strongfort:—Please send me your book, **"Promotion and Conservation of Health, Strength and Mental Energy,"** for postage of which I enclose three 2c stamps to cover mailing expenses. I have marked (X) before the subject in which I am interested. (1344).

...Colds	...Insomnia	...Poor Circulation
...Catarrh	...Heart-weakness	...Youthful Errors
...Asthma	...Short Wind	...Vital Losses
...Hay Fever	...Flat Feet	...Impotency
...Obesity	...Constipation	...Skin Disorders
...Headache	...Biliousness	...Despondency
...Thinness	...Torpid Liver	...Round Shoulders
..Rupture	...Indigestion	...Lung Troubles
..Muscular Development	...Nervousness	...Increased Height
...Neuritis	...Weak Eyes	
...Neuralgia	...Falling Hair	
...Flat Chest	...Poor Memory	
...Deformity	...Rheumatism	

NAME .....

AGE.....OCCUPATION .....

STREET .....

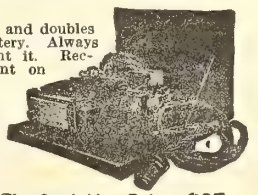
CITY..... STATE.....

Charge Storage Batteries

For Convenience or Profit

From any alternating current lamp socket with the Cambridge Rectifier. For home or garage use. As simple as turning on a lamp and fully guaranteed.

Quickly saves its cost and doubles the life of your battery. Always ready when you want it. Rectifier Bulletin R sent on request.



Bulletin Y of Wireless Telegraph Apparatus sent for 3 cent stamp.

Clapp-Eastham Co.

131 Main St. Cambridge, Mass. The Cambridge Battery Charger, Price $25

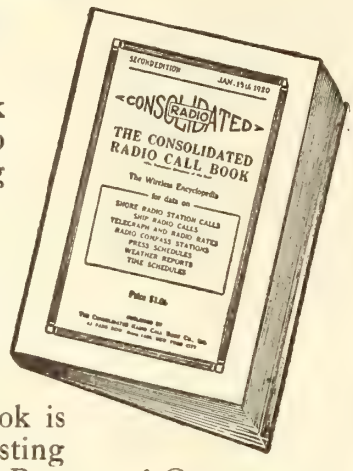
The Second Edition of the

Consolidated Radio Call Book

Will Be Out in Two Weeks

It was unavoidably delayed

owing to the vast amount of work involved in bringing it right up to date and in compiling the big amateur section that will be a special feature. We urge all those who have placed their orders to be patient—you'll be glad you waited when you receive your copy, which will be very soon.



The Consolidated Radio Call Book is the only book in print officially listing all the radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.

All Amateur Calls Also Listed

SPECIAL
Given Free with Each Copy

A Wireless Map of the World **in colors** is given absolutely free with each copy. This map shows the locations of all the high powered RADIO stations in the world, including the time signal stations. In addition it tells at a glance how far away any of these stations are. Of greater interest are the time zones, which enable the amateur to compute instantly the correct time for the zone in which he is located from any time signal station.

Price $1.00 Prepaid

Either Direct from us or for sale by the following responsible Dealers:

American Electro Technical Appliance Co., 235 Fulton St., New York, N. Y.
Atlantic Radio Co., 34 Batterymarch St., Boston, Mass.
L. Bamberger & Co., Newark, N. J.
J. H. Bunnell & Co., 32 Park Place, New York City
California Electrical Supply Co., 643 Mission St., San Francisco, Cal.
L. W. Cleveland Co. 441 Congress St., Portland, Me.
Cutting & Washington Co., 6 West 48th St., New York City
De Forest Telephone & Tel. Co., 1391 Sedgwick Ave., New York City
Dewey Sporting Goods Co., 268 West Water Street, Milwaukee, Wis.
Doubleday Hill Electric Co., 719 Liberty Ave., Pittsburg, Pa.
A. T. Hovey, 61 Belvidere St., Boston, Mass.
Lester I. Jenkins, 923 Purchase St., New Bedford, Mass.
F. S. Katzenbach Co., 35 E. State St., Trenton, N. J.
Klaus Radio Apparatus, Eureka, Ill.
Arno A. Kluge, 638 So. Figueroa St., Los Angeles, Cal.
Manhattan Electrical Supply Co., 17 Park Place, New York City. 114 S. Wells St., Chicago, Ill. 1106 Pine St., St. Louis, Mo. 604 Mission St., San Francisco, Cal.
McCarthy Bros. & Ford, 75 W. Mohawk St., Buffalo, N. Y.
A. C. McClurg & Co., 218 So. Wabash Ave., Chicago, Ill.
Mohawk Electrical Supply Co., 325 So. Warren St., Syracuse, N. Y.
National Radio Supply Co., 1405 U St., N. W., Washington, D. C.
Newman-Stern Co., 1874 E. Sixth St., Cleveland, Ohio.
Nola Radio Co., 134 Chartres St., New Orleans, La.
E. P. Noll & Co. 21 No. 7th St., Philadelphia, Pa.
George W. Parezo & Co., 808 Ninth St., N. W., Washington, D. C.
Pioneer Electric Co., 137 East 5th St., St. Paul, Minn.
F. D. Pitts Co., 12 Park Square, Boston, Mass.
Precision Equipment Co., 2437 Gilbert Ave., Cincinnati, Ohio
Radio Corporation of America (Marconi Co.), Gay and Pratt Sts., Baltimore, Md.
Radio Distributing Co., 4 West Park St., Newark, N. J.
Radio Engineering Co., 614 N. Calvert St., Baltimore, Md.
Radio Equipment Co., 630 Washington St., Boston, Mass.
Reuter Electric Co., 34 East 6th St., Cincinnati, Ohio.
Rudolph Schmidt & Co., Inc., 51 Main St. E., Rochester, N. Y.
Shaffer's, 107 Granby St., Norfolk, Va.
Shotton Radio Mfg. Co., Scranton, Pa.
Smith Novotoy Electric, Inc., 20 West 5th Street, Charlotte, N. C.
Southern Electrical Co., Third and E Sts., San Diego, Cal.
H. E. Williamson Electric Co., 316 Union St., Seattle, Wash.
Young Men's Christian Association, 715 South Hope Street, Los Angeles, Cal.
Jos. M. Zamoiski Co., Baltimore, Md.

Published by

Consolidated Radio Call Book Co., Inc.

41 Park Row, New York City

idea that I came here to steal your invention, and yet I have told you the truth when I say that I did not even know that you were in existence when I entered this house. Surely you believe me."

"I most certainly do not," he replied coldly, "and even if I did I could afford to take no chances. Have you anything else to say?"

"Just this. That you will pay, and pay dearly for anything that you do to me. Understand that, please."

Striding forward he pulled something from his pocket, and before I was aware of his design, nor could I have done ought to prevent it, I was securely gagged.

"This unpleasant step becomes a necessity in the face of your continued insulting remarks," he informed me, adding dryly, "I regret the——"

Here a splitting crash of thunder blotted out his voice for a few moments.

When it died away, he was still talking, "and I presume that you understand what I intend to do with you. I can at least assure you that death will be painless, and I am sorry that you have been inconvenienced by the rain. The transformer got rather beyond my control and destroyed part of the wall before I could turn it off."

Such cold-blooded discussion caused the sweat to stand out all over my body. This past soon, however, and left me cool and calm.

Without more ado, he crost over to the control lever, switched out the arc-light, and began moving the lever arm at a good rate over the contact points.

So suddenly did this all happen that I scarcely realized what was going on until I glanced down at my shirt front. Imagine my unutterable horror when I saw the telltale patch of red light cast on my shirt directly over my heart!

For a moment my heart actually stood still, then the blood began racing madly in my veins, pounding in my temples till I thought they must surely burst. Tugging desperately at my bonds, I soon found that escape was hopeless, and meanwhile the red had changed to blue and this in turn to a violet ray. Even as I watched, petrified with fear, the violet faded out and soon after the awful streamers began to float about the room and the purple mist appeared upon the table.

The end could not be many moments away, and even then I fancied that I could feel a strange drawing sensation in my left side.

And, now that I sat there on the very brink of Eternity, I felt calm and collected.

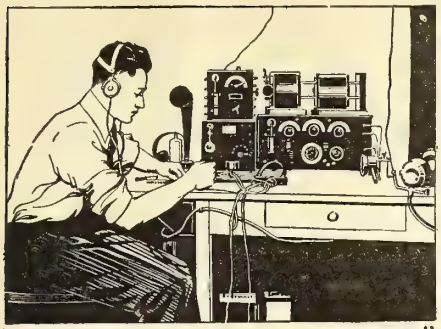
I found time to notice that the storm had suddenly ceased for a moment, that the forces of Nature seemed to be suspended for a short interval. Then came a crash as if earth and sky had met in collision, and the former had been shattered, and simultaneously, a vivid blinding sheet of flame enveloped the room. There was one awful throb of the tortured atmosphere and something struck me a terrific blow in the back that sent me halfway across the room, and I landed in a heap with twisted straps and pieces of splintered wood fastened to my wrists and ankles.

I think I realized, at the time, that the building had been struck, and I rose shakily to my knees in time to see Pax Marriote stagger backwards, his hand clapt over his forehead, and fall writhing to the floor.

Already the switchboard was vomiting flames and the whole of one wall was ablaze, so I made a great effort and slipt back the bolt on the door, succeeding in dragging myself out of the house and fifty feet away from it before I swooned.

* * *

I came to in Beaumont Hospital with Bryce bending over me. I felt very weak, and trying to move sent sharp pains shooting thru me.



You may begin at once our complete course preparing you for commercial radio license. Rapid progress, individual attention, classes of limited size.

Ask for new descriptive booklet

Y. M. C. A. RADIO SCHOOL

Marcy Avenue near Broadway

BROOKLYN, N. Y.

Telephone, Williamsburg 3800.

NEW DIAL INDICATOR



Fits standard ¼" Shaft. Made of same quality as our smaller dial. Black composition. White filled engraving. Bevelled edge.

3" Dial.....$0.75. With Knob.....$1.30 Postpaid
3⅞" Dial..... 1.00. With Knob..... 1.70 Postpaid

Moorhead Electron Relay New Style....$6.00
Moorhead V.T. Amplifier..... 7.00
Moorehead Extra Hard V.T..... 7.50

Shipping weight 1 pound. Guaranteed. Licensed under Fleming and De Forest Patents.

Our new Catalog now ready, send 10c for it.

For sale at all RADISCO Agencies and by

A. H. CORWIN & CO.

4 West Park St., Dept.E-1, Newark, N. J.

Radio Men

The Mutual Purchasers Association will save you money on all

Wireless Apparatus

Write Dept. E.E. for details.

MUTUAL PURCHASERS ASS'N, 2-4 Stone Street, New York

Vacuum Tube Control Cabinets

Beautiful mahogany finished case with handsome grained bakelite panel on which is mounted a standard socket, rheostat, grid leak, condenser and switch for arc and spark reception.
Price $15.00.
Send for our free catalogue of other "Modern" apparatus.

MODERN RADIO EQUIPMENT CO.
Elizabeth, New Jersey

MARKO

STORAGE BATTERIES

ARE GOOD—TRY ONE

Paul M. Marko & Co., Inc.

1402-1412 Atlantic Ave.

Brooklyn, N. Y.

"Take it easy, Old Scout," Bryce was saying, "you need a rest."

"You—found—m-me?" I managed to blurt out.

"Right after the storm, Old Top. I soon discovered your trail where you cut into the woods and the rest was easy. By the way, were you inside of that shack?"

"Shack? Oh, yes, of course! I went inside to get out of the storm and it was struck by a bolt." I decided to omit the details of my experience. "Burned down, did it?"

"Clear to the ground. Must have been a close call for you. You were pretty badly burnt. And say,—funny thing,—there was a piece of strap fastened around your wrist."

"Is that a fact?" I drawled. "How odd."

I laid there in silence for some minutes, gazing at the ceiling. Then I felt impelled to ask.

"Were—were any—bodies found in the ruins?"

He looked at me perplexedly. "Why no. Why do you ask?"

"Oh, I just thought that perhaps,—just curiosity, you know!"

Just then a nurse came in, and, with a parting word, Bryce took his leave.

And so it happened that I spent my long looked for vacation in a hospital ward, and to this day I don't know whether Marriote perished with his terrible secret in the flames of that burning house, or whether he is still alive and may some day startle the world of science with an announcement of his achievement.

For my part, I hope that the secret of the *ultimate ray* is buried beyond all chance of recovery.

[The End]

Which Article Do You Like?

Vote today—Right below. Please check those subjects which interest you most, tear out the coupon, paste it on the back of a post-card and mail it at once. It costs but one cent. Address—The Editor, Science & Invention, 233 Fulton St., New York, N. Y.

- Home Electrics ☐
- Radio Articles ☐
- Pictures of Latest Inventions ☐
- Scientific Jokes ☐
- New Electrical Inventions ☐
- Chemistry ☐
- Articles on Physics ☐
- "Odd Photo" contest ☐
- Automobile Department ☐
- Latest Patents ☐
- "Movie" Inventions and Developments ☐
- Editorials ☐
- Scientific Stories (Fiction) ☐
- Popular Astronomy ☐
- The Home Mechanic ☐
- X-Rays and Kindred Articles ☐
- Photography ☐
- European Electrical and Scientific News ☐
- Electrical Machinist ☐
- Articles Describing Various Trades and Professions—How to Fill the Job ☐
- Wrinkles, Recipes and Formulas ☐

(Please Sign Here)

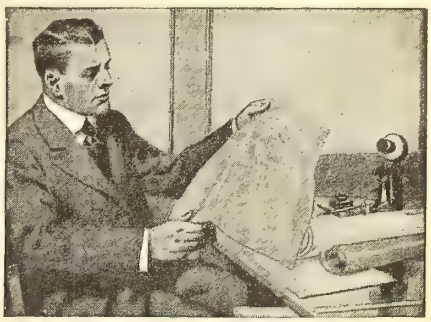
Name..... Age.....

Street and Number.....

City..... State.....

Sex.....

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6243 SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electrician
- ☐ Electric Wiring
- ☐ Electric Lighting
- ☐ Electric Car Running
- ☐ Heavy Electric Traction
- ☐ Electrical Draftsman
- ☐ Electric Machine Designer
- ☐ Telegraph Expert
- ☐ Practical Telephony
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Ship Draftsman
- ☐ Machine Shop Practice
- ☐ Toolmaker
- ☐ Gas Engineer
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREM'N OR ENG'R
- ☐ ARCHITECT
- ☐ Architectural Draftsman
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Navigator
- ☐ CHEMICAL ENGINEER
- ☐ SALESMANSHIP
- ☐ ADVERTISING MAN
- ☐ Window Trimmer
- ☐ Show Card Writer
- ☐ Outdoor Sign Painter
- ☐ RAILROADER
- ☐ ILLUSTRATOR
- ☐ DESIGNER
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Pub. Accountant
- ☐ Traffic Management
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ STATIONARY ENGINEER
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ Textile Overseer or Supt.
- ☐ AGRICULTURE ☐ Spanish
- ☐ Poultry Raising ☐ French
- ☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-28-19

Street and No._____

City_____ State_____

SKINDERVIKEN BUTTONS $1

Radio Apparatus Bought, Sold, Built

C. McCONNELL
38 Warner Street
Springfield, Mass.



HERE IT IS

A sign for your den. Exceedingly attractive. Printed in bright red on white cardboard. No electrical bug should be without it. 7¼" x 11¼". 10c each in coin ONLY. Send stamp for postage.
Carroll St., Brooklyn, N. Y.
LEONARD BECK, 1298

MURDOCK No. 55



2000 OHM SET.....$4.50
3000 OHM SET..... 5.50

That these Murdock No. 55 Sets have earned a nation-wide reputation for value, is due, not so much to the fact that they are, without question, the best low priced receivers obtainable anywhere, as it is to the recognized fact that they closely approximate in operation the sensitive performance of the most expensive sets.

The customary assurance of "Satisfaction or Money Back" affords the opportunity of proving the exceptional value of these 'phones at no risk to you.

Other instruments — MURDOCK MADE—of recognized merit at equally reasonable prices are illustrated in Bulletin 19B, a copy of which will be mailed on request.

WM. J. MURDOCK CO.
55 Carter St.
CHELSEA (BOSTON 50) MASS.
509 Mission St. San Francisco, Calif.

RADIO SMALL PARTS

Our delivery of small part orders is very prompt. Order those listed below as a trial of our efficient mail order service.

Grid Condensers .0013
Stopping Condensers .0005 **.35c EACH**

SWITCH POINTS

¼x¼" with 5/32 shaft, including nut .35c dozen

Agents for RADISCO Apparatus

Including Coils, "B" Batteries, Indicating Dials and other parts distributed by them. Mail orders given prompt attention.

Open Evenings until 9.30 P.M.

KELLY & PHILLIPS
312 Flatbush Avenue, Brooklyn, N. Y.

STUDY HUMAN NATURE

MAKE PEOPLE LIKE YOU

Get along better, make more money, develop a winning personality, learn to know people as they are. Send 5 cents (stamps) for "PERSONAL POWER," a little book that points the way. Address

PROGRESS LEAGUE, 3110 UNION SQ., NEW YORK

Home Electrics

By G. L. HOADLEY, M.E.

(*Continued from page* 386)

Poor adjustment of the distance the armature is separated from the magnets frequently causes the bell to fail to operate. The separation should be not less than 1-24 inch for the small bells up to ⅛ inch for the larger bells. Sticking of the armature to the magnets sometimes occurs, due to residual magnetism in the magnet cores. A thin piece of paper glued to that surface of the armature facing the poles of the electro-magnets will overcome this difficulty.

Poor adjustment of the sparking contacts is a common source of trouble. To adjust the contact spring the proper distance from the platinum tipt screw, hold the hammer against the bell. The armature should now *just not touch* the poles of the electro-magnet. Now, tighten the platinum tipt screw until it *clears* the contact spring by about the thickness of a sheet of brown paper. Let loose the hammer now and make certain the contact spring makes good contact with the tip of the screw. Next, try out the circuit so as to make sure the character of the ringing sound is satisfactory. Then tighten the setscrew to prevent the vibrating hammer altering the adjustment.

Sometimes the spring that bears the armature itself is either too strong (set back too far) or too weak. If too strong, the armature cannot be pulled over far enough to give a good blow; if too weak, the armature with attached contact spring will not return to its place against the platinum tipt screw. To ascertain which defect exists, operate the bell and press the spring lightly with a piece of wire first *toward* and then away from the electro-magnets. If the ringing is better in the first case, the spring is too strong, but if improvement is noted in the latter case, the spring is too weak.

Defective insulation of the winding of the electro-magnets occasionally happens on bells which have had hard usage. To ascertain this trouble and remedy it, place a smooth piece of iron ½ inch square across the poles of the magnet with the bell in circuit. Now, attach a one-pound weight to this ½-inch square iron by means of a string. If the magnets of a 2½-inch bell will not sustain this weight, they are too weak and the winding is probably short-circuited; that is, the current doesn't traverse the whole length of the coils. This makes the magnet very weak. Under these conditions, test to see if the winding is "shorted" thru the iron cores by connecting one pole of a dry cell to one of the magnet coil lead wires. Then draw the other battery pole across the clean iron faces of the electro-magnet coils. If any sparking results, it will be evidence of a "short" or "leakage" thru the iron cores, and the only remedy is to rewind the coils or else discard them.

Leakage may occur between the binding-screws and the base, or between the contact spring block and the base, and the contact pillar. Unless the connecting wires are covered with rubber tubing, leakage may occur between these wires and some part of the metal base. Carefully examine these places and apply a little glue or shellac to any suspected spot.

Summarizing, if a bell fails to ring, first, either loosen or tighten the adjusting screw of the contact pin, moving it closer to, or farther away from the armature spring as required. If the spring is too stiff, bend it toward the armature a little. A thin and sharp-pointed pin should be blunted as it offers too much resistance. Note whether the connections between the ends of the wires and the terminal screws are good and not dirty. Sticking of the armature cores can be prevented by inserting two brass pins in drilled holes in the core ends.

GET A

COMMERCIAL LICENSE

Three or four months in our day school or four or five months in evening school will fit you to pass the government examination. We placed approximately three hundred men last year.

Write for Booklet

Y. M. C. A. RADIO SCHOOL

152 East 86th Street, New York, N. Y.

"The Best Radio School in the East"

PROSPECTIVE STUDENTS

B. C. N. will give you your N.D. degree in two years, day and night classes. This institution teaches Electrical Therapeutics, Static, High Frequency, Violet Ray, Galvanic Current, X-Ray, Osteopathy, Orthopaedics, Chiropractic, Psychology, as embodied under the Triplicity of Sciences known as **Natureopathy.** The field is unlimited right now for Natureopathic Physicians. Our experienced faculty of fourteen practical physicians will guide you surely and carefully to attain success. Earn while you learn if you so desire. Graduates of single branch schools who are here now say that the Blumer System is the most wonderful drugless healing system in existence. Write today for our catalogue. Start right. Address Executive Secretary,

BLUMER COLLEGE of NATUREOPATHY
97 Ann St., Dept. H., Hartford, Conn.

15 cents postage will bring to you "The Scientific Natureopath." Address Publicity Dept. of the above college.



Radio Handbook & Catalogue

Contains much valuable radio information, tables and data. Describes a remarkable line of wireless instruments including "Red Head" 'Phones, Arlington Tested Minerals, DeForest, Murdock and Signal Apparatus. Write for this book today.

The Newman-Stern Co.
Dept. E. E. Cleveland, O.



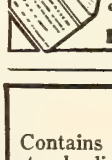
Red Head Radio Phone

$7.00

The accepted standard in wireless receivers. If they are not BETTER than anything you've ever seen return them for full cash refund. Our Radio Handy Book and Catalogue, free on request, describes them, and many other instruments.

The Newman-Stern Co.
Dept. E. E. Cleveland, O.

ARLINGTON TESTED CRYSTALS



Why buy minerals on a gamble? Be SURE when you put a crystal in your detector that it is EXQUISITELY SENSITIVE. Buy Arlington individually tested Minerals, Galena or Silicon, post paid on receipt of price.

35¢

THE NEWMAN-STERN CO.
Dept. E. E. Cleveland, O.

CATALOG J.

Contains 24 pages of reliable apparatus, standardized parts and raw materials. Complete line switch points, knobs, switches, rod, aerial wire, etc.

Send 5c in stamps for your copy today.

Shotten Radio Mfg. Co., P. O. Box 3, Scranton, Pa.

Be a Movie King

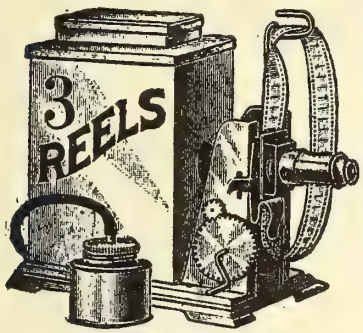


OH BOY. SOME SPORT

Surprise the Bunch—Have a Barrel O' Fun!

OWN A GENUINE MOVING PICTURE MACHINE

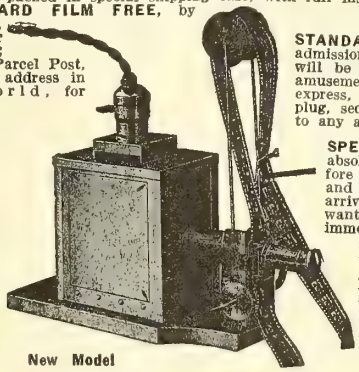
Here's what you've always wanted—a Genuine Moving Picture Machine—a machine that uses **STANDARD FILM**—like the **BIG** theatres show—at a price you can easily afford to pay. This is the **BIG** opportunity—don't **MISS** it. Read every word—then act quick. Several swell models to select from. Each the best of its kind. **ALL REAL** moving picture machines—not toys or magic lanterns—but **REAL MOVIE** Machines, that throw a big, broad, brilliant circle of light on the screen many feet away, and show a picture three to seven feet in width. One or more reels of **REAL FILM** come with each machine **FREE**, and the minute you get your machine you can start right in and give a "bully" exhibition. The "fellers" and girls and the grown ups, too, will sit spellbound, or roar with laughter, at the wonderful, lifelike, real movies you can show them.



Latest Model Cinematograph

Show Real Moving Pictures Like the Big Theatres

The New Model This is a beautiful, high-class Moving Picture Machine. Made of sheet iron with wood base. Finished in black or battleship grey with handsome red stripe trimmings. Solid and substantial construction. Size, 12x7½x5½. Uses **STANDARD FILM** same as the big machines, and throws a **BIG** picture many feet in diameter. **TWO TYPES**—Electric and Gas. The electric machine is equipped with plug and cord, complete. Gas machine has its own generator and makes its own light. The gas machines can be used anywhere and will be sent unless Electric type machine is specially ordered. Remember this and be sure to specify "electric" if you desire this type. Sent securely packed in special shipping case, with full instructions and one **STANDARD FILM FREE**, by express, for $7.50; or by Parcel Post, to any address in the world, for $8.00.



New Model

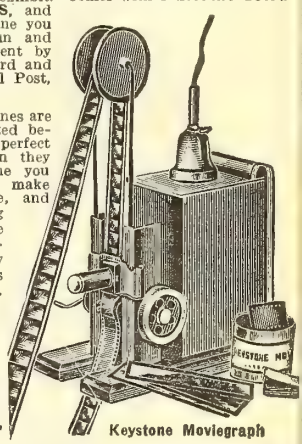
STANDARD SIZED FILMS, admission tickets—all **FREE.** Here is a machine you will be proud of. You can have endless fun and amusement, and **MAKE MONEY** with it. Sent by express, with full instructions and extra long cord and plug, securely packed, for $12.00; or by Parcel Post, to any address in the world, for 75c extra.

SPECIAL. Order from this Ad. Our machines are absolutely as described and thoroly inspected before they are shipped. We guarantee them perfect and complete and all ready to use when they arrive. Make sure of getting the machine you want—order now—from this Ad. We can make immediate delivery now—so order at once, and avoid disappointment. Prices are going up all the time and you may never have a chance like this again to buy a Genuine Moving Picture Machine at the very low prices quoted here. You've always wanted a real Moving Picture Machine. Make sure to get it **NOW.**

Charlie Chaplin Films—25c each

Keystone Moviegraph

This is our largest and finest machine. A regular beauty and all complete, ready for you to use the minute it arrives. Hang up a sheet, put on a reel, turn the crank, and you're off—that's all there is to it. Nothing to get out of order. Made of metal throughout with heavy base casting. Finely adjusted mechanism, easily operated. Equipped to show slides as well as Real Moving Pictures—just like the big machines. 12x9½x6. Made to operate with electric light **ONLY.** Simply screw in the plug and you are all ready for an exhibit. Comes with **3 EXTRA LONG 3 FINE SLIDES,** and



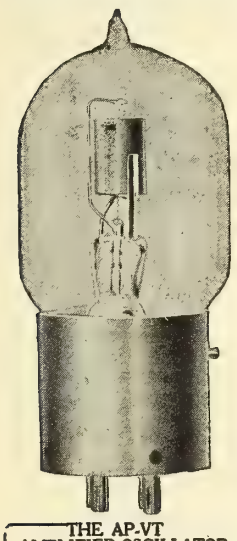
Keystone Moviegraph

BIG BARGAIN OFFER

3 Reels Free Here is an astonishing bargain. Our latest Model Cinematograph is a whirlwind value. At the price it has everything beat you ever heard of. Here is a genuine Moving Picture Machine—made of metal—solidly constructed—and put together by expert workmen—that you can buy at a price that will simply astound you—knock you plumb off your feet. This machine throws a brilliant beam many feet. Comes equipped with a **SAFETY** Carbide Gas Generator, and can be used to show moving pictures anywhere. The mechanism is scientific and simple and can be operated by anyone. This is the greatest value in a Genuine moving picture machine ever offered at the price. Think of it! a genuine moving picture machine—that uses **STANDARD FILM**—by express, charges collect—with **3 REELS FREE**—for only $3.00; or by Parcel Post to any address in the world for only $3.25!

FILMS All the films you want. Splendid subjects—15c each; Doz., $1.50 (postpaid). Extra long films, 3 for $1.00; Charlie Chaplin films—side-splitters—famous favorites, 25c each. Lantern Slides (least sold)—6 for 75c.

JOHNSON SMITH & CO. Dept., P.M. 21, 3220-3224 N. Halsted St. CHICAGO, ILL.



THE AP-VT AMPLIFIER-OSCILLATOR

THIS VT AMPLIFIER - OSCILLATOR

OF ALL VACUUM TUBES HAS THE HIGHEST

AMPLIFICATION CONSTANT

The A-P Amplifier-Oscillator is the Navy type SE 1444 "hard" tube, designed and manufactured expressly for amplification and oscillation purposes. Because of its exceptionally high vacuum and correct electrical and mechanical design this tube has the highest amplification constant of any tube known to the radio art. Recent tests by the United States Navy have established this fact. (See April, 1920, Prec. I. R. E.)

Used in conjunction with the A-P VT Amplifier-Oscillator is our A-P Electron Relay, the original tubular vacuum valve brought out by our Laboratories in 1915, but now supplied with the SHAW standard four-prong base for convenience. Of all vacuum tubes the A-P Electron relay is the most efficient spark receptor. A combination of two or more VT tubes as amplifiers with an Electron Relay as the initial detector is the *ideal receiving combination* for long distance amateur or long wave reception. In ordering ask for—

THE A-P PERFECT VACUUM TUBE COMBINATION

DEALERS *Write for prices and particulars*

The A-P Electron Relay — price $6.00 each
Immediate deliveries. Order from your dealer or write direct.

The A-P VT Amplifier Oscillator—price $7.00 each.
Immediate deliveries. Order from your dealer or direct.

AMATEURS *Write for descriptive literature*

These tubes were manufactured under the DeForest Audion and Fleming Patents

ATLANTIC RADIO SUPPLIES CO., KIRK PLACE, NEWARK, N. J., Phone, Market 1575
PACIFIC RADIO SUPPLIES CO., 638 MISSION STREET, SAN FRANCISCO, CAL.
SOLE DISTRIBUTORS FOR MOOREHEAD LABORATORIES, Inc.
Reference—The American National Bank—San Francisco

DIAMONDS ON CREDIT — **WATCHES ON CREDIT**





Diamond Rings Latest Designs

All the popular mountings, plain and fancy engraved, Green, White and Yellow Solid Gold, very special at $85, $100, $150 and up. Credit terms. See Catalog.

Loftis "Perfection" Diamond Ring and man's "Tooth" Ring

LIBERTY BONDS ACCEPTED

Send for Free Catalog

There are 128 pages of Diamonds, Watches, Jewelry, all priced **unusually low.** Whatever you select will be sent prepaid by us. **You see and examine the article right in your own hands.** If satisfied, pay one-fifth of purchase price and keep it, balance divided into eight equal amounts, payable monthly. Send for Catalog today.



Pearl Necklaces, $15 to $500. See Catalog.

LOFTIS BROS. & CO., The National Credit Jewelers

Stores in Leading Cities — Dept. C22 — 108 N. STATE ST., CHICAGO, ILLINOIS

CHARGE YOUR OWN BATTERY AT HOME FOR 10c.

F-F Battery Boosters have been in service for over 5 years and their rapidly growing popularity is a reliable measure of their ability to perform the service for which they are intended.
Our increased factory space is buzzing steadily so we can take care of your requirements.



F-F BATTERY BOOSTER or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current.

Bantam type 6-6 amp. 6 v. battery. $15
Type 16-8 amp. 6 v. battery.... 24
Type 166-12 amp. 6 v. battery.... 32
Bantam type 12-5 amp. 12 v. battery. $20
Type 112-6 amp. 12 v. battery.. 24
Type 1612-7 amp. 12 v. battery.. 32
Type 1626-12 or 7 amperes in combination for both 6 and 12 volt batteries.. 48

Shipping weight complete with **Ammeter** and **Battery Clips.** 11 to 15 pounds.

All outfits do the same work except as to time to complete a charge.

Include postage and insurance with remittance for parcel post shipment.

Ask for bulletin **No. 12** describing these and other F-F charging apparatus of larger capacities and of other voltages and cycles; also Boosters that operate on Farm Lighting Plants and Direct Current.

Write for Bulletin No. 12

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

WIRELESS MANUAL-W12

Our 180 Page Combined Manual and Catalog Illustrates and Accurately Describes the Uses of Standard Radio Instruments.

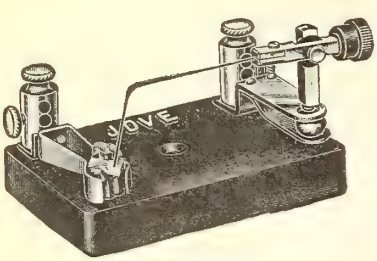
We Make a Charge of 25c for it, Issuing Coupon Receipt Redeemable on a Purchase of $5.00 or More.

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We catalog and offer for sale wireless apparatus of the highest quality, guaranteed to be mechanically and electrically perfect.

Get a copy of our complete wireless catalog and order all of your radio material from one source of supply and save trouble. Ready about May 25. Send in your request now.

MANHATTAN ELECTRICAL SUPPLY CO., Inc.

New York—17 Park Place
Chicago—114 S. Wells St.
St. Louis—1106 Pine St.
San Francisco—604 Mission St.



(GHEGAN PATENT)

Bunnell **INSTRUMENTS Always Reliable**

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

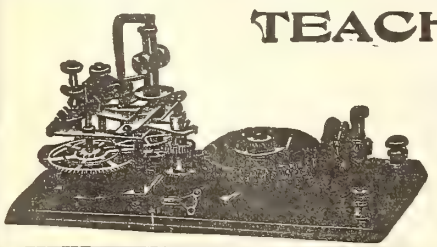
Send stamp for new edition 42E Catalog.

J H. BUNNELL & CO., 32 Park Place, New York

"THERE'S MONEY IN IT"

LEARN TELEGRAPHY AT HOME — MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter, **THE OMNIGRAPH.** Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
26 L Cortlandt St. New York

Sperry Shoal Water Indicator

(*Continued from page* 363)

reaches a *minimum water depth.* This is inserted in the upper part of the second dial, the function of which dial is to give the propeller speed.

This is actuated by transmitters placed on the individual propeller shafts which are averaged by a device, similar to the one described in the Sperry Battle Tracer article, in the March issue of this publication. From the averaging device, impulses are transmitted to the dial giving an accurate indication of the speed. On one side of this second indicator is a set screw for adjusting the scale of minimum water depth, which can be accurately determined, inasmuch as a slight movement of the indicator either way is instantly noticeable.

A shallow water indication and the sounding of an alarm is given whenever the ship is operating in a draft of water considerably less than its overall length (as this is the point where the resistance of the water to the ship's speed is increased). For a given number of revolutions per minute for the propeller shafts, the actual speed is reduced by a considerable amount in shallow water, even as much as 50 per cent of normal. However, in actual practise, the two contacts for the alarm are held a certain distance apart so that the vessel can ride in the shallow water with a short margin of safety and is enabled to pass thru channels, etc., where water is not very deep.

Now, whenever the *ratio* of propeller speed to actual forward motion of the ship is upset, a warning is rendered, foretelling the dangerous location. Only one other condition can possibly change this ratio between ship speed and propeller speed, and that is the condition of the ship's bottom, but this can be compensated for.—*Photographs courtesy Sperry Gyroscope Company.*

Audion Poem Awards

(*Continued from page* 405)

3d Honorable Mention

THE WANDERING AUDION.

I was born in the brain of science,
I was clothed in a fragile glass,
I was bound to my work with copper wires
And wedged into place with brass.

While out of the world's aste saces,
Born on the radio wave,
Came the pulsing code-rit message
That taught me I was a slave.

That spoke of boats on the ocean,
And told of the work of men,
Describing the vibrant busy world,
So far away from my ken.

I conceived a desperate longing
To break my bonds and be free;
And wander over the wond'rous world,
Myself these things to see.

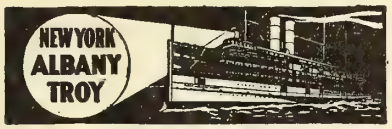
But my fragile shell made them wary;
They guarded me lest I break.
But they did not know, for I couldn't show
That my soul bore a lonely ache.

Yet, sometimes accidents happen!
Once while they were bringing me
Aboard a ship, for a trial trip,
I slipped off into the sea.

For many a moon I drifted,
And watched the ships sail by;
And saw, to my craving heart's content,
The wonderful summer sky.

(*Continued on page* 459)

HUDSON RIVER NIGHT LINES



Daily Sailings from Pier 31, N. R., (at Desbrosses St.) weekdays 6 P. M. & 7 P. M., Sundays and Holidays 6 P. M. and 9 P. M.

West 132nd St., half hour later
(Daylight saving time)

Due Albany 6 o'clock following morning. From Troy 8:30 P. M., from Albany 9 P. M. & 11 P. M., due New York 6 o'clock following morning.

Direct rail connections to all points.
Express freight service.
Autos carried.

HUDSON NAVIGATION COMPANY

No Seals-No Secrets —*But Service!*

Inspection of the interior of any Radio apparatus bearing the mark:

GREBE RADIO

reveals design and workmanship fully in keeping with its outward appearance.

GREBE RADIO apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service. Our interest in the purchaser does not terminate with the sale.

Ask your dealer to show you our line of super-grade apparatus.

A. H. GREBE & CO., Inc.,
70 Van Wyck Blvd., Richmond Hill, N.Y.

EASIEST SHORTHAND



Learn in 5 evenings home study; then acquire speed with K. I. Shorthand. Amazingly simple, easy. Approved by experts. Write dictation, messages, etc., rapidly as spoken, after brief pleasant practice. Favorite method for personal use; make notes at lectures, meetings; keep confidential diary. Big help in any profession or business; aid in your career. Used in Army, Navy, courts, commercial schools; by public and private stenographers, teachers. Slight cost. K. I. Shorthand—for busy people, including YOU. Proof Lessons, Guarantee and Brochure with Testimonials free, postpaid. Address:



KING INSTITUTE, EL-300-Station F, NEW YORK CITY

SPECIAL SUMMER SALE! **GROUND WIRE** 8c per ft. $7.00 per 100 ft.

Lightning Switches, 600 V., 100 Amp., only.... $4.00
Original Audiotron Adaptors..... $1.75
Standard "VT" Sockets with positive contacts. $1.00
Moorhead Electron Relays with Standard VT base $6.00
(Fully Licensed and Guaranteed. See Moorhead Adv.)

RADIO EQUIPMENT CO.
630 Washington St. Boston, 11, Mass.

"ELECTRIC SHOVELS" TO THE FRONT.

The development of "Electric Shovels" was discust by H. W. Rogers, an electrical engineer, in an interesting talk before the members of the General Electric Engineering Laboratory Club recently.

In outlining the development of the electric shovel of today, the speaker referred to the various changes in mechanical structure of electric shovels, dating back to the first steam shovels brought before the public, upon a manufacturing basis, some 50 years ago.

At present there are in the Ohio and Illinois coal fields electric shovels with the eight-yard bucket, equipt with two 340-h.p. hoist motors, and are practically a one-man shovel. Some of the different types of shovels are provided with friction clutches and have caterpillar tread construction.

As to the relative cost of operation, it was shown that the electric shovel operates at the rate of six to seven cents per ton of coal mined, making a saving of $9 for each working day shift, over the steam shovel.

During the course of Mr. Rogers' lecture, many slides were shown, illustrating the various shovels in use at the present time.

A Wartime Radio Detective

PART IV.

By PIERRE H. BOUCHERON.

(*Continued from page* 407)

have become known to persons located in various inns and hotels whose duty it was to notify the truck of our presence. This accounted for the fact that two weeks had now past without having discovered anything more tangible than certain sections of by-roads disfigured by large ruts made by the heavy wheels of the elusive auto.

Incidentally, our investigations up to this time had not proved entirely fruitless. Tips given us by the police and other agencies led to the discovery and dismantling of several illegal radio stations where the culprits were boys possest with perverse natures in that they thought it great fun to "listen-in" to what was going on in the ether by employing improvised indoor antennae and loops. In these cases nothing more drastic took place than severe reprimands with subsequent promises to behave in the future.

One case, however, proved more interesting than the others when a complete receiving installation was discovered in the home of a young man who had recently secured much newspaper notoriety. This "hero" was none other than the radio operator on board a certain large steamer attached to a West Indian run which had been but a short while back effectively sunk a short distance from the Jersey Coast. It was suspected at the time that the operator had been working into the hands of the enemy submarines by disclosing the presence of the ship thru an ill-timed radio signal. To make a short story still shorter the young man and his father were effectively taken care of by the Government.

All roads lead to an end and even a good cigar burns itself out so that finally our intense radio activities came to an abrupt and sudden end in the following manner:

For a week or so our "listening-in" operators had not heard the fluctuating signals and it began to look as if the truck had dropt thru a hole to the center of the island. Frequent and systematic trips thru main and by-roads as well as ceaseless search in barns and woods had so far failed to disclose the presence of the lorrie and its occupants. Even a close watch of the inn, where had first been secured the information, proved equally fruitless. The waiter had never returned to his post and upon cross-examination the proprietor explained that waiters

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6244, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____ 7-28-19

Present Occupation_____

Street and No._____

City_____ State_____

Send To-day for the
"Electrical Worker's Friend"

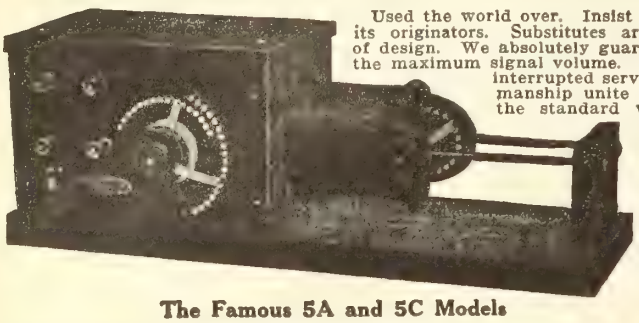
An electrical book of 66 motor drawings with complete instructions for rewinding and reconnecting A.C. motors. Special at **$4.00**

Or write for full particulars of this valuable book

SMITH & SMITH PUBLISHING CO.
Dept. B. 1524 Lowrie St., N. S., Pittsburgh, Pa.

BUTTONS—You *Must* use light buttons for good transmission anywhere. *50c each.*
J. Collins Co., Quaker City, Ohio

TRACO QUALITY
RECEIVING TRANSFORMERS

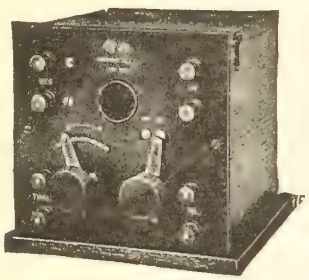


Used the world over. Insist on the genuine, built by its originators. Substitutes are expensive, irrespective of design. We absolutely guarantee our tuners to give the maximum signal volume. Delicate refinement, uninterrupted service and high class workmanship unite to make TRACO tuners the standard whereby all others are judged. If your Dealer does not handle them, order direct from us.

LIBERTY DETECTOR VALVES. RADIO AMPLIFYING PHONES, type used by the **UNITED STATES, BRITISH and FRENCH GOVERNMENTS,** now in stock, for sale. Send stamps for bulletins.

The Famous 5A and 5C Models

THE RADIO APPARATUS CO., Pottstown, Penna., U. S. A.

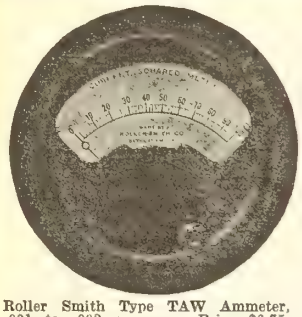


"AT LAST

our Catalogue is off the press and ready for distribution. This Catalogue has been acknowledged by Radio Experts and Associations throughout the country to be the finest Catalogue which was ever put on the market by any Mail Order House whatsoever. This catalogue contains one hundred pages of the most interesting display of Wireless Apparatus ever shown before. In addition to the display of Wireless Apparatus we have listed on the last five pages various hook-ups, starting with the small tuning coil sets and advancing to Audion and Amplifying hook-ups. One page is devoted to Radio Symbols, a photograph of our well stocked store and warehouse is shown in the front part of the book, to give you an idea of the amount of stock we carry at all times. Twenty-four hour shipments are guaranteed on ninety per cent of our orders. Despite the completeness of this catalogue there is a certain amount of apparatus we could not get in in this issue. Any apparatus you are desirous of obtaining, not listed in our catalogue, we can furnish you catalogue from manufacturer and make shipment from our own stock. This catalogue will only be sent upon receipt of 15c in stamps—Catalogue will not be sent if stamps are not remitted.

NOTICE TO WIRE ASSOCIATIONS, SCHOOLS AND VOCATIONAL TRAINING CAMPS: A limited number of catalogues will be distributed free of charge to the Wireless Associations, Schools and Vocational Training Camps throughout the country upon receipt of request from proper authority. Our Information Department is at your service—free of charge. Let our Radio Expert answer your questions—all we ask is that you remit stamped envelope for reply. Make inquiry to Dept. 156.

NATIONAL RADIO SUPPLY COMPANY, Suite 103-4-5 No. 808 9th Street, Washington, D. C.



Roller Smith Type TAW Ammeter, .001 to .002 amperes. Price $6.75.

Partial List of What We Distribute:

Loose Couplers, $5.00, $10.00, $15.00, $19.00.
Tuning Coils, 4,000 Meters, $4.75; 1,250 Meters, $3.50.
Crystal Detectors, $1.75; DeForest Type, $2.60.
Murdock Variable Condensers, .001 MFD, $4.75; .0005, $3.75.
DeForest Variable Condensers Always On Hand.
Fixed Condensers, .002 MFD, 70c; .003, 90c.
Spark Gaps, 75c, 90c, $2.00.
Oscillation Transformer (Murdock Type), $5.00.
Oscillation Transformer (Signal Type), $16.00.
Lightning Switch, 600 V.-100 AMP., $3.94.
Switch Points 3/16"x3/16", Threaded Shank with Nut, 3c Ea.
Switch Points, 3/16"x3/16" with Machine Screw, 20c Per Doz.
Dials (Black), 3" and 3½", 75c; with Knob, $1.25.
White Metal Dials, 3", 50c.
Binding Posts, 9c, 10c, 12c and 20c.
Paragon Rheostats, $1.75.
Parkin Rheostats, $1.00.
DeForest Rheostats, $1.00.
All the Wireless Press Books.
All the Cole and Morgan Books.
Hawkins Electrical Guides.
Marconi VT Bulbs, $7.00; Socket for Same, $1.50.
Murdock VT Socket, $1.00; De Forest Type, $1.50.
Western Electric Phones, $12.00.
DeForest Coils, All Sizes.
Complete Stock of DeForest, Murdock and Grebe Manufacture.
Oscillation Helex, Complete to Assemble, $3.00.
Loads of Other Apparatus on Hand

AMERICAN ELECTRO TECHNICAL APPLIANCE COMPANY, Dept. E, 235 Fulton St., New York City.

ANNOUNCEMENT—BINDING POSTS FREE!

To care for our business in the eastern section of the country we are opening a branch at 20 N. Ninth St., Philadelphia, Pa. We are placing a complete stock of radio equipment in this office and will be ready to care for the local and mail order trade with even more dispatch than formerly.

As a special introductory offer with each order of $5.00 or over bearing the postmark of any date in July, we shall give one dozen of binding posts free of charge. These binding posts ordinarily sell for 6c each and are one of our best values.

Our 64-page catalogue is now on sale at 15c which amount will be deducted on your first order for $1.50 or more.

ELECTRICAL SPECIALTY CO., Dept. E. **48-50 SO. FRONT STREET COLUMBUS, OHIO**

10¢ OR 25¢ **Anti-Kamia** AK FOR HEADACHE, NEURALGIA, INFLUENZA AND ALL PAIN- Ask For A-K Tabs **TABLETS**

and other employees came and went and that he could not be expected to keep track of their movements. Of course, he could not explain the existence of the motor truck—had never seen it, was not interested, etc.

One morning accompanied by an O N I investigator and with the use of a small car, we were traveling along one of the by-roads not far from the base of our operations when we presently noticed a small column of smoke pushing its way thru a wooded section to our left. More out of curiosity than anything else we decided to investigate and see who had started a fire in this locality and to what purpose. We traveled along for a short distance when we came to a makeshift road leading into the wooded part and of the kind used by farmers. We, therefore, turned our car in this new direction and had not gone very far when we suddenly came to a slight clearing where trees had been chopped down and carted away, leaving a great number of stumps scattered about.

SPY RADIO DISCOVERED AT LAST!

Lo and behold, there in the center of the cleared space was a large mass of twisted steel and charred wood from which arose a few lazy spurts of smoke. Judging from the remains of the framework this had evidently been a large motor truck. A great pile of lumber had been placed under the body to assist in the effective destroying of the car which seemingly had been burning for some time, as nothing but smoldering ashes remained.

It did not take a great amount of ratiocination to explain this strange and unusual sight. The truck was none other than the elusive machine we had been trying to locate for the past two weeks. With the aid of several buckets of water secured from a nearby stream we completely cooled the smoldering wreck. Sure enough, there was the twisted and bent motor generator unit of possibly a ½ k.w. output, inductances, quenched gap and what not. Altho the parts had evidently been subjected to a white heat which had melted the hard rubber, wood, and other composition pieces, the general outlines of the remaining metal portions left no doubt in our minds as to their having originally been radio instruments.

The solution of this final happening was simple. The operators of the truck had probably decided that the locality was too hot for them, and having realized that they could not hope to evade capture very much longer had decided to abandon their work, first taking the precaution to burn their equipment and *leave no trace* behind them. Fate had willed that we should just happen to pass the ruined car, possibly twelve hours after it had been set on fire, thus giving the two men ample time to escape to other parts. Also, considering the meager information we had as to their description it would have been out of the question to attempt to find them.

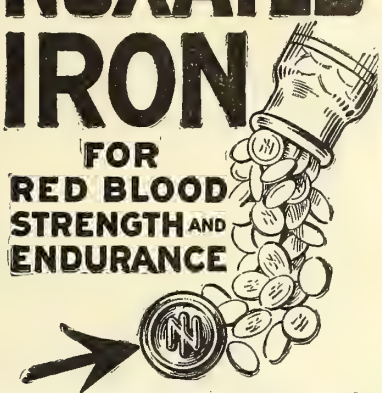
Suffice it to say that since the illegal traveling radio unit had been destroyed our work was finisht, and it is needless to add that thereafter, steps which cannot be disclosed here, were taken to prevent a recurrence of this nature.

CONCLUSION

Concerning the radio detective there is a great future for him even in peace times. He may be assigned to ferret out radio amateurs who do not confine their transmissions to lawful wavelengths and regulations. On the other hand, he may earn his salt by co-operating with the revenue agents who have lately discovered the reason for their inability to arrest moonshiners in certain sections of the country. Newspapers tell us that radio systems are in operation thru which the distilling plants are notified by cipher signals from the railroad station sent by confederates when danger threatens. When the law swoops down on a spot where the still has been reported they find the outfit missing.

NUXATED IRON

FOR RED BLOOD STRENGTH AND ENDURANCE



EACH GENUINE NUXATED IRON TABLET IS STAMPED AS ABOVE

DO NOT ACCEPT SUBSTITUTES

BURGESS "B" BATTERIES



These batteries proved so successful in Government Apparatus that they are being used by progressive amateurs. Made in three sizes and now available for general use. For full information write to

BURGESS BATTERY COMPANY

Harris Trust Bldg. -:- Chicago

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

Write Today for Our Free Blue Print Offer

Agents wanted for our ready built phonographs

Cheraleon Phonograph Co.
807 Cheraleon Bldg., Elkhart, Ind.



SAVE OVER HALF

FOR SALE

New soft yellow brass ribbon tape, in coils of 4 and 8 lbs. respectively.

65000 lbs. 5/16" x .024"
100000 lbs. 7/8" x .037"
5000 lbs. .360" x .008"

Bargain price quoted on lot.

Standard Equipment & Tool Works
307 St. James St. Montreal



Cleartone Phonographs
$4.00 to $200.00 Retail

Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B East 12th Street, N. Y.

YOU Can Double Your Ability to Earn Money! Hold Friends! Win Love and Happiness! Our System of Personal Efficiency tells you how! Success Studygram and Personality Sketch for 10c and birth date. Thomson-Heywood Company, Dept. 350, Chronicle Building, San Francisco.

Audion Poem Awards

(*Continued from page* 456)

The warm sun's kiss in the daytime;
And at night the moon on the seas,
While, cradled in perfect comfort,
I was wafted on by the breeze.

I was borne to the spicy tropics,
And skirted the jungle shores,
And, from crowded docks, I saw strong men
Go off to their cruel wars.

Strange beasts on the edge of waters;
Bright birds on o'erhanging boughs,
Canoes and sampons and sailing sloops,
Steamers and yachts and scows.

I was caught by the Equator's current
And borne thru a coral reef,
Where many a stronger thing than I
Had drifted its way to grief.

But a providence seemed to guide me
(As always it had before);
A rolling wave with gentle care,
Laid me safe and sound on the shore.

They picked me up as a keepsake
(For men consider it strange
If the things they call inanimate
Should wander out of their range).

Well, if ever I'm back in the socket,
My work no longer will pall,
For when messages come from the wide, wide world,
I will understand them all.

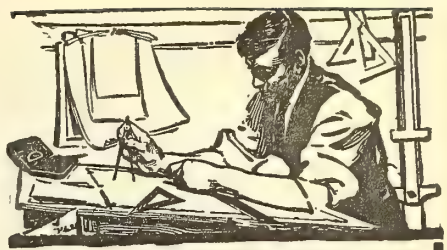
Composed by J. Simeon Numen.

4th Honorable Mention

LINES TO AN AUDION.

O magic bulb that sailed the buoyant wave,
Frail crystal audion, vacuum tube that tells
Of feeble sounds that pulsing ether swells,
What perils didst thou—mystic wanderer brave?
Didst thou solve secrets of some coral cave
Where decked with pearls some lovely mermaid dwells?
Or didst thou hear some symphony that wells
Across the plenum of the celestial nave?
Didst some wave tell thee tales of long ago—
The mystery of deep space reveal to thee?
Didst thou hear thoughts no human brain can know;
Didst thou record what human eye can see?
Or on far reefs where tropic breezes blow
Hear footfalls on the sands of life's great sea?
I heard afar the belfries of the skies
Peal solemn anthems of a distant past,
I heard from out that wondrous vault so vast
What no dull mortal mind can now surmise.
What no mentality can now devise,
What groping science has not yet amassed.
I heard a story in the typhoon's blast,
'T would fill thy pigmy brain with mute surprise.
I wish I could your querulous thoughts console,
Your doubts and fears, anxieties drive away,
And tell of realms where stellar bodies roll
In nebulous orbits, 'mid the ether gray.
What I have heard I cannot now control,
Yet science may divulge a future day.

Composed by E. Jenkins.



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

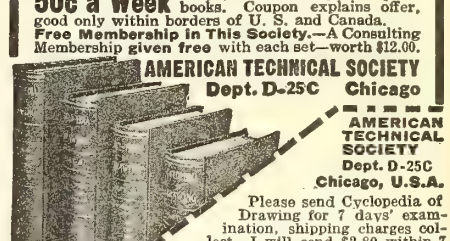
4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership **given free** with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-25C Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D-25C
Chicago, U.S.A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $2 a month until $16.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name.....

Address.....

Reference.....

Discover Your Talents!

Why is it that some men make a success of everything they touch while others work their lives out, and remain failures?

Why is it that some climb to the heights with little effort while others plod along for a lifetime in the same old rut?

It's not luck, nor pull—it's knowing how to direct your energies most effectively. It's discovering where your talents lie, and putting all your efforts along the lines where you can succeed.

Don't struggle along any longer, **against your own personality.**

Let Dr. S. S. George, the eminent psychologist and former U. S. Army expert, help you discover your talents. Dr. George has made his lifework the analysis of men's abilities.

His mental and vocational analysis course with 1,500 vocations classified, will be mailed to you on approval. Don't wait a single day. Get in touch with your abilities. This service may be worth thousands of dollars and invaluable happiness to you. Send only $3.00 for complete course and lists.

MONEY REFUNDED IF NOT SATISFIED

At the end of 5 days, if you are not completely satisfied, we will refund your money in full.

Vocational Guidance Institute, 2255 Broadway, N. Y.



PIGEONS PAY

They build their own nests and work for you 11 months in the year. A few good pair of pigeons now will bring you a good sized profitable squab farm next season

Write today for circular.

PIGEON SUPPLY HOUSE. P.O. Box 251. Hanover.

LEARN WIRELESS

At the OLDEST, LARGEST and BEST EQUIPPED school of its kind in New England. Thousands of satisfied graduates all over the world. Splendid opportunities now in the Merchant Marine. Day and Evening classes. Summer Session. Start any Monday.

EASTERN RADIO INSTITUTE
899 Boylston St. Boston, Mass.

Make Your Own
ELECTRICAL APPARATUS
with the help of our
RELIABLE BOOKS
Send for price list No. 138
COLE & MORGAN, INC.
Publishers
188-190 Greenwich St. New York

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section ten cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the September issue must reach us not later than July 25.

The Circulation of Science and Invention is over 150,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Auto Accessories.

Fords run 34 miles per gallon with our 1920 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all Motors. Runs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee. 30 days' trial. Air-Friction Carburetor Co., 270 Madison Ave., Dayton, Ohio.

Blueprints. Automobile Armatures. See ad under "Electrical". Charles Chittenden.

Battery Charging Profits $100 to $250 clear monthly with HB equipment. Your lighting current or engine operates. No expense to you. Easy payment plan lets outfit earn own way. Satisfaction guaranteed. Write Hoberts, Troy, Ohio.

Auto Motor Supplies—Buick, Michigan, Stoddard-Dayton, Cadillac-Overland, E. M. F. Continental and Buda Motors, all types, $50 each and up. Special high-tension, 2 and 4 cylinder magnetos $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Tires—Direct to you prices. Exclusive representatives wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Bond 8,000 Miles. Sample Sections furnished. Mellinger Tire Company, 980 Oak, Kansas City, Mo.

American Made Toys.

We Offer an Opportunity to manufacturer with facilities for large production, also to homeworkers on smaller scale, to manufacture Metal Toys and Novelties. Unlimited field and enormous business open for ambitious people. No experience required. No tools needed. Our castingforms turn out goods complete. Since the different Toy Expositions, manufacturers are covered with orders until December. You can enter this field now, by manufacturing "American Made Toys." We furnish castingforms for Toy Soldiers, Army, Navy, Marine, Cannons, Machine Guns, Indians, Cowboys, Warships and other novelties. Castingforms, complete outfit, $3.00 up. We buy these goods, direct from manufacturers. Yearly contract orders placed with reliable parties. We pay very high prices for clean painted goods. Samples furnished. "Bird-Whistles," great seller, just added to our stock list. Booklet, Information, Instruction free, if you mean work and business. No others invited to write. Toy Soldier Manufacturing Co. 32 Union Square, New York.

Agencies Wanted.

James Orton—Desires sole representations for South America, Casilla 366, Buenos Aires.

Motorcycles—Bicycles.

$25.00 up, guaranteed rebuilt motorcycles, Henderson, Excelsior, Indian, Harley-Davidson. Bicycles $5.00 up. Tires and accessories at wholesale. Illustrated Bulletin A free. Ash Motor Corporation, 162 N. Clinton Ave., Rochester, N.Y.

Motor Engines and Dynamos.

Motors, 2, 5 and 10 hp. Special prices. Write me. William Hobart, Troy, Ohio.

Small motors and generators; ¼ hp. AC $26.50; ½ hp., $38.50; ¾ hp. AC $67.50. Battery charging sets; charging lighting and moving picture arc generators; motors for all phases of current. Prompt delivery; wholesale prices. Write for late catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Salesmen Wanted.

Salesmen—City or traveling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment services rendered members. National Salesmen's Training Association. Dept. 158K, Chicago, Ill.

Instruction.

Cartooning Comics and Lettering. Complete Course only $5, postpaid. Over 300 illustrations. Stamp brings easy lesson. Cartoonist Ernie, Elyria, Ohio.

Crystal Gazing—The Craze. Send self-addressed stamped envelope for Free instructions. Zancigs Studio, Asbury Park, N. J.

Antiques.

Ancient Indian arrows and spears. Send stamp for list. B. Ruby, Middletown, Pa.

Agents Wanted.

Agents—$15 daily; every owner wants his gold initials on side door of automobile; applied while waiting; your profit $1.38 on $1.50 sale; or sell him set to apply his monogram; write for agency; free samples. Transfer Monogram Supply Co., Dept. 20, 191 Market St., Newark, N. J.

Free. Latest issue. New formulas. Tells how to make your own goods. Write today. S. & H. Manufacturing Laboratories, 22502 Boylston Bldg., Chicago.

Make $30.00 next Saturday. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Michigan.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Build up a national and international paint business, experience unnecessary. Orders all year around; 4c stamps brings complete information. Dept. 9, Martinek Company, 405 Lexington Ave., New York.

Agents—$40-$100 week; free samples; gold sign letters; anyone can put on store windows; big demand; liberal offer to general agents. Metallic Letter Co., 433-Z, N. Clark, Chicago.

Mexican Diamonds flash like genuine, fool experts, stand tests, yet sell for 1-50th the price. Few live Agents wanted to sell from handsome sample case; big profits; pleasant work. Write today. Mexican Diamond Imptg. Co., Box F1, Las Cruces, N. Mex.

Make and sell your own goods. Formulas by expert chemists. Manufacturing processes and trade secrets. Write for formula catalog. Chapin Mystic Company, Washington, D. C.

Delicious Pie Filler. Packed your label. Sample 12c. Kleeno Co., Goshen, Ind.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Agents—Sell automobile tires, tubes, etc. Big income. No capital required. Goody Rubber Co., 240 Broadway, New York.

Signs for store and offices. Entirely new. $50 week easily made. Chicago Sign System, G-326 River St., Chicago.

Manufacturer wants agents everywhere. Remarkable new discovery; sweetens like sugar; relative cost 3½c. lb. Greatest money making repeater on earth. A-One Products Co., Dept. M-2, 873 N. Wells St., Chicago.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, Glen Ridge, N. J.

Insyde Tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts; quickly applied; cost little; demand tremendous; profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, Ohio.

Help Wanted.

Your Government wants hundreds Railway Mail Clerks—men-women over 17; $1,600-$2,300 year. List positions open—free. Write immediately. Franklin Institute, Dept. A-26, Rochester, N. Y.

Detectives and Investigators are in demand. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. American School of Criminology, Dept. E, Detroit, Mich.

Detectives Earn Big Money. Excellent opportunity. Particulars free. American Detective System, 1968 Broadway, New York.

Be a Mirror Expert. $3-10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Help Wanted—(Continued).

Detectives Make Big Money. Travel, be your own boss. Either sex. We instruct, small cost. Write Johnson's Detective School, 232 Sheldon Ave., Grand Rapids, Michigan, Dept. A.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Preee Syndicate, 5665 St. Louis, Mo.

Firemen, Brakemen, Baggagemen, $140-$200; colored porters by railroads everywhere. Experience unnecessary. 897 Ry. Bureau, East St. Louis, Ill.

Men—Boys. Become motor boat experts. $45 week. Learn while earning. Write Franklin Institute, Dept. A., 806 Rochester, N. Y.

Business Opportunities.

Turn Your Spare Time Into Money for that apparatus you want. Start a profitable, permanent home business. Steady weekly income. No investment but your brains and spare time. Positively no soliciting, agency proposition. Write today. Address Opportunity, Box 175, Fredonia, N. Y.

"Money-Talks." The Business magazine published for progressive people. Send for sample copy. P. O., Box 236-B, Newark, New Jersey.

Wanted—Advertising managers everywhere. $50 to $150 weekly. Experience unnecessary; learn in spare time. Details free. Koehler, Dept. 25, 1961 S. Hoover, Los Angeles.

3,384 Moneymaking Plans. Formulas. Trade-Secrets. "Encyclopedia Business Opportunities." 3 volumes $1. Ideal Book Shop, 5501-EV North Robey, Chicago.

New discovery! Establish a good, steady, profitable business of your own. Whole or spare time. No canvassing or mail order proposition. Everything necessary furnished. Write immediately. Ferber Company, 296-C Broadway, New York.

Patents for sale. To sell, buy or obtain patents write Patent News-309, Washington, D. C.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

Be Independent—We teach by mail how to manufacture unexcelled toilet goods. Particulars free. School of Cosmetics, Box C, Omaha, Neb.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen; $300 to $1,500 necessary. You handle own money. Will allow expenses to Baltimore if you will qualify. For particulars address Secretary, 416 N. Howard St., Baltimore, Md.

Enter a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

I Made $30 a Week evenings with a small Mail Order Business Home. Free Booklet tells how. 2c postage. Alex Scott, Cohoes, N. Y.

Start business of your own; 24 plans; $1.00. Joel Tillberg, Proctor, Vt.

Manufacture and Sell Metal Polish. Easy to make. Formula 50c. Specialty, 1057 E. Long, Columbus, Ohio.

For Sale.

Fractions figured instantly with the Fractiometer. Adds, subtracts and shows decimal equivalents immediately. Saves time and brain fag of designers, toolmakers, pattern makers, machinists and apprentices as nothing else can. Figures and checks measurements faster than writing. A Fractiometer prepaid for $1.50 with "money back" guarantee. Dealers and shop agents wanted. Fractiometer Co., Dept. C, Rochester, N. Y.

For the Hair.

I Was Bald. Obtained hair growth by an Indian's ointment containing genuine bear oil and rare plant juices. Many others have had wonderful results. Fine for dandruff. Harmless. Will send box, postpaid, with recipe, 10c. John Hart Brittain, 150 E. 32d St., BB-300, New York.

Volume VIII.
Whole No. 89

Science and Invention

H. GERNSBACK – EDITOR
H.W. SECOR – ASSOCIATE EDITOR

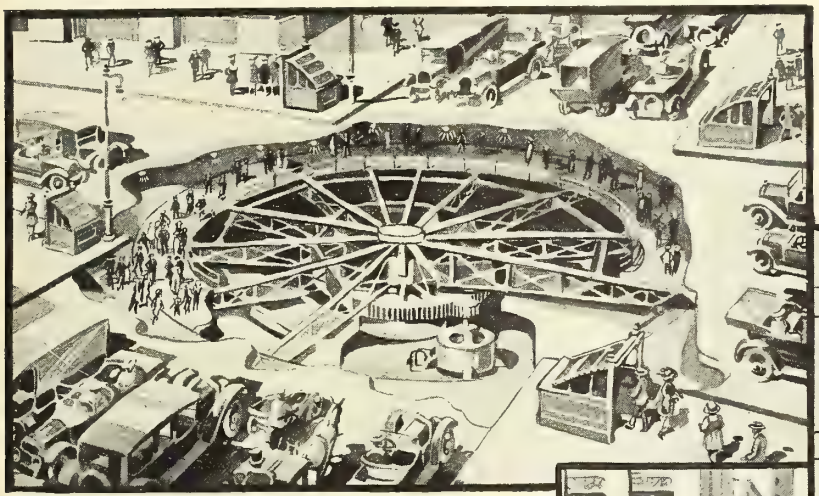
SEPTEMBER
1920
No. 5

LIBRARY
AUG 25 1920
U.S. PATENT OFFICE

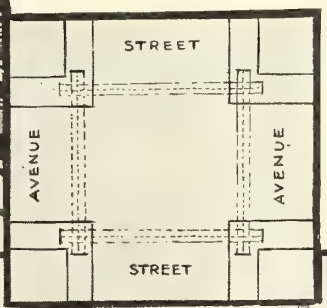
Moving Platforms for Street Crossings

By EDWIN F. LINDER, M. E.

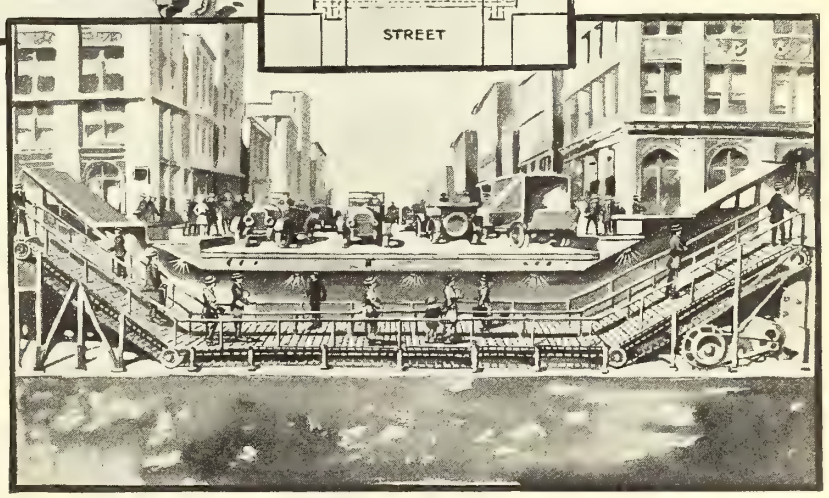
NOT so many years ago, when the country folks visited the city, they would stand at the curb of the sidewalk and patiently wait for a chance to cross to the other side of the street. The city people would glance at the confused expressions on the faces of these country cousins and dart in and out among the cabs, trucks and horse-cars



Left: Why Not Use a Rotary Turntable For Street Cross-Overs at Busy Traffic Centers in the Larger Cities, Like New York, Chicago or Philadelphia? Mr. Linder Tells All About It in the Accompanying Article.



View Below: This Illustrates a Second Idea For Moving Platforms Under Busy Street Cross-Overs. Two Platforms Move in Opposite Directions Between Every Two Corners. See Plan at Left.



and leave the astonisht visitors to wonder how so many reckless persons were able to run across the streets at will, without being trampled under hoof or ground to death under the thousands of fast spinning wheels.

The ever-increasing number of automobiles operated in the large cities has necessitated the building of a police corps of traffic experts to regulate the movements of the pedestrians as well as that of the vehicles. Much valuable time is lost at present by the halting of one and then the other at centers of congestion. To aid in keeping the movements of the rolling stock and also the steady stream of those on foot more uniform, it is suggested that moving platforms, electrically operated, be installed to carry the pedestrians from one side of the street to the other.

One scheme is to have the entrances to these underground conveyors located at a distance of about thirty feet from the street corners, from whence an inclined moving platform carries the people below the street and across to another incline operating upward to an exit similarly situated on the opposite side. This type of conveyor would serve most efficiently by the construction of eight moving endless chain platforms, placed in pairs, each working in opposite directions. The four street corners are thus connected by these sub-surface passages and as the platforms are kept in motion continuously by the electric motors which drive them, it is obvious that there need be no delay in getting quickly to the other side of the crossing. At the same time, the discontinuance of the use of the ground level as a means of crossing by pedestrians gives a much freer scope to the movements of motor-driven conveyances. In some cases, for the better distribution of the people, it might be suitable to install a set of moving platforms in the center of the blocks either at right angles to the street or possibly sometimes diagonally, should the crossing be narrow and requiring greater length to accommodate the necessary inclines.

Another idea for the purpose of accomplishing the same end is the erection of an underground "Merry-go-round." A large circular platform rotates about a center post which is geared to the driving mechanism and connected to an electric motor. This rotary platform is reached from the sidewalks either by stairways or moving inclines such as described before. The outer edge of the platform travels close to the corner stations and thus the person using it steps aboard at once on reaching the lower level. Conspicuous signs electrically illuminated designate the *Avenue* and *Street* in the same manner as on the surface overhead and as the rider arrives at the corner desired a step from the platform brings him to the exit used to ascend to the surface.

At first it may seem like going to a great deal of trouble and expense to make installations of this kind. Some may even think that ordinary passages built underneath the street surface reached by the usual stairways plenty good enough. Why all these electrically controlled mechanisms?

The answer is that the latter serve as the stern and strict regulators of the moving masses. In both schemes suggested the people are kept moving along in certain definite directions, being transported at all times safely and rapidly without delay to their proper destinations.

Liquid Air

By PROF. T. O'CONOR SLOANE, Ph.D.

DR. JOHN AYRTON PARIS, the biographer of Sir Humphrey Davy, had been invited to the great scientist's house to meet the Rev. Uriah Tonkin. On his way he past the Royal Institute and dropt in to see what was going on in the laboratory. There he found Faraday engaged on an experiment with chlorine hydrate. Dr. Paris noticed some oily drops in the compression tube and intimated that the young experimenter should exercise more care in keeping his apparatus clean. Going on to his dinner, not realizing that he had been talking to one of the world's greatest genius', he mentioned the oily drops, which he had noticed, to his host. The latter looked thoughtful and said he would inquire into the experiment the next day. Early the next morning Dr. Paris received the historic note: *"Dear Sir: The oil you noticed yesterday turns out to be liquid chlorine. Yours faithfully, Michael Faraday."*

Dr. Paris had seen Faraday's liquefaction of chlorine gas. The laboratory of the same Royal Institute since that time, March 5th, 1823, has seen Dewar's great work on the liquefaction of air and other of the old-time "permanent gases."



This Daring Experimenter Is Taking Liquid Air Into His Mouth.



An Iron Flask Cooled By Liquid Air Can Be Broken As Easily As a Glass Bottle.

Ice Is Hot Compared to Liquid Air. To Boil the Liquid Air in the Tea-Kettle, Put It On a Cake of Ice.

Fruit, a Beefsteak, a Plate Can All Be Broken Like Glass After Immersion in Liquid Air. Don't keep Your Finger in It For Any Length of Time.

EARLY EXPERIMENTS.

A liquid, evaporating, produces cold. If the finger is moistened with water, and is exposed to the air it feels a chill, which is intensified by blowing against it. Prof. Dewar prepared quantities of liquid nitrous oxide and of liquid ethylene. By passing the latter thru pipes surrounded by evaporating nitrous oxide it was chilled to a very low temperature—130° F. The evaporation of the cold ethylene gave a temperature of—229° F. Air at a pressure of 50 atmospheres past thru a tube surrounded by the ethylene was liquefied in quantity. But on drawing it off from this high pressure system nine-tenths of it was lost. Dewar's work was the legitimate following out of Faraday's researches, and was made possible by the expenditure of the great resources of the Institute.

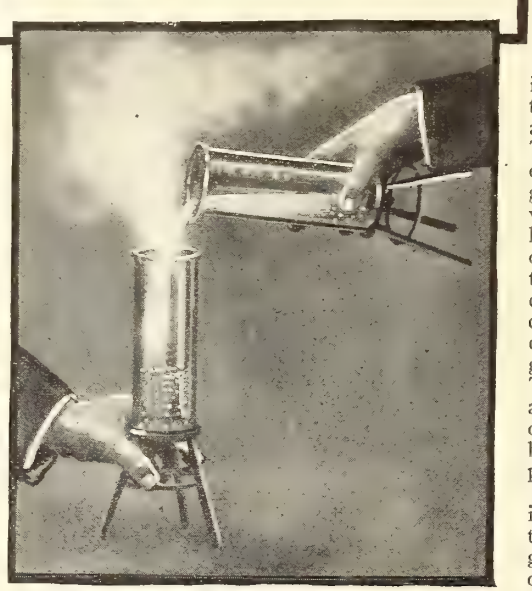
The modern methods of liquefying air use no other gas than the air itself. It is comprest and allowed to expand and in its expansion cools another portion of air previously comprest. This in its expansion cools more air to a still greater degree and the cumulative action goes on until liquid air runs off in large quantities. In the early days the production of enough liquid air to be seen as it lay in a minute quantity in a glass recipient was a triumph of science: now it is liquefied by the ton and can be poured from buckets like water, and can be shipt in barrels and milk cans.

In the above the existence of steps in the operation are indicated, but it is perfectly clear that a uniform progression of cooling and compression could be made to give the same result, and this is done in some apparatus, perhaps in most of the modern ones. But now we come to a very important thing in the phenomena of gases. If air is comprest and then expanded, a reduction of temperature occurs. If air were a perfect gas the change of temperature due to expansion would be exactly equal to that produced by the same degree of compression: But this is not the case; the expanded air is slightly cooler than it ought to be. This phase plays an important part in modern liquefaction apparatus.

MODERN METHODS.

It is fair to say that the names of Linde and Claude express the modern development of the liquefaction industry on the manufacturing scale. As an example of the theory of construction of a liquefaction apparatus, Georges Claude's method is cited. Air is pumped into the apparatus thru a pipe cooled by the escaping air which has been cooled by expansion. The comprest air does more than merely expand; it is made to drive an air engine. This gives back some of the power which would otherwise be lost and also localizes and intensifies the cooling effect of the expansion. There is a regeneration of the cold as the expanded air escapes; the entering comprest air is cooled more and more as the operation continues, until presently *liquid air* begins to accumulate in the receptacle. This is of course the merest outline of a description; there may be a number of the air engines in the same machine, but the apparatus is wonderfully compact.

Claude worked at the problem of making liquid air in quantity sufficient for the economical manufacture of oxygen gas on a commercial scale. He never dreamt that the inert and supposedly useless nitrogen, "the ashes of air" as it has been aptly called, was eventually to be the valuable product. For in the



Liquid Air Is Poured About Like Water—It Boils a Little But Will Not Scald You As It Is Colder Than Ice.

fixation of nitrogen, involving the production of fertilizer chemicals and other compounds, pure nitrogen is an essential, and this is most economically produced by liquefaction of air. The oxygen being more easily liquefied is almost perfectly separated from air, the four-fifths of the air is collected as pure nitrogen, and the life-giving oxygen, the supporter of combustion, without which all life on our planet would cease in a few moments, appears as a side product.

As soon as liquid air was produced in any quantity the problem of how to keep it arose; it was assumed that it would evaporate rapidly from any ordinary receptacle. Dewar, acting on an old device of d'Arsonval, constructed most ingenious vessels; these consisted of two concentric glass bulbs or flasks, with a vacuous space between them. This prevented the heating of the inner vessel by the atmosphere and convection. To make the insulating effect still greater the outer side of the inner vessel was sometimes silverplated, or a drop of mercury was introduced into the vacuous space. This deposited a mirror of mercury on the inner vessel. The effect of these metallic depositions was to reflect any heat, thereby making the insulating quality of the bulb still greater.

"KEEPING" LIQUID AIR.

While Dewar was thus obtaining valuable results in the preservation of the elusive fluid, an American inventor, Charles E. Tripler of New York, had succeeded in making liquid air in large quantities and, without presumably reasoning out the why or wherefore of it, had carried it about in buckets, and had shipt it to distant points in tin cans wrapt in felt. It was found, that while it would evaporate and in doing so became richer in oxygen, yet, in large receptacles especially, it would "keep" for an astonishingly long time. It is fair to say that this fact could not well have been anticipated. The reason for it is not far



At Right: Liquid Air Is Poured Over the Bare Hand. It Does Not Touch it—If It Did the Result Would Be Disastrous.





Above: Liquid Air Is Poured Into Water. At First the Globules Float, But as the Nitrogen Evaporates They Become Heavier and Eventually Sink.

A Metal Ball Has Been Cooled in Liquid Air. Placed in the Flame of a Bunsen Burner It Freezes the Carbon Dioxide and Produces Carbonic Acid "Snow."



Below: A Lead Wire After Immersion in Liquid Air Is Very Elastic and Strong. By Blowing On It You Warm It and It Looses Its Elasticity and Straightens Out.



Above: Mercury Frozen in a Test Tube of Liquid Air Can Be Used to Drive a Nail. Grapes Became Hard As Marbles and When Shot From a Gun, Will Penetrate a Pine Board.





Above: A Coil of Special Wire Is in Circuit With a Current Meter; the Coil Is Immersed in the Liquid Air. The Current Increases As the Temperature is Lowered, and the Reading Gives the Temperature.

to seek; it is due to the assumption of the *spheroidal state,* so called, by the liquid.

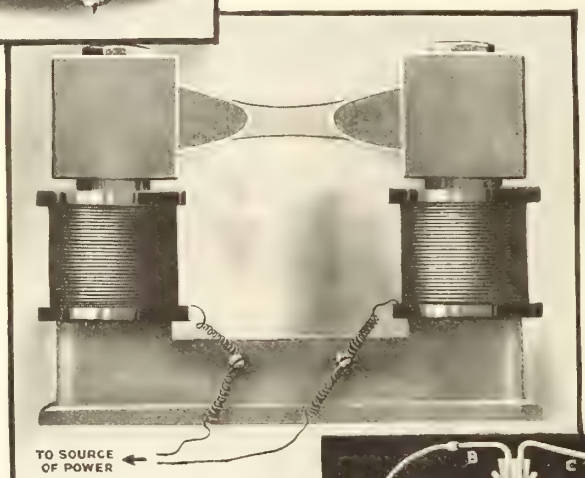
If water is dropt on a moderately hot plate of iron or other material it will boil. But let the plate be red hot; the water will gather itself into a little spheroid or flattened ball, and will evaporate with extreme slowness. A few drops of water in a hot spoon may be made to illustrate the spheroidal state, as it is termed, on account of the shape taken by the fluid. A drop of water on a red hot cover plate of a cooking stove shows it; the laundry maid tries the heat of her flat iron by touching it with her moist finger; if the iron is sufficiently hot the water will be repelled and will not wet the iron nor boil. A sort of cushion of steam forms between the water and the hot surface, which prevents contact, so that the fluid is only slowly heated. If the heat is insufficient to form this cushion, the liquid will come into contact with the hot surface and will boil violently.

In the case of liquid air all other objects exposed to the atmosphere are hot compared to it, and if it is brought for an instant into contact with such a surface, it assumes the spheroidal state, and rests quietly on a layer of gas produced from itself. The surrounding atmosphere acts like a furnace and keeps the receptacle hot, at least hot with reference to the temperature of the liquid air within the vessel.

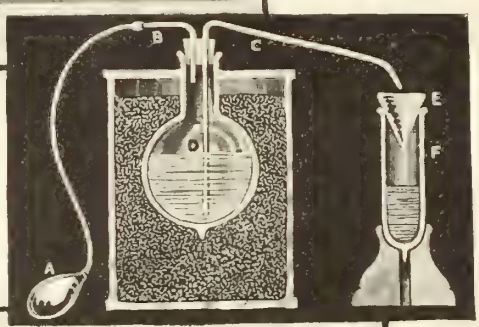
SURPRISING EXPERIMENTS

Liquid air can be poured over the hand without injury, and the hand may be dipt into it without harm *if not left in too long.* A frightful freezing effect would result from more than the shortest immersion, because the moment the hand became cold the liquid air would touch it and the hand would be frozen thru and thru instantly.

The double flasks or bulbs used with liquid air may have various shapes. The inner flask is made of very thin glass, and is fused to the outer one at the upper end or opening of the neck. The inner vessel is therefore very fragile and the weld or joining at the neck is liable to crack when liquid air comes in contact with it. If such a flask is filled with the fluid it is evident that a considerable side strain will come upon it in pouring, as the inner flask is only held in position by the joint at the neck. The thermos bottle is made on the same lines, and many of us have had experience in the breaking of these convenient picnic accessories. How to avoid the danger of thus breaking the inner vessel is shown in one of the illustrations. Air is forced in thru a tube and the liquid flows out by the other tube into any desired receptacle. Both tubes pass thru holes in a cork which tightly fits the mouth of the flask. This saves all strain and exposure of the glass weld at the neck to differences and change of temperature.



At Left: A Quantity of Liquid Air Is Supported Between the Poles of a Powerful Electro-Magnet. It Is the Oxygen That Does It.



At Right: The Bulb, A, Forces Air Into the Dewar Flask, D, Thru the Tube, B; the Liquid Air Is Forced Out Thru the Tube C, and Is Filtered Thru the Filter Paper, E, into the d'Arsonval Tube, F. Do Not Leave the Rubber Cork in the Neck of the Dewar Flask or It Will Get as Hard as Stone.



Dewar Glass Flasks With Double and Triple Walls For Holding Liquid Air.

LIQUID HYDROGEN

Liquid hydrogen is of much lower temperature than that of liquid air. It can manufacture its own Dewar container. For if there is no vacuum between the two concentric flasks, the intense cold of the hydrogen soon makes one by freezing the air in the space. It would be perfectly easy to carry out this idea for liquid air by filling the space with the vapor of some readily frozen substance—even carbon dioxide might answer. But there is this difficulty about it: the carbon dioxide is almost sure to contain enough air to seriously impair a vacuum so produced. The inner vessel in the Dewar flasks is made extremely thin.

At low temperatures charcoal absorbs air and other gases with great avidity. A double walled vessel such as shown in the illustration is provided with a tube projecting into the inner vessel. Some charcoal is placed in the tube and the annular space is pretty thoroly exhausted. If liquid air is put into the inner vessel it chills the charcoal which absorbs completely the last traces of air in the outer space and a Dewar flask results. Claude proposed to make such recipients of metal. This however is very brittle when at such temperature, so there would be a chance of breakage after all.

It has been aptly said that a piece of iron or other metal cooled to the temperature of liquid air is more dangerous than liquid air itself. This is because there can be no spheroidal state for the metal to protect anyone touching it, it would at once produce a so-called "burn."

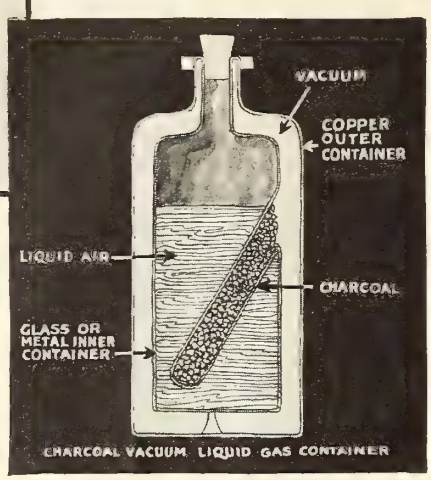
If cotton or some other organic substances are saturated with it a powerful explosive is produced. This can be detonated readily and used for blasting. The explosive must be used as soon as made, because the air evaporates rapidly leaving it inert. But this is a great element of safety, as if a cartridge fails to explode an hour or less of delay makes it innocuous. Many accidents occur in blasting operations by the explosion of such cartridges when loaded with permanent explosives.

But at the present time the all important use of liquid air is for the production of nitrogen and oxygen. The latter gas is acquiring increased importance for cutting iron and steel in the acetylene or blau gas blowpipe, and it is impossible to foresee how far the fixation of nitrogen may be carried, requiring enormous quantities of nitrogen.

In the line of scientific investigation the

(*Continued on page 528*)

Below: A Flask for Holding Liquid Air Using a Vacuum Produced By the Wonderful Absorbing Qualities of Charcoal.



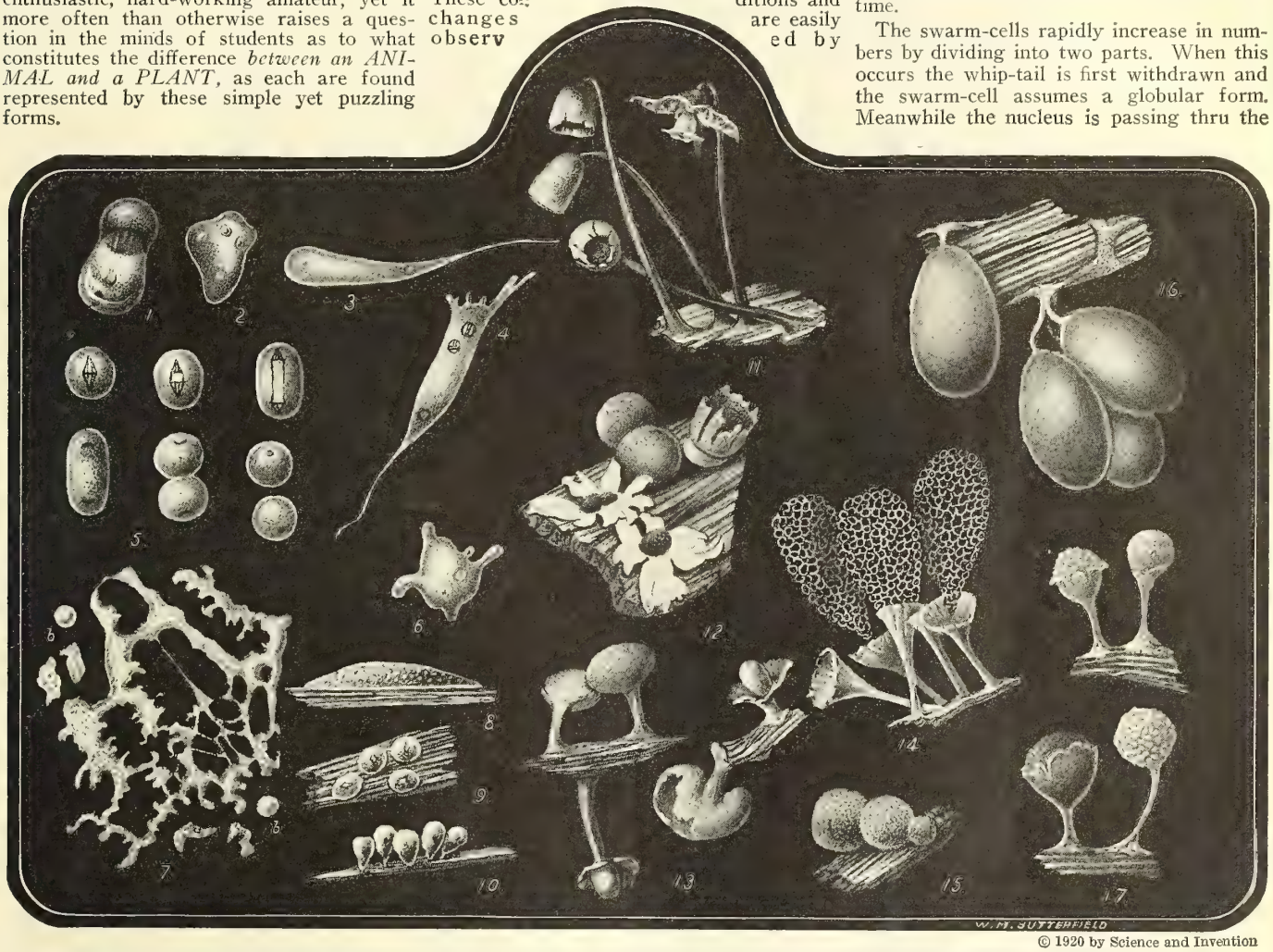
Plant or Animal—Which?

On the Border Line Between the Animal and Vegetable Kingdoms

By WILLIAM M. BUTTERFIELD

THE border line between the animal and vegetable kingdoms has for the past fifty years been placed among a rather unsatisfactory group of minute organisms that may be clast in the vegetable groups, and under the animal groups. These forms are supposed to be the lowest expression of life, as it is very reasonable to believe they are.

And altho a vast amount of work is being accomplisht, both professionally and by the enthusiastic, hard-working amateur, yet it more often than otherwise raises a question in the minds of students as to what constitutes the difference *between an ANIMAL and a PLANT*, as each are found represented by these simple yet puzzling forms.



© 1920 by Science and Invention

This Plate Shows Actual Development of an Animal Into a Plant of the Kind From Which the Animal Was Originally Evolved.

1. Swarm-Cell Escaping From Seed-Case.

2. Young Swarm-Cell with Nucleus and Three Cavities.

3. Swarm-Cell with Its Whip-Tail.

4. Swarm-Cell Swimming with the Aid of Whip-Tail and Producing a Filament at Rear End, by Which Aid It Captures Swimming Bacteria For Food.

5. The Process of Double Partition by Which a Single Swarm-Cell Becomes Two Individuals; Perfect Swarm-Cells.

6. Lowest Animal Swarm-Cell Ready to Join with Others in Forming Jelly-Like Mass.

7. Jelly Mass Composed of Many Animal Swarm-Cells Creeping and Feeding as a Single Organism. (bb) Animal Cells Budding in Diminutive Pouches.

8. Concentrating Jelly Mass Before the Individuals at Last Divide Into Centers, From Which the Plants Develop.

9. Individuals Forming Centers.

10. The Plants Developing.

11-17. Various Plant Specimens, All of Which Were in an Animal State Previously.

A British museum publication appeared about a dozen years ago describing the life histories of a few members in a group of fungoid plants, and portrayed them as organisms which are at one stage of their lives *animal;* and at another, *plant!* The study of the group has since become popular with microscope workers both in this country and abroad, probably because the problems referred to above seem solved by these easily obtained and observed groups.

Considered for a long time a doubtful member of the fungi, to which the mushroom and puff-ball belong, the plant part was alone studied, without any consideration of the true life-history. The plant, ranging in size from 1/64 to ⅛ of an inch in height, resembles for the most part, tiny puff-balls or similar fungi, and is found inhabiting dead wood bark, grass or dead leaves. The chief interest to-day is in the portion of the life spent as an animal, and the portion where it changes into the plant. These conditions and changes are easily observed by anyone using a microscope and are about as follows:

After a period of immersion in the water of a pool or pond, the *swarm-cells* emerge from the spores as amoeboid bodies (the lowest form of animal) (see plate of drawings, figures 1 to 10); they soon acquire a long whip-like end and creep in a linear form with this whip extended in advance, or swim in the surrounding water with a dancing motion occasioned by the lashing movement of the whip-tail. Each possess a single nucleus placed immediately behind and connected with the whip-tail and a pulsating cavity.

To a large extent the swarm-cells feed on bacteria which are caught by a filament projected from the hind end of the body. The bacteria are conveyed into the body substance where they are digested in cavities which form around them; there may be one or more such digestive cavities, each containing several bacteria at one time.

The swarm-cells rapidly increase in numbers by dividing into two parts. When this occurs the whip-tail is first withdrawn and the swarm-cell assumes a globular form. Meanwhile the nucleus is passing thru the process of division, and in the course of a few minutes the halves of the nucleus separate and retreat to the opposite ends of the constricted cell, which now divides into two; each segment soon acquires a whip-tail and resumes the former active state.

A few days after the germination of the spores, the process of dividing into two parts, by which the number of swarm-cells has greatly increased, ceases. The majority of swarm-cells now withdraw the

(*Continued on page* 538)

Electrical "Meals"

By JACQUES BOYER

PARIS CORRESPONDENT "SCIENCE AND INVENTION"

HERE is indeed a unique remedy to combat the high cost of living. To replace meats and other victuals which are at present almost out of reach, by means of the electric fluid—which by the way is a menu worthy of Hapagon—is the method very seriously proposed to us by Professor Bergonié, of the Bordeaux Faculty of Sciences.

As the result of numerous methodically conducted experiments, this scientist has demonstrated, in effect, that it is possible to partially sustain the human body by means of electricity served in the form of low as well as high frequency currents. It is, of course, understood that these "repasts" are of a nature designed to relieve a suffering organism by furnishing it, in a natural way, with a complement of heat indispensable to its existence. Such medication in truth cannot replace all nourishment, for cellular life must draw necessary energy from various foods having very complex chemical compositions, which the blood makes use of thru the intermediary of the digestive tract.

Lefevre has estimated that for a normal man the equivalent of 1,500 calories for each twenty-four hours is the minimum alimentation necessary to sustain and properly function normal activities.

In order to make this heat penetrate into the organism M. Bergonié makes use of the diathermic method accredited to d'Arsonval. By means of the Nagelschmidt apparatus, in addition to a Telefunken spark gap which may be seen on the table illustrated in our photograph and which is a method described in all physiotherapeutic treatises, currents of high frequency are thus produced. By referring to the same photograph the ampere-meter in front of the scientist's hand indicates that the proper electrical intensities of from 2 to 3 amperes traverse without harm the relaxed body of the subject stretched out on the long chair. With a potential difference varying between 150 to 2,500 volts, the patient receives in the neighborhood of 3,000 calories every hour; that is to say, in addition to his daily organic ration. The electric current enters into his body thru the metallic electrodes, which may consist of lead, tin or thin sheets of aluminum, and which are placed in good contact with the arms and legs. These are firmly adjusted by means of adhesive tape and sometimes the sharp edges of the electrodes are insulated by means of wide bands of tape.

In a general diathermic application having for its object nutrition by means of heat, the electrodes are distributed to the number of 6 for each pole in the following manner: Three on the limbs of the left side for the one pole and 3 on the limbs of the right side for the other pole. An example permitting the appreciation of the marvelous results obtained by Mr. Bergonié is perhaps not out of place.

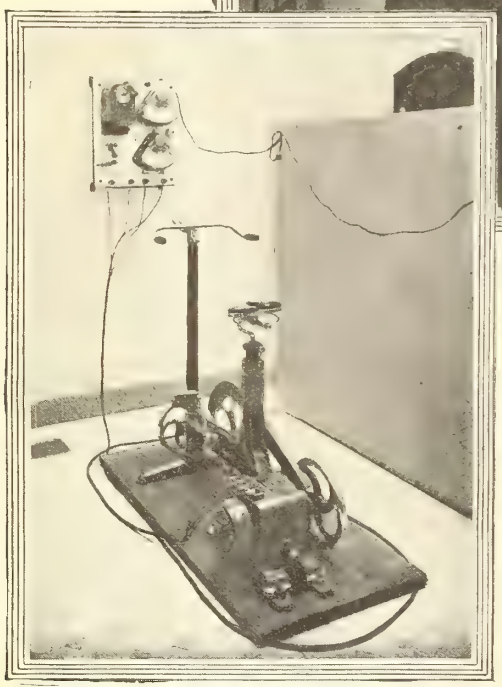
A subject very much weakened by chronic *enteritis* was absolutely unable to walk 100 meters without assistance and in addition to being incapable of any physical or intellectual work had become considerably emaciated, his weight having been reduced to 49½ kilograms. Under the influence of high frequency currents for a period of 35 days, giving the patient two treatments each day, this man, at the end of the treatments, regained the normal weight of 63.2 kilograms. He was able to walk for many hours without fatigue and had regained a really remarkable bodily vigor.

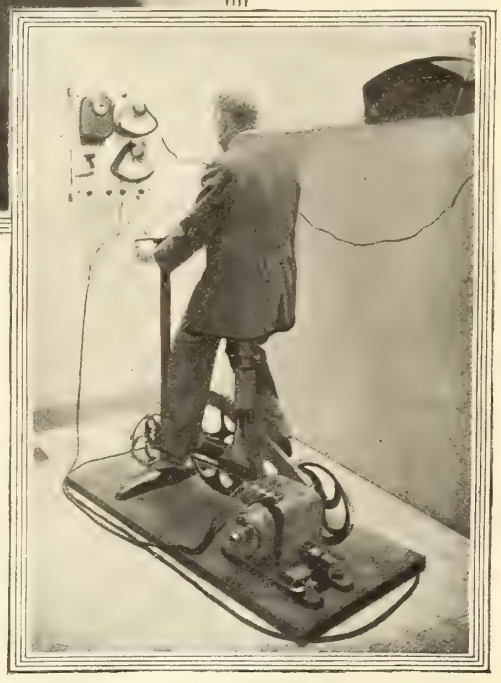
In brief, the diathermic method actually seems to be the one most efficacious for the relief of organs in low physical condition no matter what cause, whether it be cancer of the liver, stomach, or the intestines, large hemorrhages, blood poisoning, critical periods following serious sickness, etc. This method will furnish to the body, in the form of natural heat, a sufficient ration which while supplementing its energy deficit, accomplishes a desirable result without the assistance of the digestive apparatus.

This same practitioner has also demanded of electricity that it *reduce* the avoirdupois of his too obese clients. Instead of recommending the practise of sports or various forms of gymnastics, like many of his colleagues are in the habit of doing, he has invented the *ergometer* which is designed for the use of stout citizens. This apparatus is a sort of bicycle electrically propelled which will permit them to re-establish the equilibrium of energy necessary to the proper functioning of their organs. This is accomplisht by means of forced exercises regulated in a scientific and rational man-

(*Continued on page* 568)







Professor Bergonié, the famous French Researcher, Has Discovered That It Is Possible by Means of Certain Electric Currents to Convey Calories Into the Human Body. Calories Being the Equivalent of Food, Will Increase the Patient's Weight.

The Professor Has Also Constructed a Machine Which He Calls "the Ergometer," Shown at the Left. This Machine Makes Stout Persons Work Their Muscles.

To the Right, We See the Same Machine in Actual Use, and After the Patient Has Worked for a Certain Length of Time and Delivered the Prescribed Energy Into the Machine a Bell Rings and the Machine Stops.

Timing Sunlight for Plants

Too Long a Day Stops Flowering, Scientists of the Department of Agriculture Discover

SCIENTISTS have known for generations that sunlight was necessary for normal growth of most kinds of plants, and, altho the summer sun might occasionally become too hot, they have understood that it could not cause any injury except perhaps the injury due to *burning*. A recent discovery by W. W. Garner and H. A. Allard, of the Bureau of Plant Industry in U. S. Department of Agriculture, demonstrates that entirely apart from any effect of burning it is possible for plants *to have too much daylight* or, in other words, too many hours of daylight in comparison with the number of hours of darkness. Too long a day as well as too short a day will prevent many kinds of plants from ever reaching their stage of *flowering and fruiting*.

FLOWERING AND FRUITING PERIODS OF PLANTS CAN BE CONTROLLED.

Furthermore, the intensity of the light has very much less significance upon the growth of the plant than has usually been supposed. Greenhouse experiments prove that the flowering and fruiting period of practically any plant can be made to take place *at any time of the year* by darkening the greenhouse in the morning and evening if the day is too long, or by lengthening the day by artificial light if the day is too short! This new theory of controlling flowering and fruiting of plants undoubtedly will be used by florists and other greenhouse operators. For example, violets bloom only during the comparatively short days of spring; but if violet plants are covered with light-proof boxes at night and not uncovered until the sun is about half an hour high each morning during the summer-time, violets can be forced to bloom again in the summer. Spring flowers and spring crops happen to be spring flowers and spring crops because the days at the season of their flowering and fruiting have the proper number of hours of daylight. Correspondingly, the early summer flowers and crops must have a longer period of daylight. This has been proved as to a large number of plants, and the scientists believe that the principle will hold thruout the higher forms of plant life, and that it is probably applicable to animal life as well.

REPRODUCTION DEPENDS ON DAY LENGTH.

The plant cannot attain sexual reproduction, it has been shown, except when it is exposed to a favorable length of day. The requirements, however, differ widely with species and varieties. But a length of day that is unfavorable to reproduction may be favorable to growth. Under that condition, the plant continues its vegetative development profusely and indefinitely without bearing fruit. A length of day may be found that is favorable both to sexual reproduction and vegetative growth. That tends to bring about the "ever-bearing" type of fruiting.

By employing *dark chambers* to shorten the period of light and artificial lights to extend it, scientists of the Department have shortened or lengthened the life cycle of plants, have made some of them complete two cycles in a single season, have brought others into flower and fruit months in advance of their regular time and, with still others, have greatly delayed and even completely prevented fruiting.

Long series of tests have been made with soy beans, tobacco, wild aster, climbing hempweed, beans, ragweed, radish, carrot, lettuce, hibiscus, cabbage, violets, goldenrod, spinach, cosmos, iris, beggartick, buckwheat, and various other plants.

A test made with Biloxi soy beans will show how the principle works. For the test plants the day was shortened by several hours. That is, they were exposed to the light only from 10 o'clock in the morning till 3 o'clock in the afternoon. They were first placed in the dark house on May 20. Control plants, otherwise treated exactly like the test plants, were left exposed to the light from dawn till dark. The first blossoms appeared on the dark-house plants on June 16. No blossoms appeared until September 4 on the plants that were left in the light all day. But the dark-house plants averaged only 6 or 7 inches high, while the plants that were left in the light all day grew to an average height of 57 or 58 inches.

These plants required a short day and a long night for flowering and seed bearing. In tests with other plants, just the opposite was found to be true. The plants that were left in the light all day did not grow luxuriantly, but produced flowers and seed, while those that were kept in the dark a part of the day made abundant growth, but produced no seed or else were greatly retarded in producing seed.

TEMPERATURE HAS LITTLE INFLUENCE.

Temperature appeared to exert no influence in these tests. The results were the same, even when the temperature was higher in the dark house than on the outside. Another striking illustration of the relative unimportance of temperature is the fact that plants kept in the dark for a part of the day underwent, in midsummer, the changes that in Nature come in the fall and have always been attributed to lower temperatures. This, also, was true even when the dark houses registered a higher temperature than that of the outside summer atmosphere.

The results obtained by artificially extending the period of light are just as interesting as those obtained by artificially shortening it. The artificial illumination, in a test with iris, was so arranged as to give 18 hours of continuous light in a greenhouse during the winter. Control plants were kept in a similar greenhouse with no artificial light. The test was begun on October 20, 1919. In the greenhouse where daylight was supplemented with electric light the plants made rapid growth, soon attained normal size and produced blossoms on Dec. 24. The plants in the greenhouse where no artificial light was used, tho it was kept at the same temperature, remained practically dormant and (*Cont. on page* 536)



Biloxi Soybeans. Plants on Right Exposed to Light From Daylight to 10 A. M. and From 2 P. M. to Dark. Plants on Left Exposed to Light From 6 A. M. to 6 P. M., or 12 Hours Daily.

Ragweed. Plants on Left Exposed to Light From 9 A. M. to 4 P. M. Daily. Pollen Shedding Freely. Plants on Right Left Out of Doors as Controls. No signs of Flowering.

Aster Linariifolius L. Plants on Left Exposed to Light From 9 A. M. to 4 P. M. Daily. In Full Bloom. Plants on Right Left Out of Doors During Test. No Flower Heads.

Small "Dark Chamber" Used in the 1918 Sunlight Experiments.

How We "Taste"

By JOSEPH H. KRAUS

ONE of our most important functions (without which much of the pleasure of existing in this sphere would be lost), is our ability to detect differences and similarities of foods and beverages or in other words, differences in taste. This we owe to the brain and its communicating nerves travelling to the cells relegated to perform that duty. These end organs in the human being are found in the tongue and represented as *taste-buds,* tiny oval single cell structures imbedded in the upper cell epithelium (skin covering of the tongue). This epithelium is arranged in layers. A few of these taste-buds are scattered on the hard palate, in the throat, the tonsils, the inner surface of the cheek, and other surrounding tissues.

On the tongue, they are found chiefly in the grooves around certain hill-like structures, called vallate, or circumvallate, papillae (a small nipple). If the tongue is examined on close range, it will be found to be extremely rough, due to these hill-like structures and the four distinct types of hills dependent on their shape can readily be ascertained, even by aid of an ordinary magnifying glass.

First, we have the vallate papillae or otherwise known as circumvallate papillae. These contain the greatest number of taste-buds. Each bud has an elongated pore opening on the surface in the groove surrounding these papillae of which there are seven to twelve in number and so arranged as to form the two limbs of the letter "V."

The formation can be readily seen in examination of the tongue, even without the aid of a lens. In form the vallate papilla is a broad and nearly cylindrical "pimple," altho it is slightly narrower at its base than at the top and is, so to speak, sunk into a pit. It is thus surrounded by a trench or groove, much resembling the cross-section of a moat surrounding a castle.

Second, we find the fungiform papillae much smaller but greater in number than the former. They are found chiefly at the tip and sides of the tongue, altho a few are scattered elsewhere. They can readily be distinguished by their bright red color. The conical papillae are smaller in size and are found even to a greater extent than the fungiform. They are minute conical projections tapering toward the free ends; and lastly, the filiform papillae which are similar to the above but the epithelium or skin on the surface is broken up into threadlike filaments.

Scattered thru the tongue are the taste-buds each of which, on examination under the microscope, will be found to consist of one cell with a tube-like projection running to the surface of the tongue. Around this cell, if the specimen has been properly stained, will be found the tree-like terminal nervé endings which do not enter the cell itself, but surround that cell.

This is the typical taste-cell depicted in our illustration. In order, however, to determine the presence of any taste we must have a substance which will stimulate these taste-buds, and therefore, the substance must be soluble in some liquids or if not already in solution and in powder form, it must be soluble in the saliva contained in the mouth.

Altho at first this may be difficult to comprehend, it can easily be demonstrated in the following manner.

Quinine in powder form, due to the fact that it is *insoluble* in neutral or slightly alkaline solutions, is practically tasteless, although in reality, if dissolved in some solution slightly acid as for instance saliva, the sensation produced is very bitter and disagreeable.

Strange to say, the number of different tastes which we recognize is very limited, six being the maximum number. We recognize sweet, sour, bitter, salt and alkaline and a metallic taste, and altho many authorities claim that other substances when taken into the mouth, would give us a marked sensation, such a sensation is due not to the stimulation of the taste-buds, in the tongue, but to the fact that the foods stimulate in addition to these taste-buds, the nerve ending of *Smell!* Another strange feature is that one solution can neutralize the taste of another, for instance *a solution of salt is rendered almost tasteless by the addition to it of a few grains of sugar.* On the other hand, if these primitive tastes are taken in strong enough quantities, we get a mixed sensation in which salt and sweet are distinctly noticeable. And altho we get no such sensation as in the eye, where a white light may result from stimulation of the retina by two complementary colors, we can very often neutralize the tastes, in the ways before described, deceiving ourselves.

Distilled water, as is well known, is absolutely free from all impurities, *and is both tasteless and odorless;* yet if the mouth

(*Continued on page* 533)



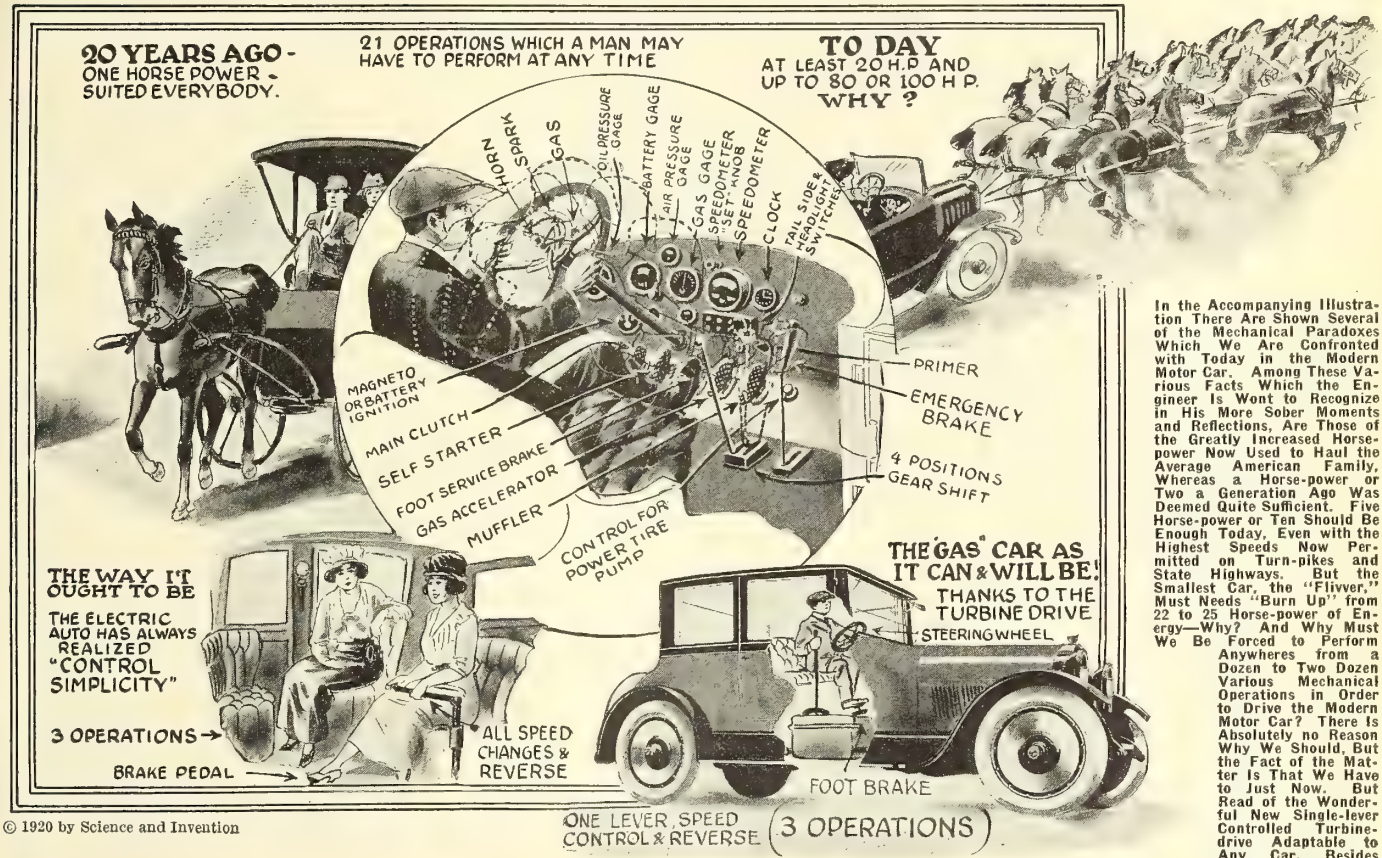
Above We See a Representation of the Tongue on Which Are Found in Great Numbers the Organs of Taste, or Better Known as "Taste Buds." The "Vallate Papillae" Are Small Hill-Like Structures Each Completely Surrounded by a Groove and Are Arranged in Inverted "V" Formation. Into the Bottom of These Grooves, the Pores of a Great Many Taste-Buds Open. Each Taste-Bud Is Completely Surrounded By Tree-Like Ramifications of Nerves, Ending in Very Fine Delicate Fibers.

Assuming Then That the Condenser-Like Action Between a Cell and Nerve Takes Place, We Have a Very Clever Analogy Simply Seen in the Condenser Effect, Which Everyone Has Already Noticed, and the Reason Why the Nerve Terminal Is More Sensitive at Its Fine Filamentous End. Is Because of the Fact That the Insulating Membrane, Known as Krause's Membrane, Is Not Present in That Region and in Addition, Electricity Concentrates at Pointed Ends. This Is Noticed in the Tesla Coil, the Secondary of Which in Operation, Will Have a Greater Brush Discharge at the Pointed End of a Wire, Than at Any Other Portion.

On the Tongue Itself, With the Aid of a Magnifying Glass, the Hill-Like Structures Can Readily Be Likened to Those Shown Enlarged in the Above Diagram. Here We Have the Papillae Already Mentioned, Then in Addition, a Conical, a Flat, and a Fine Thread-Like Set. The Complete Structure of the Taste-Bud Is Clearly Depicted in the Upper Right Hand Corner. Here, the Group of Taste-Cells Is Seen to be Firmly Supported By Surrounding Tissues, the Cellular Structure Running Off Into the Skin and Muscle Coats of the Tongue.

What's Wrong with the Motor Car?

By H. WINFIELD SECOR



© 1920 by Science and Invention

In the Accompanying Illustration There Are Shown Several of the Mechanical Paradoxes Which We Are Confronted with Today in the Modern Motor Car. Among These Various Facts Which the Engineer Is Wont to Recognize in His More Sober Moments and Reflections, Are Those of the Greatly Increased Horse-power Now Used to Haul the Average American Family, Whereas a Horse-power or Two a Generation Ago Was Deemed Quite Sufficient. Five Horse-power or Ten Should Be Enough Today, Even with the Highest Speeds Now Permitted on Turn-pikes and State Highways. But the Smallest Car, the "Flivver," Must Needs "Burn Up" from 22 to 25 Horse-power of Energy—Why? And Why Must We Be Forced to Perform Anywheres from a Dozen to Two Dozen Various Mechanical Operations in Order to Drive the Modern Motor Car? There Is Absolutely no Reason Why We Should, But the Fact of the Matter Is That We Have to Just Now. But Read of the Wonderful New Single-lever Controlled Turbine-drive Adaptable to Any Car, Besides Other Automobile Improvements Which Are Bound to Come.

As you sit behind the wheel of your new Hudson Super-Six or your twelve-cylinder Packard, you undoubtedly entertain, and for very good reasons, the idea that here indeed, is one of man's finest mechanical productions. But while it looks all very fine and beautiful to see a string of modern motorcars moving along at a speed of from 20 to 30 miles an hour on our interurban turnpikes and boulevards, the engineer looks at this same line of moving horseless vehicles from an entirely different point of view from the layman. Some of the ideas and reflections which constantly revolve in the mind of the trained technician, as he watches the performances of the twentieth century automobile, are presented in the following.

Altho we believe the modern motor car to be nearly perfect, there is a vast field for improvement

TWENTY-FIVE TO ONE HUNDRED HORSE-POWER INSTEAD OF ONE!

Twenty years ago, back in the good old horse days, when the obituary column of the daily newspapers did not contain several dozen notices of automobile casualties, when Old Dobbin was King of all he surveyed and the gasoline-engine propelled vehicle, a thing of mystery and novelty indeed, you and I and our fathers and mothers were glad enough to have a ride along the public highways with a horse and wagon. If several people were going out driving, then we generally had recourse to two horses, or a team.

Now bear in mind that in those palmy days you went out driving in a one H.P. or two H.P. vehicle. Most probably, you do not reconcile the value of the one live horse-power as developt by Old Dobbin plodding jauntily down the road with the evaluated horse-power developt by the modern automobile engine. But such is the case nevertheless, and the fact of the matter is that when you step into your "Flivver" and start feeding the gas to the engine, you are warming up a mechanical horse with a power equivalent to 22 Old Dobbins—just think of it!

This statement is based on the fact that the horse-power, as it is usually exprest, is the amount of energy required to lift 33,000 pounds one foot per minute. (This was originally determined upon and evaluated by taking a number of measurements on several big London draft horses, back in the days when the first steam engines were being built, and when the need of a unit of work or energy was badly wanted.) It was then found that one of these big draft horses such as were used to pull heavy drays, could lift a weight of 240 pounds thru a height of 138 feet in one minute. This is the same as lifting 33,000 pounds one foot in one minute's time; or lifting one pound thru a distance of 33,000 feet in one minute. Thus, the horse-power is evaluated as the equivalent of 33,000 foot-pounds exerted thru one minute of time. A man working steadily, can, for a limited period, exert about 1/5th H.P. A professional strong man might perform a feat of weight lifting and exert momentarily, one H.P. of energy.

And so it comes to pass that when we start to analyze the modern motor car, we find that we are paying for gasoline at a good, fat price to feed the mechanical horse rated at anywhere from 20 to 30 H.P. and even up to 100 H.P., such as possest by big engines like the 12-cylinder motors used in some of the highest powered motor cars, all for the purpose of flying along main thorofares and highways at speeds of anywhere from 15 to 60 miles an hour! Not only is this the cause of many accidents, (which the writer predicts will eventually have to be curtailed by a law, either state or national, which will prohibit the building and operating of such high power cars, or else to enforce the enplacement of an automatic speed governor when it is licensed); but the present gasoline shortage is one of the answers to this problem. Incidentally, the cost of owning and operating an automobile today is very far beyond what it should be for the average American citizen or family.

Why is this? There are several reasons, pro and con, but we come face to face with facts which prove, to begin with, that a high horse-power motor car is nothing else but a nuisance and danger to the community. Even a 25 H.P. car is usually much stronger than one needs.

"But," you will say, "If they put a smaller engine than the 22 H.P. type in my car, I cannot climb a steep hill." Perhaps this may be so under the conditions by which you prefer to ride. What are these conditions? Simply this: Instead of having a light vehicle like that you used to ride in twenty years ago, i. e., a buggy or phaeton, you now demand luxurious and heavily upholstered leather cushions, on a heavy chassis, supported by some more uncessarily heavy wheels and big rubber tires; besides carting along a quarter to half a ton of dead weight in the form of a gasoline engine—and for all these things, and also due to the loss of power in friction and gearing; and furthermore due to the

(*Continued on page 526*)

Archimedes—The World's First Great Inventor

ARCHIMEDES was undoubtedly the first real, scientific inventor of our world. According to history, he was born about 287 B. C. and died at the age of 75, having perished in the sack of Syracuse, 212 B. C. Archimedes was the son of Pheidias, the Greek astronomer, and was on very intimate terms with (if not related) to King Hieron and his son Gelon. In his early years he spent considerable time at Alexandra in carrying on some of his intensive studies. Later he returned to the city of Syracuse, where he lived a life practically entirely devoted to researches in mathematics.

We of today are quite wont to think that the mathematics and kindred laws of today are solely the work of mathematicians who have lived in the past few hundred years, but when we come to examine the remarkable and extensive amount of mathematical work done by Archimedes we are astonished indeed. Archimedes undoubtedly had very clear conceptions regarding some of the foremost mathematical problems and laws upon which we still base some of our major calculations today. His researches, especially in his later life, branched out now and then into some of the more utilitarian applications of science; but it was a well-known trait of Archimedes, oft repeated by his friends and recorded in the history of his life, that he scorned wasting any time on practical everyday affairs. He devoted all of his time and energy solely to the more deeper and philosophical aspects of earthly problems. However, be that as it may, it is because of his very ingenious and mechanical practical inventions that the average person of today knows anything at all concerning Archimedes; and not because of his more abstract mathematical theories, which have been to a great extent quite lost sight of except to students of ancient history and particularly the older history of mathematics and inventions.

In the words of Plutarch—"Archimedes possest so high a spirit, so profound a soul, and such treasures of scientific knowledge that, tho these inventions had obtained for him the renown of more than human sagacity, he yet would not deign to leave behind him any written work on such subjects, but, regarding as ignoble and sordid the business of mechanics and every sort of art which is directed to use and profit, he placed his whole ambition in those speculations in whose beauty and subtlety there is no admixture of the common needs of life." As a matter of fact Archimedes wrote only one mechanical book on "Sphere-Making."

During the siege of Syracuse by the Romans, however, many ingenious devices were invented or contrived by Archimedes and used with overawing effect. When the Romans attacked the city, he contrived giant catapults so cleverly constructed that they would hurl heavy projectiles in the form of rocks and other objects over both long and short ranges, and he devised as well powerful machines for discharging showers of missles thru holes made in the walls of the forts.

THE ARCHIMEDES' PUMP.

Among the many accomplishments in the realm of inventions by Archimedes we find his famous *water-screw*, or *pump*. This perhaps is one of the best known today of this early philosopher's work. Even yet, one may find in far parts of the world, water pumps operating on the principle of the Archimedes spiral screw. This pump is simplicity itself and merely comprises a tube wound around a central axle in a spirular formation, as shown in the accompanying illustration. When the handle on the upper end of the pump axle is turned, either by man-power on small pumps, or by horse or cattle on the larger pumps used to irrigate land in Egypt and other countries, the water is forced up thru this tubular spiral and flows from the upper opening in a constant stream.

THE "BLOCK AND FALL."

Archimedes found from his extensive study of the many and varied problems of geometry that there was undoubtedly a very close relation between those geometrical laws and the everyday problems of moving large weights or loads with small forces, etc. The lifting tackle, or "block and fall," illustrated herewith, suspended from a tripod, represents the discovery of the multiple sheeve lifting tackle by Archimedes. This marked a great advance in the accomplishment of mechanical work in the early years of history, as may be readily imagined. Thanks to the multiplying power of the "block and fall," one man could lift as great a weight as a dozen men, providing 12 ropes were used, with a corresponding set of pulleys in the two blocks, and Archimedes successfully demonstrated that he could move a large vessel with one of his multiplying blocks or mechanisms single handedly! The King and the people were amazed at this remarkable demonstration, and special commendation was accorded to Archimedes for this spectacular demonstration of applied science.

One of the most famous mathematical problems worked out by Archimedes and familiar to students the world over today is the Archimedian spiral. Archimedes worked out all of the mathematical relations and factors having to do with the building of this spiral and, of course, when once this was done, architects and others could easily work out this curve of any size desired. The drawing of the Archimedian spiral and Latin text describing it, shown on the opposite page, were photographed from an old book dated 1500.

ARCHIMEDES DISCOVERS "SPECIFIC GRAVITY" RATIO.

"Specific gravity" is defined as the ratio of two bodies of different densities determined by various physical means, one method of determining which is to divide the weight in air by the loss of weight in water, which gives the specific gravity of the object. Hiero, King of Syracuse, once commissioned Archimedes to discover, if he could, whether the gold which he had given to an artisan to work into a crown for him had been worked up with baser metal. This puzzled Archimedes for some time, until one day as he was stepping into his bath he observed the water running over, and it at once occurred to him that the bulk occasioned by the addition of an alloy could be measured by placing the crown and an equal amount of gold separately into a vessel filled with water and observing the exact difference of overflow. It is recorded that he was so enthused and overjoyed with this discovery that he ran home without his clothes, shouting, "Eureka, Eureka! (I have found it, I have found it!")

It is believed that this eventually led to his establishing the great fundamental principle of hydrostatics, which is still known by his name—*that a body immersed in a liquid exerts an upward pressure equal to the weight of liquid displaced.*

BURNING OF SHIPS BY HUGE MIRROR AND LENS.

One of the stories which has been repeated a million times, but which historians are generally wont to discredit since there seems to be no authentic record by the ancient historians—nor modern proof—is that describing how Archimedes designed and built a huge *burning mirror* with suitable reflectors, which projected such a powerful ray of sunlight that it set fire to Roman ships when they were within a bow-shot away from the fortress wall. It is thought by later historians that such a principle had been worked out and demonstrated for philosophical and other reasons by Archimedes; and that it is not so probable at all that this had anything to do with the setting on fire of the Roman ships. However, there is a possibility that such an effect could have been attained under the stress of war, as the bits of history and writings which have come down to us regarding the work of Archimedes are very meagre and scattered indeed.

The wonderful possibilities and the various operating principles of the lever were first discovered and shown in their application to mechanics by Archimedes. His own estimate of the capabilities and possibilities of the lever is shown in his expression, "Give me a fulcrum on which to rest and I will move the Earth."

ASTRONOMICAL DISCOVERIES.

One of the principal philosophical studies in which Archimedes indulged was that of

(*Continued on page* 563)

For "October"

Photographing Flight of Bullets. By Pierre H. Boucheron.

Weighing Light Beams. By Dr. Alfred Gradenwitz.

Radio Transmission of Power. The real Thing with photos of the Actual High-power Apparatus. By Samuel Cohen.

Velocity of Light. By Prof. James S. Stevens.

Electricity and the Weatherman.

A Day with "Central"—Written by a "Hello Girl." Illustrated.

What you Should Know About Electric Lamps—Watts, Voltage and Candle-Power Explained.. Written by an Illuminating Engineer.

The Sun's Unknown Rays. By Rogers D. Rusk, M.A.

A Miniature Electrical Universe. The Startling work of Dr. Birkeland. Fully Illustrated.

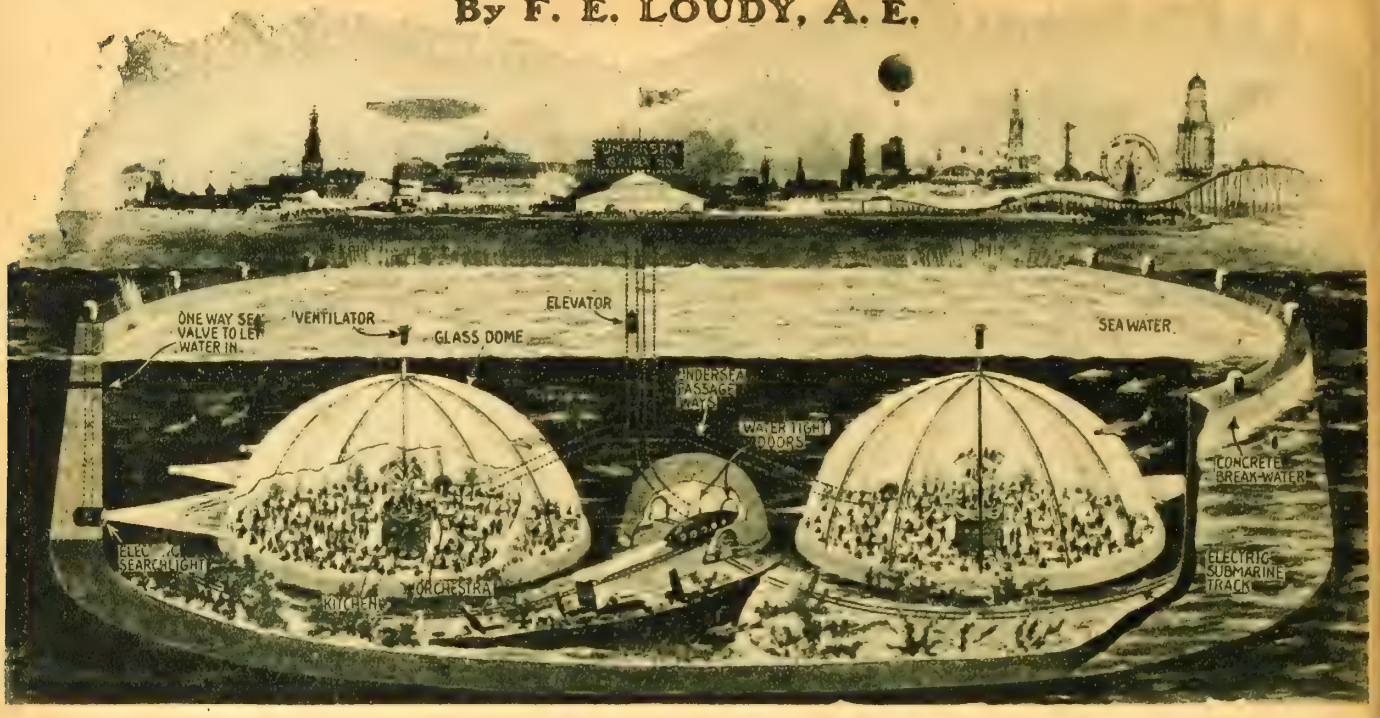
Simplest Long Wave Radio Receiver. Full Specifications and Drawings. By Elliot A. White.

How Big are Molecules? By Rogers D. Rusk, M.A.


DISCOVERED THE PRINCIPLE OF THE LEVER
"EUREKA" HE DISCOVERS THE PRINCIPLE OF SPECIFIC GRAVITY.
THE FIRST "BLOCK & FALL" WITH MULTIPLYING PULLEYS
CATAPULTS FOR STORMING ROMAN FORTS
ARCHIMEDES' WATER SCREW
ARCHIMEDES
THE WORLD'S FIRST GREAT INVENTOR
COMPOUND GEAR FOR MULTIPLYING POWER
BURNING SHIPS WITH MAGNIFYING GLASS AND SUN'S RAYS.
TOMB OF ARCHIMEDES
ARCHIMEDES' SPIRAL AND PAGE FROM BOOK DATED 1500
INVENTED VARIOUS INSTRUMENTS FOR MEASURING SIZE AND ANGULAR POSITION OF THE HEAVENLY BODIES
ΠΡΟΒΛΗΜΑ.
Spiralem describere.
ARCHIMEDES' PLANETARY SYSTEM
DEATH OF ARCHIMEDES

Undersea Amusement Park

By F. E. LOUDY, A. E.



© 1920 by Science and Invention

The Newest Innovation in Pleasure Resorts and Amusements Is the "Undersea Amusement Park," Here Proposed by Mr. Loudy. The Cost of Building Such an Amusement Feature at Our Seaside Resorts Would Not Be So Great as It Might at First Be Imagined. The Electrical Illuminating Features Are Very Spectacular and Entrancing, and Those So Disposed Can Enjoy All the Thrills of a Submarine Trip Under the Ocean in the Small Submersible Boat Which Runs Along the Rails Propelled by Electric Motors Geared to the Wheels on Which It Runs. Electric Elevators Take the Pleasure-Seekers Down to the Sub-Sea Restaurant and Amusements.

THE Prince of Monaco may descend to the bottom of the ocean at the base of a cliff, sixty feet below the surface of the Mediterranean, and here thru a large window he may view the fauna and flora of the sea. It may not be long before we may all enjoy these pleasures at our sea or lake resorts. It is proposed to erect a large horseshoe breakwater adjoining the shore, and dredge to a depth of fifty feet. The breakwater will act as a cofferdam, wherein the two glass-domed observation stations and the submarine chamber will be erected, as well as a railway for the submarine. When this park is ready for operation the water will be admitted, and everything will be submerged.

The breakwater keeps boats out, prevents the waves from damaging the park, as well as keeping ice from breaking things up in the winter. One-way valves are located at intervals around the breakwater to allow the water to enter, but not to escape with the rise and fall of the tides.

A visitor to the Subsea Park will first enter a concrete elevator shaft, protruding above land, and will descend to the concrete tubular walkway to either observation station. Here he may seat himself at a table and order all of the choicest seafoods. The galley or kitchen is located in the center of the station above which is the orchestra. At the top of the glass dome is a ventilating tube, extending above the surface of the water. The visitor may observe all the different forms of subsea life as fish from all parts of the ocean will be placed inside of the breakwater, where they cannot escape.

Next he will go thru the subterranean passageway into the submarine chamber, and take his seat near a large portlight. The door on the submarine is closed. Next the entrance door to the chamber is closed. The chamber is then filled with water, and the four large doors opened. The navigator turns his controller and the electric motors turn the propeller. The boat begins to move along the track, first passing a sunken ship. The illuminated observation stations present a gorgeous spectacle thru the water. Searchlights are also placed at intervals along the base of the breakwater. Here again the visitor observes the fishes as they swim around. The submarine, after traveling once around the figure eight track, returns to its chamber. The large doors are closed, the water removed by comprest air, the passageway door opened. The visitor then walks to the elevator shaft, and is then taken from the coolness of the ocean bottom to the torrid heat of the world above once more.

SOME MECHANICAL FEATURES AND PROBLEMS.

We have now considered some of the interesting and extremely novel pleasure features of this new undersea amusement resort, and probably, a few words as to the building of the subsea resort will be of interest. Most probably, the glass dome chambers shown will not be built of a particularly great height or depth which ever you want to call it, as for every foot that you go down beneath the surface of the water, the pressure increases .4 lb., or nearly ½ a pound per square inch.

Thus at a depth of 50 feet, the water pressure is about 20 pounds per square inch, and at a depth of 100 feet, it is about 40 pounds per square inch. Thus it will be seen what the engineering features met with in building such a pleasure resort, are. Great care must be taken to see that the steel frame-work and the glass plates used in building the domes and side walls are made thoroly water-tight, and also sufficiently thick to withstand the water pressure at the lower depths.

A very interesting feature which has already been touched upon, is the chamber housing the submarine. The entrance door to the central submarine housing chamber is shut just before the submarine takes its passengers on board, and prepares to make a trip over the figure eight track around the glass domed restaurants. After closing the doors on the submarine, it is then a simple matter by the aid of an electrical or pneumatic mechanism, to cause the sea doors to open, so that the submarine can move along on its electric motor-propelled wheels over the rails provided.

The submarine will contain the usual apparatus for supplying fresh air for the short period in which the passengers are en route. When the submarine arrives back in its central disembarking chamber, several interesting things occur. There are numerous ways in which the sea doors opening out of this chamber can be closed and the water removed from the chamber, such as by pumping out the water with large electrically driven pumps, or else by blowing out the water by means of comprest air, supplied by large, electric motor-driven air compressors.

Assuming that one or the other methods are used, the sea doors are closed as soon as the submarine has entered the chamber; and by means of signal lights or else by observing the conditions of the chamber thru one of the thick glass port windows in the submarine, the Captain in charge of it will know when it is safe to open the door of the latter, and discharge his passengers. Special means will be provided, of course, for quickly drying out the chamber and draining the water from the floor, which effect may be hastened to a great extent by making the floor in the form of a grill or lattice work.

SPLENDORS OF UNDERSEA ILLUMINATION.

Not only will such an undersea amusement resort present features of unusual attraction and enchantment to those patronizing it, but it will also be a thing of wonder and awe to those on shore, who can look down into the water and see the flickering shadows and flashing lights thru the rippling waters covering the resort.

The extraordinary lighting effects which can be obtained very easily in such an un-

(*Continued on page* 542)

The Unknown Avenger

By HAROLD F. RICHARDS, Ph. D.

IT was a strange group that stood on a broad, flat rock which formed a little open space at the water's edge on the barren coast of Iceland. Four there were in the party, and in the eyes of three of them gleamed the look of evil satisfaction that comes into the eye of the hunted tiger when he has finally turned at bay and placed his paw safely upon the neck of his prostrate enemy. Slim Kelly, crack ferret of the Secret Service, calmly leveled a deliberate glance at the three. His hands were trussed behind his back, his automatic no longer occupied its familiar place at his hip and his silver emblem of the Service had just been tossed into the cold waters of the sea. But he was game.

"What are you going to do?" he questioned in exactly the same tone that he would have used in asking for a cigarette.

Jacob von Hernholtz stood erect before the prisoner. German spy that he was, he possest a dignified bearing, which was enhanced by his long fur coat. His face was that of the aristocrat accustomed to the best that wealth can afford. His close-set blue eyes seemed to glow with a greenish glint as he contemptuously surveyed the captive. His voice was velvety and as smoothly modulated as the liquid tones of a contralto as he addrest Slim Kelly.

"First of all, Mr. Kelly, I think that we had better make a little bonfire of those papers which you just took from my desk on the yacht." His eyes turned to the elegant steam yacht riding easily off the shore.

Carefully, with every regard for the comfort of the prisoner, von Hernholtz extracted from Kelly's inner pocket several official-looking documents, and his eye revealed his satisfaction as he deliberately looked thru them. He handed the papers to Lendorff, whose face lighted as he scanned their contents. Lendorff had every appearance of the scholar, and as Slim watched his sharp, black eye, academic severity of countenance and brow much furrowed as if by close application to many abstruse manuscripts, he wondered mentally at the many types of men whom the German diplomatic service had been able to enlist in the nefarious plots that circulated as an undercurrent thruout the length and breadth of the land. At length Lendorff seemed satisfied and, crushing the red-sealed papers in his hand, he placed them in a little heap on the rock at their feet. Turning to the third member of the group, he bowed deferentially, and said:

"And you, Madame Holt, shall have the pleasure of destroying these little souvenirs which Mr. Kelly has so assiduously sought for the last ten months."

Elaine Holt smiled in acknowledgment. It was not a pretty smile, but rather one which revealed a hardness that seemed out of place on her beautiful face. Her features were perfectly modeled, giving to her countenance the distinguished look of a patrician of undiluted extraction, but the cold, calculating expression in her black eyes suggested at once those qualities which had made her one of the most valued agents of the whole German service. Beautiful, polished, resourceful and unrelenting in her pursuit of any information that might prove of value to the government which paid her so extravagantly, she had ferreted out many valuable secrets. Many an officer or diplomatic attaché had felt the power of her magnetic personality, had succumbed to her overpowering attractions, and waked from his dream of love only to find himself hoodwinked and disgraced, with no recourse but to resign his position and start anew in some spot far removed from Washington.

Withdrawing one gloved hand from the warm depths of her luxurious black seal muff, she took the embossed gold case which Lendorff extended, twirled with a dainty

(*Continued on page* 553)



"Too Bad That Madame Will Have to Wear a Heavy Veil All Her Life. New York's Gatherings Will Regret the Loss of One of Their Loveliest Women" . .

The Airpla[illegible]

By H.



This 1,000-Foot Monster Airplane of the Future, Which Can Carry From 1,000 to 1,500 Passengers and Tons of Cargo, Is Not a Wild Dream, But a Reality. A Smaller Similar Machine (See Actual Photo Below) Has Already Been Built by Mr. Wm. B. Stout. This Future "Batwing" Will Fly at the Tremendous Speed of 500 Miles an Hour. In Other Words, the Trip From New York to London Will Take But Six Hours!

WE are about to witness a great revolution in airplane construction in the very near future. The present airplane as far as its construction is concerned has about reached its limit for a number of reasons. One of the most important reasons is that the extra bracing and struts required to give strength to the present day giant airplane retards its speed due to the greatly added air resistance. The other chief reason is the limited passenger and cargo space available even in our huge, present day machines. Every pound of cargo that we add increases the spread of the wings and again makes it necessary to use more and larger struts, which in turn decreases the speed of the machine.

During the war William B. Stout, an American aeronautical engineer, formerly with the Air-Craft force in Washington, produced a wonderful new airplane, a photograph of which appears on this page. He was assisted by Orville Wright, the inventor of the airplane, as well as the U. S. Government. The machine is known as the *hollow wing type,* and it is claimed that this machine anticipates the German machine of the same type recently put into use in the United States. Mr. Stout built his original machine at Dayton, Ohio, during the war and the first flight of the new airplane was made in the year 1918.

The plans had been kept secret and more than 1,000 men located in different cities made the various parts of the machine inasmuch as the Government wished to keep the design secret. However, photographs and blueprints were stolen during the war and thus found their way into German hands, thus giving them the idea for their airplane.

The revolutionary feature of the Stout "Batwing" is nothing but a giant double wing with all the machinery, trussing, etc., housed right inside of the hollow wings. The engines are placed in the front edge, while the passengers and cargo are enclosed between the wing surfaces. The important point is that every part of the machine exposed to the air is designed with the sole idea to LIFT.

Altho the new airplane has 480 square feet of wing surface, or 40 square feet more than an army two-seater, it only weighs half as much as the latter. In other words, 1,550 pounds as against the 3,220 pounds of the army machine!

The "Batwing" has been tested in a wind tunnel for a speed of 217 miles an hour, and it is claimed that it can rise easily to 32,000 feet. It can climb a mile in 2½ minutes and all this is accomplisht with a little 180 horsepower motor. An unexpected result of the new construction is that inasmuch as the radiators are housed inside of

Below: Actual Photo of the Hollow-Wing "Batwing" Airplane Invented by Wm. B. Stout, Who Was Assisted by Orville Wright and the U. S. Government. The Machine Was Built in 1918.





Above: A Side View of the Airplane of the Future. The Lower Surfaces of the Wing Are Curved Downwards to Obtain a Better Purchase on the Air. Note That Such a Machine Has no Struts or Wires. Everything Is Inside of the Metallic Envelope.

of the Future

GERNSBACK



© 1920 by Science and Invention

Eight 100-Foot Monster Propellers Drive the Huge Air Liner, Which Is Entirely Enclosed Within a Metallic Envelope Made of Magnesium, a Metal Thirty Per Cent Lighter Than Aluminum. Altho This Airplane Does Not "Look Safe," Experiments Have Shown That It Is SAFER Than the Present Type Airplane. Due to Its Huge Surface, Such a Machine Acts Like a Parachute, and Actually Prevents the Air Monster From Making a Too Rapid Descent.

the wings, the passengers and pilot are easily kept warm when the machine rises to high altitudes.

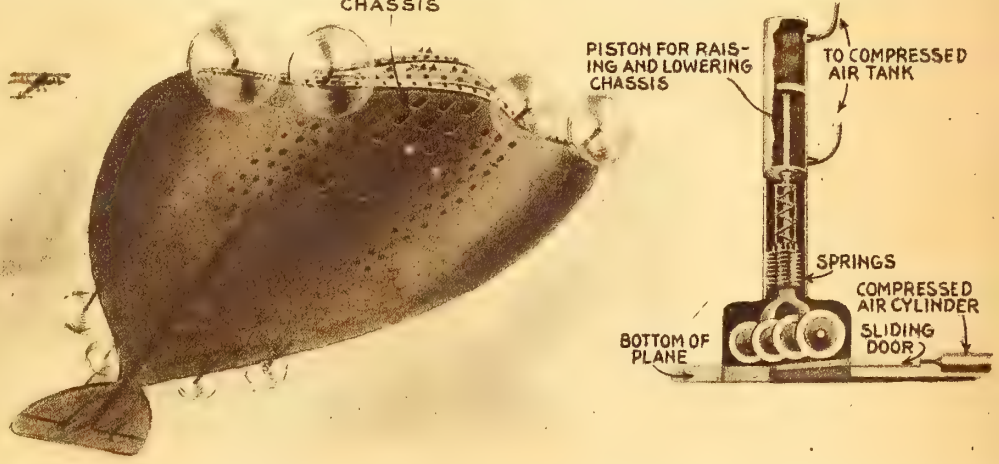
Another novel idea presents itself in the larger types, where the landing gear is made to pull into the wing so as to give less air resistance. So much for the machine that has been actually built and is in existence. We now get a good conception of what the huge aerial liner of tomorrow will look like. We have tried to show in our large illustration just how such a new aerial monster will appear in ten or fifteen years from now. All of our preconceived ideas as to what an airplane should look like are swept away by Mr. Stout's revolutionary invention.

The important and outstanding fact as well as the revolutionary possibilities which made the "Batwing" possible are best explained in the following:

The lifting power of an airplane wing depends solely on its curve and it is not affected by its thickness. You will have to ponder awhile over this seemingly impossible statement, which is not a theory by any means but has been brought out by actual tests of Mr. Stout's "Batwing." In other words, this means that the future airplane will be constructed, not like a frail kite-like machine, such as our present day airplanes, but rather like an ocean greyhound built on sound engineering principles. Once our struts and braces are enclosed between two parallel surfaces nearly all our wind resistance vanishes and the plane can be pusht ahead at a very much smaller expenditure of power. Not only this, but the size of the future airplane is no longer of consequence as long as we have sufficient power to propel the airplane. Furthermore, if we provide sufficiently large landing fields or air ports, the airplane of the future can be built in unbelievably large proportions. A thousand-footer will be nothing to wonder at tomorrow and will be as common as the 200-foot steamship is today.

We have tried to show in our large illustration how such a thousand-foot monster appears winging its way homeward from its European trip. A machine of this kind driven by a great many propellers easily averages 500 miles an hour and for that reason can make the trip from Europe readily in six or seven hours. In other words, a man can transact business in New

(*Continued on page* 576)



© 1920 by Science and Invention

Bottom View of the Machine. Note Particularly the Chassis or Landing Gears Withdrawn Within the Machine—Just Like a Bird Draws Its Feet Close to the Body to Cut Down Air Resistance. The Landing Skids, Too, Withdraw, But Are Pusht Outward Just Before Landing. The Circular Holes in the Lower Surface of the Machine Are Glass-Covered Portholes. Insert Shows How Chassis Is Lowered by Means of Compresst Air.

The Airpla[illegible] of the Future

By H. GERNSBACK



This 1,000-Foot Monster Airplane of the Future, Which Can Carry From 1,000 to 1,500 Passengers and Tons of Cargo, Is Not a Wild Dream, But a Reality. A Smaller Similar Machine (See Actual Photo Below) Has Already Been Built by Mr. Wm. B. Stout. This Future "Batwing" Will Fly at the Tremendous Speed of 500 Miles an Hour. In Other Words, the Trip From New York to London Will Take But Six Hours!



© 1920 by Science and Invention

Eight 100-Foot Monster Propellers Drive the Huge Air Liner, Which Is Entirely Enclosed Within a Metallic Envelope Made of Magnesium, a Metal Thirty Per Cent Lighter Than Aluminum. Altho This Airplane Does Not "Look Safe," Experiments Have Shown That It Is SAFER Than the Present Type Airplane. Due to its Huge Surface, Such a Machine Acts Like a Parachute, and Actually Prevents the Air Monster From Making a Too Rapid Descent.

WE are about to witness a great revolution in airplane construction in the very near future. The present airplane as far as its construction is concerned has about reached its limit for a number of reasons. One of the most important reasons is that the extra bracing and struts required to give strength to the present day giant airplane retards its speed due to the greatly added air resistance. The other chief reason is the limited passenger and cargo space available even in our huge, present day machines. Every pound of cargo that we add increases the spread of the wings and again makes it necessary to use more and larger struts, which in turn decreases the speed of the machine.

During the war William B. Stout, an American aeronautical engineer, formerly with the Air-Craft force in Washington, produced a wonderful new airplane, a photograph of which appears on this page. He was assisted by Orville Wright, the inventor of the airplane, as well as the U. S. Government. The machine is known as the *hollow wing type*, and it is claimed that this machine anticipates the German machine of the same type recently put into use in the United States. Mr. Stout built his original machine at Dayton, Ohio, during the war and the first flight of the new airplane was made in the year 1918.

The plans had been kept secret and more than 1,000 men located in different cities made the various parts of the machine inasmuch as the Government wished to keep the design secret. However, photographs and blueprints were stolen during the war and thus found their way into German hands, thus giving them the idea for their airplane.

The revolutionary feature of the Stout "Batwing" is nothing but a giant double wing with all the machinery, trussing, etc., housed right inside of the hollow wings. The engines are placed in the front edge, while the passengers and cargo are enclosed between the wing surfaces. The important point is that every part of the machine exposed to the air is designed with the sole idea to LIFT.

Altho the new airplane has 480 square feet of wing surface, or 40 square feet more than an army two-seater, it only weighs half as much as the latter. In other words, 1,550 pounds as against the 3,220 pounds of the army machine!

The "Batwing" has been tested in a wind tunnel for a speed of 217 miles an hour, and it is claimed that it can rise easily to 32,000 feet. It can climb a mile in 2½ minutes and all this is accomplisht with a little 180 horsepower motor. An unexpected result of the new construction is that inasmuch as the radiators are housed inside of the wings, the passengers and pilot are easily kept warm when the machine rises to high altitudes.

Another novel idea presents itself in the larger types, where the landing gear is made to pull into the wing so as to give less air resistance. So much for the machine that has been actually built and is in existence. We now get a good conception of what the huge aerial liner of tomorrow will look like. We have tried to show in our large illustration just how such a new aerial monster will appear in ten or fifteen years from now. All of our preconceived ideas as to what an airplane should look like are swept away by Mr. Stout's revolutionary invention.

The important and outstanding fact as well as the revolutionary possibilities which made the "Batwing" possible are best explained in the following:

The lifting power of an airplane wing depends solely on its curve and it is not affected by its thickness.

You will have to ponder awhile over this seemingly impossible statement, which is not a theory by any means but has been brought out by actual tests of Mr. Stout's "Batwing." In other words, this means that the future airplane will be constructed, not like a frail kite-like machine, such as our present day airplanes, but rather like an ocean greyhound built on sound engineering principles. Once our struts and braces are enclosed between two parallel surfaces nearly all our wind resistance vanishes and the plane can be pusht ahead at a very much smaller expenditure of power. Not only this, but the size of the future airplane is no longer of consequence as long as we have sufficient power to propel the airplane. Furthermore, if we provide sufficiently large landing fields or air ports, the airplane of the future can be built in unbelievably large proportions. A thousand-footer will be nothing to wonder at tomorrow and will be as common as the 200-foot steamship is today.

We have tried to show in our large illustration how such a thousand-foot monster appears winging its way homeward from its European trip. A machine of this kind driven by a great many propellers easily averages 500 miles an hour and for that reason can make the trip from Europe readily in six or seven hours. In other words, a man can transact business in New

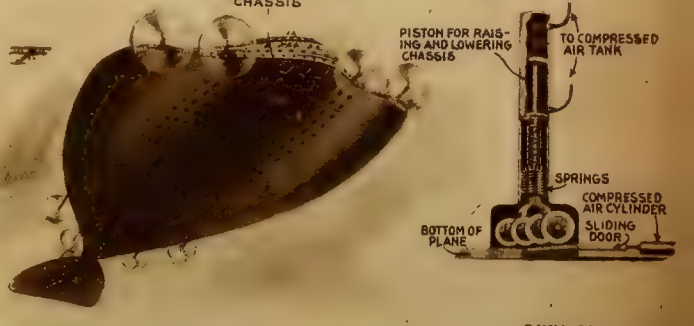
(*Continued on page 576*)



Below: Actual Photo of the Hollow-Wing "Batwing" Airplane Invented by Wm. B. Stout, Who Was Assisted by Orville Wright and the U. S. Government. The Machine Was Built in 1918.



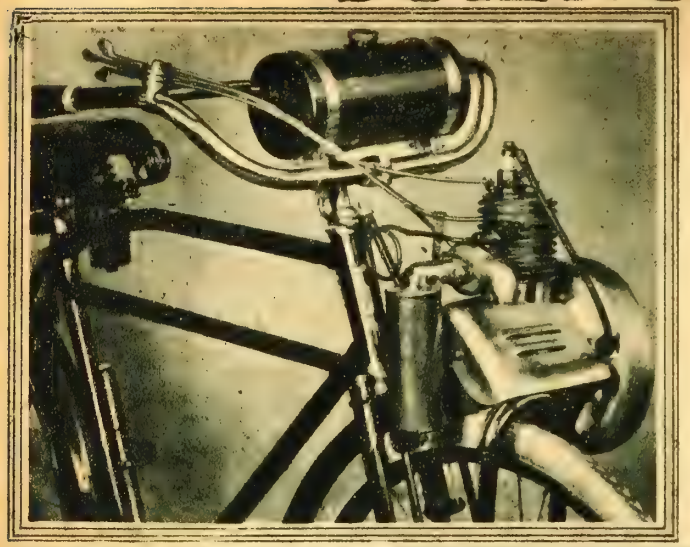
Above: A Side View of the Airplane of the Future. The Lower Surfaces of the Wing Are Curved Downwards to Obtain a Better Purchase on the Air. Note That Such a Machine Has no Struts or Wires. Everything is Inside of the Metallic Envelope.



© 1920 by Science and Invention

Bottom View of the Machine. Note Particularly the Chassis or Landing Gears Withdrawn Within the Machine—Just Like a Bird Draws Its Feet Close to the Body to Cut Down Air Resistance. The Landing Skids, Too, Withdraw, But Are Pusht Outward Just Before Landing. The Circular Holes in the Lower Surface of the Machine Are Glass-Covered Portholes. Insert Shows How Chassis Is Lowered by Means of Compresst Air.

SCIENCE NEWS



Latest Gasoline Motor Converting Any Bicycle into a Motorcycle Capable of 20 Miles Per Hour



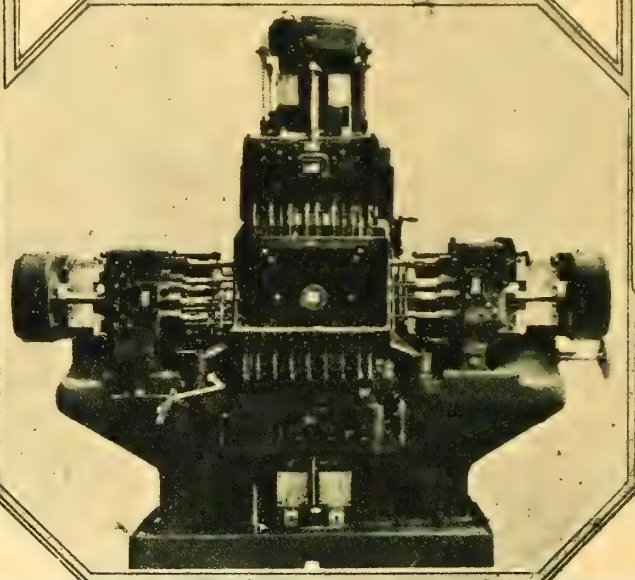
'Safety-first" Electric Sign 2 Miles Under-ground in Western Gold and Silver Mine. The Latest Idea in "Safety-first" Mine Work.



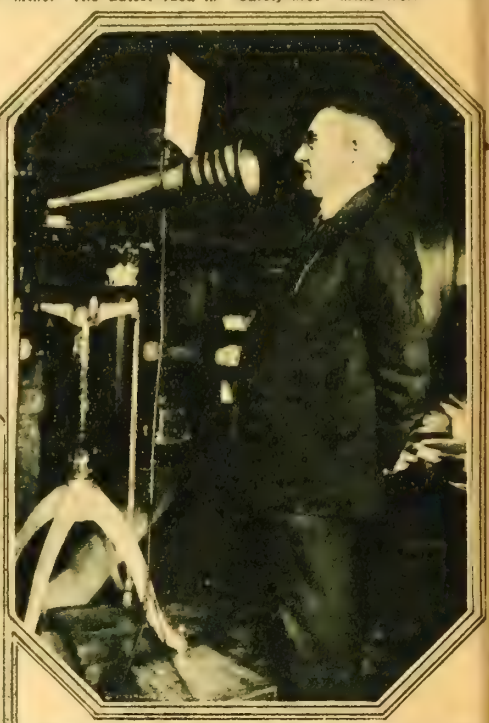
Above—First Electrical Apparatus Built and Used by Benjamin Franklin in 1754. It Is a Static Electrical Generator.



Latest Curtiss "Scooter," Driven by Aerial Propeller and 400 H.P. Airplane Motor. Draws but 3 Inches Water at 50 Miles Per Hour.



Below—Latest Electric Motor Car Being Built by the Thousand in Germany. It Is Run by a Dry Battery Renewable Every 4 Hours. Speed 17½ Miles Per Hour.

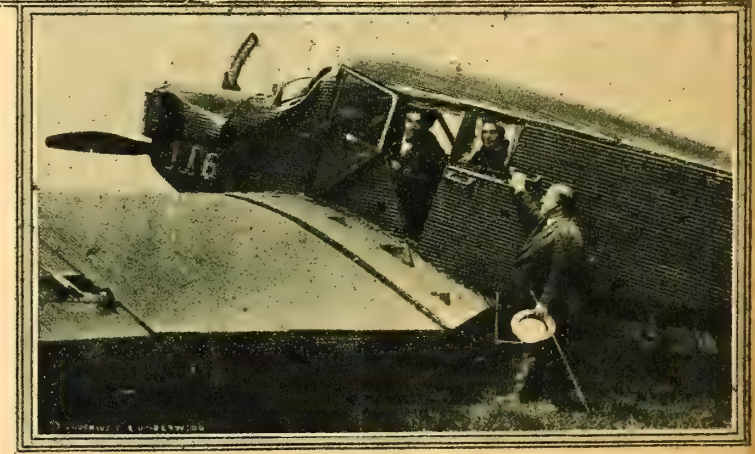


Above—Senator Harding, Republican Nominee for President, Delivering His Phonograph Speech Being Recorded by the Apparatus Shown. His Subject Was "Americanism."

At Left—Wonderful Electric Drilling Machine Boring 60 Holes at One Time in the Top, Bottom and Two Ends of Automobile Engine Bloc.

Below—Mr. J. Larsen (with Cane) and All Metal Monoplane, In Which He Recently Broke the American Non-stop Record by Flying 1200 Miles.





The Whirling Eye

By THOMAS W. BENSON and CHARLES S. WOLFE

NIGHT had fallen over the big institution as I crossed the connecting bridge between ward seven and ward six. The chill breath of late autumn swept thru the partly open bridge, and I shivered as I strode hastily toward the door of six. Just that ward to do, and my evening rounds were over, my day's work practically done.

As resident of this big state asylum for the insane it was my duty to make daily inspection of the wards, interview the patients, listen to complaints from them and receive the reports of the captains in charge of the wards.

It was my most irksome task. Nine out of every ten patients had some grievance to pour into my ear, and possibly seven out of the nine were purely imaginary, specters of poor, disordered brains. It is truly remarkable how much the average insane man can imagine has happened to him in a day.

The captain of six met me at the door. "Complaints run high tonight, Peters?" I asked with feigned sternness in my voice. I pitied this overworked man who had charge of the institution's receiving ward. Getting them all as they came in, the good, bad and the violent, he averaged a particularly nasty lot of patients, and his position was far from being a sinecure.

Peters shrugged at my question. "Usual run, I guess, doctor," he replied, resignedly. "So many brutally beaten, so many starved and a few tortured."

I laughed. "Restraints?" I queried, perfunctorily, for it was my business to know how many patients had been forcibly prevented from injuring someone or themselves.

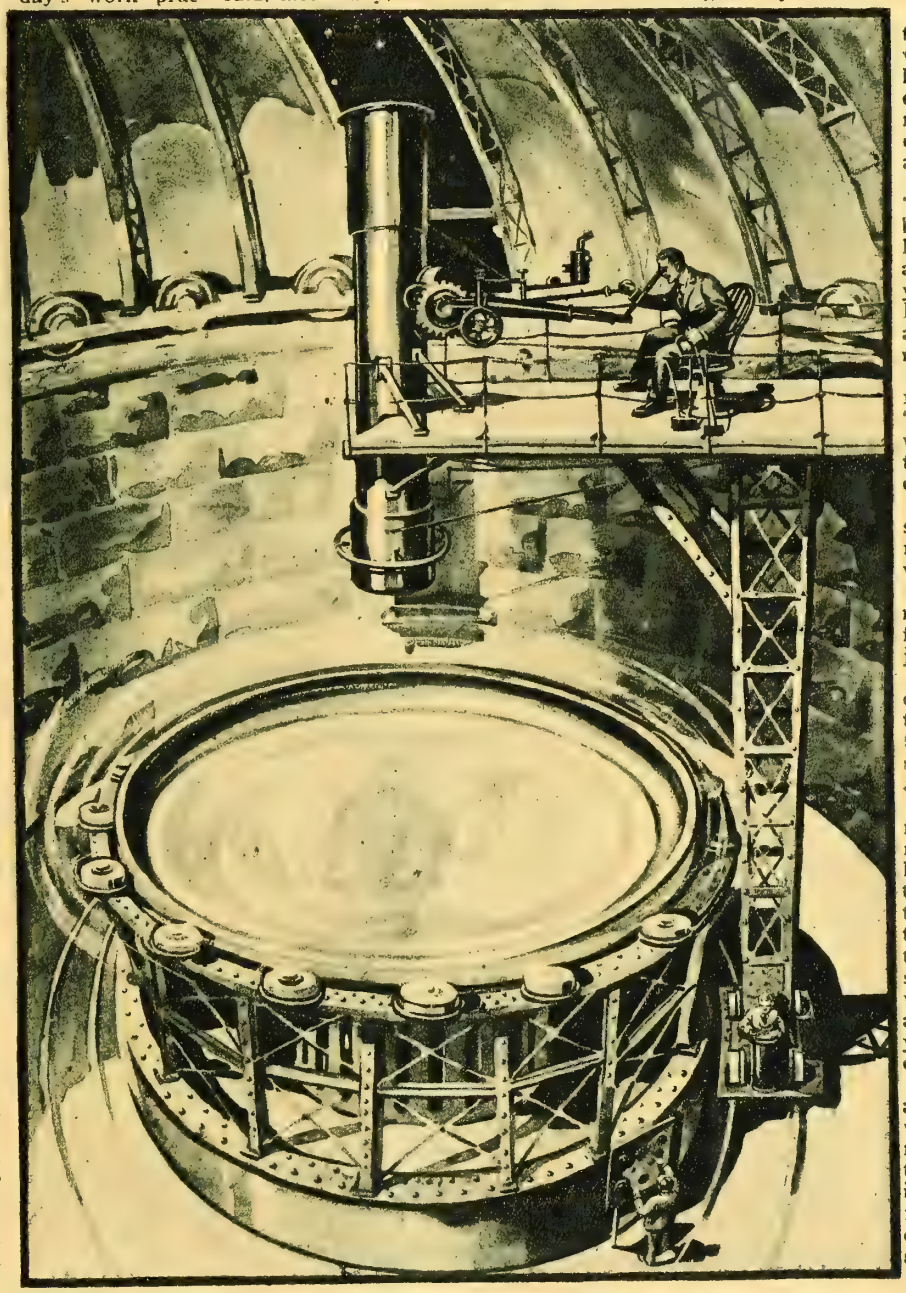
"Four," replied the captain; "absolutely necessary, of course."

"Of course," I agreed, absently, and moved on to the inspection.

"Quiet," returned the captain. "Unless he turns nasty, I'll send him over to eleven this week yet, with your permission."

"If you think he's fit," I rejoined, carelessly. "Needn't wait for me here, captain; run along and get your supper. I'll let myself out."

Peters looked his relief. "Thanks," he said, laconically, and started down the hall.



"And Rose, Those People Are Centuries Ahead of Us." His Voice Sank to a Whisper. "Night After Night I Watched Them; Night After Night I Followed Them Thru the Streets of Their Cities, at Their Daily Tasks, As They Assembled in Their Big Open-Air Auditoriums.

"And, Rose, There's a 'Girl' Up There I Want. I Never Had One Down Here, You Know . . . "

It was over at last. I paused before the door of the last of the rooms, or cells, call them what you please. "This one is unoccupied, isn't it?" I asked, for it had been empty for the last week.

"No," replied Peters. "There's a new one in there. Man named Mehlman, brought in this morning."

"Oh!" I replied, and moved toward the door. "How is he?"

I drew my keys and opened the door of the new patient's room.

Years of work in institutions for the insane have rendered me very nearly immune to surprise. In asylums the unexpected happens with such monotonous regularity that your veteran is only thrown off poise with difficulty. But the shock that awaited me behind that plain and unprepossessing cell door was too much for my *sang froid*. It will live in my memory as the greatest jolt that my nervous system was ever called upon to assimilate.

As I flung open the door, a short, stockily built man of perhaps my own age rose from the cot on which he had been sitting. "Good evening, Doctor Rose," he said, with a quiet, pleasant smile. "I thought I recognized your voice."

I reeled limply against the door-frame, my very soul shaken with horror. "Mehlman!" I cried, my voice scarcely recognizable in my own ears. "My God! What are you doing here?"

The man grinned. "On my vacation," he bantered, good-naturedly. "Retired. By the alienists. I can't tell you for just how long." He waved his hand airily. "Stay indefinite."

My tongue seemed to function reluctantly. "What's the matter with you?" I managed to articulate, inanely enough.

Mehlman laughed shortly. "Crazy," he rejoined. "Rather obvious, don't you think?"

"Great heavens, man!" I gasped, horrified. "How can you jest?"

"Well," he retorted calmly, "better jest than weep, don't you think? Take your medicine standing up—all that sort of thing."

Slowly my wits were returning. I began to regard him narrowly, looking for the little tell-tale signs that betray the demented t the practised observer those little breaks an slips that stamp a ma who is to all intent and purposes as sane a you or I, as, in truth out of his mind.

"Well, are you?" asked deliberately, and waited tensely for the reply. For this question, put to an average insane man, will bring forth a gushing torrent of indignant denial and self-pity.

But no emotional outburst followed. Instead, Mehlman regarded me steadily, quizzically. "I don't know, old man," he said finally. "I'm not sure myself. Likely as not I am. For that matter, I've always thought that we all are to an extent. But if you mean in the conventional sense of the term, I don't believe that I am. It is for you, not me, to answer that question. Three of the State's best have assured me that I am. At their salary, they shouldn't make mistakes."

I winced. It was a quiet jab at my

(*Continued on page 544*)

MOVIE THRILLERS



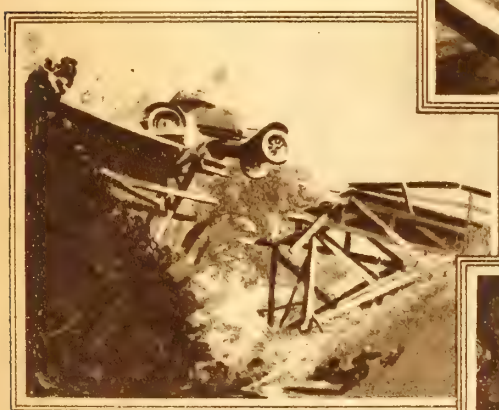
William Duncan Is Again Shown Here in the House of Knives. The Knives Are Placed Thru the Ceiling of a Room so That Their Sharp, Wicked Points Project. Gradually, the Entire Ceiling Is Moved Downward by Complex Mechanisms. The Knives Slowly Approach His Body. He Extends His Feet so as to Stop the Knife Onrush and the Descending Ceiling Momentarily. The Diabolical Fiends Thinking That They Had Ended Their Victim's Life, Shut Off the Power. When Bill Sees That the Knife Descent Has Been Successfully Checked, He Simply Bends the Knives and Escapes.



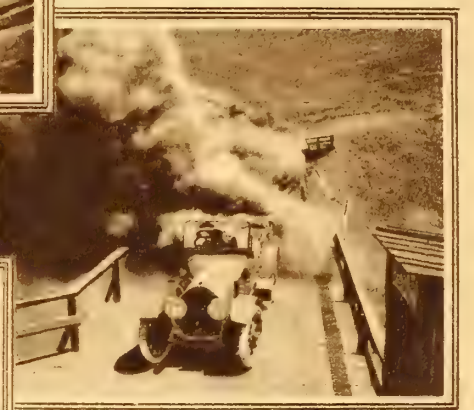
Probably No More Fascinating Story Has Ever Appeared, Nor a More Thrilling Scene Rendered, Than That In "The Juggernaut," Where a Full Size Railroad Train Leaps from a Rickety Bridge (After the Piling Had Collapsed Under Its Weight) into a River. Actors Were Actually in the Train When It Leaped from the Trestle, and Fought Their Way Out of the Cars into Six Feet of Water in the River.



One of the Favorite Methods of Torture and Death in the "Movies" Is the Buzz-saw Arrangement Shown Above Wherein the Old Sawing Machine Gradually Draws Its Victim into a Certain Death. But, Never Fear; the Hero Will Surely Be Snatched from Death's Clutches, without Even Having His Hair Singed



A Death-defying Leap in an Auto Across a Broken Trestle Is Depicted Above. The Auto Is Given a Very Good Start Due to a Steep Incline Which Leads Down to the Trestle. The Latter Was so Arranged That the Auto Was Sure to Leap the Air Gap Between the Two Ends, Much Like Those at Amusement Resorts. Even Then the Impact Created Great Anxiety When the Trestle Started to Sway, and the Auto Hesitated a Moment—but Luckily for the Driver, It Proceeded Safely on Its Way.



William Duncan Again Furnishes Us with a "Thriller" by Traveling Across a Burning Bridge, at Full Speed in an Auto. The Bridge Was so Arranged That It Would Collapse Immediately Upon His Trip Across It. If It Had Collapsed Beforehand, Bill Would Undoubtedly Have Been One of Those "Heroes" of the Movie World of Days Gone By.





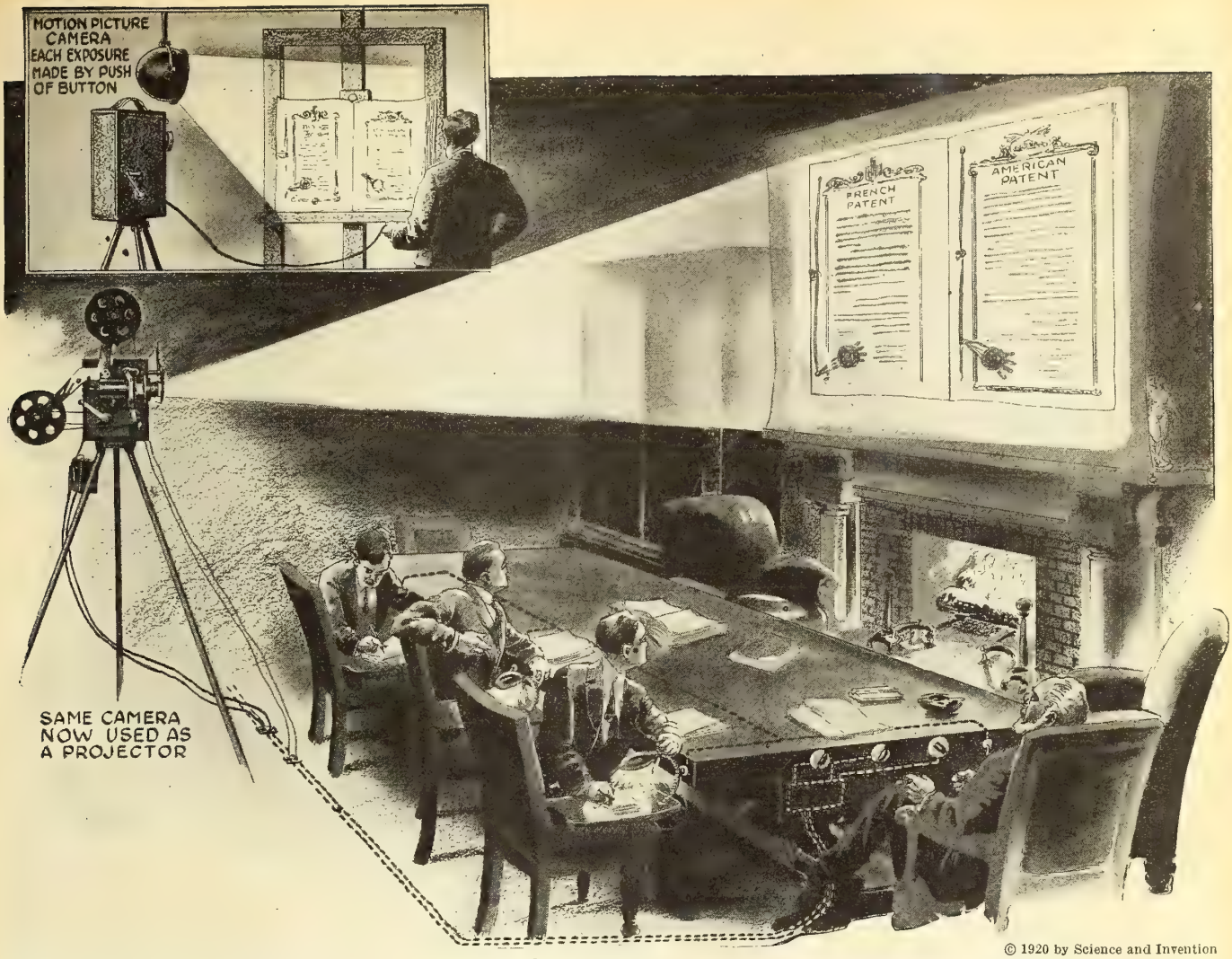
"Bill" Duncan, as His Favorites Call Him, Playing in the "Silent Avenger," Is Shown Here Executing a Very Difficult Stunt. In His Escape from Gangsters, He Leaps to the Vanes of a Revolving Windmill. He Is Carried Aloft, Clinging to the Structure, and Suddenly Releases Himself to Go Flying Thru Space Several Hundred Feet into a Net Stretched as Shown. Of Course, the "Movie Fans" Never See the Net, but Even so, the Leap Is Fraught with Danger.

Antonio Marino, in the "Invisible Hand," Produces Some Stunts Which Are Not at All Short of Miraculous! Above He Is Seen Tied to a Ledge While the Diver Attempts His Rescue from a Submarine Cave. The Instant the Glass Was Broken, the Submarine Cave Filled with Water. Simultaneously, the Diver's Life Lines and Air Hose Were Cut, so That It Meant a Mad Rush for the Shore Entrance Before the Onrushing Waters. The Cave Shown Was Actually Constructed at Great Expense, at the Low Water Line and the Movies Taken at High Tide, Insuring an Effective Flooding at the Opportune Moment



Comedy Could Very Often Be Transformed into Tragedy and Scenes Such as This, in Which a Genuine, Honest-to-goodness Automobile with Three Occupants Plunges from a Dock. It Is Necessary, of Course, for the Occupants to Free Themselves Before the Auto Turns Over Upon Them, as Otherwise Death by Drowning, Unless Speedy Assistance Presented Itself, Would Occur.

—Photos Courtesy Vitagraph Film Co



© 1920 by Science and Invention

Instead of Using Photographs of Books, Legal Papers and Other Documents, the Idea Here Suggested by the Author Is to Make Use of the Standard Motion Picture Camera in Such a Way That Practically Anyone Can, with the Proper Arrangements Made at Libraries, Photograph Many Hundred Pages in a Few Hours on the Small Film of the "Movie" Camera. These Small Pictures Can Afterward Be Flashed Up in the Library or Study Room, Lecture Halls, Etc., and Discussions Held on the Subjects in Question. A Clever Arrangement of Interlocking Push-Buttons Is Suggested by the Author, Whereby the Next Picture Cannot Be Flashed Upon the Screen Until Everyone Present Has Closed His "Release" Push-Button.

"Movie" Camera Copies Books and Legal Papers

By O. C. ROOS

PROLOGUE.

A PUBLIC library "photostat-room" in 1925. Place—Any up-to-date large city of over 20,000.

Dramatis Personae—An engineer, a promoter and their two legal advisers.

Properties—One film camera "snapping" 60 pages a minute, when worked by cable or bulb control; in its new rôle of photographing rare records at library by an operator turning pages.

* * *

First Lawyer to Engineer—"You say, George, that we can take these things as fast, or faster than they can turn the pages?"

Engineer—"Yes, it's certainly saved me hundreds of dollars personally in one year, just to be able to come here and have photographed, or *do it myself,* a whole book in from ten minutes to half an hour."

Promoter—"I wish I had seen the possibilities of this thing five years ago. It beats any lecture circuit subscription scheme I ever met with. Why, it must cost next to nothing to record a whole patent which is *out-of-print,* thru competitors' efforts in keeping it *bought up.* That's an old dodge, you know."

Promoter's Lawyer—"It costs about 1 cent per unit exposure, including development and printing, and this is a very high estimate."

Engineer (watching operator "snap-snap-snap" bulb as he turns pages of *evidence* taken from patent records in library)—"The beauty of the thing is the compactness of the result. Ten feet of film and close to thirty exposures, each of two pages! Then you get at least a 12-fold linear magnification on a study screen, when you project your film with a 20-foot throw."

Promoter—"But what is the size of your picture at that distance?"

Engineer—"Well, to be very conservative, say 20 by 16 inches. Small print type is about ⅜ inch high at that distance."

First Lawyer—"You'll see for yourself when we go to the club and examine this evidence on the screen over our cigars, how easy it is to study it at leisure, and manipulate it."

Second Lawyer—"I'm surprised the film doesn't burn up when we lawyers dawdle over the fine points in the patent claims we're trying to break."

Engineer—"Well, you see, it's a fact that even in 1920 there were films which could be used on Mazda lamps, projecting say this documentary positive 60 feet, with a five by four foot picture for half an hour, without harming the film, even to the extent of warping it!"

First Lawyer—"That gives plenty of time to make our notes and then we really don't have to keep the current on when we're discussing a mooted point."

Engineer—"Here comes our film. 640 pages and 10 feet of it! Costs about $1.00 Well, it's certainly a great convenience. Now we're off for the club."

ACT 1.

Misc en Scene—Exhibit or projection room of any first class professional club, in same city as the Prologue. It might perhaps be in the library or a branch thereof.

Each chair is arranged so as to give an intimate atmosphere and yet a clear, uninterrupted view of the screen. Pear-shaped, hand-push switches are hanging at the chair positions. The club projection room operator takes the film from the engineer and inserts it in the projector—then darkens room, leaving the observers by themselves.

Promoter—"Well, I can grasp the *modus operandi* of everything here, except those push switches near each chair. Will we use them?"

Engineer—"Probably not, as we are more particularly interested in a single page to-night than in *series-groups,* you know. That is, a party of a certain number of persons, say five, would be given five

(*Continued on page* 540)

Argon—The New-Old Gas

By E. W. DAVIDSON

How This Laziest of All Elements in the Air We Breathe Has at Last Been Put to Work to Help Light the World

ONE of the most useless of the constituent elements of the air we breathe was turned to a highly valuable use for mankind when argon gas was first injected into incandescent lamp bulbs. By filling lamps with this gas, which is among the laziest of all gases, and by observing certain precautions, the efficiency of the lamp thus made was greatly increased. Furthermore, argon gas has helped the larger sizes of incandescents up to the huge 1500 watt lamp to displace arc lamps for street lighting purposes.

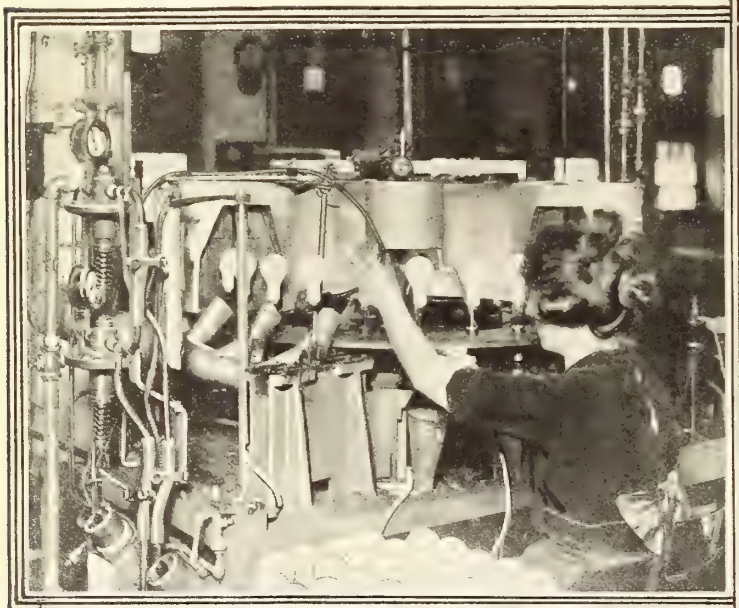
Sir William Ramsay first discovered argon in 1894 which he found to constitute about one per cent of the atmosphere. By this discovery he filled out one of the "blanks" in the chemical periodic system. Previously it has been noted that nitrogen extracted from the atmosphere was heavier than nitrogen produced by chemical process. The search for an explanation of this led to the discovery of argon. But he found absolutely no practical use for the new gas. For 20 years this valuable element was permitted to continue in its happy state of desuetude.

Nobody used argon until Dr. Irving Langmuir in the Research Laboratory of the General Electric Company at Schenectady discovered the increased efficiency to be gained in incandescent lamps by filling them with inert gas instead of merely making them vacuous. He used both nitrogen and argon.

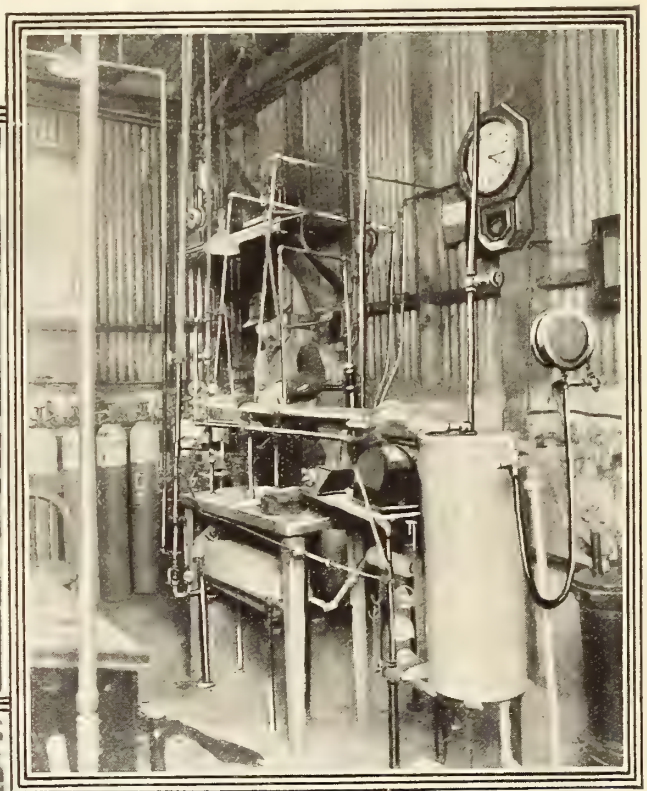
Nitrogen was promptly put to use in lamps because it is comparatively easy to extract so prevalent an element from air, but nobody used any argon on a large scale until about 1914. At lamp factories the oxygen is thoroly removed by passing the mixed gases thru a tubular furnace nearly filled with copper filings at red heat, and about 90 per cent of the nitrogen is extracted in another furnace. Then the argon, about 90 per cent pure, is injected into lamp bulbs.

The very inertness which once stamped argon as absolutely useless has proved to be its valuable quality. The facts that it is relatively stubborn in its refusal to serve as a conductor of heat and that its density discourages the evaporation of tungsten filaments even at tremendous heat, have therefore made it possible to increase the temperature of lamp filaments with a consequent increase in lamp efficiency beyond the point which was the previous maximum.

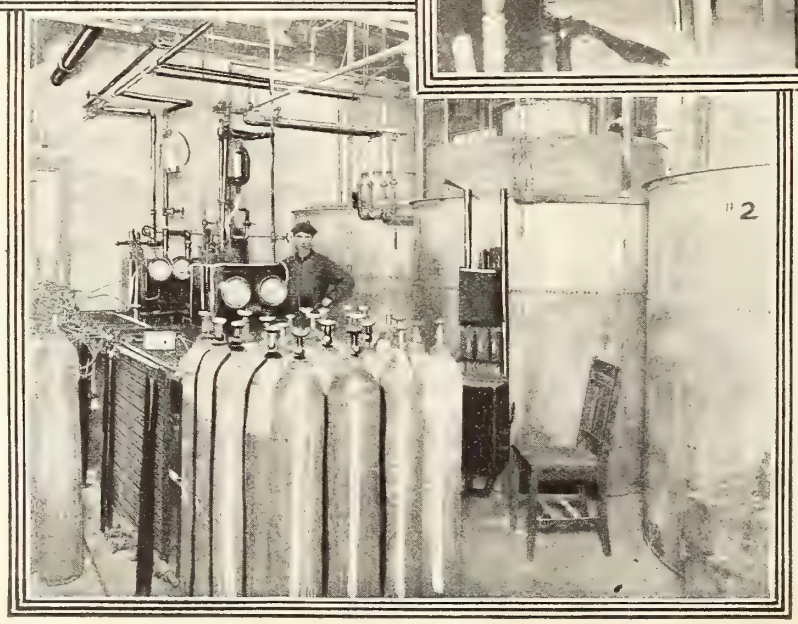
Altho it has not been economically advantageous to use argon in the lowest current lamps, its use renders the higher current lamps more brilliant and efficient. Large argon-filled lamps equal in efficiency the magnetite arc, so as to serve for any sort of street lighting except to produce the brilliant glare needed for "white ways." Argon-filled incandescents, which can be mounted in various sizes on a single circuit to meet varying needs as arcs cannot be, and whose glow never flickers as does the glare of arcs, have establisht their supremacy for general outdoor lighting as well as for other medium and high-power illumination needs. Thus argon gas has at last been put to work.—*Photos courtesy General Electric Co.*



Above:—Here the Lamps Are Thoroly Exhausted on the Turn-table Which Carries Them Thru the Oven. As They Come Out (Left) They Are Cooled by Three Blasts of Air. The Argon Is Injected From Beneath When the Lamp Reaches the Position at the Operator's Left Hand. The Bulb Is Sealed and Ready for Use—an "Argon Filled" Lamp.



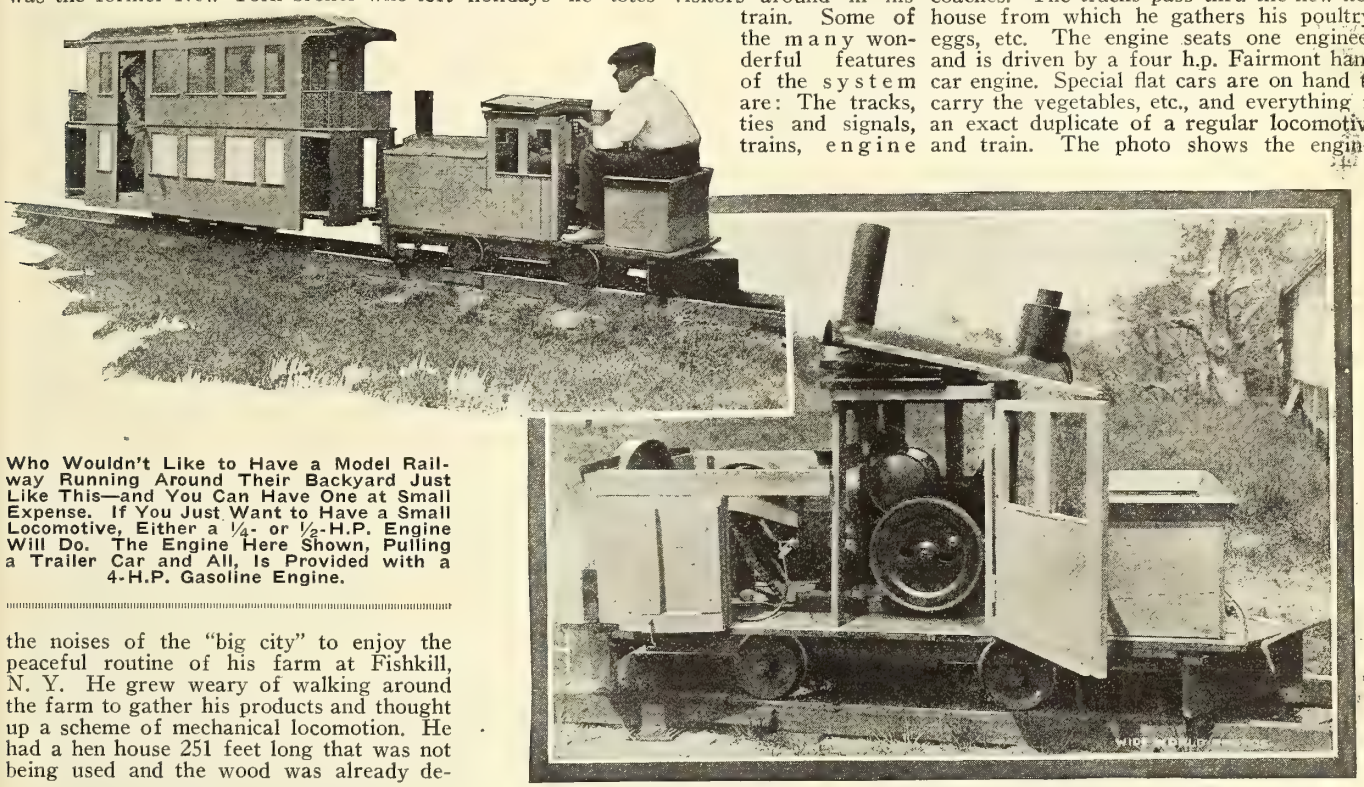
Above:—First Step in the Lamp Factory. Here the Approximate 30 Per Cent of Oxygen in Commercial Argon Shipt in the Cylinders at the Left Is Burned Out in a Hydrogen Flame, Leaving Argon and Nitrogen.



The Purified Argon Is Pumped Into the Big Gasmeters from Which It Is Drawn Into the Cylinders. These Are Connected to the Machine Which Injects the Argon Into the Lamps. (At Left.) The Fact That It Is Relatively Stubborn in Its Refusal to Serve as a Conductor of Heat Has Made It Possible to Increase the Temperature of Lamp Filaments with a Consequent Increase in Lamp Efficiency.

All Aboard! On Model Railroad

EVER feel like getting away from things in general and go back to your boyhood pranks? That's what a New York broker felt like and he did it in style—a style which you and I can follow and get a world of fun from. Mr. Cecil Gage was the former New York broker who left the noises of the "big city" to enjoy the peaceful routine of his farm at Fishkill, N. Y. He grew weary of walking around the farm to gather his products and thought up a scheme of mechanical locomotion. He had a hen house 251 feet long that was not being used and the wood was already deteriorating. He dismantled the hen house and from the wood alone he built a miniature railroad, tracks, car and engine that now runs around the entire acreage of his farm. During the week he travels around his farm gathering the products and on holidays he totes visitors around in his train. Some of the many wonderful features of the system are: The tracks, ties and signals, trains, engine and tender are built of wood. The passenger cars are capable of carrying two passengers with seats built in them; one double-decker car is five and one-half feet high with regulation glass windows built after the fashion of the foreign railroad coaches. The tracks pass thru the new hen house from which he gathers his poultry, eggs, etc. The engine seats one engineer and is driven by a four h.p. Fairmont hand car engine. Special flat cars are on hand to carry the vegetables, etc., and everything is an exact duplicate of a regular locomotive and train. The photo shows the engine.



Who Wouldn't Like to Have a Model Railway Running Around Their Backyard Just Like This—and You Can Have One at Small Expense. If You Just Want to Have a Small Locomotive, Either a ¼- or ½-H.P. Engine Will Do. The Engine Here Shown, Pulling a Trailer Car and All, Is Provided with a 4-H.P. Gasoline Engine.

"Live Wire" Window Display

It being a well-known fact that in advertising that light and a movable object will always attract attention, especially if the movable objects can be so arranged that they will move in the out of the ordinary way, and also to have more than one object to observe.



Moving Electric Lights, Such as in This Display, Fitted with a Remarkable Flexible Shaft and Guide Frame, Provides Entirely New Possibilities in Show-Window Trimming.

Therefore, the combining of these four features in such a manner that the device can be used in practically every field of commercial enterprise; by simply placing that particular object in transparent miniature form over the lighted bulbs and made to travel in any position that the flexible guideway has been placed as clearly shown in the photographs. It being quite evident that the guideway can be readily concealed, easily handled, as the same can be laid, placed, hung, swung or suspended in any position to suit the conditions.

Then if we are to advertise say in an automobile supply store a tire, can of oil, spark plug, etc., is placed over the lighted bulb in miniature form of a transparent material—or in a grocery store a can of peas, box of biscuits, etc.—or in a tobacco store various brands of cigars or cigarettes, etc., etc.—in a music store, various records, etc.—and in this way we could go thru the entire list of our daily wants, all being brought before us in miniature, illuminated and moving form.

As a toy it could be used on a Christmas tree and birds and other objects of that character placed over the bulbs and made to travel in and around the tree, thereby causing a very beautiful as well as novel effect, and an object of interest to both young and old. The devices can also be used as a scenic railway, roller coaster, loop the loop, ad infinitum.

The whole effect is accomplisht in the most simplest manner by means of a suitable flexible slotted housing or guideway, a flexible shaft carrying the various objects and the electrical conductors, the said flexible shaft being driven by a pair of friction rollers from a small electric motor.

EDWARD A. DIETERICH.

Foot Warmer For Police

This electric foot warmer is designed for outdoor service and makes it possible, in winter weather, greatly to relieve outdoor workers obliged to remain in one spot for long periods of time from the discomfort of cold feet. Investigation as to how this relief could be furnished by means of an electric heater resulted in the development of an electric foot warmer different from anything previously on the market.

The amount of power consumed can be regulated to 200, 100 and 50 watts respectively, at 120 volts, for the different positions of the switch. Six feet of cord with a snap switch is supplied with each warmer. The rubber insulated cable enters the device through a bell-mouthed waterproof fitting mounted in the middle of one end.



Electric Foot Warmer For Policemen and Others Stationed at Outdoor Posts. The Device Is Thoroly Water-proof.

The resistance which constitutes the main element of the heater is of the slotted ribbon type distributed uniformly over the entire surface. The ribbons are assembled between two plates of built-up mica 0.025 inch thick, cemented together to form a unit.

—Photo courtesy Westinghouse E. & M. Co.

The Romance of Tungsten

By E. W. DAVIDSON

This Hardest and Heaviest of Metals Was Brittle and Therefore Unworkable in Its Pure State for More Than a Century After Its Discovery Until Dr. W. D. Coolidge Made It Ductile. Tungsten Saves This Nation Alone a Billion Dollars on Its Annual Electric Light Bill and Otherwise Benefits Mankind.

A CASUAL look at the filament of the incandescent lamp in your library or at the tiny spark coil contacts on your automobile brings no suggestion of the romance of science which lies back of those devices. It is the Romance of "Tungsten," one of the heaviest of metals, a metal nearly 140 years old, but which resisted the efforts of mankind to make use of it in its pure state for about 130 years.

But the service pure tungsten has rendered the world in the last decade since it was "conquered" is almost too great for calculation. Tungsten in its various forms reduced America's electric light bill a billion dollars a year and more than doubled the usefulness of the incandescent lamp. Ductile tungsten kept the automobile industry alive during the war. It helped make possible the Coolidge X-ray tube with tungsten targets which tremendously increased the value of the X-ray machine to mankind. With it the pliotron was built so that wireless telephony could be developed to a useful and dependable point. With it phonograph needles are being made more than 50 times as good as the steel and the fiber needles, heretofore the best that could be produced.

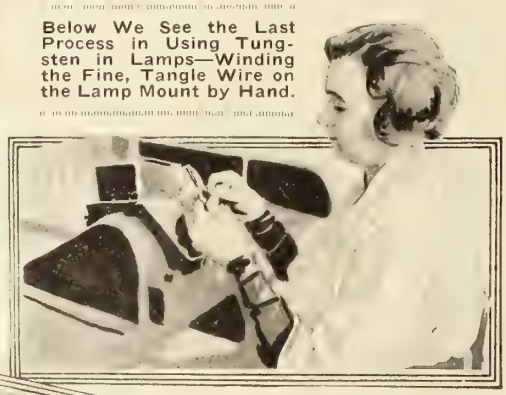
Tungsten bullets might have served in the recent war as projectiles hard enough to pierce the heaviest armor the Germans could put on their aircraft, for a few were made to prove their usefulness in that capacity, but the plan to use them was given up after a less expensive way to accomplish the result was discovered.

Before the war only a few thousand tons of tungsten ore were mined in all the world and the price of raw tungsten ranged around 90 cents a pound; but with the war came a tremendous demand for tool steel, hard enough to work at high speed even tho red hot. Tungsten was required as an alloy to make such steel.

The price rose steeply when the supply diminished before the sudden demand until it reached $7 or $8 a pound. The world's production in 1918 mounted to 35,800 tons. The control over the sources of it was 59 per cent American, and 35 per cent British. The price and production slumped with the end of the war until today raw tungsten can be bought for a little over a dollar a pound.



Right:—One Step in Making Lamp Filaments. Squirting Pulverized Tungsten Ore Into 2,200 Fahrenheit Degree Furnace Which Removes Oxygen and Produces Pure Tungsten in Powder Form Ready for Compression Into Bars Which Are Hammered and Then Drawn Into Finest Wire.



Below We See the Last Process in Using Tungsten in Lamps—Winding the Fine, Tangle Wire on the Lamp Mount by Hand.



Above:—After Tungsten Has Been Swaged Down to Heavy Wire, the Drawing Process Begins. Here It Is Being Drawn Thru a Gas Flame and Then Thru a Die Reducing It From 0.030 to 0.014 Inches. It Is Tough and Thoroly Ductile by This Time, But Is Far Too Large for Lamp Filaments.

At Right:—Putting Red Hot Tungsten Bar Thru One of the Many Swagers, Whose Revolving Hammers Chatter on All Sides of the Bar, Reducing It to Smaller and Smaller Diameter.



Above:—Drawing Tungsten Down to Finest Proportions, About Four Ten-Thousandths of an Inch or One-Sixteenth of the Size of Fine Human Hair, and Which Cannot Be Seen Except Against a Background If Exactly the Right Color. It Is Used as Filament in the Smallest "Bug" Lamps. The Thread of Tungsten Unwinds From the Spool at Extreme Right, Passes Thru Small Box of Lubricant, Then Thru Gas Furnace Which Has a Diamond Die at Its End Nearest the Operator. The Wire Then Winds on a Receiving Spool and Is Ready to Be Put Into the Tiniest Lamps.

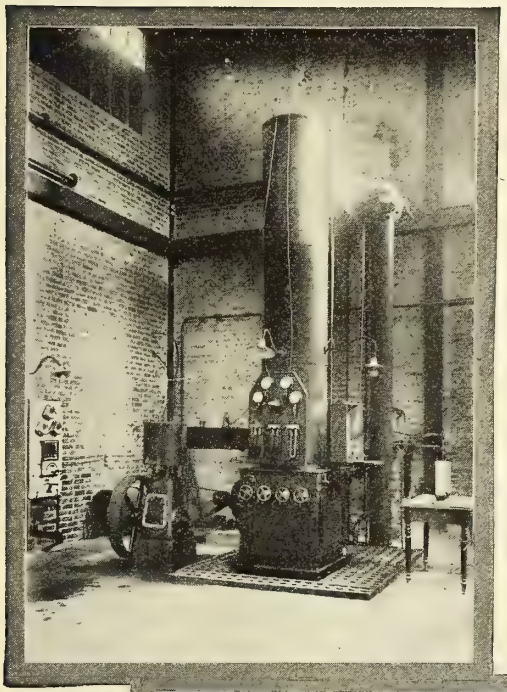
TUNGSTEN MADE DUCTILE.

Most of the adaptions for tungsten are due to a discovery made by Dr. W. D. Coolidge, of the General Electric Company.

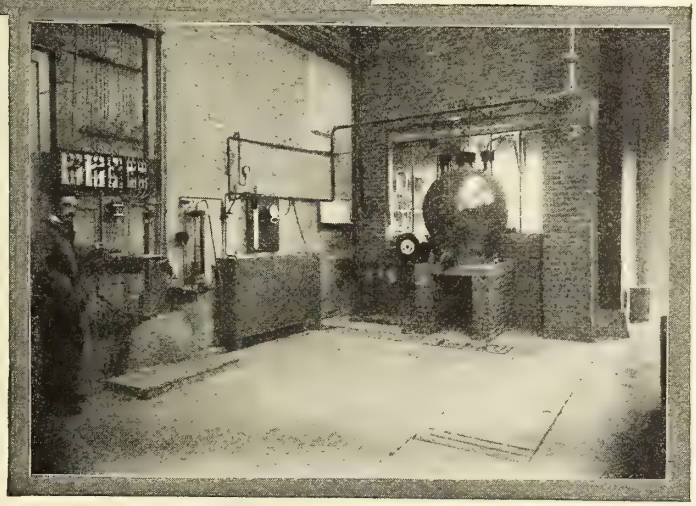
(*Continued on page* 558)

SYNTHETIC AMMONIA

By LUCIEN FOURNIER



Above: Apparatus for the Production of Nitrogen at the Plant of Georges Claude, Montereau, France.



Liquefaction of Ammonia. To the Left May Be Seen the Attendant Who Watches the Electric Current Which Maintains the Catalyzer at the Desired Temperature. To the Right Is Seen the Cylinder in Which Is Received the Liquid Ammonia; While in the Center Is the Glass Gage Thru Which the Liquid Ammonia Falls.

ORDINARILY ammonia is produced in large quantities by Nature during the process of decomposition of organic matter. Industry generally extracts it from waste waters and gas plant waters which are charged with ammonia during the distillation of coke. This distillation is possible for the reason of the easy separation of ammonia from water steam. However, it would decidedly be much more advantageous to produce ammonia by synthesis thru the separation of the two elements, nitrogen and hydrogen.

The German organization, *Badische Anilin*, while exploiting the patents of Haber, has for several years manufactured synthetic ammonia. Mr. Georges Claude, already known thruout the entire world for his wonderful work with liquid air, has enriched science by the discovery of new elements destined to give them a very economic industrial character.

Previous to this, however, as well as to another Frenchman, Charles Tellier, who is known as the "Father of the Cold," there is still another Frenchman to whom the entire world gives thanks for one of the most useful of discoveries. For this reason it is but natural that he has earned the sobriquet of "Father of Synthetic Ammonia."

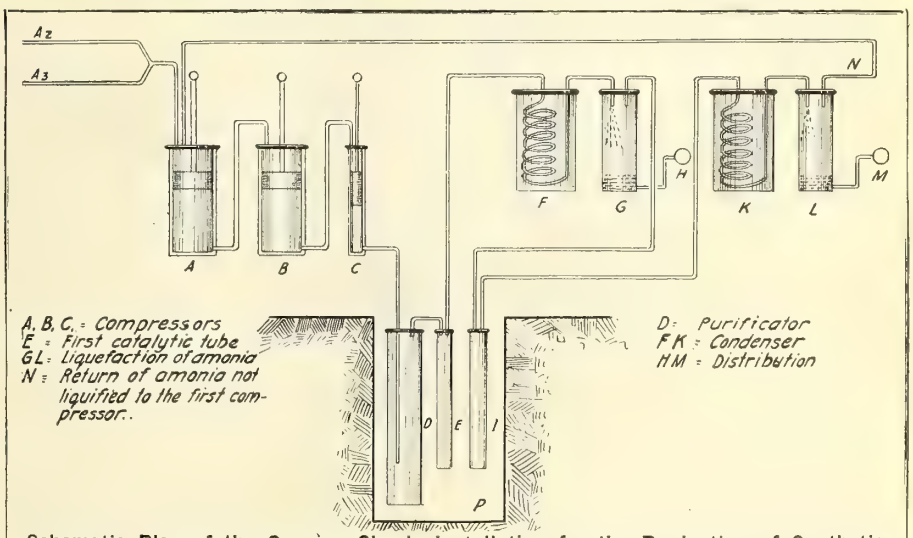
TWO GASES REQUIRED TO MAKE AMMONIA.

In order to manufacture ammonia it is necessary to make use of two gases: nitrogen and hydrogen. The first is obtained from the air of the ordinary atmosphere at low temperature after which it is placed in tanks under pressure similar to oxygen. As for the production of hydrogen this can be accomplisht by several methods, viz.: by an electrolytic process which furnishes a very pure gas but, however, at a cost too great for practical purposes; by the reaction of an acid upon iron or zinc; generally, however, it is secured from an inferior gas or from a water gas, so that it is possible to procure it at plants where coke is manufactured and where it is mixed with other gases. However, it is necessary to bear in mind that the hydrogen gas must be very pure, and that in order to furnish ammonia in large quantities it must sequently be itself manufactured at a *low cost*. The two gases are, therefore, manufactured in proper proportions, after which they are submitted to a very high pressure. The mixture is then directed thru the catalyzer at a reasonable temperature and from which is generated ammonia vapors which are condensed and thus liquefied. After passing thru the condenser the result is liquid ammonia.

The German company, *Badische Anilin Werke*, which previously manufactured large quantities of ammonia, utilized pressures of 200 atmospheres. This is a very satisfactory industrial result since it was by this means that the liquefaction of air was obtained. It was here that Georges Claude arrived at the conclusion that much greater pressures could be secured without greater expense and by which the synthesis of ammonia could be obtained under very economical conditions. Thus, thanks to the use of a final compressor having a piston of small diameter, it was found that if we use the quantity 2 as the necessary mechanical energy to produce the pressure of 200 atmospheres, the quantity 3 may represent the necessary energy for a pressure of 1000 *atmospheres*. In other words, 1000 additional atmospheres are obtained at an additional expense of only 1/3 of the energy necessary to obtain 200 atmospheres!

It is therefore seen that there exists a direct relation between the temperature under which the catalyzer must be submitted and the pressure. The value of this relation has been placed by Georges Claude by the reaction $Az_2 + 3H_2 = 2AzH_3$. The catalyzer tank fills to a length of 10 centimeters a tube having the length of 80 centimeters and a diameter of 8 millimeters, the latter being heated by electricity. The inventor has stated that while under pressures of 200, 400, 600, 800 and 1000 atmospheres, special temperatures are necessary in order that the catalytic phenomena be produced under conditions favorable to large production. However, beginning with 200 atmospheres, the practical temperatures must not be lower than 500 degrees, nor higher than 700°.

(*Continued on page* 561)



Schematic Plan of the Georges Claude Installation for the Production of Synthetic Ammonia: A, B, C—Compressors; P—Well; D—Purificator; E—First Catalytic Tube; I—Second Catalytic Tube; KF—Condenser; LG—Liquefaction of Ammonia; MH—Distribution; N—Return of Ammonia Not Liquefied to the First Compressor.

"Eclipses"--How Caused

By A. M. HARDING, Ph. D.

University of Arkansas

MAN, in ancient times, considered his own little city as the center of the world and his own world the center of the universe. He thought the sun, moon and stars shone for his benefit, and that were it not for him they would have no reason for existence. The sun furnisht him heat and light, the moon serving as its substitute, while the sun was not visible. Every star was supposed to have been placed in the sky for some definite purpose, altho just what this purpose was may not have been evident in every case.

These celestial objects soon became of such importance to man that they were considered as "Gods." In fact, several ancient nations worshipt the sun, moon, and stars. Our attention is called to this fact by the writer of the second book of Kings, who tells us that Josiah, king of Judah, destroyed all those who worshipt the sun, the moon, and all the host of heaven.

Man soon became familiar with the motions of the sun, moon, and stars, but was always thrown into a panic by the appearance of an eclipse, a comet, a meteor, or a shooting star. These phenomena were generally considered as omens of evil.

Even at the present time we find some peoples who believe that when the moon is eclipsed it is fighting with a great dragon. They beat on drums and tin pans in order to frighten the dragon and rescue the moon. Of course, if they keep up the noise for two or three hours, they are sure to succeed.

For the scientific man of today, an eclipse has no terrors. It is a phenomenon which can be predicted years in advance and when it arrives on scheduled time it is just another evidence to him that mathematical law reigns supreme in the universe.

There will be four eclipses in the year 1920, two of the sun, and two of the moon. The data for these eclipses, which are taken from the American Ephemeris, are given below. The time in each case is Central Standard Time.

TOTAL ECLIPSE OF THE MOON, MAY 2, 1920.

All of the inhabitants of the United States, except those in the extreme northwestern portion, saw the last part of this eclipse. The moon entered the shadow of the earth and the eclipse began at 6:01 p. m The moon went deeper and deeper into the shadow until 7:15 p. m. when the entire disk was obscured. At 8:27 p. m. the moon began to come out of the shadow and at 9:41 p. m. the eclipse ended.

Since the moon must be full when it is eclipsed, it rose at sunset, and those who had a clear view of the eastern horizon saw the moon rise as a round disk with part of its surface obscured by the shadow of the earth.

PARTIAL ECLIPSE OF THE SUN, MAY 17, 1920.

This eclipse began on May 17, at 10:17 p. m. and ended on May 18, at 2:13 a. m. While we inhabitants of the United States were peacefully slumbering, ignorant of the fact that anything was wrong with the appearance of the sun, the sailors on the Indian Ocean and the people of Australia watched the moon's disk creep over the sun until ninety-seven per cent of its surface was covered up.

TOTAL ECLIPSE OF THE MOON, OCTOBER 27, 1920.

The moon enters the shadow and the eclipse begins at 6:25 a. m. The total eclipse begins at 7:28 a. m. and ends at 8:54 a. m. The moon leaves the shadow at 9:57 a. m. Since the full moon will set at sunrise it is evident that this eclipse will not be visible in the eastern half of the United States. The first part of the eclipse will be visible in the western portion of North America.



© 1920 by Science and Invention

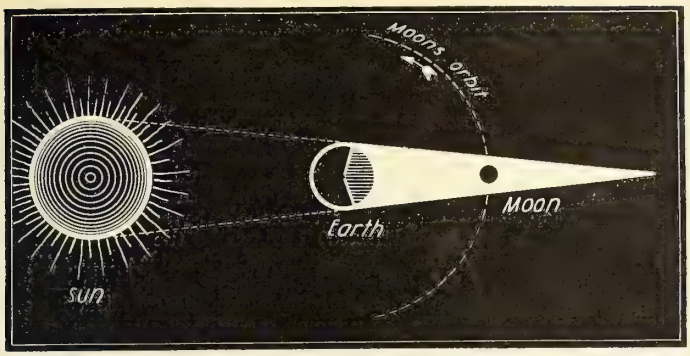
Eclipses of the Sun and Moon Have Caused in Years Gone By, Some of the Greatest Perturbations Among the People of the Earth, As One Can Well Imagine. Probably There Is Not One of Those Instances Which Is More Interesting to Americans Than That of Christopher Columbus and the Indians. Christopher Columbus Used His Knowledge of Eclipses to Free Himself and His Companions From the American Indians, Who Held Him Prisoner and Had Reduced Him Almost to Starvation. He Happened to Remember That an Eclipse of the Moon was Due to Occur On March 1, 1504, and He Told the Indians That He Would "Cause the Moon to Go Out If They Did Not Bring Him Food." They Paid Very Little Attention at First, But When the Moon Disappeared They Brought Him Plenty of Food and Worshipt Him As a "God."

PARTIAL ECLIPSE OF THE SUN, NOVEMBER 10, 1920.

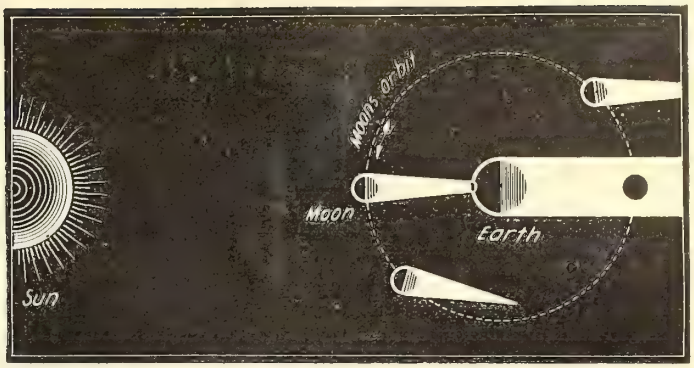
This eclipse which begins at 7:47 a. m. and ends at 11:57 a. m. reaching its maximum (74%) at 9:52 a. m., will be visible in the eastern and north central parts of the United States.

The sun's rays are scattered in every direction thruout space. Some of these are intercepted by the earth and give us light and heat. Thus the earth excludes the sunlight from a small part of space; that is, the earth has a shadow.

Most of us, when we see our shadow on the ground, think of it as something *flat* like a leaf. As a matter of fact a shadow is the *space* from which the light is ex-



In This Illustration We See the Rays of the Sun Cast Upon the Earth. The Side of the Earth Turned Away From the Sun Casts a Black Shadow Out Into Space Which Envelops the Moon Whenever It Enters This Shadow, Causing a Moon Eclipse.



In Its Orbit Around the Earth, the Moon Has Many Phases as Is Well Known. If the Moon Is Directly Between the Sun and the Earth As Shown Above, We Have a Solar Eclipse On Earth. The Shadow of the Moon Is Shown Above in White. It Is Shown in a Few Positions Covering Several Phases of the Moon's Orbit.

cluded by an intervening object. Since the sun is very much larger than the earth, the shadow of the earth will end in a point; that is, it is a cone.

As the earth moves around the sun year after year it is accompanied by its shadow, which, of course, always remains on the side of the earth away from the sun. The shadow moves thru space at the rate of 18½ miles per second but most of us are not aware of its existence except when it passes over some celestial body.

The ancients used to think that the light of the sun was put out every evening and rekindled every morning. In this way they were enabled to account for the alternation of light and darkness on the earth. We know that darkness is due to the fact that we are in the shadow of the earth, and that the succession of night and day is caused by the rotation of the earth which carries us into the shadow every evening and brings us out again every morning.

When we call to mind the fact that this shadow is not something flat which covers the earth like a layer of snow, but that it is a cone whose base is the earth and whose vertex is somewhere out in space in the direction opposite to that of the sun, the questions arise, "How long is this shadow? How far does it reach?" We know that when night comes it is just as dark upstairs as it is downstairs. If we climb to the roofs of our highest buildings we find darkness there. The birds of the air when they fly at night are invisible, no matter how high they may be. Aviators may destroy a city by dropping deadly bombs from a purring aeroplane while they remain invisible, protected by the shadow of the earth. No matter how high they may go they are still in the shadow.

The answer to our question is furnisht by the astronomer. He tells us that the average length of the earth's shadow is 857,000 miles and that its length varies about 14,000 miles on acount of the fact that the earth is not always at the same distance from the sun.

The moon makes a complete circuit around the earth every month and, since the distance to the moon (240,000 miles) is less than the length of the earth's shadow, it may happen that the moon will go into the shadow and be eclipsed. There are, in fact, three possibilities:

(1) The moon may pass above or below the shadow. In this case there is no eclipse.

(2) The moon may go into the shadow but pass so far above or below the center that only a portion of her disk is in the shadow. This is said to be a *partial* eclipse.

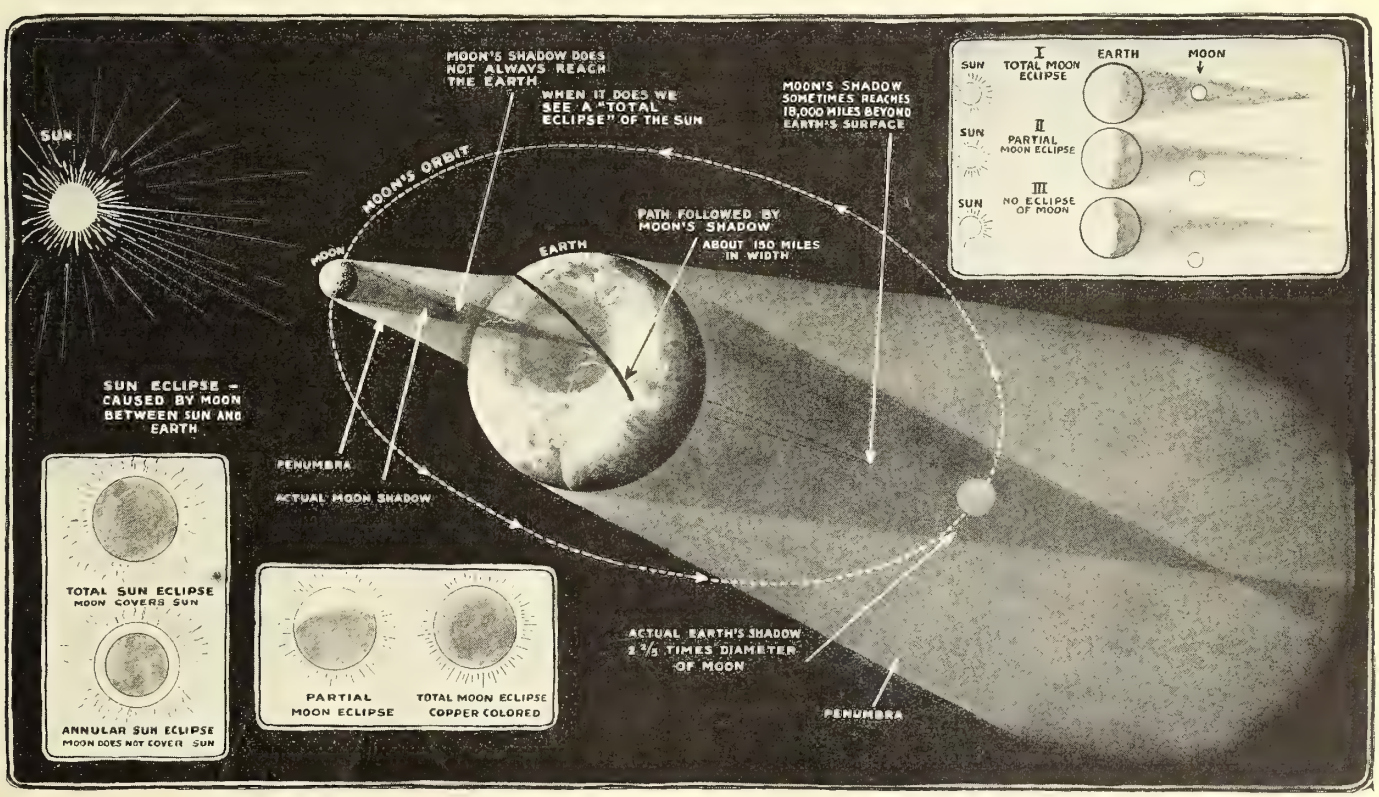
(3) The moon may pass near enough to the center of the shadow that her entire disk is buried in the shadow. This is said to be a *total* eclipse.

Since the moon and the sun are on opposite sides of the earth only at the time of full moon, every lunar eclipse must occur when the moon is full. How amusing is the following statement which once appeared in a daily newspaper at the end of a paragraph describing a recent eclipse of the moon! "This eclipse was especially beautiful since it occurred at the time of full moon."

On May 2, and again on October 27, the moon will pass near the center of the shadow and her entire disk will be shaded.

The diameter of the earth's shadow at the point where the moon crosses it is about 5,700 miles, which is about *two and two-thirds times the diameter of the moon.*

(*Continued on page* 522)



© 1920 by Science & Invention

The Center Drawing Shows What Happens As the Moon Moves Along Its Orbit Around the Earth. It Shows In Perspective What Has Been Explained in the Two Diagrams on the Top of the Page. Note Particularly That When There Is a Solar Eclipse, the Moon Is Between the Sun and the Earth As Shown in the Illustration. If the Moon Comes Close Enough to the Earth as Sometimes Happens, We Have a Total Eclipse, Because to the Observers Who Are in the Path of the Moon's Shadow, the Sun Is Blotted Out Entirely By the Body of the Moon. If, however, the Distance Between the Moon and the Earth Increases During an Eclipse, the Body of the Moon Is Then Not Large Enough to Cover Up the Entire Disc of the Sun, and for That Reason We Have an Annular Sun Eclipse. (See Left-Hand Insert For Phase of the Solar and Lunar Eclipses Which Are Also Graphically Represented.)

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

PLATE RACK FOR THE SINK.

THERE are sinks and sinks, so the admirable device here shown must be constructed in dimensions to fit each particular case. It is devised to meet a particular want common with all wooden draining racks, that of being taken apart for cleaning when incrusted with grease. And this hitherto faulty part of rack construction is important in the eyes of careful housewives, for the so-called grease is not caused altogether by carelessness, but it is an accumulation of soap which it has been impossible to remove in the racks as in those heretofore constructed. This device is made of hard wood, and, fastened with pins that are quickly removed or replaced, can be got at and thoroly cleaned.

It consists of end pieces (8″x8″), rather ornate in the matter of handle holes (3″x1½″) and feet; and their 1½″ holes bored in the sides (4″ from top or bottom with centers 1¼″ from the sides) for the tenons on the side rails. There is also a piece of wood screwed with copper screws to the inside of each end piece to keep the

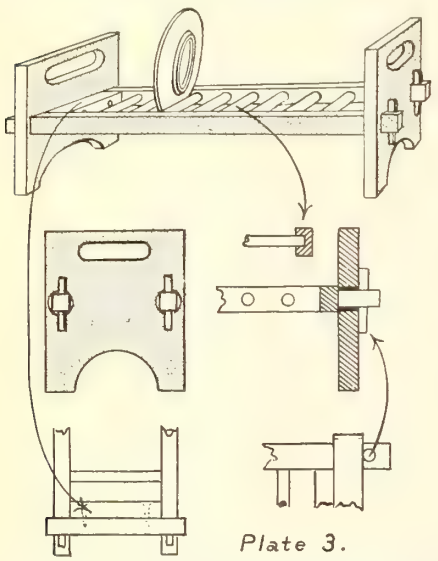


Plate 3.

The Principal Advantage of This Useful Plate Rack For Use in the Sink Is That It Can Be Readily Pulled Apart and Thoroly Cleaned, Which Is Not the Case with the Average Rack That Is Nailed or Glued Together Rigidly.

rack from twisting when the side rails are in place. These pieces fit between the rails as shown in cut. The side rails are 1⅜″x 2″ and as long as required. The tenons are 1⅜″ square by 2″ long and have a ⅝″ hole bored with centers 1⅛″ from shoulder of tenon, the sides being ¾″ thick. Round tapered binding pins are used for locking the end pieces. Half inch holes are bored 1¼″ apart, part way thru the side rails, to hold the 7/16th″ glass rods in the manner illustrated.

MAGAZINE AND NEWSPAPER RACK.

The tall, narrow, bookcase-like piece of furniture designing illustrated is particularly useful in the porch room of the modern suburban home, but will be found desirable in any room occupied by members of the family who wish to keep their "pet" periodicals in presentable condition. The height of such a rack (5 feet) and its small lateral dimensions (16½″x10½″, inside measure) make the building of it important in two respects, namely, a solid reinforced base and a top construction that will hold together when the rack is moved with its load of books. It will be seen from the illustrations that the base is con-

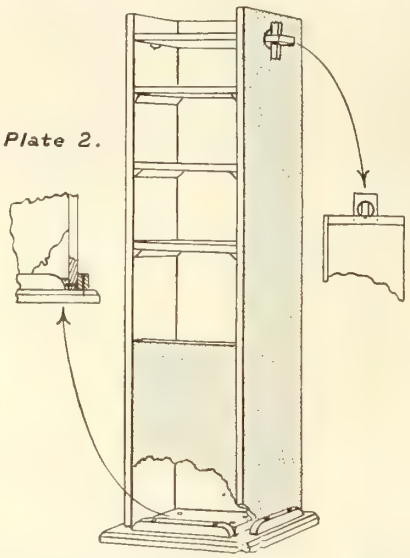


Plate 2.

Here's How to Make a Simple, Yet Exceedingly Strong and Useful Magazine or Newspaper Rack, Suitable For That "Odd Corner" on the Porch or in the Reading Room and Library.

structed of a bottom board, a second inside board and three pieces of moulding placed outside of the sides and front, thus forming a deep groove to hold the upper part of the rack. The sides and front are fastened with nails to the second inside piece in the usual manner.

The top is formed by boring one hole (2″ in diameter) with center 3″ from on the top in the middle of each side. Tenons are then formed (1⅞″ wide) on the top piece by sawing four corners out of a board (22½″x10½″), as shown. The top will then be 16½″x10½″ with a 1⅞″ tenon, 3″ long at each end. As the lumber for the rack is ¾″ thick, we should allow ⅛″ for the binding pins to squeeze the side when put thru the tenons, therefore bore their holes 1″ in diameter with centers 1⅛″ from the shoulder, or inside corner of the notch. A round tapered pin (3″ long and 1″ at the big end) forms each pin. The back can be of thin wood (3/16″ thick or of that thickness in straw-board, known as "wall-board") and nailed on when the rack is otherwise completed.

BEACH SEAT AND LUNCH BOX COMBINED

A home-made beach seat with a convenient lunch box attachment is shown in the illustration herewith. In the top view

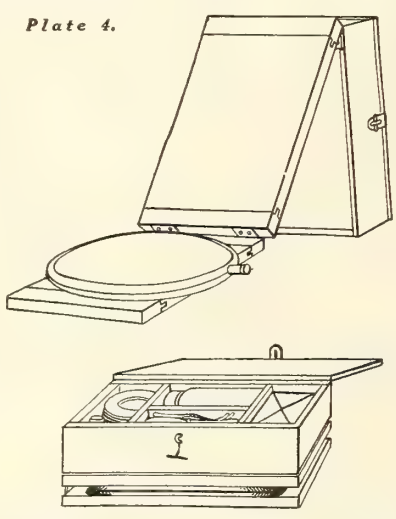


Plate 4.

A Beach Seat with a Lunch Box Attachment, Which Everyone Will Find Useful.

this handy device is seen in a conventional position with the box forming a back brace for that part of the seat, and a pneumatic (air-inflated) cushion on the lower section. The three parts are hinged as shown. In the lower view the lunch box is shown open, with the back and seat folded, inclosing the cushion. A shawl-strap or series of straps permanently attached to the box can be used for carrying.

The thickness of the seat should be ⅝ inch, the back ½ inch and the box lumber ⅜ inch. Both the back and seat to be reinforced with end pieces as shown. The ordinary breadboard sold in department and hardware stores will answer for these parts, one ⅝ inch thick and 14 by 20 inches is about the size required. A straw pad of the Japanese variety can be used in place of the pneumatic cushion. If the complete device is painted a light blue, yellow or green, it will have an increased appearance of lightness.

CLEANING KIT-BOX.

Many an ink-stain, drop of paint or grease-spot could have been instantly removed with the proper use of such an outfit. A little book of first aid recipes for doctoring house or furniture ailments such as the above, or water or heat stains on varnish, for instance, could be a part of the outfit. One can see that a white spot on the dining table, caused by an overheated teapot, would succumb to this treatment very nicely.

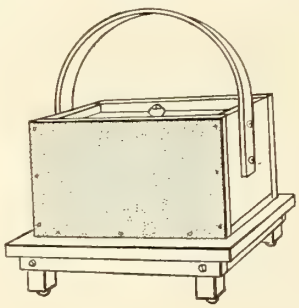
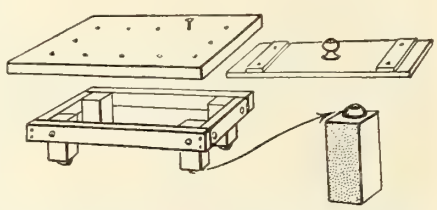


Plate 1.



Here Is Something That You Probably Have Never Thought of—a Neat Little Box Provided with a Handle and Rubber Feet, Not Forgetting a Cover—to Contain Cloths and Chemicals for Cleaning Woodwork, Etc.

In the interim we show a plain device for plain people, one which anyone, plain or otherwise, can make from a common packing box, a wooden barrel hoop and a little odd lumber, all of which can be obtained from a grocer or druggist with very little persuasion or trouble. The idea is to have the outfit box so easily obtained or made that it will be in every home; a kind of national institution for reducing the high physical or mental asset of house-cleaning as we now know it. This original, only institution of its kind is shown in the figure herewith. The object of raising the box on legs is to allow air to circulate beneath it, thus keeping its contents from becoming damp. Rubber chair leg buttons are put on the legs so that the box can be set on wood or tile floors without scratching them. The illustrations show the details.

"Home Electrics"

By G. L. HOADLEY, M. E.

SIMPLE BELL CIRCUITS

THE four main items necessary to put up an electric bell are the bell, the battery or other source of current, the push button, and the wire. The simple bell circuits will be shown first. Figure 1 illustrates the simplest type of circuit. Pressure on push button PB, closes the circuit and current travels as indicated by the arrows from the positive post of the battery to binding-post, P_1 thru the spring contact of the vibrating armature A, and tip of the contact screw F, thence thru the magnet M, and out at binding-post P_2, back to the battery.

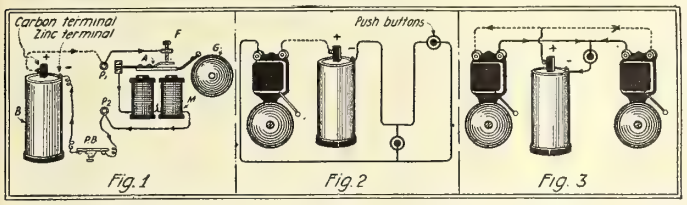


Fig. 1—Showing Dry Battery "B," Push-Button "PB" and Vibrating Bell "M," as Well as Path Taken by Current. Fig 2—How to Ring One Bell From Two Different Push-Buttons. Fig. 3—Two Bells Rung From One Push-Button.

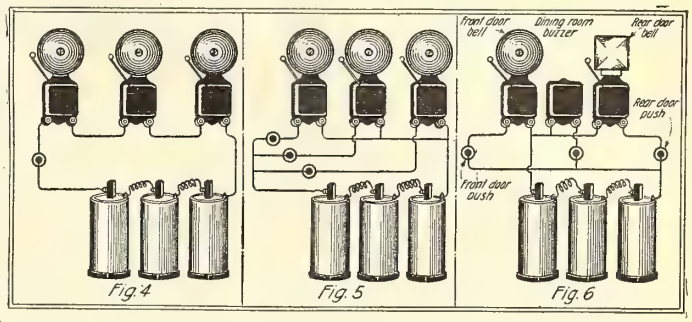


Fig. 4—Shows Several Bells Connected in Series. All of the Bells, Except One, Are Made "Single Stroke." Fig. 5—Shows Three Distinct Bell Circuits Operated From "Common Battery." Fig. 6—Shows Three House Signals on Common Battery.

One Bell and Two Pushes.—In Fig. 2 is shown how a single bell can be made to ring from two (or more) pushes situated in different rooms, for example, or at the front and back doors of a house. Even if both pushes be operated, the bell rings because the carbon or positive terminal is connected to each pusher.

Bells in Multiple.—Fig. 3 shows how two (or more) bells may be rung from one push button. Since the bells are in "parallel" here, the current divides itself between the two bells and larger batteries or more cells are required to supply the extra current needed. Vibrating bells will operate satisfactorily in multiple under these conditions.

Bells in Series.—In Fig. 4 is shown the wiring for bells in series with each other. This arrangement requires more current to operate than the parallel circuit in the previous diagram because the resistance of the circuit is larger. Vibrating bell and one or more single stroke bells will work satisfactorily when so connected. A number of vibrating bells can be made to operate in series if a short circuit be placed round the make-and-break contacts on all the bells *except one*. Then the master bell will make and break the circuit for all of them and all the bells will vibrate together.

Bells in Parallel With Common Return.—Fig. 5 shows how three bells may be connected up in multiple using a common return wire.

Two Bells and Buzzer.—An arrangement suitable for a residence is shown in Fig. 6. Both the front and back door bells are usually located in the kitchen and have different sounds to indicate from which door the call comes. The push for the dining room buzzer is within that room, and the buzzer is located in the kitchen or pantry.

Note.—In the above sketches the dotted line wire may be replaced by the earth if desired. A saving in wire is effected by using the earth as the *return circuit*. As a general proposition, however, the ground return circuit is undesirable, as one ground on one of the normally ungrounded wires will render the system inoperative. In cities and towns and near electric railway circuits "stray" currents are likely to interfere with the normal operation of the bell circuits.

Parts of Bell Circuit.—A knowledge of the construction of the various parts of the circuit is necessary to master the operation of the more complex bell circuits and follows herewith.

Push Button.—In Fig. 7 are shown the details of a very commonly used "push" which makes a single contact. This type is generally used for the simple bell circuits previously described. For return call systems (see Fig. 13), a "Double contact" push is necessary. This type is shown in detail in Fig. 8 and is also termed the "three-point" or "return call" push button. Typical applications are shown later in Fig. 13.

Source of Current. Battery.—The dry cell is most generally used for door bell circuits as it is more convenient and reliable than the wet battery and really cheaper in the long run. The dry cell lasts a long time for ordinary bell work and is quickly replaced. Where several bells are to be operated or where a circuit of considerable length is operated, several dry cells are connected either in series or in parallel or in series-parallel; the proper connection being a matter of "cut-and-try" to see which gives the best results. Fig. 9 shows a series-parallel connection of two batteries, each having two cells in series.

Lighting Circuit.—About 0.1 ampere is required to operate the ordinary bell, and in operating a bell from the electric lighting circuit, enough incandescent lamps should be used to cut down the current to this value. Fig. 10 shows the proper connections. Care should be taken to have at least one lamp in series with each side of the circuit at the cut-out to prevent trouble in case of an accidental ground on the bell circuit. The ordinary trembling bell arcs too much at the vibrating contacts unless a lamp is connected in shunt with it as shown in Fig. 10. A *differential* bell will work very satisfactorily, however, with lamps in series as shown in Fig. 11. There is, of course, *a waste of power* in the added resistance and the necessity of renewing broken globes are two disadvantages to this source of power.

Bell-ringing Transformer. — Wherever *alternating current* is available the bell transformer should be used for operating the bells. Such a transformer properly installed will give service at all times and need never be replaced. The cost of operating a well designed bell ringing transformer is practically nothing, as the current for operating 1 or 2 bells is not sufficient to start an ordinary watt-hour meter, such as is used in residences. There are no losses whatever, therefore, that the owner bears in a transformer installation. The installation of the transformer requires a little care on the part of the electrician or wireman. The National Electrical Code rules require that the primary side of the transformer, with the wiring shall be in accordance with the regular rules for the installation of lighting wires. The secondary circuit of a transformer may be installed in accordance with the Code rules for signal systems. Fig. 12 shows the bell ringing transformer connected to the lighting mains, with the bell wiring circuit attached.

(*Continued on page* 522)

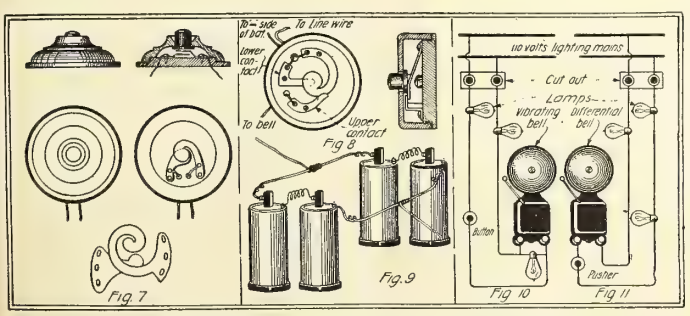


Fig. 7—Shows Plan, Section, Elevation and Metal Contacts of a "Push-Button." Fig. 8—Shows Plan and Section of Double Contact Push. Fig. 9—Battery Cells Connected in Series-Parallel. Figs. 10 and 11—Bells Being Operated From Lighting Mains.

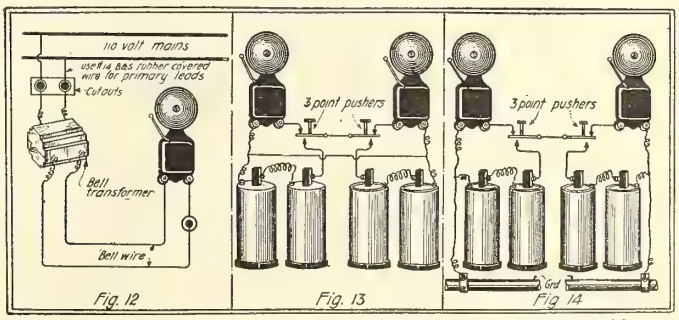
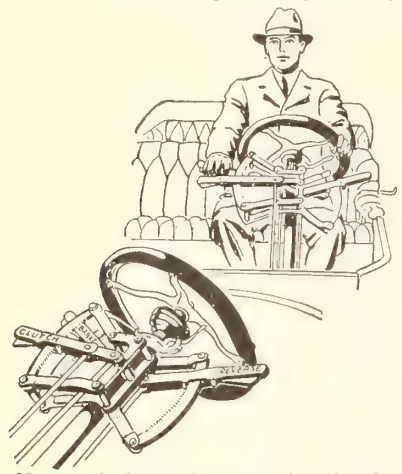


Fig. 12—Shows Connections of Step-Down Bell-Ringing Transformer. Fig. 13—Two-Line "Return Call" Bell System with Two Sets of Batteries. Fig. 14—Illustrating a "Grounded" Return Call System; Separate Batteries For Each Circuit.

MOTOR HINTS

1st Prize $25.00.
A HAND-CONTROLLED CAR

Some time after receiving a bullet-wound that disabled my legs, I read a newspaper announcement to the effect that the judges in a certain competition had declared me a successful participant, and had wished onto me two of the chief prizes—specifically, a



By Means of These Three-Toothed Quadrants and Handles Anyone Who Has Lost the Use of the Lower Limbs Can Readily Steer and Control the Car.

player-piano; and a touring-car with four sturdy cylinders behind its radiator and four name-letters in front.

Two mechanisms, both workable only with the feet—and my feet helpless! What ironical luck!

But not for long. Taking the contest judges at their full word that I was "a winner," I put aside for a while the simpler problem of converting the foot-power piano into a *hand-pumper,* and focused my thought upon contriving some means to control the car *with the hands alone!*

Several of the necessary parts I fashioned in my own garage; for the rest, drilling and forge work, I submitted my drawings to a machinist. Briefly, the device consists of three toothed quadrants bolted to the steering column. Each quadrant carries a lever; and each lever, pawls to engage the teeth at any point in its up-and-down throw. Three oblique rods run from the levers down thru the dash to a trio of bell-cranks—small L-shaped pieces each pivoted at its corner to the engine-base. From these, in turn, run three more rods, horizontally beneath the floor, to the extended pedal-shafts. Tension springs from dash to bell-cranks cause the levers under the steering-wheel to return automatically; and the brake lever, when prest, interacts very simply with the clutch, releasing it without resort to the clutch lever itself.

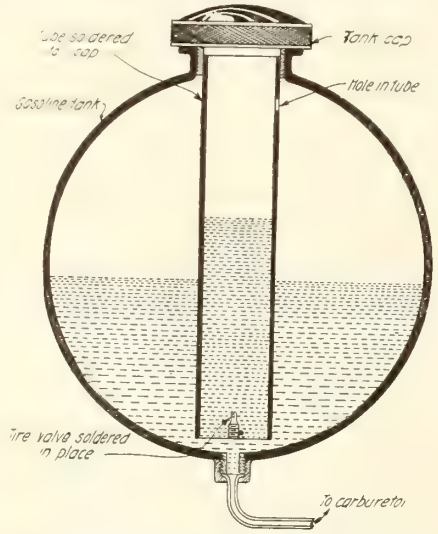
Twenty thousand miles of city and mountain motoring have taught me that the advantages of driving thus by hand instead of by foot are many, while I have yet to discover a single disadvantage. I have none of these hand-control appliances for sale. But if any "Buddy" injured in the late World War, or anybody else, is earnestly curious, I shall gladly supply further details *gratis* in response to inquiries forwarded to my address by the editor.

Contributed by A. B. TRIPP.

2nd Prize $15.00.
EMERGENCY GASOLINE SUPPLY.

The experienced motorist aways carries a spare can of gasoline in the expectation of the time he will be caught without gas in his tank. But too often he forgets to fill the spare can and he is as bad off as ever. Herein is described a can that it is impossible to forget to fill for it fills itself every time the tank is filled.

A tin tube is soldered to the cap of the gasoline tank long enough to reach to the bottom of the tank. A hole is cut in the tube just below where it is attached to the cap. The bottom of the tube is closed by a disk of tin having the valve taken from a bicycle tire soldered in the center. The function of this valve is to permit gasoline



Ever Been Stuck 20 Miles From Home with the "Gas" All Gone? Here's a Clever Idea For an Emergency "Gas" Supply.

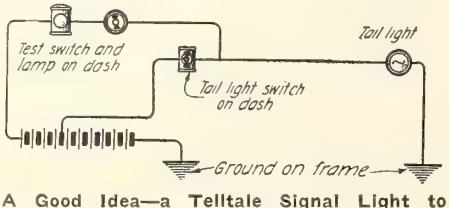
to flow up into the tube when the tank is filled and then to retain it there as the tank empties.

This reserve supply of gasoline is usually sufficient to reach the next gas station. The tube can also be used as a gage by properly marking it.

Contributed by THOMAS W. BENSON.

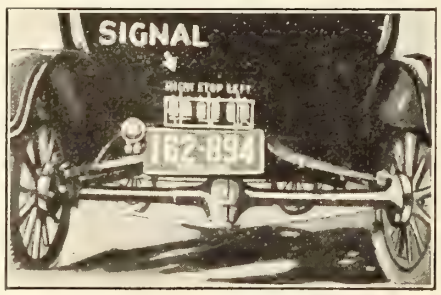
Third Prize, $10.00.
REAR SIGNAL LIGHT.

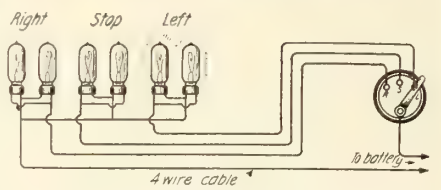
The accompanying photograph and diagram show how I constructed and installed a rear signal lamp and sign on my automobile. The diagram is practically self-explanatory—a three point switch is mounted in a convenient position for the driver and current for lighting the lamps is obtained either from a car battery or from dry cells, or magneto.



A Good Idea—a Telltale Signal Light to Indicate Whether the Tail Light Is On.

The lamps used may be all white ones or colored as the owner wishes. The best way





A Simple Yet Positive Electric Signal For the Rear of Your Automobile. It Is Operated From the Seat.

of course, is to build a small sheet iron box, water-tight, and paint letters on the front of the box for the corresponding lamps or sets of lamps. But one signal is flasht at a time, either RIGHT, STOP, or LEFT.

The wires used in installing this signal in a car should be rubber covered and the heavier the better, if you want to make it real trouble-proof.

The second diagram shows a scheme which I have used successfully to indicate when the tail-light is out, without having to get out of the car. In other words, it serves as a tell-tale signal.

Contributed by JOHN J. SLANINA.

DO NOT "RIDE" THE CLUTCH.

One of the commonest faults of auto drivers is that of keeping their feet on the clutch pedal while driving. There are different kinds of clutch throw-out collars which are brass, bronze, ball-bearing and some of wood.

By keeping the foot on the clutch pedal as a *rest,* no matter how gently you press on the pedal, you will always put a pressure on the throw-out collar which causes great friction, causing the parts to heat up and the lubricant to thin up and run off; this friction wearing off the throw-out collar.

It is a good practise to learn to drive with the foot *off* the clutch pedal!

The best way to operate the clutch pedal is to have from one-eighth to five-sixteenths inch play from foot-boards, thus insuring removal of all possibilities of any friction.

Contributed by C. C. MOREAU.

FILLS CRANK-CASE WITH WATER IN EMERGENCY.

How many of us, that drive Fords, have run out of lubricating oil just where it is unobtainable? I have had it happen several times, but it never worries me. I simply fill my crank-case with water until oil flows out of the top pet-cock. This has always brought me home, In fact I have made as much as fifty miles this way.

Contributed by HOWARD SUTTLE.

$50.00 IN PRIZES.
Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundreds words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

PHONOGRAPH PRIZE CONTEST

What Can You Do With Your Phonograph?



The Phonograph Needle Sharpener Is the Latest Invention of Mr. J. G. Hobson. It Is a Small Attachment Which Screws to the Top of a Phonograph, and by Means of a Friction Wheel Rotates an Abrasive Stone, Sharpening the Needle in a Jiffy.

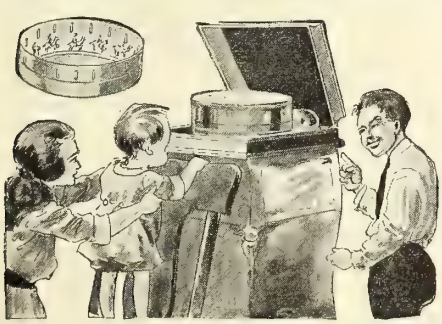
THERE is a phonograph of some sort or other in almost every home nowadays and it is of course used chiefly for musical purposes; or, from the viewpoint of the man who does *not* own one, for the purpose of annoying him and keeping him awake when he wants to sleep. At any rate phonographs are built primarily to dispense music.

Has it however, occurred to you that the phonograph might be used for other purposes besides playing records?

In the modern phonograph we have a powerful silent spring motor and we have also a speed regulator. In other words we have here a motive power of no little force which is constant and which can be utilized for a variety of other purposes than for merely whirling the black disks.

The purpose of this contest is to test the ingenuity of our readers and to ascertain whether or not something real useful and practical can be discovered for the purpose of utilizing the motive energy of the phonograph.

On an average a phonograph works hardly more than one hour, seldom running as long as two hours per day. In other words for a considerable time it is idle, when it might be doing some useful work or perhaps amuse someone. What can our readers do by way of suggestions?



Here We Have the Moviescope, Which Was the First Moving Picture Machine in Existence. It Is a Great Favorite with Children From Four to Ninety Years Old. It Can Be Placed upon the Phonograph and Works Well.

Let us give a few illustrations to show just what we are after. The editor has a little girl who used to be afraid to go to sleep in the dark, and even with the light burning it always took her from three-quarters to one hour to fall asleep. So the editor one day hit upon a novel means to artificially bring about sleep in a harmless manner. He took a pasteboard box, as shown in the illustration, and cut a dozen slots about four inches long and about a half inch wide equally spaced apart into the cardboard. Then he pasted thin strips of colored tissue paper inside the round box so that the slots were covered up. Four colors were used: red, white, blue and green. The pasting of these pieces of paper was done so that the colors alternated from slot to slot. This box was then placed on top of the turntable after having pusht a hole into the bottom to fit the stud on which the phonograph records are so placed.

An electrical lamp from a nearby fixture was hung within the box which was open at the top and the phonograph, after having been wound up was started at its slowest speed.

$50.00 IN PRIZES

We want original ideas on how to use a phonograph for other, besides musical purposes. Every phonograph has a powerful spring motor, a regulator and a rotating turntable. WHAT DOES THIS SUGGEST TO YOU? Read this article for suggestions—and note particularly that if the idea is patentable you will be protected for two years.

We will pay the following prizes:

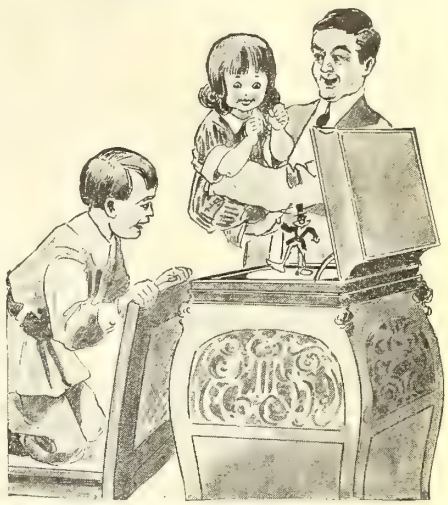
FIRST PRIZE $25.00
SECOND PRIZE..... 15.00
THIRD PRIZE 10.00

—Editor.

The little girl whose room was adjoining just managed to see the rotating box and being in a dark room her eyes were naturally fixt on the whirling colored box. After watching the box for five or six minutes she usually fell asleep after which the device was stopt and the light turned off.

A second idea is shown in another one of our illustrations, which shows a coon jigger dancing up and down on the record and which may be bought at most novelty stores. At one time this was a quite popular device selling from about 50c to 75c, and it is reported that hundreds and thousands of these were sold for the amusement of children; thousands are in use today. This device of course can be used while the phonograph is playing, or it can be used without a record using the rotating turntable only. It just gives an idea what can be done along such lines.

In our next illustration we have the *movie-scope* called the Zoetrope. This toy is well known and was the forerunner of the present day "movies." It is simply a cardboard cylinder open at the top; it is about seven to eight inches in diameter and about five inches high. Different strips of paper are placed along the inner circumference of the cylinder and on these strips are printed various pictures such as a jumping cat or a running horse, each pic-

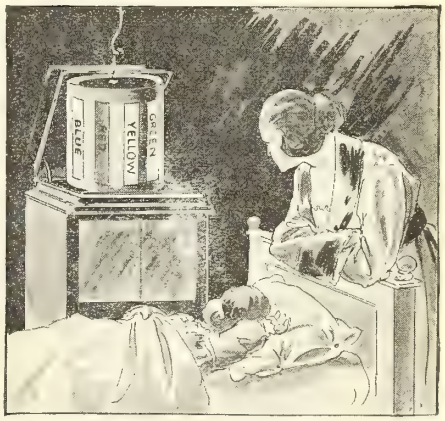


Dancing Toys Attached to the Top of a Phonograph Have Been Very Popular For Amusing Children. There Are at Least Four or Five Different Styles on the Market.

ture showing a different pose from the preceding one. The box is then rotated and the picture is viewed by looking into the inside thru the narrow slots which are about ¼ inch wide and four inches high. As the box rotates a true animated picture is seen exactly as our present day moving pictures. This movie-scope can be placed upon the phonograph turn table and will work very well. Toy dealers have been selling such movie-scopes for some time.

A very original idea is shown in our next illustration and this is the invention of Mr. J. G. Hobson who conducts the department *What To Invent* in this publication. Recently M. Hobson sent a little machine to the editor and there seems to be a great demand for such a device. Mr. Hobson reports that his factory is behind with about 4,000 of these needle sharpeners and that they have sold over 50,000 so far. The device is a small affair which screws to the phonograph and is for the purpose of resharpening the worn-out phonograph needles instead of throwing them away. The device is very simple and sells at a low cost. It consists of a friction turn-wheel, the shaft of which has a small abrasive stone. As the wheel turns this stone presses against the phonograph needle which is inserted into a small top hole and held in place. In a few seconds the needle is resharpened. In ten minutes' time a great many needles can thus be resharpened.

(*Continued on page 523*)



If Your Little Boy or Girl Is Afraid of the Dark, Take an Old Hat-Box, Cut Slots in the Sides and Paste Colored Papers Over the Slots. An Electric Light Inside Completes the Device. Rotate It on the Phonograph. It Will Put Any Child to Sleep.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

Of U. S. Naval Observatory

Collision of the Earth with Heavenly Bodies

WHENEVER a moving body is brought to rest its energy of motion or kinetic energy is transformed into heat. The amount of heat evolved depends on the mass of the body and on the velocity with which it was moving.

An astronomical example of this transfer of energy of motion into heat is afforded us in the stoppage of millions of meteoric particles daily by friction with the earth's atmosphere. These particles average less than a grain in weight and are moving with an average velocity of twenty-six miles per second when they enter our atmosphere. The amount of heat evolved when these "shooting stars" are stopt by friction is hundreds of times greater than would be afforded by burning an equal quantity of coal in pure oxygen and is more than sufficient to fuse the most refractory substances. Tho the particles are extremely minute the intensity of their light arising from friction with the air makes them visible to us at distances of sixty miles or more. Anyone who has observed the passage thru the air of a large meteor, or fireball, weighing possibly a pound or so, knows what terrific explosions are produced and what blinding flashes of light, indicative of the tremendous amount of energy suddenly released from such an insignificant mass.

It can be shown by simple computation that the amount of heat evolved in arresting the motion of a kilogram of matter (2.2 pounds) entering the earth's atmosphere with a velocity of twenty miles per second, is about 125,000 calories.

The amount of heat received from the sun per square meter of the earth's surface per minute is thirty calories, and if one hunded tons of meteoric matter fell daily with a velocity of twenty miles per second over every square mile of the earth's surface *as much heat would be furnished to us from this source alone as we receive from the sun!*

In view of the fact that such a tremendous amount of heat is evolved in arresting the motion of matter it was believed at one time that possibly the radiant energy of the sun might be replenished by the falling of meteoric matter onto its surface.

A kilogram of matter falling to the sun from the distance of the planets would acquire a velocity of 380 miles per second by the time it reached the surface of the sun and the amount of heat released in arresting its motion would be 45,000,000 calories. Now the sun radiates from every square meter of its surface per minute about 1,400,000 calories, and computations showed that a quantity of meteoric matter equal to one-seventy-fourth of the earth's mass, or a little more than the mass of the moon, hurled against the solar surface *every year* with a velocity of 380 miles per second would suffice to maintain the sun's energy of radiation. We may say in passing that this theory of the source of the solar energy fails for the reason that if such a quantity of meteoric matter were actually striking the solar surface yearly it would imply that there existed within the solar system such a tremendous total mass of meteoric matter that the planets as well as the sun would be bombarded by meteors to a far greater extent than they actually are and thru its gravitational effect it would seriously perturb the motions of all the members of the solar system. That a certain small per cent of the solar energy is replenished by the fall of meteoric matter to the surface of the sun there can be no doubt, but it must be extremely small.



The Earth Has Past Many Times Thru the Tail of a Comet, and This Happened Only a Few Years Ago. The Tail of the Comet, However, Is So Fine That We Were Not the Wiser for It, and Only Astronomers Knew That the Earth Past Thru the Comet's Tail. In This Illustration Is Shown Graphically What Would Happen If the Earth Would Plow Its Way Thru the Head of a Comet. Such a Head Measures About 100,000 Miles in Diameter, and Is Not at All Solid as Has Been Thought for a Long Time. It Has Been Calculated That the Head of a Comet Has Only About One Hundred Millionth Part of the Mass of the Earth and Therefore While Such a Collision Would Be Disagreeable, It would Not Destroy the Earth.

Outside of Doing Local Damage in Various Parts of the Earth, Killing Cattle and People, and Wrecking Buildings, the Earth Would Emerge Practically Intact After Such a Collision. It Is Interesting to Note That a Head-On Collision With the Comet's Nucleus Occurs Only Once in Fifteen Million Years.

If a mass of matter equal to that of the moon falling into the sun yearly would actually account for its entire radiation during that period, one can imagine what disastrous results to the solar system would follow if a body the size of our planet were to fall into the sun from outer space or from the distances of the planets.

If the earth's orbital velocity should suddenly be *completely* arrested, the earth would fall to the sun in a period of sixty-four and a fraction days! The sudden stopping of the earth in its orbit would be attended by a tremendous evolution of heat and light and by explosions of the earth material. Particles of the earth material thrown from the parent mass by the force of explosions would revolve about the sun in orbits intersecting at the scene of the catastrophe and particles that were ejected with equal velocity would return at the same time whatever their direction of ejection. The remnant of the shattered world possessing no velocity of translation would fall into the sun under gravitational attraction and bring about a second catastrophe by suddenly increasing the intensity of the solar radiation. If all the energy produced by arresting the motion of a mass equal to that of the earth and moving with a velocity of 380 miles per second should be instantly available, *it would amount to as much as the sun radiates in seventy-odd years* and would probably turn our sun into a *Nova* (new star) and our solar system into a chaotic nebulous mass in place of the orderly family of planets with their satellites that now encircle the sun in orbits, that are almost perfect circles and in periods of time that remain practically invariable for millions of years.



A Distant View Taken From Space Shows How the Earth Would Plow Thru the Head of a Comet. Note That the Head of the Comet Measures About 100,000 miles. It Would Take About 40 Minutes for the Earth to Traverse Thru the Nucleus of the Comet for the Reason That the Two Bodies Move at the Rate of 40 Miles per Second.

If the earth were moving thru a resisting medium instead of thru a vacuum, its speed of axial rotation would be gradually diminishing, just as the rate of rotation of a spinning top is continually decreased by the resistance of the air, and as a result the length of the day would be increasing continually. Moreover, the earth's speed of revolution around the sun would decrease and it would therefore be constrained to move in an orbit of smaller size and its distance from the sun would accordingly decrease. In the course of ages it would draw in nearer and nearer to the sun until finally it would be torn asunder by tidal strains and its pulverized remains would fall upon the solar surface.

Judging from the invariability of the rates of axial rotations of the planets and also of their periods of revolution around the sun there exists within the solar system no extensive resisting medium that retards to the slightest degree the movements of any of the planets or their satellites or even the tenuous comets with one or two remarkable exceptions.

Enck's comet, which revolves about the sun in the shortest of all known cometary periods, shows at times a peculiar acceleration of motion of about two and one-half hours in a revolution of 3.3 years that can be explained only by assuming that it encounters some form of resisting medium at some point in its path. Such a medium would be incapable of checking in the slightest degree the speed of the more massive members of the solar system and may be effective in slacking the speed of this comet only because it is composed of matter in an extremely tenuous form.

Comets are in proportion to their mass the bulkiest of all celestial bodies. Their heads are anywhere from ten thousand to a million miles in diameter, and their tails, which develop only when they are comparatively near to the sun, may be millions of miles in length. We know next to nothing regarding the total mass of a comet tho we can set an upper limit that it cannot exceed. Comets have past so close to the planets at times that were their individual masses as great as one hundred-thousandth part of the mass of the earth they would have produced measurable disturbances in the motions of the planets and no such disturbances have ever been observed. It has also been observed frequently that stars have shone thru the tails of comets and even in some instances thru the heads without any appreciable diminution of brightness, tho a few observers have suspected at times a slight decrease in the brightness of a star when viewed thru the head of a comet.

It is therefore probable that the total quantity of matter in the average comet does not exceed one-millionth part of the mass of the earth and it may be far less. Probably by far the greater part of this mass is collected in the nucleus and head of the comet. The tail, which consists of minute particles driven off from the head by the pressure of radiant light and electrical repulsion, having a density about the same as that of the solar corona or of the best vacuum man can produce.

The individual particles in the nucleus of the comet may be no larger than grains of sand or they may be of the size of hens' eggs, or possibly they may be boulders weighing tons, separated from one another by hundreds of feet.

Now, if the earth's surface were weighed at its surface piecemeal it would total six times ten to the twenty-first power tons—that is, six followed by twenty-one ciphers (6,000,000,000,000,000,000,000 tons). Assuming that there is in the nucleus and denser portions of the head of the average comet a quantity of matter equal to one hundred-millionth part of the mass of the earth, we find that this gives the quite considerable quantity of six followed by thirteen ciphers tons for the amount of meteoric matter thus assembled. If we take as the diameter of the head of the average comet one hundred thousand miles and assume that this quantity of matter is distributed with fairly uniform density thruout a sphere of this diameter, we find that the average amount of matter in the head per cubic mile would be about one-tenth of a ton.

What would be the effect of a head-on collision of the earth traveling at the rate of eighteen miles per second, with the head and nucleus of this comet, which we will assume is traveling at the rate of twenty-two miles per second?

The relative velocity of the two bodies at the time of impact would be forty miles per second! The earth would pass thru the head of the comet in a little over forty minutes. The forward or day side of the earth only would feel the direct effects of the encounter. Every square mile of this hemisphere of the earth would be bombarded with four tons of meteoric matter per second for a period of two thousand five hundred seconds (forty-one and a

(*Continued on page* 570)

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

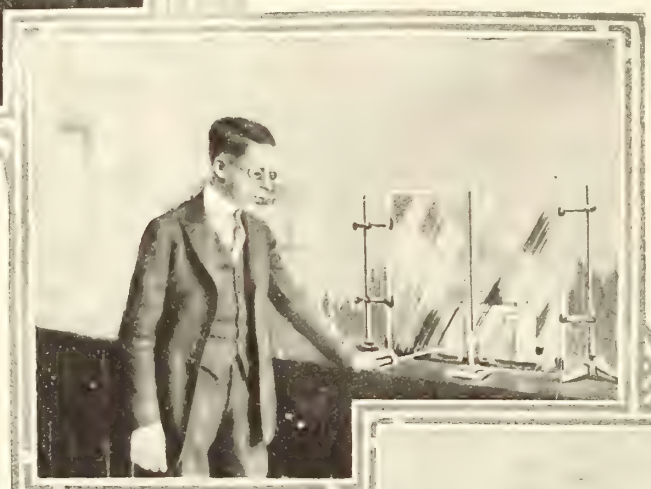
CHEMICAL EFFECTS OF LIGHT



Producing Oxygen By the Action of Sunlight on the Chlorophyl of Green Leaves.

TO a vastly greater degree than many of us are aware this planet and its inhabitants are dependent upon the chemical effects of Light for the energy we use and the pleasures we enjoy. It is the energy transmitted in the chemical rays of the sun that takes the carbon dioxide breathed in from the air, and the water absorbed thru the roots, and builds them into the woody fiber of the tree. Many other processes of life and decay are directly or indirectly dependent upon the chemical energy of sunlight, while the chemical effects of the violet rays of the spectrum upon the silver salts of photography are among the marvels of modern science.

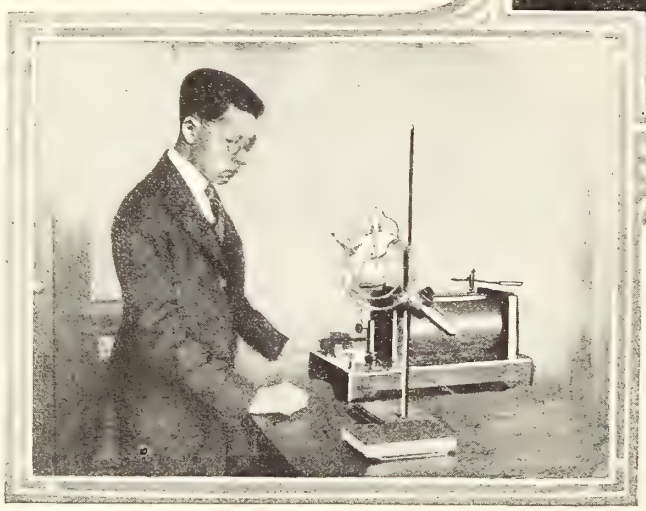
Effect of Sunlight upon a Mixture of Hydrogen and Chlorine: Set up apparatus for the generation of hydrogen and chlorine in exactly the same way as was described in the article of this series for July. Select a small thick-walled bottle—one holding not over two ounces, for a small quantity of the gases produces a big explosion. Fill the bottle with water and invert in a basin of water. Then start the hydrogen generator and fill the bottle half full of hydrogen by displacement of water. Fill the remainder of the space with chlorine, collecting it over water in the same way as the hydrogen. *Be sure this is done in a well-shaded room and that no direct sunlight falls upon the bottle.* Slip a glass plate under the bottle, remove it and tightly stopper with a solid rubber stopper. Place it under a heavy thick-walled battery jar raised on quarter-inch blocks from the table. In front of this mount a substantial glass screen. See Figure 1. Have at hand a flash powder made by mixing equal parts of magnesium dust and pulverized potassium chlorate. Place a small quantity of the powder on an asbestos square at a distance of six or eight inches *in front of the glass screen.* Ignite the powder with a long wax taper. As the intensely bright white light, especially rich in violet chemical rays, falls upon the mixture of gases they combine with explosive violence and the liberation of great energy. It is the chemical effect of the violet rays that produces the change.



Exploding a Mixture of Hydrogen and Chlorine by the Chemical Rays of a flashlight. (A Very Small Bottle of the Mixture Is Placed Under the Heavy Battery Jar Behind the Glass Screen.



Preparing Blue Print Paper By Lightly Drawing a Piece Over the Sensitizing Solution.



At Left: Making a Radiograph of a Key Placed in a Book Which Lies upon a Photographic Plate, Wrapt in Black Paper.

An interesting modification of this experiment can be had by placing between the battery jar and the flash powder a screen of red glass. In this case the chemical rays are cut off and no explosion occurs. If, however, a screen of blue glass is used the gases will combine just as readily as they did in the first case.

Effect of Sunlight on Cuprous Chloride: Prepare a concentrated solution of cupric chloride and immerse in it a sheet of polished copper. The copper will become coated with a layer of insoluble cuprous chloride, the metallic copper reducing the cupric salt to cuprous form. The cuprous compound is white in color. Now wash the copper in running water and place over it some design cut from heavy paper. Upon exposure to the light the uncovered portion will turn a dark purple while the part covered by the paper will remain white. This action again is due to the chemical effects of light.

The Effect of Sunlight upon Green Leaves: Arrange apparatus as shown in Figure 2. In a two-liter flask place green leaves, not too closely packed, and fill with water thru which carbon dioxide has been allowed to bubble for some time. In the neck of the flask insert a one-holed rubber stopper carrying a funnel and so firmly prest in that the water will rise and fill the stem of the funnel. Then fill the funnel two-thirds full of water and invert in it a small cylinder filled with water. Place the whole apparatus in strong sunlight and leave it for a few hours. When examined again the cylinder will be found partly full of gas. Place a glass plate beneath it and remove the cylinder in the usual way. Upon introducing a glowing splint into the gas it will burst into a flame, showing the gas to be oxygen. The same chemical action has taken place here that occurs in the leaves of a growing plant. The chlorophyl of the leaves, aided by the chemical effects of the sun's rays has caused the water and carbon dioxide absorbed by the leaves to unite to form *cellulose,* accompanied by the liberation of oxygen.

In Nature, plant life is all the while breathing in carbon dioxide from the air and giving off oxygen. When the woody fiber of these plants decays or undergoes combustion, carbon dioxide is given back to the atmosphere and oxygen is absorbed. Thus the carbon and oxygen cycle completes itself.

Blue Printing: One of the simplest and most practical applications of the chemical effects of light is found in the process of blue printing. Blue prints are made by the action of light on certain salts of iron.

To learn the chemistry of this process prepare two *very dilute* solutions of ferric chloride and ferrous sulfate respectively. To each of them add a few drops of a solution of potassium ferricyanide. Note that the color of the ferric salt is greenish, while that of the ferrous salt is a deep blue.

Now prepare a test tube of dilute ferric chloride solution and add to it 3 or 4 cubic centimeters of a saturated solution of oxalic acid and a few drops of potassium ferricyanide solution. Mix thoroly and expose the test tube to strong sunlight. Almost immediately you will observe streaks of blue color in the tube, and very shortly the solution will have changed to a deep blue thruout. It is evident from these tests that the ferric salt has been reduced to ferrous form, for the ferric salt does not give a blue color with potassium ferricyanide.

To show that light is essential to this change prepare another test tube exactly similar to the previous one, but this time keep it in the dark. No change of color will be observed.

To make a blue print on paper prepare a mixture of a dilute solution of ferric chloride and a saturated solution of oxalic acid, using 3 parts of ferric chloride to 1 of oxalic acid. Place the mixture in a tray and in another tray prepare a dilute solution of potassium ferricyanide. Place these trays in a dimly lighted room. Then secure some good quality of unglazed paper and taking a square 3 by 4 inches, draw it lightly across the surface of the ferric chloride and oxalic acid solutions. Place in the center of it a coin or some other opaque object and expose to the sun light for two or three minutes. Upon floating the paper face down on the solution of potassium ferricyanide a blue color will appear over the surface except in the center where the opaque object was placed.

Preparation of real Blue Print Paper: First prepare two solutions as follows:

Solution I
- Ferric ammonium citrate....20 grams
- Water .....100 cc.
- Add ammonium hydroxide until a decided color appears.

Solution II
- Potassium ferricyanide.....20 grams
- Water .....100 cc.

Make a mixture of equal parts of the two solutions and to 10 parts of the mixture add 3 parts of a saturated solution of oxalic acid.

In a dark room draw squares of good quality unglazed paper across the surface of the prepared mixture, distributing it as evenly as possible and keeping the upper side of the paper from getting wet. Dry these squares of paper in the dark. Press them if you like between the pages of some large book and they will be ready for use. The paper, like all blue print paper, will have a greenish cast when freshly prepared and before exposing to the light.

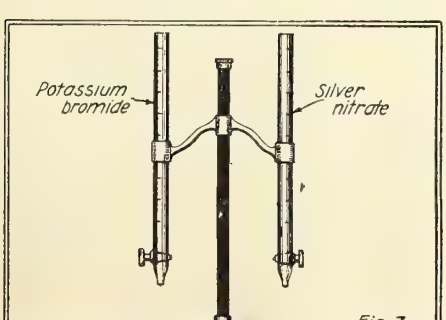


Figure 3—Apparatus From Which to Measure Solutions for the Preparation of Silver Bromide

Place upon the paper some opaque object and expose to the light for a few minutes. A bluish tinge will begin to appear. Then immerse the paper in water and a deep blue will at once come wherever the paper has been exposed to the light. Wash the print long enough to remove the sensitive salts from the unexposed part. Then dry and the impression will be permanent.

Silver Salts in Photography: To learn the action of light on silver salts and the chemical action which takes place in the developing and "fixing" of a plate, film or print four solutions will be required as follows:

Silver nitrate—17 grams per liter of water.

Potassium bromide—36 grams per liter of water.

Hypo—250 grams of sodium thio-sulfate per liter of water.

Developer—10 grams hydrochinone, 20 grams sodium sulfate, 1 gram potassium bromide, 1 gram citric acid, 20 grams sodium carbonate.

Keep the silver nitrate and developer in dark colored bottles or in a dark room.

Wrap a test tube in heavy dark paper and fill it one-fourth full of water. Then either from burettes, as in Figure 3, or small measuring cylinders add 1 cc. each of silver nitrate and potassium bromide solutions. This will precipitate suspended silver bromide. Mix well by very gentle shaking and carrying the test tube to a window remove the paper and expose the silver bromide to the action of the sunlight for a few minutes. In doing this turn the test tube about and gently shake it so as

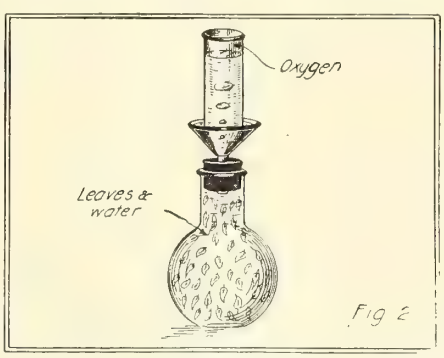


Figure 2—Liberating Oxygen From Green Leaves by the Action of Chlorophyl and Sunlight

to expose all parts equally. If there is no organic matter present there should be but little discoloration.

Now add about 5 cc. of the developer to the exposed bromide and allow the action to continue for two minutes. Note the darkening of the contents of the tube. Then add 10 cc. of the hypo and shake the tube well. Hold it to the light and you will notice that the contents are no longer opaque, but that little fine black particles seem to be floating in the liquid. These are particles of metallic silver.

In order to convince yourself of the necessity of light in bringing about this action prepare another test tube of silver bromide, keeping it well protected from the light, and add 5 cc. of developer. Keep the tube in the dark for five minutes and then add hypo as before. You will observe that the silver bromide entirely dissolves and that there is no reduction of metallic silver.

The chemical action of light in photography is simply this: The sunlight initiates a latent change in the silver salt, not apparent to the eye, but one which the developer is capable of taking up and continuing. This latent change undoubtedly consists in the reduction of an infinitesimal amount of metallic silver and this acts as a so-called "catalyzer" to start the action of the developer. On a film or plate the amount of silver deposited will be in proportion to the intensity of the light falling upon it. Therefore those portions of the film upon which are focused the white parts of the object will be dark and vice versa. Hence we have a negative. In the printing of the

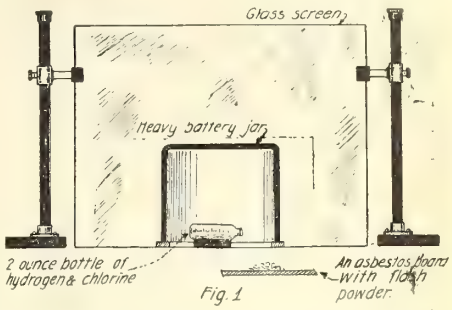


Figure 1—Exploding Hydrogen and Chlorine by the Chemical Effects of Rays of a Flashlight. A Small 2-ounce Bottle Containing the Gases Is Placed, as Shown, Under a Strong Glass Jar Behind a Protective Glass Screen, the Jar Being Raised on Wooden Blocks

negative these lights and shades are again reversed and the result is a positive. The silver bromide is made wonderfully more sensitive by the presence of organic matter, as gelatine.

Photographing without a Camera: At first thought a proposition of this sort seems impossible, but as we shall see it is not. For this work it will be necessary for you to obtain from a dealer in photographic supplies a dozen sheets of "self toning" paper. One excellent kind of such paper is known as "Aristotype" paper. Self toning paper requires no developer. It prints out in the sunlight and needs only to be placed in the fixing bath and then washed. To learn its action hold a small piece in the sunlight. It will begin to darken almost immediately and quickly change to a deep brown color. But the part covered by your thumb will remain white.

Now suppose you want to make a reproduction of some picture in a book. Select a picture which is white on the reverse side of the sheet, having no printing or pictures on that side. If you will hold this up to the light with the white side toward you, you will notice that the picture can be clearly seen thru the paper. The light passes thru the white portion more readily than it does thru the picture itself.

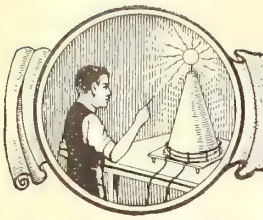
To make a picture place a sheet of the self toning paper underneath it with the glossy side up and over the two place a piece of glass. Now put your book in the bright sunlight and leave it exposed for five to ten minutes, according to the thickness of the paper and the brightness of the light. Upon removing the paper you will find a clear print of the picture. But in order to keep it from becoming dark all over you must fix it. Therefore immerse it for ten minutes in a hypo bath. Then wash it and dry it. This print, however, will be a negative. In order to get a positive place the negative face down on another piece of the self toning paper and expose it to the sunlight as before. Then fix it, wash it and dry it.

Self toning paper contains silver chloride suspended in egg albumen.

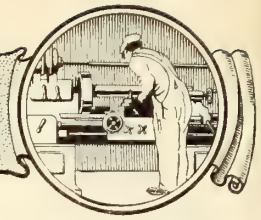
Making an X-Ray Picture: If you have a spark coil that will give a 2 to 5 inch spark you will be able to use it on an X-ray tube. The expense, too, of a small or medium sized X-ray tube is not prohibitive. The photographic action of the rays given off from the cathode of an X-ray tube is among the most marvelous of all the chemical effects of light.

Set up your apparatus in a dark room in accordance with the accompanying photo. So mount the X-ray tube that the X-rays will be thrown down upon the table

(*Continued on page* 533)



THE CONSTRUCTOR



The Rogers Printing Telegraph

By H. WINFIELD SECOR

SOME time ago, while on a visit to Washington, D. C., the writer had the pleasure of visiting the radio and electrical laboratory of Dr. James Harris Rogers, the inventor of the new world-famed underground and undersea radio system, whereby the antenna wires are buried underground or laid under water, instead of being elevated above the earth.

While visiting Dr. Rogers' laboratory, the writer was greatly imprest with several large machines having giant fly-wheels mounted in them, as well as typewriter keyboards, perforated tape reels and several other electrical devices, and, upon inquiring of the good doctor, the latter interestingly explained how he had develop this, his *rapid printing telegraph,* a good many years ago, and how it had transmitted the first printed telegraph letters between Baltimore and Washington on March 14, 1895.

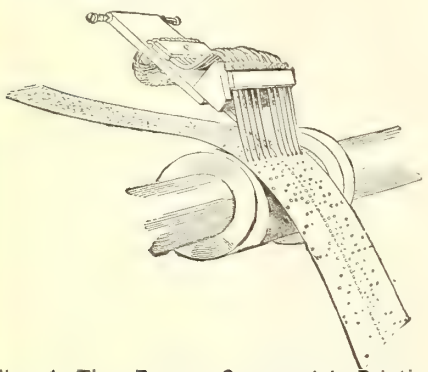


Fig. 1—The Rogers Commercial Printing Telegraph Employed a Perforated Tape, a Set of Insulated Metallic Fingers Making Contact Thru the Perforations Onto the Metal Drum, as the Tape Moved Along.

Altho you will not find mention of the Rogers Printing Telegraph System even in the most elaborate and sumptuous reference books on telegraphy, probably (at least in those with which the writer is familiar) it is of remarkable interest, both to the experimenter and to those who like to read the true history of the advance of electricity, to learn how simply Dr. Rogers eventually worked out his system.

The accompanying illustrations will aid in showing how, with eight simple marks or characters on his magnetic printing machine, he was able to form any letter of the English alphabet, as the sample of printing herewith clearly shows. A close study of the letters in this facsimile message (as transmitted over the Rogers system for considerable distances and for which purpose a corporation was formed over a quarter of a century ago to install this system thruout the country, after many successful trials on long circuits) demonstrated what a great amount of research work had to be devoted to the development of such a system in order that the various component parts of each letter could be transmitted over a single telegraph wire with earth or full metallic return circuit at a very high speed. We will content ourselves with a consideration of a simple working system of the Rogers type, which may be experimentally used by amateur telegraphers and which may prove useful to those interested in electrical and wireless typewriters.

THIS INVENTOR ABANDONED THE TYPE WHEEL OR STEP BY STEP MOVEMENT OF PRINTING TELEGRAPHY ABOUT EIGHTEEN YEARS AGO AND SOUGHT FOR RAPID PRINTING TELEGRAPHY- STUDYING OUT THE ELEMENTARY CHARACTERS OF THE ROMAN ALPHABET HE FOUND WITH EIGHT MARKS OR TYPE WHICH PRINT SINGLY AS FOLLOWS [illegible] HE COULD IN PROPER COMBINATION CONSTRUCT THE ALPHABET THUS- A B C D E F G H I J K L M N O P Q R S T U V W X Y Z- THEN HE SOUGHT AND DISCOVERED, WHILE EXPERIMENTING WITH SENDING OF PHOTOGRAPHS OR OBJECTS BY TELEGRAPH SYNCHRONISM- BY THE AID OF A VISUAL INDICATION, AN ELECTRIC SPARK HE IS ABLE TO MAINTAIN SYNCHRONISM OF MOTORS AND THUS TRANSMIT 200 WORDS PER MINUTE OVER ONE WIRE AND RECEIVE THEM PRINTED READY FOR DELIVERY AS PER THIS SAMPLE- VERY RESPECTFULLY

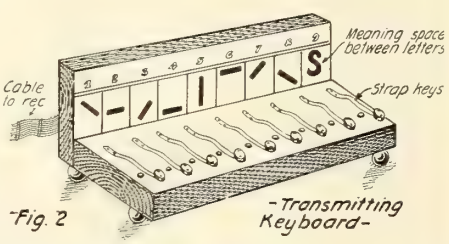
E - S - NORTON-

A Good Idea of Just How the Different Letters of the Alphabet Are Formed by the Rogers Eight-Character Type. This Message Was Sent From Washington to Baltimore by the Rogers System.

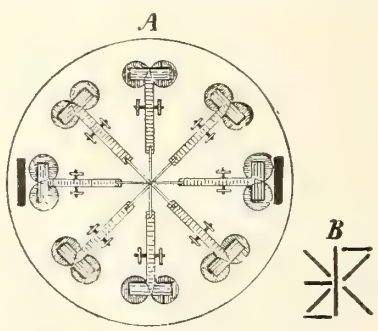
It may be said here that in the complete Rogers Rapid Printing Telegraph System he employed heavy rotating wheels which carried contacts around stationary commutators or segmental switches mounted on the machines, each of the segments connecting to a different pair of electromagnets actuating a certain mark or part of the letter on the *printing head.* In order that the successive signals should be transmitted and received at the proper fraction of a minute, Dr. Rogers devised a simple, yet effective, *spark synchronizer,* whereby the two machines could be operated in absolute synchronism.

The signals were not transmitted by hand to write or print each component part of a letter, but were transmitted at very high speed over the telegraph circuit by means of a perforated paper tape, such as shown at Fig. 1. The transmitting current was past thru the various contact fingers on to a metal drum thru the perforations in the paper tape, this tape having been previously perforated by a keyboard machine resembling the typewriter.

The experimenter will not be interested in all these elaborate apparatus, but undoubtedly will find of constructional and historical interest the simplest working form of such a machine, even tho he has to push a different key to actuate each of the eight type-bar magnets. A simple transmitting keyboard can be constructed of wood, with ordinary small strap keys fastened on to it, as shown at Fig. 2. There are nine keys instead of eight, the last key being used to space the letters after each individual letter has been completely formed. To use this system the embryo operator, who, of course, thoroly memorizes the different position of the eight component parts of the type-printer, by having these placed either in front or in back of each key, as shown at Fig. 2, he will soon be able to gain quite a headway in transmitting the proper sequence of currents over the cable line to the receiving station.



The Experimenter Can Make a Simple Keyboard For a Printing Telegraph After the Fashion Illustrated. Each Key Prints One Part of the Eight-Character Composition, with One Key For "Spacing."



A—Plan view of type arms.
B—Face of type magnified

Fig. 4—How the Eight Pairs of Electromagnets and Type Bars Are Arranged on the Rogers Printing Telegraph. Also Close-Up View of Type Components.

The system may look quite complicated when looking at the diagram, Fig. 3, but many house and office telephone systems are many more times complicated than this, indeed, and but nine wires are required in the cable. This may even be ordinary double cotton-covered magnet wire, about No. 20 gage, or even finer, if fairly high voltage is available, or twenty to thirty volts. Of course, the longer the cable, the greater the voltage, and the proper voltage can be determined by trial or by calculation, taking into consideration the ohmic resistance of the line. For ordinary telegraphic voltages, the type-bar actuating magnets,

of which eight pairs are required, can easily be made or may be ordinary telegraph sounder magnets. The nine-bladed reversing switches throwing the connections from "send" to "receive" may be easily constructed either in the form of a drum switch, or else from small pieces of copper bar about one-quarter inch by one-sixteenth inch mounted on an insulating rod, such as wood, fiber, etc., and provided with a handle at the end, in the manner shown.

The nine cable wires at each station are secured thru flexible cord, such as small lamp cord, to the nine moving blades of the reversing switch in either case. Ordinary small size switch jaws or contacts could be purchased from any electrical supply house and these can be suitably mounted on either side of the switch, and each side of the nine contacts connected, respectively, to the magnets and spacer relay of the receiving apparatus, and also to the nine keys of the transmitter keyboard.

We find it interesting to next consider the arrangement of the printing head, with its various electro-magnets for controlling their respective components of the letters, as shown at Figs. 4 and 5. The simple eight-character, magnetically operated printing head devised and used by Dr. Rogers marks the earliest successful rapid printing telegraph, see Fig. 4.

A later development comprising ten characters and ten pairs of electro-magnets for operating each type-bar is shown at Fig. 5. In the lower part of Fig. 5, or in the side view, may be seen a spacing relay which also rotates the typewriter ribbon drum so as to keep the ribbon moving in one direction or the other, the same as on a typewriter, and this causes a fresh surface of the ribbon to be successively presented before the type.

A very good arrangement of the typewriter ribbon and relay for spacing the letters or advancing the paper tape, etc., is shown at Fig. 6. The paper tape is here held on a freely moving reel, the same as on the regular telegraph tape registers, this tape passing along underneath the typebars, each of the eight type members being centrally supported at a common focus or center, as shown in Figs. 4 and 5. A spring or electric motor may be easily rigged up to turn the fiber or other roller, which can be moved into or out of contact with the idler roller, so as to bind the paper tape between them and pull it, whenever the spacer relay causes the two rolls to be prest together, as becomes clearly evident upon inspection of Fig. 6. It is best to place a guide plate with a hole in it slightly larger than necessary to accommodate all of the type members just over the back-up plate and in front of the moving paper tape, the same as on modern typewriters. This helps to prevent the ribbon from smudging the paper. As shown in the apparatus at Fig. 5, the spacer relay may be arranged so as to have its armature operate a pawl or ratchet acting on one or the other of the typewriter ribbon reels, or a gear fastened to the latter, so as to continuously move the ribbon for the purpose aforementioned.

The operation of the system will now be quite clear, here, we believe. For instance, if you wish to transmit a letter from Station A to Station B (at Fig. 3), then the long central line of the type members; the letter "U" will be composed of the No. 5 line, and then imprint 4 and then 5; the letter "N" is composed of number 5, then

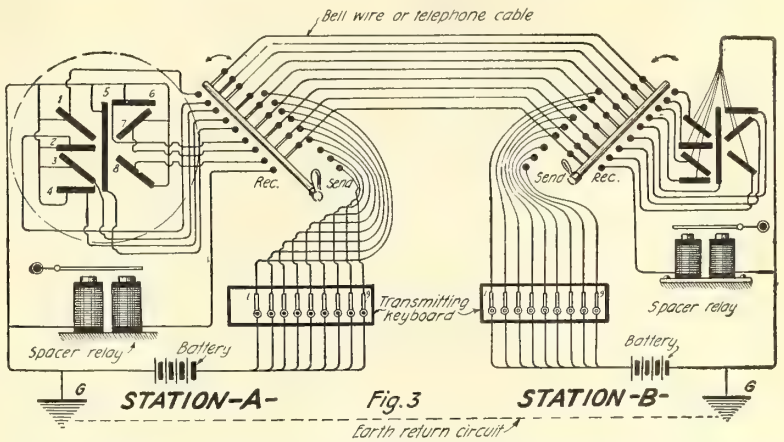


Fig. 3—Simplified Circuit For Printing Telegraph of the Rogers Type. Each Part of the Letter Is Formed by Pressing the Proper Strap Keys at the Transmitting Station, the "Receiver" Being Switched Into Circuit, of Course.

A operator throws his nine-blade reversing line switch to the "send" position to call the B operator (the line-reversing switches are always left in the receiving position normally) by sending Morse code signals or any prearranged dot or dash combination of signals by means of the spacer relay and its corresponding No. 9 key. But as

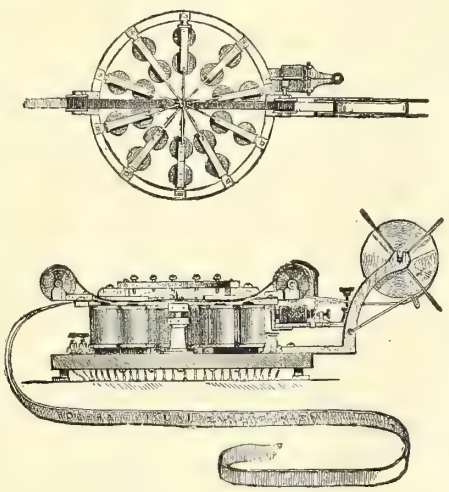


Fig. 5—A Rogers Type Printing Telegraph Having 10 Characters Instead of 8, Together with 10 Pairs of Operating Electromagnets, "Spacing" Relay Magnets, Paper Reel For Tape, Etc.

the B Station apparatus is normally always in readiness to receive messages, it is not necessary to call the B operator unless desired. The A operator will then proceed as follows: Suppose the letter "I" is to be reproduced on the tape at the receiving end of the line, he would then have to press the key No. 5, corresponding to the 1 and 8, then character 5 again. With a little ingenuity this system can be worked out and adapted to many different requirements which the average electrical experimenter may have in mind.

One of the things which has not been worked out in the arrangement shown at Fig. 3 and on which the experimenter can exercise some good gray matter is the development of an accurate interlocking and spacing arrangement, so that he can form the letters properly without too great a space in between them or between the component parts of the letter, and also a scheme whereby he has a tell-tale system so as to know just how the letter looks which he has printed in this way. In other words, like the ordinary telegraph system, where the home station sounder clicks out the dots and dashes as the operator transmits the message.

Those who are particularly interested in the complete operation of the Rogers Printing Telegraph System and the method whereby the transmitter and receiver instruments were synchronized and maintained in synchronism, and also the method of perforating the paper tape with the proper sequence of signals in order that the correct and consecutive impressions of the type characters are formed, will do well to look up some of the patents on this system. Dr. Rogers originally discovered and provided a simple synchronizing means between the transmitting and receiving instruments, placed at the opposite ends of long telegraph lines, and which proved very successful in their trials, which consisted in causing each motor at every revolution to record its movements on the rim of the opposite revolving wheel by the appearance of an electric spark, this furnishing the visual indication of the synchronous or non-synchronous position of the motors. The U. S. Patent covering this most ingenious invention bears the number 358,753.

The electrical apparatus for punching holes in the paper tape and which is adjustable to any ordinary typewriting machine bears U. S. Patent No. 412,001. Patent No. 420,358 covers the printing device made of eight primary type members and electro-magnets for actuating the same in the manner outlined in the present article. Patent No. 524,118 describes the automatic moving carriage which holds and turns the paper page; also many improvements in the manner of operating the eight type arms with a single electric relay, instead of one relay for each type arm. Those interested in machines of this type will do very well indeed to procure copies of these patents from which they will learn a great deal.

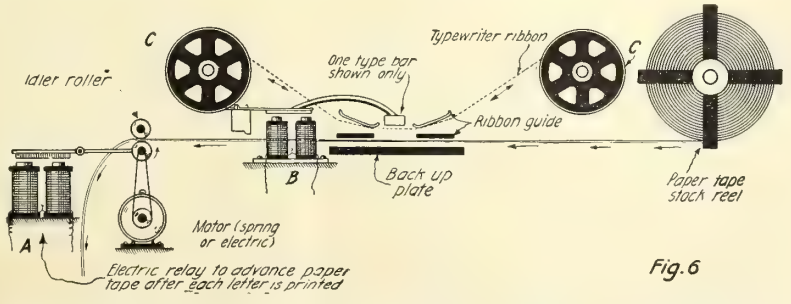


Fig. 6—Working Diagram Showing the Principal Parts of the Printing Telegraph, Here Described, in Detail. Only One of the Eight Printing Type Bars Is Shown For the Sake of Simplicity.

Building "Your Own" Phonograph

Part I

Full Details Describing How to Build Motor, Turn-Table, Tone Arm, Reproducer and Sound Chamber

TODAY, the phonograph or talking machine has become so much simplified and standardized, and there are such a great variety of parts available on the market, that many people have found great pleasure in building their own phonographs.

In the present article, the writer will endeavor to present the practical aspects of building one's own phonograph, which he has learned thru considerable experience in building several of his own, one of which is used for parlor use and two others for laboratory experimental work, where "looks don't count."

One of the main things to be considered in building your own phonograph, usually, is that you do not want a cheap looking machine so far as external appearance is concerned, if it is to be used in the parlor or living room for family entertainment. It is very simple now to purchase a small table cabinet at a cost of a few dollars, up to a full size 50" floor cabinet with sound chamber already built in it for the price of anywhere from $25.00 up to $50.00 or more, depending upon how ornate a cabinet you may desire. Then to tickle the heart of the "how-to-make-it" bug, there are dozens of different makes of motors, tone arms and what not, available from numerous dealers.

However, an effort will be made in the present treatise to provide sufficient instruction and detail so that those who like to feel the real thrill and enjoymnt of building the "whole works" and perhaps the cabinet too, can do so; as the only things you cannot make just yet, are the records.

SOMETHING ABOUT PHONOGRAPH MOTORS.

A typical high grade phonograph motor is shown at Fig. 1, and if you are not already familiar with the operating features of such a motor, you can learn a great deal by carefully studying this drawing. Practically all regular phonograph motors are of the spring propelled type, and contain anywhere from one to four or more barrels or cylinders in which are placed powerful steel springs about the size of those in an 8-day clock, but somewhat longer, which are packed in grafite and oil. The power is transmitted from the springs once they have been wound by means of the handle and ratchet in the well-known manner, to a train of toothed gears and which include an automatic *speed governor* and *regulator*. Details of this speed governor which you may want to build yourself, if you already have some other form of power such as an electric motor or a gravity motor for the purpose of rotating the turn-table, are given at Fig. 2.

Phonographs, like every other piece of machinery, should be kept oiled at all of the bearing points and about once a year it is well to see that the springs are thoroly lubricated and packed in grafite and oil, which mixture is available from phonograph manufacturers. New springs are also available from these companies or thru phonograph dealers. It is important to note in connection with the phonograph motor shown at Fig. 1, that the main turn-table shaft doesn't rest on its regular shoulder bearing, but has a foot-step or pivoted bearing placed under it, which is fastened to the main frame.

It is surprising what a difference this makes, as the writer found in improving a small spring motor which he used in his first experimental machine. When the motor would run a 10-inch record scarcely at all, the same motor ran off the record in fine style, when a polisht steel plate bearing was rigidly secured under the lower end of the main turn-table shaft, the end of this shaft being rounded off or crown shaped And of course, if you take the trouble to make a cup-shape bearing under the shaft, and place a ball-bearing on it, you will get still better results.

With regard to the automatic speed regulator and governor you will soon learn, if you are not already familiar with phonograph matters and phonographs in general, that one of the most important things is that the speed of the turn-table must be as constant as possible, and further—that you will want to change the speed now and then for various records. The average speed for flat disc type records, is about 68 revolutions per minute. This can be timed either by means of a speed indicator held in contact with the center stud of the turn-table as it revolves, or else by placing a chalk mark on the felt cover of the turn-table and counting the revolutions for a half or full minute by means of your watch. If you cannot procure a governor to use in connection with your electric or gravity motor, or perhaps to regulate the spring motor such as that from a large discarded clock movement, etc., you can, with a little ingenuity, readily build one. Details of the standard three-ball governor are shown clearly at Fig. 2.

Two brass collars are usually made, which fit the shaft with a very even clearance. One of these has a set screw threaded thru it so that it can be secured tightly to the governor shaft, while the other collar has a perfectly flat brass or steel disc about 1/16" thick and 1½" in diameter, rigidly secured to it. Both hubs should have three spots filed on them at exactly 120 degrees apart, and three holes drilled and threaded in each for about No. 6-32 thread machine screws, to be used to hold the ends of the three steel governor springs as shown in the figure. For a small size governor, these springs may be pieces of corset steel, etc., and may measure about 5/32" in width by 1/64" thick. The weights on them may be round or of cylinder shape and if made of lead, steel or iron, they may measure about 7/16" in diameter by 3/16" in thickness. These weights must be secured to the exact center of the three governor springs, either by riveting or by means of a 6-32 screw threaded into the weights.

The speed control lever with its felt brush is shown clearly in the drawing and this presents no difficulty in construction. The action of the governor is now quite apparent, the three balls or weights tending to fly outward and make a larger circle as the motor speeds up, and vice-versa by moving the speed regulator screw. The felt shoe bearing against the brass disc mounted on the free hub of the governor will retard the further movement of this disc, so that the weights can only fly out a certain distance and thus keep the speed down to whatever limit may be desired. The hub at the opposite end of the governor is tightly secured to the shaft and it is best to "spot" the shaft with a drill or file where the set screw it to rest.

BUILDING A GRAVITY MOTOR.

One of the finest motors used in telegraph recorder and similar work, is the gravity operated motor. This motor, for one thing, possesses the characteristic of giving very constant speed, more so than the spring motor where the power of the spring is constantly decreasing as the motor unwinds. The force of gravity or pull exerted on a given weight is constant, and thus, as long as the weight is in action, the pull exerted on the gears and turn-table or other devices propelled by the gears, is constant also.

Fig. 3 shows the principal parts which may be used in building a gravity motor. The gears may be the same or in fact the identical gears in an old phonograph motor, or other mechanism. You will require either the two-ball or preferably the three-ball governor to keep the speed under control, and even. The weight used to actuate the motor may comprise one large size boulder (Belgian blocks will do just as good work) also pig-iron or any other good *hefty* scrap. Even a large can of water, etc., or pail full of sand can be used.

The whole secret of the gravity motor is this: You wind up the heavy weight, say 50 to 75 pounds, slowly, by means of the handle attached to the ratchet and drum, but no ratchet is required if you do not happen to have one, and this weight moves very slowly in its downward descent.

You can usually figure out the ratio of the gear teeth and the comparative drop or fall of the weight for any train of gears, by consulting any machine shop or mechanics' manual.

The governor can be mounted on its own shaft and geared to the main train of gears as shown in one of the figures, or it may be mounted on the main turn-table shaft; and there are several other ways in which it can be connected to the main gear train so as to regulate the speed.

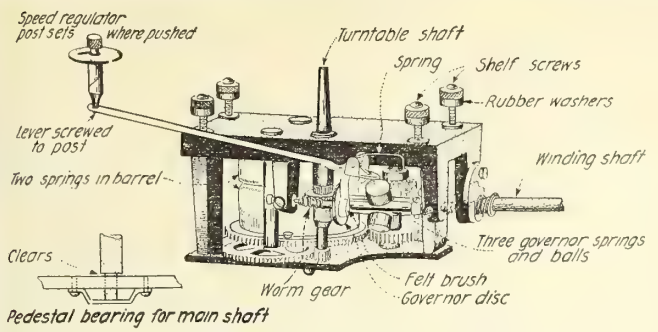
(*Continued on page* 572)

MAKING PHONOGRAPHS

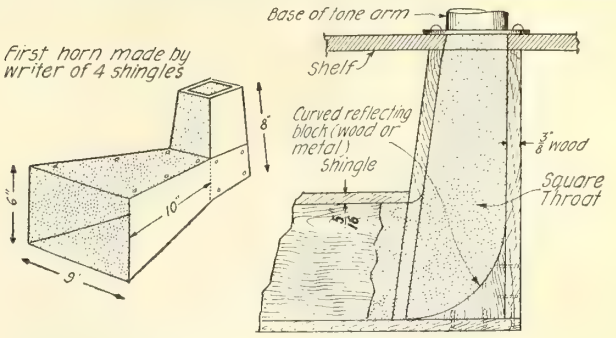
TO build your own phonograph, may sound like a very difficult problem to those who have never experimented in this direction before, but once you have started and succeeded in building your first model, you will find it one of the most fascinating and interesting endeavors you have yet ventured into. Just to build your own phonograph is not the whole story, as there is a good opportunity to build phonographs for others. There is one fine feature about building your own phonograph today, and that is you do not have to experiment and develop your own motor, or in fact your own tone arm or anything else among the machine parts proper, as these can be readily obtained from the innumerable phonograph supply companies advertising in this and other publications.

The future of the phonograph is thoroly assured, but not with the present type of machine, it is prophesied by scientists and engineers; who predict that the talking machine of tomorrow will be a marvelous mechanism indeed, not only for its simplicity but for its purity of note and fidelity of reproduction of the human voice. The experimenter of today, therefore, has one of the finest opportunities ever given to anyone to invent something "real new" in the realm of talking machines. The present talking machine is not perfect by any means, and the "germ" of the perfect talking machine which everyone desires, has yet to be discovered.

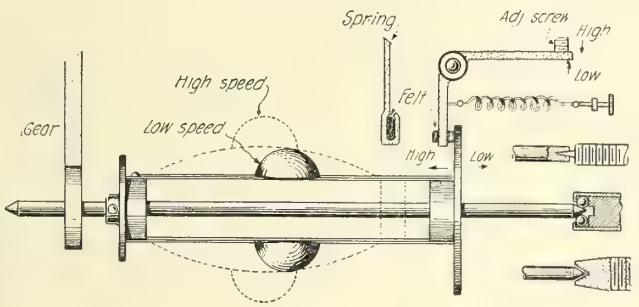
BUILDING "YOUR OWN" PHONOGRAPH



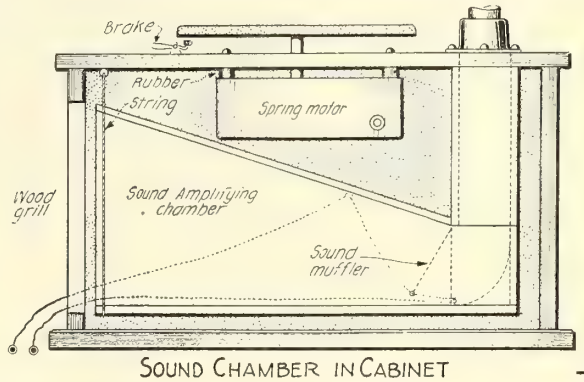
TYPICAL PHONOGRAPH MOTOR -1-



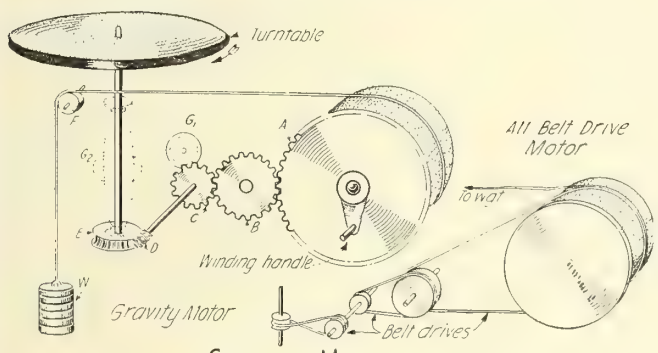
THE SHINGLE SOUND CHAMBER -6-



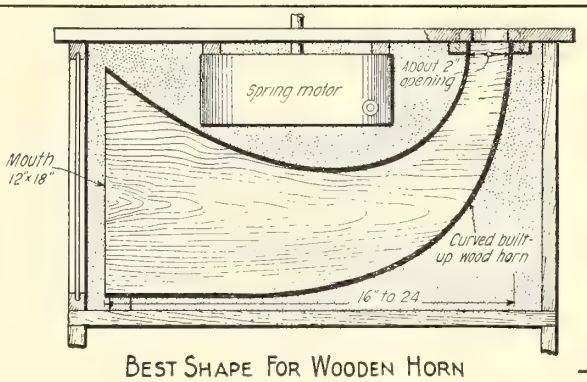
DETAIL OF PHONOGRAPH GOVERNOR -2-



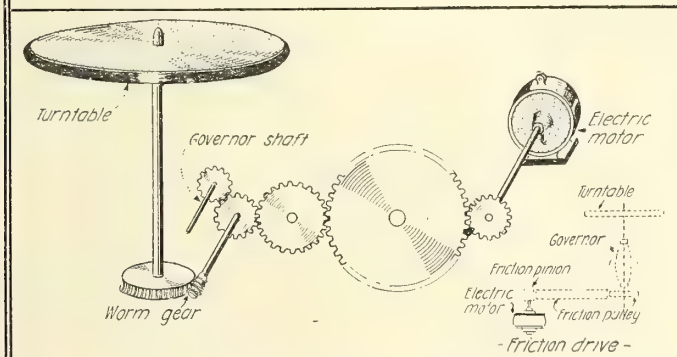
SOUND CHAMBER IN CABINET -7-



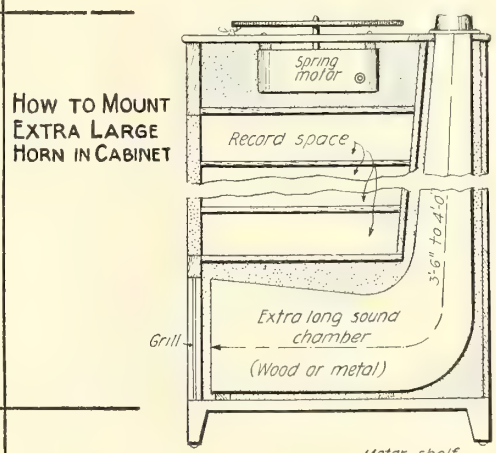
GRAVITY MOTOR -3-



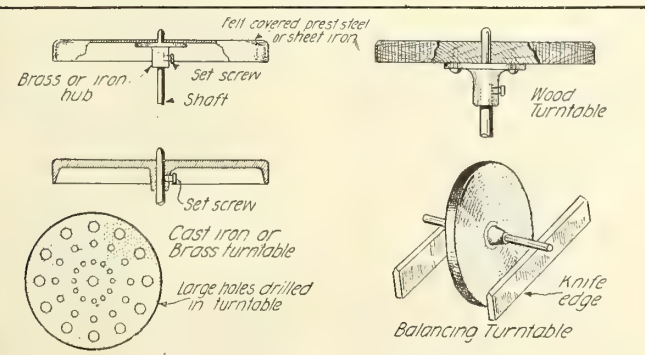
BEST SHAPE FOR WOODEN HORN -8-



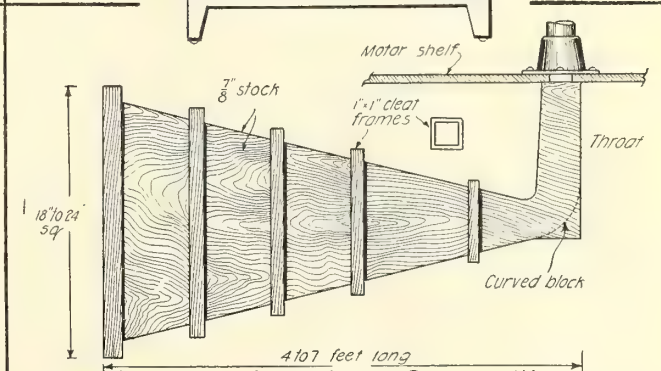
ELECTRIC PHONOGRAPH MOTOR -4-



-9-



VARIOUS STYLES OF TURNTABLES -5-



LARGE EXHIBITION STYLE HORN BUILT OF WOOD -10-

Electrical Machinist

By H. WINFIELD SECOR

NO. 11—REPAIRING ELECTRIC FANS.

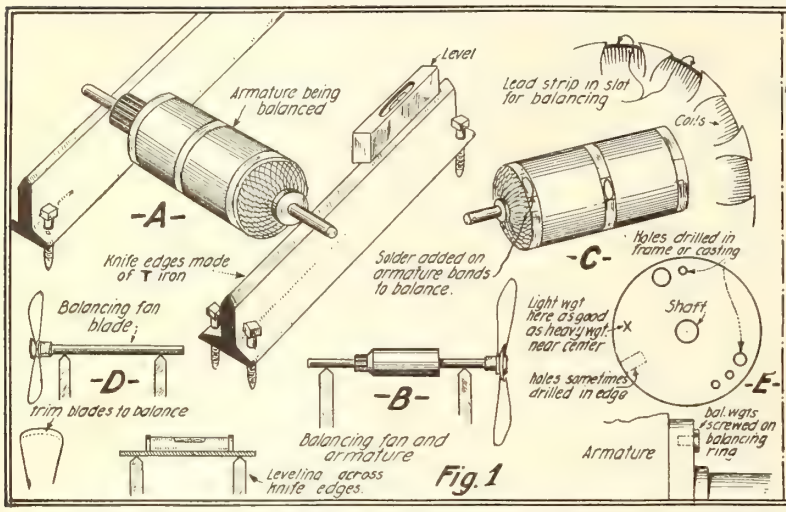


Fig. 1. Shows Some of the Various Operations and Methods Employed in Balancing Fan and Motor Armatures in General. The Armature Is Balanced By Placing It On Two Leveled Knife Edges, and Weighted Until It Will Remain in Any Position.

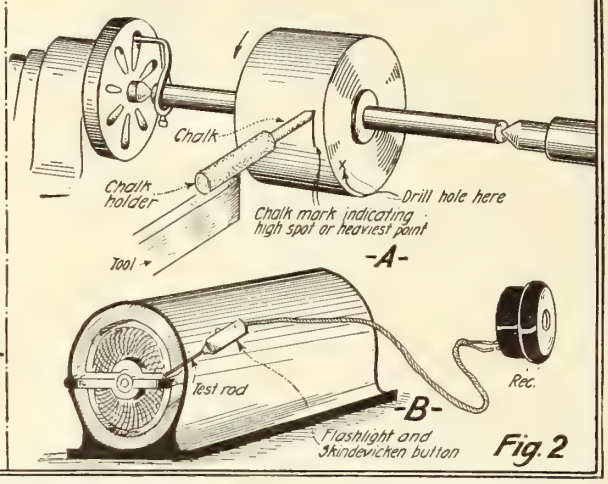


Fig. 2. Two Other Methods of Balancing Rotating Masses Are Here Shown at "A" and "B". Method "A" Involves the Rapid Rotation of the Mass in a Lathe and a Chalk Marker, While Method "B" Utilizes the Principle of Vibration and a Stethescope.

THE following remarks on the repairing of electric fan-motors would also apply to the repairing and assembly of small motors of all types, particularly those of the fractional horsepower class. There are many interesting points to be watched in the repairing of even such small electric motors as those used for driving fans, and by watching these various important factors, much dissatisfaction is avoided—both on the part of those having repairs made, and also with regard to those wishing to realize the highest efficiency and noiseless operation of fans.

BALANCING ARMATURE AND FAN BLADES.

In many electrical repair shops, no attention is given to the proper balancing of such small armatures as those found in ceiling and desk fan-motors, rated at approximately ⅛ and 1/16 horsepower, respectively, but if this is not done, then the fan is very likely to make a considerable noise and operate unsatisfactorily in other ways. Of course, the fan blade itself must be balanced also, and preferably it should be balanced when mounted on the shaft of the armature as shown at Fig. 1.

At Fig. 1-A may be seen how two knife edges, constructed from short lengths of "T" iron and provided with 3 or 4 leveling screws threaded thru the lower web, are arranged on the bench so that they can be leveled up in both directions, with an accurate machinist's level. By means of a steel straight edge, if the level itself will not span across the two knife edges when set at the proper distance apart to receive the armature, the two edges are lined up perfectly level with respect to one another, i. e.—crosswise. The two knife edges should then be lined up individually with the level by adjusting the four screws in the manner apparent. The armature shaft rests on the two knife edges as shown at Fig. 1-A and pieces of flat lead may be pusht or driven into the tops of the slots as shown at "C", care being taken to see that a piece of thin fibre or heavy paper rests on top of the coil, so that the wire in the slot will not be cut, and these balanced weights are placed on the *light* side of the armature repeatedly, until it will rest on the leveled knife edges *in any position to which it may be turned by hand.* When it will rest at *any point* along the knife edges when turned to successive positions by hand it may be considered as properly *balanced.*

At B is shown how the fan blade is balanced simultaneously with the armature. At D, a single fan blade is balanced by mounting it on a steel shaft and then placing it upon the leveled knife edges. Fan blades are balanced either by placing solder on the hub on the *light* side, or else by trimming the metal off the outer end of the *heavy* blade with a pair of tin-snips. Small holes are sometimes drilled in the hub or in the outer end of the blade on the *heavy* side. If the end of the blade is cut off, this of course also occurs on the *heavy* side, that is, the side which tends to swing to the bottom each time.

After carefully watching the blade and adjusting the weight by cutting or soldering, etc., you will find that the blade will rest in any position you may place it *without turning to a new position by itself.* It is then *balanced* and under proper conditions will rotate at the speed for which the fan was designed with the minimum of

(*Continued on page* 528)

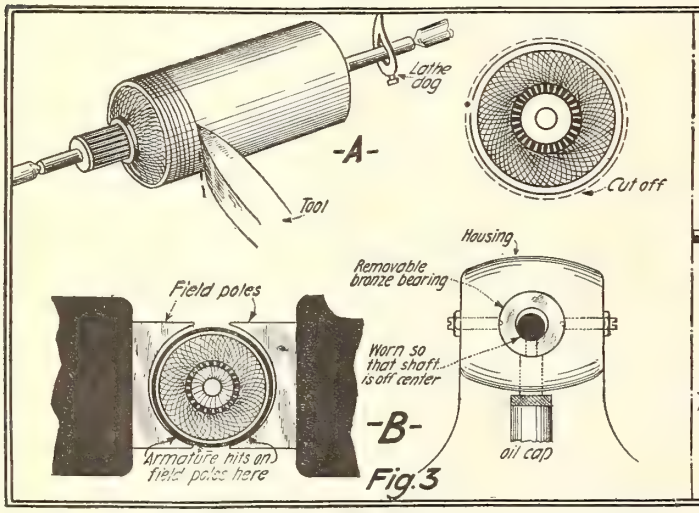


Fig. 3. Some of the Things That Happen When an Armature Strikes the Field Poles and the Methods of Overcoming This Trouble Are Here Illustrated. Small Armatures Are Often Placed in the Lathe and a Cut Taken Across the Perifery of the Core as Shown at "A". Fig. "B" Shows How Worn Bearings Cause the Armature to Drop and Hit the Pole-Shoes.

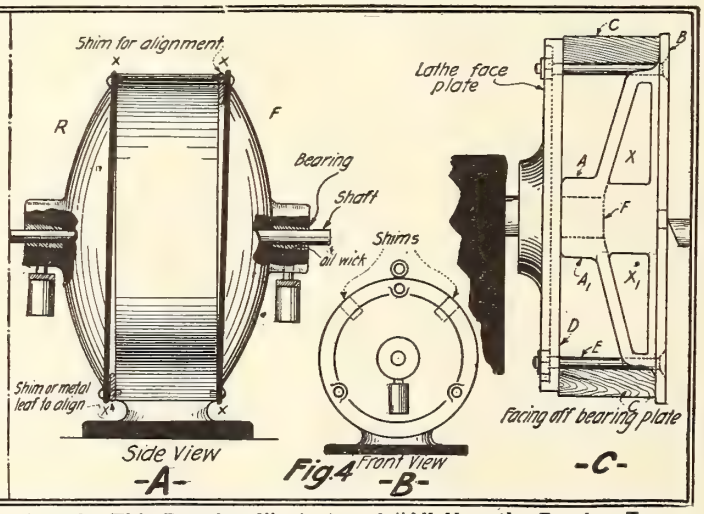


Fig. 4. This Drawing Illustrates at "A" How the Bearing Frames On Electrical Machines Sometimes Have to Be "Shimmied" Out in Order that the Armature Can Turn Freely. At "C" Is Shown a Method of Mounting A Bearing Frame On the Lathe Face-Plate For Machining.

The "Vibro Whip"

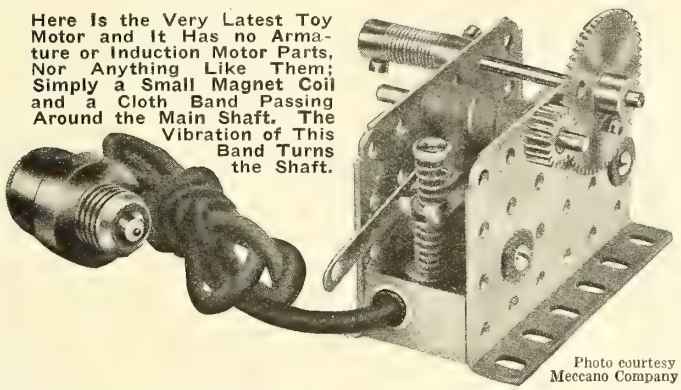
A Motor Freak

By O. C. ROOS

IT is a long time since most of us used the whip-top of childhood days. We can easily remember how hard it was to give it the initial spinning twist with the right hand, to prevent a wobble and sudden spin on its side! At last it stood shakily for a precious half second, and we whipped it with frenzied haste only to knock it down again. We had to repeat the performance until bitter experience taught us moderation, and we finally kept the top spinning with short, rapidly repeated "wiping" strokes. It was a lesson in life.

Who would think that this toy would give a new prime mover to the scientific and engineering world. Yet it is a fact that small motors are now being tried out for phonographs and other small moderate speed machines, and these motors are really "whip-top" motors.

It is the purpose of this article to show the final elements first, giving in Fig. 1 the essential parts of the apparatus and then showing their relation to the whip-top in bare outline, so that the principle underlying this very curious prime mover may be rendered obvious, when the mechanics of the whip-top are understood.



Here Is the Very Latest Toy Motor and It Has no Armature or Induction Motor Parts, Nor Anything Like Them; Simply a Small Magnet Coil and a Cloth Band Passing Around the Main Shaft. The Vibration of This Band Turns the Shaft.

Photo courtesy Meccano Company

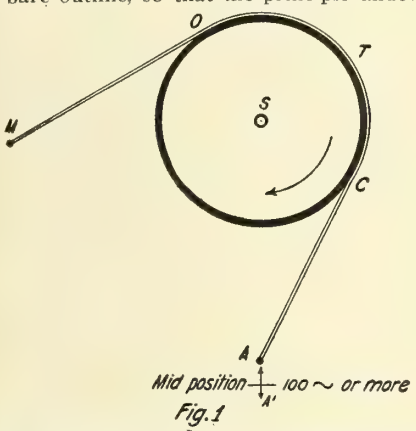


Fig. 1

Fig. 1—The "Vibro Whip," Described by Mr. Roos, Is Based on the Principle of the Old "Whip-Top," Which We Used to Spin in Our Boyhood Days, and the Action of Which Is Partly Shown in the Above Figure—the Band Around the Drum "S" Being Pulled and Released Alternately in the Direction A-A¹.

In Fig. 1 are shown the essential parts of the apparatus. They are:

1st—A fixed rotatable shaft—S.

2nd—A flexible partly extensible, friction-band MOTCA.

3rd—A vibratory motion in the point A, of such a periodic character that it causes the band MOTCA to alternately grip and release the shaft S several hundred times per second. There are strict requirements prompting the special motion of the point A.

These can best be presented by showing *how and how not* to construct the elements in Fig. 1.

1st—The point A must have a special type of motion, otherwise its power to drag or "whip" the shaft in one steady direction is zero. It must *not* in general be simple harmonic.

2nd—This motion must be so arranged when in Fig. 1 the point A reaches A_1 and starts to *return* toward A again, that the whole band will loosen up around OTC, or at least a part of that distance before A_1 reaches A. It must *not* be so slow that the rotating shaft will catch and "bind" it before A_1 reaches A. In other words the *suddenness* of the *necessary* "crack-the-whip" effect at A_1 on the return to A depends on the speed of the shaft S to some extent.

If we did *not* specify these requirements, Fig. 1 would not work. That's all there's to it! We would have, with simple harmonic motion at AA^1, the conditions shown at Fig. 2, where the friction band BB is held continuously against the shaft by the spring action of the band, represented by an "equivalent spring" P fastened to the band B and the fixed point F. When A^1 moves to A and back *there is simply oscillation of the shaft,* and nothing more. A fine motor that would make!

It is realized that the above description is only general in character and that the younger experimenter wants to know the real mechanism of the whip-top before the above results can be made perfectly clear to him. For his benefit then the following non-technical analysis of the whip-top is given, followed by a still simpler analysis of the actual operation of the "crack-the-whip" phenomenon on a driving-shaft.

THE WHIP-TOP.

In Fig. 3 we have five views of a whip-top, S, giving a "moving picture" story of its behaviors and that of the whip, with handle at H. We see the first whip-stroke at view 1, where the small curved arrow in S shows the initial twist given to the top, as the whip in position 1 strikes it. The second view shows the top moving bodily to the left, as indicated by the arrow at S, with increased rotation and changed direction of the handle H, more toward the bottom of the page

The third view shows the tip of the whip, quite curled up around the top, whose rotation is increased, but whose bodily motion along the ground is now almost in the same direction as that of the whip handle H. The fourth view shows this last motion fully accomplisht with the top rapidly spinning and moving toward the bottom of the page.

The final view shows the top asleep—no bodily motion—and the whip being *properly* applied with a small motion at point toward the top, and a large "wiping" motion of the whip as shown by the large arrow. The handle has now practically a vertical motion relative to the page.

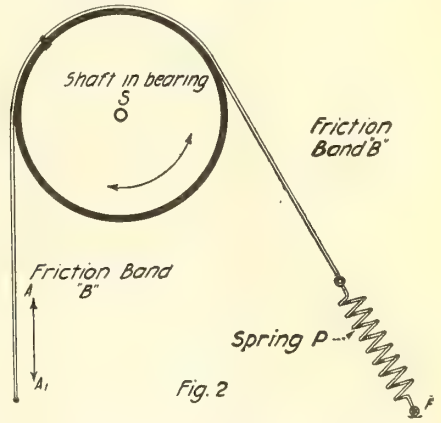


Fig. 2

Fig. 2—The Motion Required to Cause the Whip-Top Action to Take Place Must Not Be Harmonic, But Irregular in a Fashion. The Arrangement Shown Here Would Give Simple Harmonic Motion, and the Shaft "S" Would Simply Oscillate and Not Revolve.

Now, if in the last view, we could suddenly fasten the spinning top in ball bearings and could move H back and forth—as shown in this same view—with a *proper* motion, keeping the other end of the whip fastened somewhat as in view III, we would have the general arrangement of the vibro-whip elements, which we have shown in Fig. 1.

By having the shaft S, fixt, we have a fixt top, and can follow the action by studying Fig. 4 by taking a heavy fork with an electrical driver as shown, we see that the driven fork whips the shaft so that at each complete vibration of the fork the band MOTCA advances the shaft thru an arc equivalent to a small circular motion—about .02" in some cases.

(*Continued on page* 560)

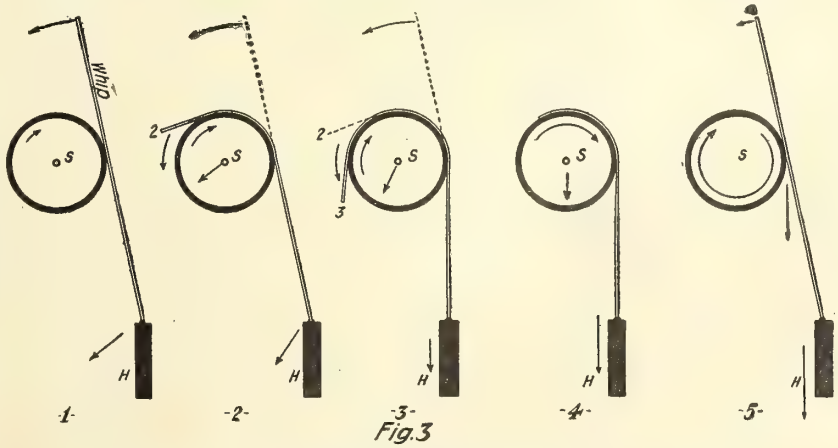


Fig. 3

Fig. 3—This Shows Five Successive Stages of the Whip-Top "S," Giving a Motion Picture Story of Its Behavior and That of the Whip with the Handle at "H."

HOW-TO-MAKE-IT

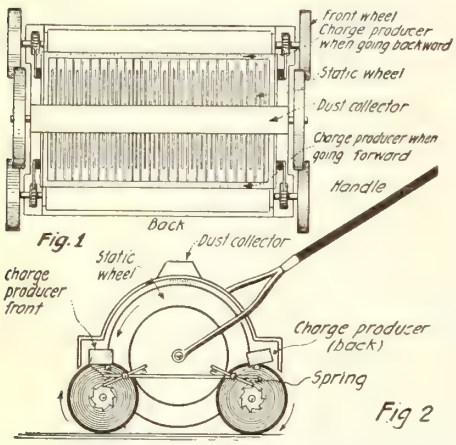
This department will award the following monthly prizes: First prize, $5.00; Second Prize, $3.00; Third Prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

AN ELECTRIC CARPET SWEEPER.

I found that when a Victor record was rubbed with cat's fur, it had the power to attract any small articles which were found on a rug.

The static wheel (see Fig. 1) is made of a number of ten-cent records and is rotated the opposite way from the wheels which propel it. The static wheel has a charge producer on both sides which is



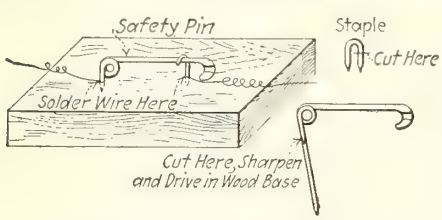
Here's How to Make an Electric Carpet Sweeper of the Static Type. It Is Readily Built From Old Phonograph Records, and the Small, Ten-Cent Variety Will Do.

made of cat's fur and rubs the static wheel giving it an electric charge. At the top of the sweeper there is a dust collector which collects the dust from the wheel. The dust collector is a brush with cotton wool wound around the bristles. The charge producers are changed as the carpet sweeper goes backward and forward (see diagram 2). This carpet sweeper is used like any other one would be; only when the cotton wool is dirty it must be changed for a new one.

Contributed by
JOHN BATLES SWANN.

"SAFETY-PIN" SWITCH.

I give herewith a rough sketch of a "safety-pin" switch for the "How to Make It" hounds. It is simple and saves the



A Nifty Little Battery Switch Suitable For Bell and Other Circuits and Which Creates a Positive Contact; It Is Made From the Ladies' Greatest Friend—the Safety Pin.

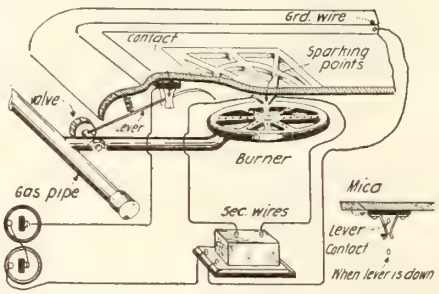
worry of how to close battery circuits when no suitable switches are available. Excellent for bell circuits, and mind that the contact is positive, owing to the spring tension exerted by the pin bar.

Contributed by REUBEN HORN.

SECOND PRIZE, $3.00

AUTOMATIC GAS STOVE IGNITER.

This device is designed for a gas stove, so that when a kettle is set upon it, the



This Automatic Electric Igniter For Gas Stoves Employs a ¼- to ½-Inch Spark Coil, the Primary Circuit of Which Is Momentarily Energized as the Gas Valve and Its Attached Contact Lever Is Turned to the "On" Position.

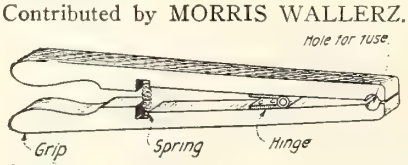
burner lights automatically without a match. The principal thing about this device is that when putting the kettle on the gas stove it pushes down a lever that makes it come in contact with two springs, as shown, thus putting the coil in circuit whose secondary spark ignites the gas. The secondary wires are run thru insulators in the side of the stove. When the receptacle is removed a spring pulls the lever back, cutting off the gas and the current. When the lever is pushed down it turns on the gas at the same time it passes (momentarily) thru the contacts, so that the coil is only used for a second or two. Time should be allowed for the gas to get to the burner and so to the points.

Contributed by
ROOSEVELT STONER.

A SIMPLE CARTRIDGE FUSE PULLER.

This useful device can be constructed from a piece of wood with dimensions as follows: 10" x 1½" x 1½". First a hole is drilled a quarter of an inch in diameter, an eighth of an inch from the top. The next thing to do is to make a rectangular opening six inches below the hole and half an inch from each side. This opening should be half an inch long and quarter of an inch wide. The piece of wood is then sawed in two, lengthwise. Next these two pieces are put together by means of a hinge three inches below the hole at the top. After this a strong spring is fitted in the rectangular opening and a nail five eighths of an inch long is driven in from each side to hold the spring in place. The ends may be rounded out to make a convenient handle. This simple device will be found handy for store and home use.

Contributed by MORRIS WALLERZ.



It Is Ticklish Business at Best to Remove Cartridge Fuses on "Live" Circuits, and This Suggestion of a Wooden or Fibre Fuse Remover Is, Indeed, Welcome.

THIRD PRIZE, $2.00

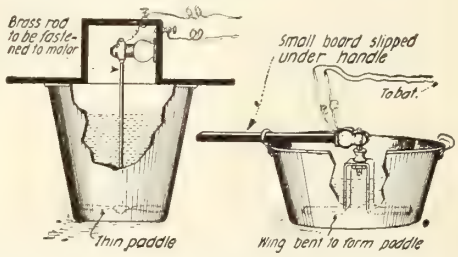
MOTOR FOR STIRRING LIQUIDS.

I am sending in to the "How to Make It Department" an idea that I have used successfully. All those who have had to stir catsup or other preserves while boiling down will appreciate it. I am giving sketches for two kinds. A small toy (series wound) motor was used. The long end of the shaft is threaded.

An eight-volt motor will make about 32 R.P.M. in catsup. The motor needs no more support than shown, as it revolves so slowly.

If the motor windings are soaked in paraffine the steam will not injure them.

Contributed by JOHN ROTCHKA.

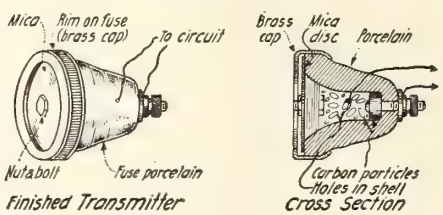


Why Not Put That Small Battery Motor to Work? Here Is an Ideal Purpose For Which Mother and the Girls Will Surely Bless You. Rig It Up to Serve as a Motor "Stirring" Handyman by Means of a Small Paddle, as Shown.

A FUSE PLUG MICROPHONE.

Herewith I submit a plan for a simple telephone transmitter which when used gives a very clear tone. The shell is a discarded fuse-plug without a contact end on it, and the hole in which the fuse metal enters should be cleaned out, the brass screw shell on the outside having been removed.

Remove the mica cover and brass cap, without injuring them so they can be put on again. The carbon discs are made by sawing them off from battery carbons and shaping them to fit. The shell is then filled with carbon grains (buy them at any electrical supply house or visit your local telephone exchange and get acquainted with the "wire chief"—don't bother with broken up carbon bits) and the fuse cap and mica put on. The wire from the upper carbon disc goes out thru the hole in the shell.



A Clever Wrinkle in Building Your Own Microphones. This Particular One Is Built From a Porcelain Fuse Plug. If You Want Success, Use Polisht Carbon Granules and "Not" Pieces of Broken Arc Light Carbons.

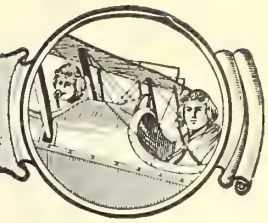
Ground coke has been used satisfactorily in the transmitter.

The lower part can be punched out very easily.

Contributed by
ARTHUR A. HUMPHREY.



RADIO DEPARTMENT



A Giant Radio Central Station

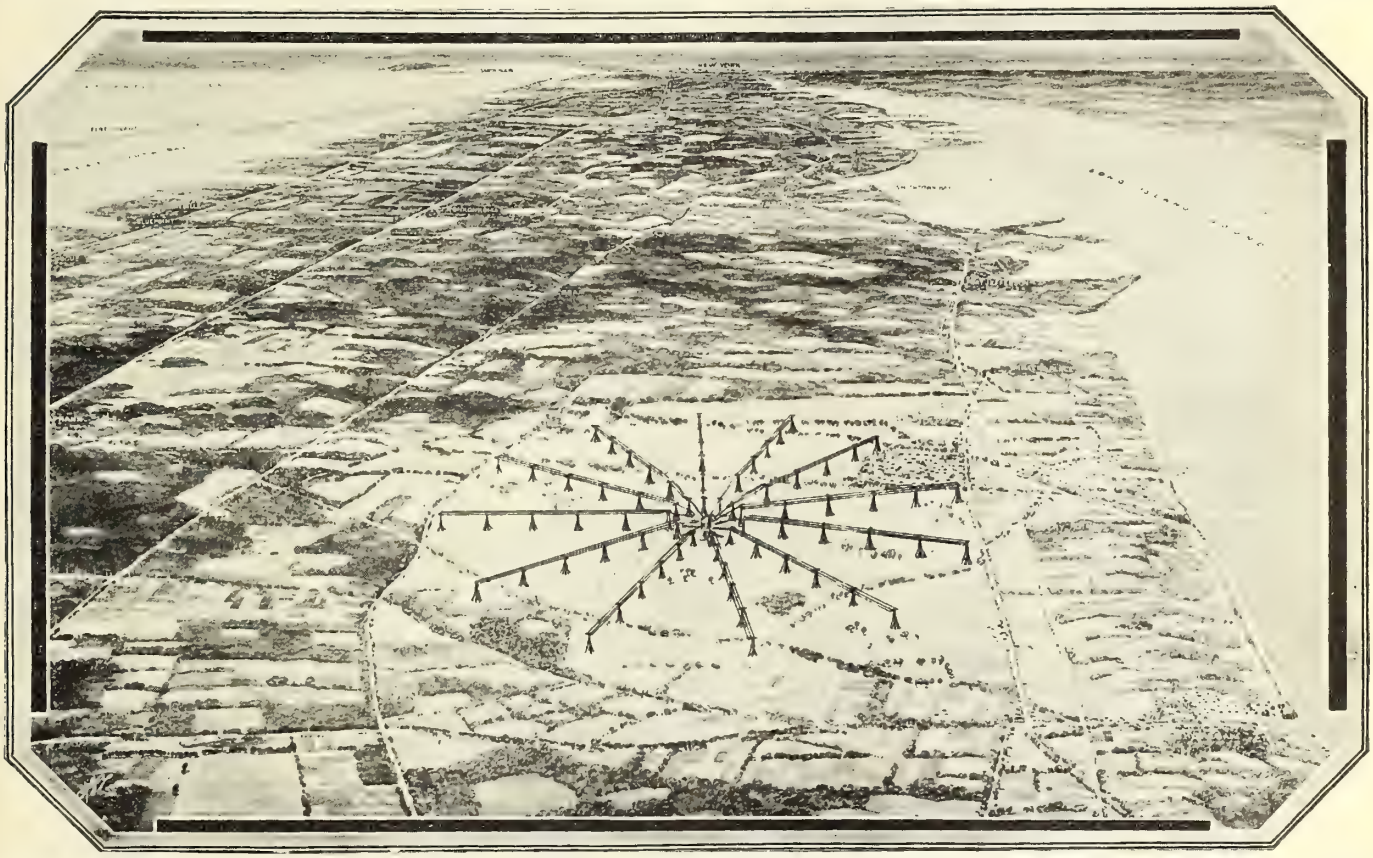
Description of a 2000 Kilowatt Radio Station To Be Erected on Long Island

FOR more than two decades the wonders of wireless have so unceasingly intrigued the public imagination that it would appear little remained to be accomplisht in developments of revolutionary character. Yet, once again, it is disclosed that a startling conception in wireless communication has been quietly brought to a point of realization. On the north shore of Long Island, near New York, the Radio Corporation of America is about to begin construction of a super-powered radio station that will simultaneously send to and receive messages from five great nations of other continents.

of Port Jefferson, with a long frontage on Long Island Sound. The preliminary engineering studies have been completed, contracts for all the construction materials are being let, and a force of radio experts, after months of preparation, will immediately take the big job in hand.

with a corresponding receiving station located nearby. *All five transmitters and the five receivers will operate simultaneously and will transmit and receive messages over thousands of miles* continuously during day and night.

"New York will be the direct focal point of world's intelligence in an entirely new sense under this communication scheme," he continued. "As soon as the station is completed immediate message service will be establisht with France and Germany to supplement the existing commercial circuits; ultimately, radio from this station will connect up Buenos Aires and other



The World's Most Powerful Central Radio Station, Rated at 2000 Kilowatts, To Be Constructed at Port Jefferson, Long Island, by the Radio Corporation of America. View Looking Toward New York City, Showing Giant Antenna System Supported on 400-Foot Masts.

The bare announcement presages a new era in commercial radio communication. It is one conceived in the convention-defying spirit which, coupled with engineering skill, has brought about the expansion of wireless to its present status as a world-wide public utility. Instantly obvious is the fact that the plan will result in the contribution of an important means of breaking down America's isolation from the peoples of certain other continents and open up visions of communication possibilities which, thru inherent limitations, could never be realized by the undersea cables.

The new and great medium of far-reaching economic and political influence will bear the name of *New York Radio Central Station,* the steel towers of which will arise on a 6,400-acre tract, comprising nearly ten square miles of land lying east

A definite idea of the ultra-modern character of this radio plant may be gained from the observations of Edward J. Nally, president of the Radio Corporation of America, under whose direction the world-wide wireless system has emerged from an idea into a reality. "Everyone at all familiar with wireless," said Mr. Nally, "knows that at Nauen, Germany, and Bordeaux, France, are two of the largest stations in the world. Up to now they have been viewed with admiration; consider, then, the tremendous advance represented in this latest step; the New York Radio Central Station in the aggregate, *will be five times more powerful than either of these.*"

He explained that there will be five complete transmitters, each one a duplex unit

points in South America, and ether-wave messages will be flashing to and from Poland, Sweden, Denmark and other European countries. Like the ripples that race in circles over a pond when a stone is dropt in the water, the electromagnetic waves from this station will soon encompass practically the whole of the civilized globe. It is a plant that dwarfs all existing wireless stations into insignificance.

AERIAL TWO INCHES IN DIAMETER.

The form of aerial construction, too, is wholly a new departure. From the central power house six spans of aerial wire will radiate out in a star pattern, to a distance of more than one mile from the center. The wires of this huge antenna will be

(*Continued on page* 567)

New De Forest Buzzer Radiophone

A NEW buzzer Radiophone transmitter for operation on two six-volt storage batteries is the latest feature which has recently been placed on the market. This requires no "B" or secondary battery of a high voltage whatsoever, and will prove ideal for all small portable work, the set being readily placed upon motorcycles, and very small power boats or automobiles as well as on the larger craft. The total weight is about sixty pounds which is, we believe, the nearest approach to a practical commercial light-weight set ever before seen. Dr. de Forest, who has originated the device, has given a demonstration of it and claims a range of at least 10 miles, altho it will talk much further; and the speech heard is clearer than with his well-known 110-volt A. C. set.

The operation of it is quite simple. He incorporates into the device a transformer which operates on one of the storage batteries as do likewise the two rectifier bulbs which are the ordinary vacuum tubes procurable wherever radio instruments are sold. This transformer is slightly different from the regular spark coil type inasmuch as the vibrator is of a rocker-arm style and two cores are in the transformer proper. Thus when one side of the vibrator is attracted, the other side is away from the magnet. Whereupon the other side is immediately attracted and the first side moves away, just like the two pans on a balance or scale; when one is up the other is down. In this way a complete difference in phase of 180 degrees is obtained. The current is then stept up and rectified by the two audion bulbs which act here as rectifiers. One bulb only is used for transmitting purposes and is not of any special type. A lever on the side of the cabinet is thrown to the position marked "talk" whereupon the buzzer commences to vibrate and the outfit is placed in use for transmission purposes. When the switch handle is thrown in the opposite direction and the buzzer stops and the rectifying tubes suddenly go out, then the complete conversation from the distant wireless 'phone station can be heard. With an antenna having a capacity of .002 M.F. to .007 M.F. a radiofrequency current of 200 milliamperes is actually put into the antenna.

On the front of the cabinet are mounted the transmitter, the three tubes, a stopping condenser, a variable condenser and a milliammeter, together with a switch for changing the connections quickly.



The Very Latest in Radiophone Sets. It Talks on Two Six-Volt Storage Batteries—No "B" Battery Required. Just the Thing for Motorboats, Camping Parties, Motorcycle, Automobile or Airplane.

A Direct-Reading Microfaradmeter

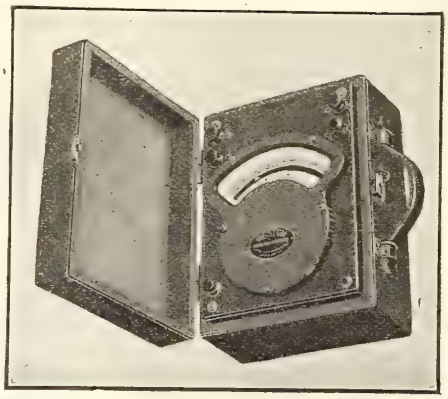
The increased use of condensers for a great variety of purposes has created a demand for a means of determining their capacity accurately and quickly. There has been a long-felt want for a more satisfactory means of determining the capacity of telephone, telegraph and power lines and cables, and altho many methods have been devised for measuring electrostatic capacity, some of them dating back to the pioneer days in the electrical art, there has not been a completely satisfactory means of accurately determining the capacity with ease and rapidity demanded by numerous commercial requirements, until this microfaradmeter was produced.

When the facility and precision with which capacity measurements may now be made with this new instrument is appreciated by engineers, much more attention will undoubtedly be devoted to them than has been commercially possible in the past.

To use this meter, it is only necessary to connect two of the four binding posts on its top to a suitable source of alternating current and the other two binding posts to the capacity to be measured, press the contact key and note the deflection of the pointer exactly as in the case of a voltmeter or ammeter. The movable system does not have springs or any other control, therefore the pointer may rest at any part of the scale when the instrument is not being used.

Variations in the voltage or frequency of the supply do not affect the accuracy appreciably, unless they amount to more than 15 per cent from the normal, and even much greater variations would not cause large enough errors to be of importance in most work. Two forms of this instrument are made. One is for operation on 60-cycle circuits and the other on 500-cycle circuits.

This direct-reading microfaradmeter is supplied with scales reading from .05 microfarad with 100 scale divisions, up to 10 microfarads with 100 scale divisions, for 130-volt circuits with 60-cycle frequencies. Other types of these meters are made for 500-cycle circuits of 100 to 130 volts potential.



Measure Your Condenser Capacities with This Direct-Reading Microfaradmeter—Don't Spend Hours Calculating It, Which Is Only Approximate, Anyway.

THE HAM'S COMPLAINT.

There is a certain class of radio amateurs, fortunate enough to own high power stations, who seem to take great delight in knocking, threatening and brow-beating "ham" operators. For the benefit of the uninitiated we will say that the "hams" are that odd group of air-hogs who operate those confounded little spark coils. According to the aforesaid amateurs, the "ham" is an unnecessary nuisance, and has positively no right to occupy any portion of the ether with his feebly propagated energy. The "ham's" side of the question has not been made public as yet. The spark coil ham was the first exponent of amateur wireless, not the 1 K. W. know-it-all. The deep roar of a power station is far more obnoxious to the fellow who is trying to copy some distant commercial station than the faint squawk of a one-inch coil. There are two reasons why all amateurs cannot have transformers. One is the lack of commercial current; the other, the size of the pocketbook. The fellows who think they are the whole cheese in a certain relay league suggest that the smaller stations keep quiet for a specified period every night. They do not offer in turn to shut up themselves once in a while, and give the spark coil a chance. One of these "bosses" gives portions of his *log* where he has written something as follows. "BVD BVD BVD BVD BVD BVD BVD de de de de XX XX XX XX XX XX XX ? ? ? ? ? sore neck gukrslm slt eggs for breakfast krrr krrrrr awk ssssss."

Even this is better than to hear a 1 K. W. eight miles away call a station in New York State for five full minutes, only to ask him —*what time it was!* Now, some agreement must be obtained or the "hams" will rebel. They will all bring their spark coils and batteries to a centrally located point, hook them all together and then proceed to sit on the key for six months!

M. C. MATHISON.

Glen Ellyn, Ill.

AUDION POEM CONTEST



THE poems which we publish on this page are a continuation of the Audion Poem Awards from our August issue. Dr. de Forest personally selected the poems which we already publisht as well as the poems which we publish herewith; they were considered the best ones from the 460 submitted to the Editor.

In closing this contest we wish to thank our poet readers for their whole-hearted and earnest co-operation in connection with this contest. It has shown us that our readers are not only interested in scientific matters but can become first class poets as well. It speaks well for their versatility.—EDITOR.

5TH HONORABLE MENTION. THE FRAIL SURVIVE THE STRONG!

Man-blown bubble of glass and wire!
Thy thread-fine filament
Still glowing with the God-like fire!
What has thy coming meant?

Whither on the crest of angry wave
Thy silent way pursue?
From what far shore dared ye to brave
The leagues of ocean thru?

Have you once felt the glowing juice
Thy filament enfold?
Did grid and plate the electrons loose
To sing their message bold?

Has worldly gossip filled thy mouth
Far on the lonely sea?
Or ghostly ship, to North or South,
In passing, spoke thru thee?

Have you, Triode, thrilled at the touch
Of one, a master's hand,
Who worked and nursed you overmuch,
To hear the distant land?

Have you the vigil kept with him
Thru dark and awful night,
While waves roll high and stars grow dim?
Have you been thru the fight?
Most fragile and most delicate
Of all things on that trip,
By what untold caprice of fate
Escaped the sinking ship?

O! Did nerveless hands out-thrust it
With purpose to confound?
Or did they perhaps entrust it
With a message never found?

Man-blown bubble of glass and wire!
Thy thread-like filament
Still glowing with the God-like fire!
What has thy coming meant?

No answer comes but this I know
From living over-long:
The frailest tube that man may blow
Oft times survives the strong!

Composed by
WALTER ELMO CHORPENNING.

Articles to Appear In September Issue of "Radio News"

"Wired Wireless" in the U. S.
By J. W. Kean
Radio Frequency Amplification
By A. S. Blatterman
A Trans-Oceanic Receiver
By Frederick J. Rumford
"Wired Wireless" in Germany
By Dr. Alfred Gradenwitz
Radio Telephony Simplified
By H. L. Beedenbender
The Arc or C. W. Transmitter
By J. Donald Haig
Ideas—Sixth Spasm
By Thos. W. Benson
"One of the Gang"
By Marianne C. Brown
Construction of a Loud Speaker
By H. Winfield Secor

6TH HONORABLE MENTION. TO AN AUDION.

Little audion, washed ashore
By the billows of the deep,
Where you once kept watch all o'er,
Guarding thousands in their sleep;
Thru long watches you, just you,
A guardian angel's beacon light,
Assured the passengers and crew
Their folks were safe, that all was right.

In the days of buccaneers,
Pirates, and the Spanish main,
Brave men's hearts were filled with fears
'Till their ships reached port again.
But now, thru you, we know each hour
What transpires on land and sea,
From a distant aerial tower,
Sending word to you and me.

You tell of fortunes lost and won,
Of prices on the stock exchange,
A mother who has lost her son;
Your work is varied, weird and strange.
You ofttimes play the villain's rôle,
Telling when a soul departs;
"The expedition's reached its goal,"
Bringing joy—breaking hearts.

How came you here, come—speak to me;
Why so silent, cold and pale,
You always spoke while on the sea,
Think you of a mighty gale,
A foundered ship and blackened skies
And lightnings like a mighty hell,
Which heeded not the terror cries
As a doomed ship creaked and rose and fell?

Trembling, dainty, little globe,
Let your terror now subside,
I'll send you to a safe abode,
A recompense for all you've cried.
No more I'll question you, I'll swear,
Of suffering and pain you've seen,
And you will have a home up there,
With playmates drest in red and green.

(*Continued on page* 574)

How to Become a Professional Radio Man

Part I

By PIERRE H. BOUCHERON

Inside Information Concerning the Ups and Downs of One of the Most Fascinating Vocations of Modern Times

FOREWORD.

Many letters are received by the editors of this and other magazines giving space to radio matters from young men asking the whys and wherefores of radio operating as a profession. That is to say queries of this nature: "How Shall I Go About It In Order To Become A Radio Man?" "What Books Shall I Buy?" "What School Shall I Attend?" "What Instruments Shall I Buy?" "How Much Money Does It Cost?" "What Are The Salaries And What Is The Status Of A Radio Man On Board A Ship?" "How Can One Secure A First Grade Commercial Radio License?" "Where Shall I Apply?" "What Are The Chances For Promotion?" "Can An Operator Learn Navigation And Eventually Become A Merchant Marine Navigating Officer?", Etc., Etc.

From this, it would seem that an article written by one who has experienced many of the stages incidental with this profession, in other words, one who has been "thru the mill" would prove timely indeed to the many young men who are at the present day casting long and copious glances in the direction of large seagoing vessels "equipt with the latest system of radio telegraphy".

The writer, in this case, has personally been thru many of the ups and downs, thrills and glooms, connected with this fascinating game. He began as a deep-dyed-in-the-wool "amateur." One day, armed with a letter of introduction to THE CAPTAIN (a mighty being was he, you may bet) and a ninety-eight cent papier-maché suitcase containing a nice new uniform with sparks and everything, plus a rather colossal quantity of nerve,—for he did not even know how to start a motor-generator set (no operating licenses were needed in those days)—he boarded a miserable tramp steamer loaded above her Queen's mark with bridge iron, which to him looked like a Mauretania, *and thereupon embarked upon a sea of enlightenment and adventures lasting the best part of six years. Two years later he secured an assignment to his first passenger ship, and four years afterwards quit the sea for good—his education in the great university of experience being that much ahead of many more conservative landlubbers.*

Should his attempt to throw a little light and encouragement on the subject interest some who are about to make the step to the point where they may wish to ask brief questions, he shall be glad to answer, providing a self-address and stampt envelope accompanies his letter.



Snap-Shot of the Author Taken Some Years Ago While He Was Attached to the S. S. Mexico as Senior Operator.

THE PROSPECTS.

NO, I am not going to start out by telling you that "A lot has been written in various magazines about radio operating, but very few if any have attempted to—etc., etc." It is going to be a straight-from-the-shoulder talk concerning those who are eligible to become professional radio operators, what is to be expected when one starts out, when these facts are establisht, how to go about it in order to become one, and finally, just exactly *how long* one should remain as such.

For the young man in his teens or in his early twenties who contemplates securing a license in order to become a *seagoing radio man*, the proposition as to whether or not he shall do so is indeed a vital and most important one and may be said to depend upon three basic facts. Is the young man just out of school and about to cast his lot into the great commercial maelstrom—or has he gone thru that period and is he now engaged in some sort of occupation which,—owing to its constant grinding and monotonous nature, is beginning to pall on him—to the extent that he is now wondering perhaps whether or not he is not a square peg in a round hole. Or, on the other hand, is he now engaged as an apprentice in some sort of a profession or trade and has decided that the pace is too strong for him and that the proverbial easy (?) life of a radio operator would be one of *least resistance?*

The first two cases are the only ones we will consider. The third is probably that of a quitter. We are not concerned with him, for he is not wanted; seagoing radio being indeed a *man's* game. Therefore, let our prospects weigh well their present status and future chances in their employment of today. To be sure, being hemmed in by four walls all day does not appeal to everyone. If they cannot see any future advancement, or if at best it is a hit-or-miss affair, or if they feel they must give vent to an inborn feeling of *wanderlust*, professional radio operating offers a possible solution. There are several bona fide, tried and proven reasons for this.

First, any young man from 18 to 25 years of age, possessed of a common school education and average intelligence may learn radio within a comparatively short time. By this is meant a matter of months, not weeks as some would have us believe.

Second, owing to the fact that an operator has the opportunity of traveling to many foreign parts of the world, he will, if he keeps his eyes open and his camera and note-book within easy reach, learn many things having to do with the broadening of his mind, wisdom and experience.

Third, by making profitable use of the great amount of spare time at his disposal between ports of call, he may study subjects allied with his chosen work and thereby prepare himself. Remember the words of Lincoln, "I will study and get ready and maybe my chance will come". It is needless to say that these should be uppermost in a young radio man's mind.

Fourth, one's *wanderlust* may be given full sway, for tell me of the man with real red blood running thru his veins who is not *blest* with a certain amount of it. Romance, adventure, excitement and danger beckons to one at every new port visited. The open sea, the never-ending sky line, the approaching storm—one is ever wondering what is going to happen next!

Five, radio telegraphy, like land telegraphy, has its Carnegies, Edisons, Hills and others who started their careers as telegraphers and became famous. Many high officials and well-known engineers of the foremost radio companies began as *seagoing* operators.

NECESSARY PREPARATION.

There is no great secret about learning radio. Particularly is this true of the seagoing operator. As previously mentioned the average young man possest of an ordi-



Sleeping Berth in the Radio "Shack" of a Typical One-Man Freight Ship, So-Called Because There Is Only One Operator and the Complete Radio Equipment Is Installed in the Same Room. Comfort Seems To Be the Keynote in These Well Furnished Quarters.

nary education and a keen interest will take to radio like a fish does to water, literally speaking. If he intends to see the game thru, however, and wishes to eventually become a radio engineer, that is another matter. For the latter, a high school education or some technical college work will prove of great advantage when he enters the realm of radio mathematics. Still, even this is not absolutely necessary. There are today many foremost radio engineers who have done much for the development of the art as well, of course, as many others masquerading under the title of R. E. whose mathematical knowledge was practically nil at the beginning of their careers. Some of these men, by burning the midnight oil on long sea trips and *by keeping a close watch on opportunities* eventually won minor positions on shore and, the game being in its infancy, soon won recognition in a comparatively few years. Even today, however, there is plenty of room for development and advancement and many radio problems remain still to be solved.

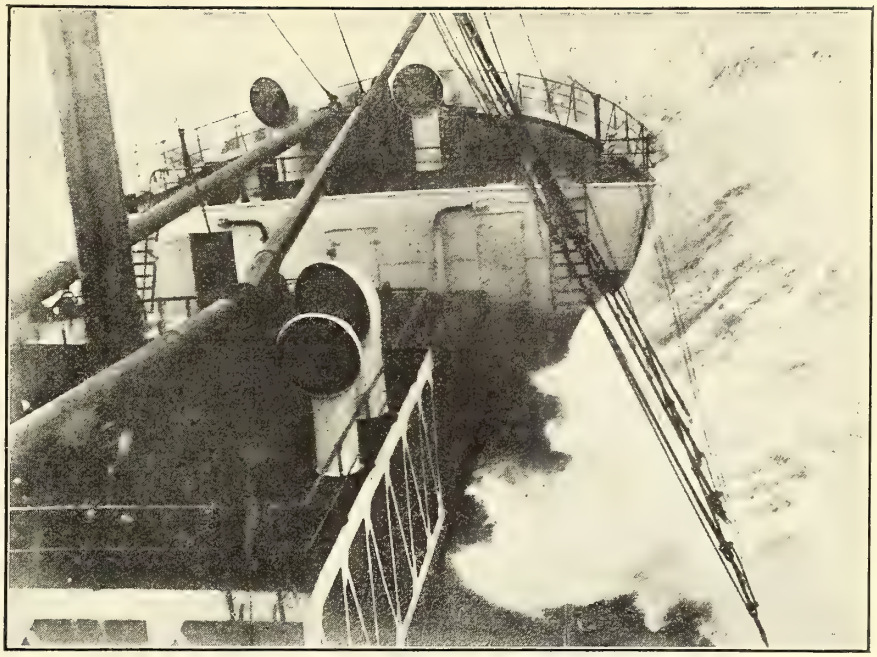
It may be said, incidently, that there are certain individuals who find it comparatively easy to break into professional radio operating. These gentlemen are land line telegraph operators familiar with either the Morse or Continental Codes; the radio amateurs or experimenters who have had several years experience with their home instruments, and finally but not least, the ex-Army or Navy men who had the good fortune to be taught the rudiments of radio communication in either the Signal Corps or some of the great naval radio training stations so often mentioned in the newspapers.

I quote below an excellent paragraph taken from a typical letter recently sent in by a young man who has given some attention and thought to the matter:

> "One of the best and most used means to enter this field is to get a commercial license and enter the Merchant Marine. It also pays exceedingly well and there is abundant opportunity to learn the art from the practical side. The most practical way to pass this examination if one cannot go off to a school is to procure an omnigraph and a few good text books and study by one's self, especially if he happens to be an amateur. However, in doing this several great difficulties present themselves."

This young man has sensed the right idea. There are indeed several difficulties which present themselves to one who is contemplating this study when not properly counseled. These difficulties and the way to overcome them will be given full attention in Part III of this article. That is to say, the proper procedure in learning to receive, to send, the theory of radio, and finally, the practical operating conditions.

Unlike most articles of this kind it is the mission of this one to first tell you about the external consideration connected with radio, telling you just what to expect and not to expect, its joys and sorrows, then when all these have been presented before you, if you still believe that the game will appeal to you, you will be in a more receptive frame of mind to tackle the serious business of the less interesting details of technical preparation. As a matter of fact some of the remarks mentioned here might well be taken to heart by full-fledged seagoing radio operators who still have a lot to learn concerning the business of getting along and making a real success of their work.



If You Have a Weak Heart or a Tendency Towards Chronic Seasickness, Keep Away From the Sea, For There Will Be Times When the Pouring of Tons of Water into the Main Deck of a Ship Is Very Likely to Prove Unpleasant and Cause a Sudden Disastrous Feeling in the Pit of Your Stomach. (Actual Photograph Taken at Sea During a Severe Storm.)

THE AMENITIES ON BOARD SHIP OR "HOW TO GET ALONG."

Many otherwise bright young men go to sea as operators with the idea that they are the *finisht* product of a popular and desirable profession. Some do not complete their first voyage before the realization comes to them that it is not so very amusing after all; and after a year or so of service resign with the firm conviction that the game is not worth while and that the experience has been so much wasted time.

Let us look into this business of going to sea a little deeper than seems to have previously been done. How many operators have started on their first voyage with even the most primary knowledge of what constitutes ship etiquette and discipline?

First there is the matter of discipline which often differs among ships of various companies and nationalities. Then there is the difference in the authority of various ship's officers. On some vessels the Purser seems to have considerable prestige; on others the Chief Steward is quite "some pumpkins," still others the Chief Mate, and so it happens that friction is often caused between these officers and operators due to varying and conflicting conceptions of what is right and wrong. Since operators are frequently transferred from one vessel to another, it would be well to remember the great need of politeness and tact toward officers with a view of adapting themselves to the conditions existing on that particular ship.



The Crew Went on Strike at a Foreign Port So the Ship's Officers, Consisting of Chief Officer, Doctor, Purser, Two Engineers and the Radio Man "Turn-To" in Order to Coal Ship. Note Author at Extreme Right.

For no apparent reasons, new operators often meet with coldness, even snubbing at the hands of some of the ship's crew. A volume might well be written as to the cause for this initial unfriendliness.

Suffice it to say that this is suggestive enough in itself and the reason not hard to find if one cares to inquire into the record of *former operators of that particular ship.* For instance, there is the case of a certain operator who, after his ship had left port bound on a three months' voyage to South America, went up to the British skipper and between flippant puffs of his cigarette coolly told him that if he had known beforehand he was being sent on *such a small vessel* he would not have sailed; he had thought it was one of the new and larger vessels of that particular line. The captain in a tone full of contempt at such stupendous arrogance answered that he could very well have done without him, and the result was that this operator, instead of being invited to the various social functions that prevail on this class of ships, was practically ostracized for the remainder of the voyage by most of the officers and passengers—the captain saw to that.

Another operator of 18 summers or less, upon being civilly requested by the Chief Officer to "stop sending" for a few minutes, while a sailor went aloft to fasten a guy-stay, thought he would demonstrate his independence from the rest of the ship's personnel by sending back a note to the officer saying, "Sorry *old man* can't stop now —piled up with biz".

As a matter of fact this cargo vessel was at the time many hundred miles from the nearest coast station with remote possibilities of the wireless man being "piled up" with traffic. Still another operator contested the right of the captain asking for the name of a passing ship, and so they go.

These may be extreme cases of ill-judgment and lack of tact on the part of opera-

(*Continued on page* 578)



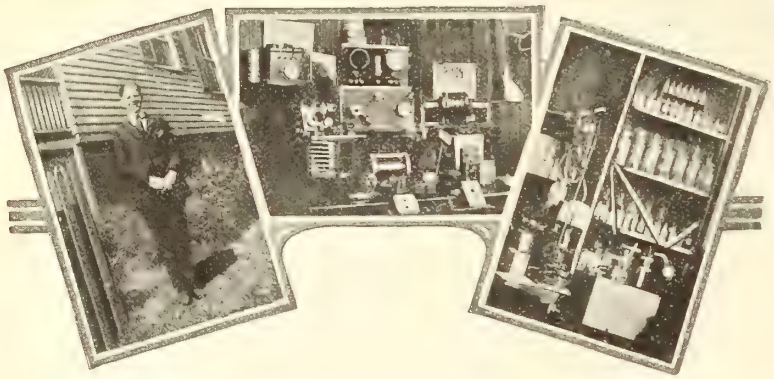
WITH the AMATEURS



Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

This Month's $5.00 Prize Winner—Stewart S. Perry



I AM sending three "shots" of my Electrical "Lab.", which is the result of three years' work. Most of the apparatus I have built myself, with the help of plans and suggestions in the ELECTRICAL EXPERIMENTER, to which I attribute much of my success in building apparatus.

The first photo shows the chemical end of the "Lab." Most of the chemicals are for use in electrical processes, as for example, distilled water and sulfuric acid for storage batteries, and nickel nitrate for nickel plating. I have, besides, quite a few solutions of acids, bases, and salts, and a complete developing and printing outfit for photographic work.

Another picture shows my wireless set, most of which I made myself. I am using an original hook-up which permits me to use either a crystal detector or audion bulb, and to shift readily from either of my small loose couplers to the large coils for undampt waves. I have two aerials, one a four-strand antenna about forty feet long, and the other a loop aerial. The large coils for undampt waves can be seen at the top of the picture. With a 42-plate condenser across the secondary, these coils will tune up to twenty thousand meters. Using them with an Audiotron vacuum tube detector, I have heard Lyons, France (YN). I use a "break-in" key which allows me to listen in even while sending, as long as the key is not actually prest so as to complete the sending circuit.

Another photo shows some of my miscellaneous electrical gear. At the top of the picture is an Audion control box. Directly below it is a step-down transformer. To the left (in front of the ELECTRICAL EXPERIMENTER) is my AC rectifier, which I use to charge storage batteries. The Tesla coil I use for experimenting.

There are a number of electrical apparatus which I use in some of my experiments and investigations which are not shown in the photograph here publisht. This includes electromagnets, condensers and rheostats, galvanometers, etc. I have carried on experiments with X-rays, radio and also experimented with high frequency currents developed from the Tesla coil shown in the second photograph. I have telephone instruments also which are distributed thru the house, as well as telegraph sounders, keys, etc. Most of my instruments and apparatus, particularly my radio instruments, are mounted up in neat hard wood cabinets.

I also have two three-cell storage batteries, several step-up and step-down transformers, several small motors, wave meter coils, telephones, etc. I am always after new ideas and would be glad to exchange "dope" with any amateur in the good old U. S. A. or elsewhere.—Stewart S. Perry, 38 Pleasant St., Winthrop, Mass.

Honorable Mention—Bernard P. Mulcahy, $2.00 Prize

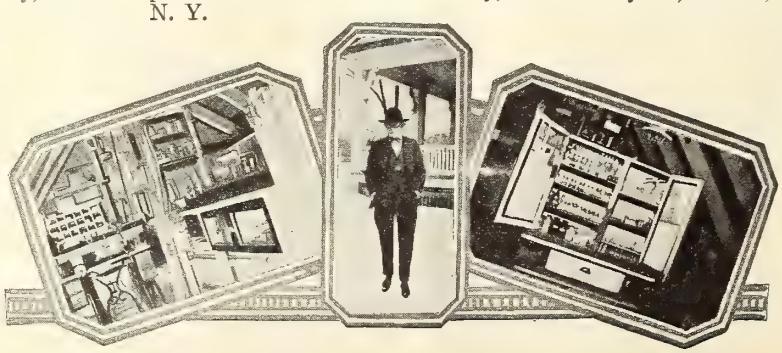
HEREWITH are represented a few photographs of my laboratory and workshop, constructed in an attic. Ingenuity was necessary in the building of the same, on account of the shape of the attic. While the photographs show simply the chemical department, I have, like most Amateurs, a large quantity of electrical apparatus, stowed away. Being greatly interested in Electro-chemistry, I work mostly along these lines.

It will be seen by the accompanying photographs, my workshop has in addition to the regular tools found everywhere, a lathe made from an old sewing machine. This lathe has a saw attachment whereby I can do small scroll saw work. All tools have to be arranged in as orderly a manner as possible, and yet be out of the way, lack of space not permitting my having extensive tool chests.

My chemistry outfit consists of a well equipt set of chemicals, almost 200 in number. In addition to the chemicals, the apparatus usually found in chemical laboratories serves its purpose. By being careful and keeping my breakage list down, I am able to keep this well supplied with all kinds of paraphernalia needed in my work.

A delicate balance which is essential for good work is also contained in the outfit. At present, my electrical laboratory is not so elaborately equipt, except for the purpose of Electro-chemistry, but I intend to broaden out later.

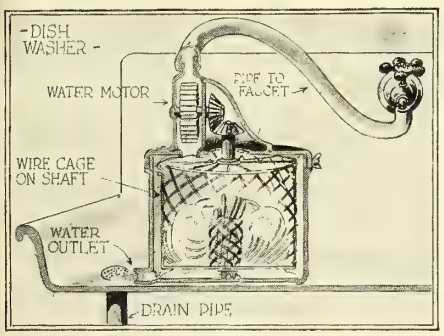
Wishing you a successful future for your exceptional publication.—Bernard P. Mulcahy, 305 Pulteney St., Geneva, N. Y.



What To Invent

By JAY G. HOBSON

OF all the important improvements needed around the home to lighten a mother's or wife's work and save their patience for cheerfully serving the men folk's whims, nothing is more in evidence than a *burnless cloth* for ironing boards.



What the American Housewife Needs by All Means Is a Cheap and Efficient Dish-Washing Machine. One Driven by a Water Motor From the Spigot Is Here Suggested.

An old sheet or piece of muslin is generally used which soon becomes scorched, dirty and torn, making linen and fine wearing apparel discolored and smell burnt when ironed. Silk goods are badly roughened on such and in addition to considerable waste in ironing board cloth there is no little loss in clothes ironed on the same. This unsatisfactory condition suggests a new kind of cloth for the purpose. One that I believe would prove acceptable to the great army of American housewives could be constructed in the cotton mills where muslin is woven. Asbestos fiber closely woven between and with the cotton fabric into finisht cloth should serve the need amply.

In other words a cloth woven of both cotton and asbestos fiber, arranging the asbestos so it overlaps the surface of the cloth. Then when woven run this non-burn material thru warm steel rollers to polish and press the surface down smoothly, which will prevent roughing silks and the like when ironed.

There is great need for a cloth of this kind in every home. It could be used for many purposes besides ironing boards, such as dining table covers, match pockets for men's clothes, lamp shades, electric insulation and numerous places where a burnless cloth of light, flexible texture is desirable. A large profitable industry could be quickly built from the sale of this invention, and it would be as substantial as the need is practical.

LAUNDRY MARKER.

I have a reputation for being a normal person with a love for fairness to all and malice to none, but I must confess that my balance of mind has recently been sorely tried with the confounded *laundry markers* now in use for men's sox. No doubt many of my readers fully sympathize in this predicament but to be more explicit I had better tell you all about it so you may help us disgruntled fellows invent something to eradicate this great annoyance.

Only yesterday I skinned a perfectly good leg on these rough metal markers while pulling on my sox in a hurry. The inventor who reduced this tormentor to a reality, certainly had a grievance against laundries in general, and chose this way to get revenge. History repeats itself again—the innocent must suffer for the mistakes of the guilty. Why any laundry uses this device is beyond my comprehensive powers.

It is a flat, sharp edged, shark toothed piece of non-rustable metal clampt over the top rim of the sock with a pair of pliers, there to stay until the owner gets so disgusted with them he either cuts that part of the sock off; or throws them away with a sigh of relief. This device is the most impractical invention I have seen and yet, many laundries keep right on using them as if they were a boon to mankind instead of a bore. A different marker is sorely needed for men's sox. One that will no tear them nor the flesh upon which they are worn must be invented to take the place of the inefficient kind now in use. An arrangement like the illustration would serve the purpose splendidly and should easily replace the present design, proving very profitable commercially.

This improvement would be so constructed that it can be quickly secured to the sox very much as the eye is put into the shoe. Being round, smooth and made of copper it is non-rustable, doesn't tear nor feel weighty in use.

SOFT DRINK DISPENSER.

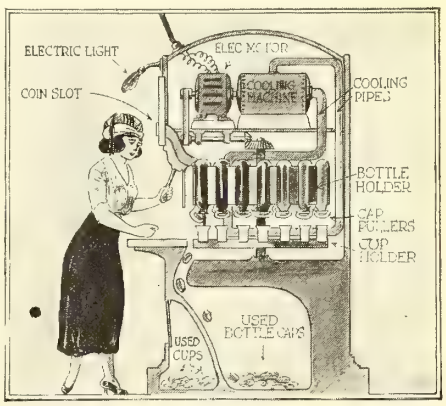
Millions of bottles of Coca Cola, Ginger Ale, Grape Juice and similar soft drinks are sold over fountains paying fancy rents for good business locations. Many bulk dispensers for these beverages have been introduced, but so far a practical dispenser for bottled drinks to be installed on busy street corners, in stations and public places has failed to appear. In my opinion here is the "germ" of a mighty valuable idea.

To perfect such a device to keep the product cool in Summer without ice, to remove the cap from the bottles, pour the drink into paper cups and issue it to the customer promptly, means a whole lot of hard study and work but it is not impossible for many reasons. To begin with the cooling problem is already solved in a new automatic electric cooling system now being nationally introduced by a large Chicago corporation for installation on refrigerators to entirely replace ice.

One of these could be used for cooling the drinks in the dispenser. The bottles could be stood on end with caps resting in individual cork pullers operated by the motor that runs the cooling machine. Paper cups are arranged directly beneath the bottle openings to catch the liquid as sold. The operation of this dispenser can be so timed that paper cups containing the drinks will not be pusht out to the customer until contents of bottle has had enough time to run out into the cup, and this entire operation should happen in less time than is now required to receive a drink at the fountain.



There Is Not a Single Satisfactory "Laundry Marker" For Hosiery on the Market—Why Not Invent a Good One and Make a Small Fortune?



Why Doesn't Some Genius Give Us Public Soda Fountains Which Will Dispense Bottles of Soft Drinks After a Coin Has Been Deposited?

To operate such a dispenser the customer places the coin required in the slot, pulls a small lever that swings a full bottle into position, waits a second, and then a paper cup containing the soft drink comes out thru serving opening within easy reach. Paper cups once used are thrown into receptacle at bottom of dispenser as illustrated.

AUTOMATIC HOME DISHWASHER.

To my knowledge there have been several unsuccessful inventions for washing the dishes of the average family. All of them have failed because they either were too expensive to own or operate, broke more dishes than they cleaned—or, worse still, never cleaned them at all.

There are several important items that enter into the construction of a successful dish washer. The retail cost must be within reach of the average family, the device must be as simple as possible, it must not break dishes in operation, water must be employed economically, it must not require the hands to be placed in the water, and above all it must *thoroly cleanse* the dishes and also dry them if possible.

One in the form of a round case, with another case made of wire to revolve inside the outer case, a small water motor secured on top to supply the power necessary and the outlet of the motor furnishes the hot water for cleaning the dishes as it rotates them. This constant agitation of the water and the revolution of the dishes in the water should thoroly clean them. When clean they could reman in the washer until dry.

A fortune of first magnitude will reward the successful efforts of the inventor who perfects a device for this purpose, but the greatest satisfaction will come from knowing the good accomplisht for the millions of women now washing their dishes by hand.

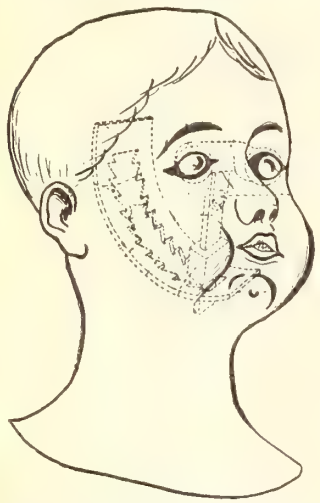
Copyright 1920 by J. G. Hobson.

LATEST PATENTS

Doll.

(No. 1,343,422, issued to Robert A. Thomson and Gordon Alvis.)

An ingenious idea indeed is this one whereby in a doll the eyes will close gradually when the doll is placed in a recumbent position, resembling very closely the appearance of a living child gradually closing its eyes as if going to sleep. The doll, of course, must be rocked from side to side in order to cause this effect. On awakening, or when the doll is placed into an upright position, its eyes open practically instantly. The structure consists of a toothed slot in which a pendulum

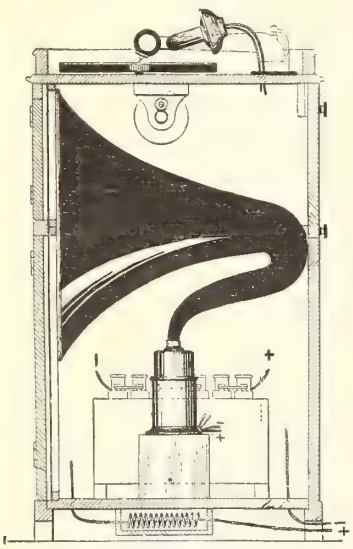


weight moves. This pendulum weight is directly connected to the eyes. When the doll is rocked from side to side the toothing arrangement allows the pendulum weight to slip a tooth in the guide with each rocking motion till finally the eyes of the doll are closed.

Sound Magnifying Phonograph.

(No. 1,329,928, issued to Edwin Stewart Pridham and Peter Lauritz Jensen.)

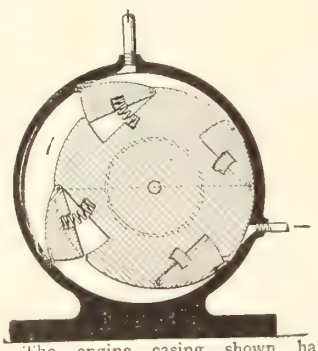
This novel device is a machine for magnifying phonograph records in large halls, auditoriums and out-of-door gatherings. The results are



accomplisht thru the application of a microphone transmitter, together with the ordinary sound box. The sound from the microphone transmitter is then carried thru to a magnetic amplifier thru an induction coil.

Rotary Engine.

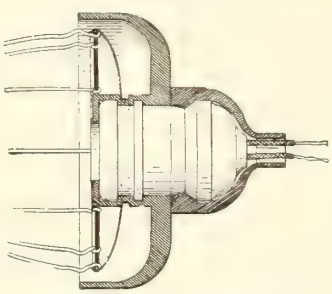
(No. 1,343,115, issued to George E. Current.)



The engine casing shown has two tubes leading into it, one to admit the fluid and another for the exhaust of that fluid. Within this is mounted the rotor, eccentrically, leaving a chamber which is wider at one end than at the other. This rotor has formed in the perifery recesses or pockets, four such pockets being shown in the accompanying diagram. Each of these is mounted pivotably and is of considerable weight, so that it will swing outwardly from the respective pockets by centrifugal force and upon passing the inlet of the liquid will be held in that position by the force of the fluid.

Electric Socket and Lamp Protector.

(No. 1,336,761, issued to Frederick Stolzenwald.)

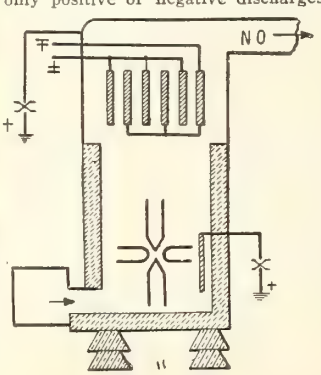


Two soft rubber protectors fit over the socket. When the socket is then pushed together into place and locked, the soft rubber pieces are joined together. Should the socket be dropt no injury to the lamp can be sustained, due to the bell-shaped guard surrounding the lamp and this elastic covering over the socket. In addition, the elastic medium is of exceptional insulating merit

Nitrogen Fixation.

(No. 1,334,590, issued to Jacob E. Bloom.)

Hot surfaces of metal, grounded in the proper manner, so that either only positive or negative discharges

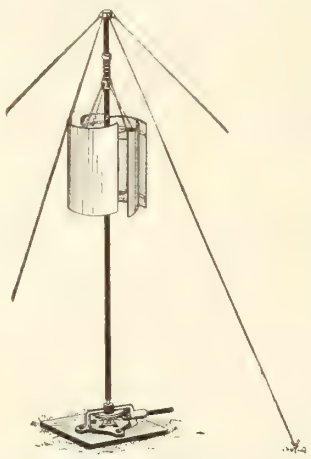


are produced are used, and hot refractory granules or crystals employed as absorbents until the proper oxidation is attained. A single phase A. C. current not exceeding 440 volts is employed and upon this is superimposed a direct current whose voltage is about 1½% of the A. C. voltage. In the tower for the purpose of obtaining nitric acid from gases and having them absorb by water, an electro-positive absorbent is used.

Windmill.

(No. 1,341,045, issued to Charles Fremont Currey.)

This invention relates to windmills in which the vanes are in an upright position so that the rotor turns about an upright axis, the vanes themselves being so constructed as to give maximum power

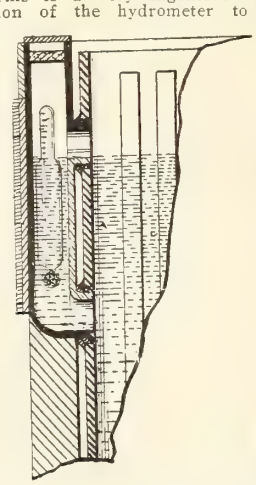


for a given wind velocity. By extending the blades it is possible to provide a rotor with a very large area of effective surface, and yet the fact that they hinge (so that a portion of the vane would turn inwardly while another turns outwardly), a very large effective area is possible without placing the mill in danger of collapsing or striking any guys which hold it in an upright position.

Storage Battery Indicator.

(No. 1,301,516, issued to Franklin G. Smith.)

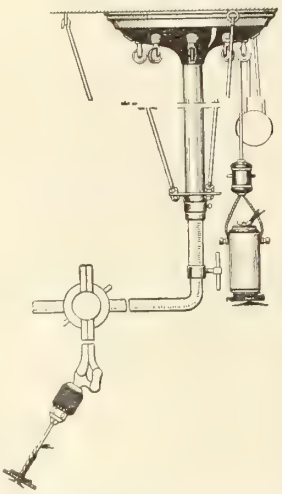
This is a very ingenious application of the hydrometer to the



storage battery wherein the hydrometer is permanently mounted in the face of the storage battery so that it cannot get lost, and at all times renders a visual reading of the battery condition, a matter of a mere second.

Electric Hair Curler.

(No. 1,340,738, issued to Arnaud Pausser.)

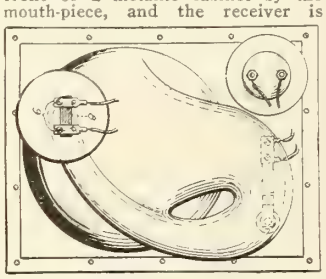


The hair is first twisted upon a rod and held in position by a nut on each end which grips the hair. The hair after having been moistened either with hot or cold water and wrapt with a moistened pad, is inclosed in an asbestos tube provided with electric heating units.

Telephone Set.

(No. 1,339,814, issued to Henry C. Egerton.)

The transmitter is mounted at the front of a metallic cabinet by the mouth-piece, and the receiver is

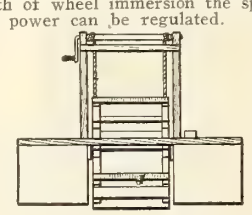


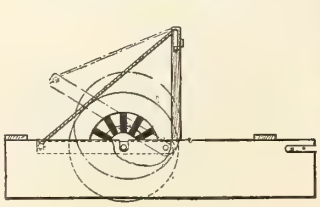
likewise mounted by its horn in the same cabinet. In this way the set, which can readily be placed into the wall of a vessel or a room, and particularly submarine vessels, is not subjected to the excessive vibration generally found in these vessels.

Water-Motor.

(No. 1,339,012, issued to William H. Ammons.)

The floats are so arranged as to create a deflecting pocket so that the moving water will be concentrated upon the wheel. By changing the depth of wheel immersion the speed and power can be regulated.





Scientific Humor

The Difference Between Thine and Mine.—Two mine engineers were discussing deep mine shafts, and one had told in glowing terms about mines in which he had worked.

"Jump into my car and I'll show you a regular mine," said the other.

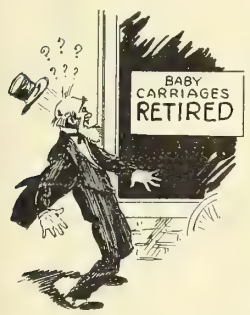
Arriving at the mine they saw the hoisting engine revolving at a terrifying rate. The engine-man was asleep. Rushing to the sleeping man, they cried:

"Wake up man! You'll pull the cage thru the roof!"

"What day is this?" the engine-man asked sleepily.

"It's Tuesday, but stop the engine, quick!"

"Aw g'wan," he replied, disgustedly, settling himself back in his chair. "She won't be up till Friday."—*J. H. Schalek.*



Probably on the Pension List.—"Are there no more babies in this town?"

"Why do you ask such a question?"

"Well I noticed a card in a repair shop window: *"Baby carriages Retired."*—*Wallace R. Harris.*

So That's Why It Smells So!—Ben Zeen: "I know a good joke about crude oil."

Carry Seen: "Spring it."

Ben Zeen: "It's not refined."—*J. H. Schalek.*

Besides It Gets Less!—Teacher: "What kind of a change is there from water to ice, John?"

Hopeful Student: "Change of price, Sir."—*Harold L. Schrock.*

Personal Magnatism.—Mollie: "Jane certainly attracts all the young men around here."

Gertie: "Sure, her father is a big steel magnate."—*Martin F. Keane.*



How About Peaches and?—1st Farmer: "I have made a plant that produces strawberries and cream."

2nd Farmer: "How?"

1st Farmer: "By grafting a strawberry plant on a milk-weed."—*Floyd G. Kirkham.*

Some Clock.—"Do you mean to tell me that clock will run eight days without winding?"

"Yes."

"Well, then how long will it run if you wind it?"—*Martin F. Keane.*

So That's Why We "Boil."—"What is steam?"

"Water in a high state of perspiration."—*A. G. Kalmbach.*

FIRST PRIZE $3.00



Filming the Pup.—"Father! Father! The bull-pup is chewing up the roll of ilms I got for ıy camera and won't let go!"

"Go and get some of that toothpaste that removes the film from the teeth!"—*J. H. Schalek.*

A Tidy Answer.—"Why do they have knots on the ocean instead of miles?"

"If there were no knots there wouldn't be any tide."—*Everett Brooks.*

Not at Present Prices.—Inquisitive Pupil: "Will electricity cure a person of anything?"

Teacher: "It will if enough of it is taken."—*No Name.*

A Slip Twixt Cup and Lip.—A small boy rusht into a drug store and excitedly called for some liniment and cement. When askt why he desired them both at once he said nervously, "Pa hit Ma with a cup."—*W. R. Windham.*

ALL jokes accepted and publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

Perfectly Logical.—Professor: "Young man, what is "Mineral Wool?"

Freshman: "The shearings from a hydraulic ram, sir."—*W. Buck.*

Next They'll Cross Ham and Eggs.—1st Farmer (With big idea): "Do you know what I am going to do?"

2nd Farmer: "No, what?"

1st Farmer: "I am going to graft beans, red pepper and tomatoes together and raise ready made Chili Con Carne."—*Theodore Streeter.*

"Applied" Astronomy.—She: "There goes a shooting star."

He: "You know that when a girl says she sees a shooting star, it means she wants to be kist."

She: "There goes a constellation."—*Sterling R. Decker.*



"Pointed" Wireless.—Askit: "What do you think of this scheme of telegraphing without wires?"

Tellit: "That's nothing new. My wife has been kicking my shins under the table for the last twenty years."—*J. H. Schalek.*

Solid Ivory.—Prof.: "What is density?"

Student: "I can't define it but *I* can give a good illustration."

Prof.: "The illustration is good, sit down!"—*Sterling R. Decker.*

Holy Smoke!—Johnny: "Mother, how old is that lamp?"

Mother: "About three years."

Johnny: "Turn it down then, it's too young to smoke."—*Carl Brecht, Jr.*

Alas—'Tis True.—Staff Photographer: "I've caught a snapshot of the fleeing gambler!"

City Editor: "Good! Now take a time exposure of the police in pursuit."—*No Name.*

Cheap, If It Keeps Her Beautiful.—"Since when have you become interested in chemistry?"

"Nonsense, that's my wife's toilet table."—*Daniel Blair.*



She'd Fetch a Good Price Today.—Sunday School Teacher: "Now who can tell me what happened to Lot's wife when she looked back at Sodom?"

Small Boy With Large Spectacles: "Please, teacher, she was transmuted into chloride of sodium."—*C. C. Sabin.*

Try This on Your Girl.—The chemist has a scene with his wife who finally breaks into tears.

"Your tears don't have any effect on me, —for what are they? A mighty small percentage of phosphorous salts and a trace of chloride of sodium—all the rest is water."—*C. C. Sabin.*

A Smashing Hit.—A lady who had her hand in a sling was explaining to a friend that the hurt was due to reckless driving.

"Of your auto?" asked the friend.

"No," said the sufferer, "Of a Nail."—*Ralph McRobert.*



This One Hails From London.—Sign in London Shop: Experienced Electrician for large Butcher's store used to mincing machinery and hooking up the lights.—*Geo. Heasman.*

Mr. Logwood Please Note!—Inquisitive Layman—"Is it true, they are using trees now for receiving radio messages?"

Radio Bug—"Yes, De Forest wireless is getting to be very popular!"—*Paul Briniotte.*



THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

LAMP COLORING FORMULA.

(1055) Prince Alhinini, New York City, N. Y., asks for:

Q. 1. A good coloring formula for lamp bulbs.

A. 1. Two of the best substances which suggest themselves as excellent vehicles of color and which are at the same time soluble in water are water-glass, its chemical name being potassium and sodium silicate; and gelatine. Into solutions of these substances in water are added some analin water soluble colors.

The thickness of this solution must be tried and ascertained by experiment. The globes prior to dipping, should be made as free of dirt, grease, etc., as possible. In using gelatine, it is not advisable to make it very thick, so that no appreciable layer will form, it being best that some non-drying material, such as glycerine be added, so as to prevent cracking.

WHY ISN'T THE EARTH UNBALANCED?

(1056) William H., Newark, N. J., writes:

Q. 1. Would like to ask you why the earth apparently continues to rotate without any appreciable variation when one half is possibly heavier than the other.

When large cities like New York are built heavy material is taken from one part of the earth's surface and added to the other part, this would make one part heavier.

Coal is taken from the earth and burned, don't this make the part of the earth lighter where the coal is taken? The burning of the coal still lightens the surface.

Why is it that this changing of weight does not effect the cycles of rotation?

Does the center of gravity change when great quantities of matter are transferred?

The above has got me thinking and thought I would like to hear what had occurred to others along the line.

A. 1. In our opinion, the amount of coal that is taken from different places of the earth and burnt in cities like New York, where the material is massed in one spot, is really so insignificant compared to the total mass of the earth that it would cut no more figure than the smallest fly speck would on the largest orange. That would be about the proportion.

While there is a difference in weight, this amount is so small that it would never be able to make any tangible difference. As a matter of fact, very much greater differences occur every day of the year due to rain or snow. These amount to tremendous proportions as compared to the weights of buildings in large cities. Still these differences are so small as compared to the total weight of the earth that they really amount to nothing at all in the long run.

DATA ON 2 K. W. RADIO TRANSFORMER.

(1057) M. E. Hulderman, Akron, Ohio, writes the Oracle:

Q. 1. Please give data for building a 2 K. W. radio transformer for laboratory work.

A. 1. Data on 2 K. W. 18,000-volt radio transformer for use on 110-volt, 60 cycle A. C. circuit:

Laminated Sheet Iron Core: The core should measure 17½ inches long by 8¾ inches wide, outside dimensions, and have a cross-section of 2¼x2¼. Both the longer legs should be well insulated with several layers of oiled linen.

Primary Winding: The primary winding will comprise three layers of 13½ lbs. No. 8 D.C.C. magnet wire. The primary contains 244 turns, and is wound on one of the longer legs.

Secondary Winding: The secondary winding will comprise 21 lbs. of No. 28 D.C.C. magnet wire, wound in 30 pies or coils, each ¼ inch thick, with suitable insulating discs placed between them in assembly. Each coil should contain 920 turns, or a total of 27,600 turns for the whole secondary. The secondary potential can be varied by bringing out taps on the end of the first, second and third layers of the primary. The secondary voltage with all primary turns cut in, is 12,440 volts; with 200 primary turns in the circuit, the secondary potential is 15,180 volts, and with only 100 primary turns in circuit, the secondary voltage equals 30,360.

HEATING OF TWISTED WIRE.

(1058) Armistead Andrews, of Memphis, Tenn., asks:

Q. 1. The reason for the violent heat generated when a piece of wire of large gage is vigorously twisted.

A. 1. The explanation of this phenomenon is due to the compression of the molecules that go to make up this iron wire and likewise the friction that results, causes the heating of the wire.

The wire need not be twisted vigorously to obtain this heat but can be obtained by merely bending the wire back and forth at short intervals.

POWER OF ELECTRIC LOCOMOTIVE VERSUS STEAM TYPE.

(1059) A. L. Simmonds, S. S. Caribbean, Cristobal, Canal Zone, writes:

The members of our ship are patrons of your magazine. A heated discussion has arisen in regards to an article in your June, 1920, number. This article, appearing under the title of "Electricity Triumphs Over Steam." Please answer these questions:

The General Electric Company, Engineering Department, advises as follows:

Q. 1. How heavy was the electric locomotive?

A. 1. 265 tons, of which 458,000 lbs. was on drivers.

Q. 2. How heavy was each steam locomotive?

A. 2. Passenger locomotive, 421,000 lbs. total weight, including tender; 173,000 lbs. on drivers. Freight locomotive 509,500 lbs. total weight including tender; 234,000 lbs. on drivers.

Q. 3. Was it at all necessary for the electric locomotive to be heavier than the two steam locomotives?

A. 3. An electric locomotive of the same total weight will outpull a steam locomotive because of the larger proportion of its total weight being on drivers.

Q. 4. What would happen were two locomotives of equal weight, but one having more power, to meet in such a contest?

A. 4. If the steam and electric locomotives were of the same total weight, the electric locomotive would outpull the steam for the reason given in question 3. If they have the same weight upon the drivers in each case the electric locomotive would still outpull the steam, as its motors deliver to the drivers a perfectly uniform turning motion, while the reciprocating steam engine with quartering cranks delivers about 88 per cent uniform turning motion to its drivers; hence with equal weight upon the drivers there is about 12 per cent differential in favor of the electric locomotive.

MAKING GUN COTTON.

(1060) D. M. Scott, Oakland, Cal., inquires of the Oracle:

Q. 1. For the formula used in making gun cotton.

A. 1. We give herewith the necessary data for the making of gun cotton.

Take one part by volume nitric acid, two parts sulfuric acid. Pour the nitric acid *very* slowly into the sulfuric acid, stirring constantly. Be sure to do this in the open, as the nitrous acid fumes are very dangerous and deadly. This will be found to heat up rapidly and must now be left in the open air to cool to normal atmospheric temperature.

Some cotton or celluloid is now obtained. After having washed it of its impurities in sodium hydroxide, and then in water until not even the slightest trace of the hydroxide remains, a test being made with litmus paper, it is dried. When thoroly dried, it is put into the sulfuric nitric solution, this being also done in open air. It is allowed to remain in said solution from ten to fifteen minutes, timing by a watch, then removed and placed in a running water bath. It is again washed in running water, until not the slightest trace of acid shows its presence, dried, and is ready for use. This will not explode if struck by a hammer, nor will it ignite, unless it is placed in a confined space or container.



Santa Fe Special WATCHES

"Meet Every Test Where Seconds Count"



The TEST

In the intense heat of engine service, with the shock and vibration of the train, with varying climatic conditions encountered around the world, the Famous "Santa Fe Special" watch has proved absolutely dependable to the last degree.

Standard Railroad Accuracy, Marvelous Beauty, Unsurpassed Life-Long Dependability

The ILLINOIS Famous $ Santa Fe Special 21 JEWEL RAILROAD WATCH 3.50 A MONTH

—are all combined in the highest possible degree in the famous **Santa Fe Special** Watch.

The Standard Railroad Watch that is GUARANTEED TO LAST A LIFETIME AND GIVE SATISFACTORY SERVICE. SAVE ONE-THIRD TO ONE-HALF OF YOUR MONEY by purchasing one of these famous "Santa Fe Special" Watches at our Rock Bottom price. MOST LIBERAL OFFER EVER MADE.

Our "Direct-to-You" low wholesale terms and **Extra Special Distribution Plan** is fully explained in the **new** Santa Fe Special Watch Book in full colors which shows the newest case designs and tells facts you should know before buying a Watch. The "Santa Fe Special Plan" means a big saving of money to you and you get the BEST watch value on the market today. **WATCH SENT FOR YOU TO SEE WITHOUT ONE PENNY DOWN.**

The extraordinary sale prices we are now making mean a tremendous sacrifice on our part, owing to the advancing cost of materials and skilled labor. All we ask is that every man who takes advantage of these low prices will tell his friends about the "Santa Fe Special" and the BUNN SPECIAL Watches.

The Santa Fe Watch Co.
980 Thomas Bldg. Topeka, Kans.



New Case Designs

You must see these remarkable watches in order to fully realize the marvelous beauty of these NEWEST DESIGNS; see the 3-color inlay work, think how distinctive your watch will be with your own name or monogram or an emblem inlaid in the solid gold. See the special New French Art designs in watch cases, or any special emblem or monogram combined to suit your own ideas.

Write today and receive the **free** watch book postpaid. All the **newest watch case designs** are shown. **Read our easy payment offer.** Wear the watch 30 days **Free.** Watch sent for your examination and approval without a penny down. Nothing to risk. **See the Watch** before you buy.

HON. CHAMP CLARK
House of Representatives
Washington, D. C.

"I have carried a 'Santa Fe Special' for three or four years and find it to be an admirable timepiece.

Champ Clark."

A letter, post card or this coupon will bring my Free Watch Book

SANTA FE WATCH CO.,
980 Thomas Bldg., Topeka, Kansas.

Please send me your New Watch Book with the understanding that this request does not obligate me in any way.

Name.....

Address.....

State.....



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6161B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____ 7-25-19

Present Occupation_____

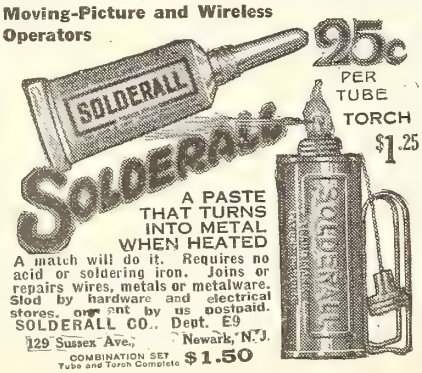
Street and No._____

City_____ State_____

A NECESSITY

For the Home, Shop, Garage, Automobile, Moving-Picture and Wireless Operators

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR



95c PER TUBE

TORCH $1.25

A PASTE THAT TURNS INTO METAL WHEN HEATED

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. E9
129 Sussex Ave., Newark, N.J.

COMBINATION SET Tube and Torch Complete $1.50

Dealers Send for Quantity Prices.

Home Electrics

By G. L. HOADLEY, M. E.

(*Continued from page* 497)

Return Call Bell Circuits.—By a *return call system* is meant a circuit in which the home push button will ring the distant bell and the distant push button will ring the home bell. With such a system when a station is signaled, the party called can signal back by pressing his push button.

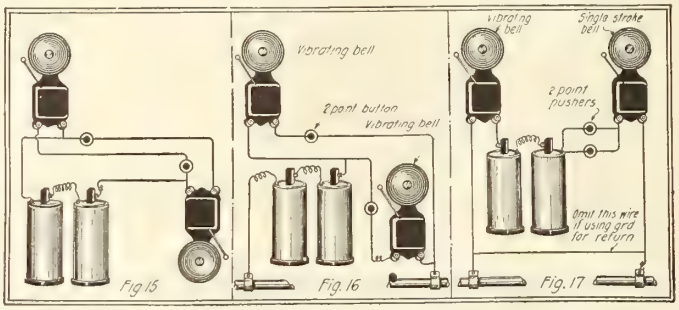
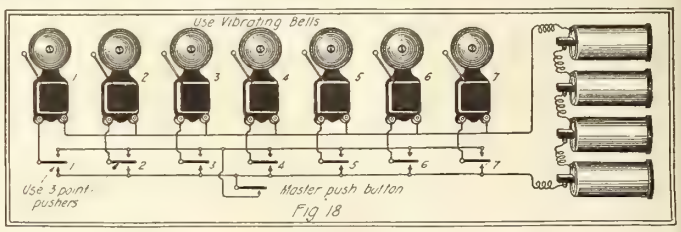


Fig. 18. Below Shows a Very Good "Master Call" Electric Bell System, Suitable for Schools and Other Institutions or Large Houses. Double Contact Push Buttons are Used in Order That All of the Bells May Be Rung in Case of Fire or Drills, Etc., By Depressing the Master Push Button.

Fig. 15. Three-Line "Return Call" Bell System, — One Battery Ringing Either Bell. Fig. 16. Two-Line Grounded Return Call System With Common Battery. Fig. 17. Three-line Return Call System, Common Battery.



Two Line Return Call.—Fig. 13 shows this type of circuit. Two batteries are required. The double contact push buttons needed have the line wire connected to the strap or spring in the button, the bell wire is connected to the upper contact. One line wire may be eliminated by using the earth for the *return path* as shown in Fig. 14. By using the ordinary push button in either Fig. 13 or Fig. 14 both bells will ring simultaneously.

Three Line Return Call.—Only one battery is needed for this circuit which is illustrated by Fig. 15 and ordinary two-point push buttons are satisfactory. An extra third wire is necessary, however, between the two locations. This third wire can be eliminated by using the ground for the return path of the current as shown in Fig. 16. With a circuit wired as shown in Fig. 17, the single stroke bell if used at the calling station shows the caller that the distant station is ringing because the single stroke bell is operated only by the ringing of the vibrating bell at the distant station.

Master Call System.—An installation suitable for a school building is shown in Fig. 18. Here, each school-room bell may be rung individually by its own push button. All bells will ring simultaneously by pressing the master button.

Bell System With Relay.—Fig. 19 illustrates the use of the relay to operate bells at a distance. Installing such a system, place the relay close to the distant bells and the local battery C as shown. Then, adjust the relay to work from line battery A. On pressing any one of the push buttons, a, b, c, current from battery A passes thru the relay at the distant station, making contact at y. This throws into circuit local battery C, which rings the bells, at the distant station. Only a very small current is needed to operate the relay itself and the weak current supplied from the distant battery, A, is amply sufficient.

Illustrating the Use of a Relay for Ringing Bells Over Long, High Resistance Circuits. Only a Small Current Is Required to Work the Relay.



Eclipses--How Caused

By A. M. HARDING, Ph.D.

(*Continued from page* 495)

Since the moon moves its own diameter every hour, it follows that an eclipse of the moon, when central, may continue total for about two hours. The refraction of the atmosphere of the earth deflects the sunlight around the earth into the shadow. Consequently, after the moon has buried itself in the shadow it is usually visible, shining with a reddish or copper colored light.

There is nothing mysterious about an eclipse of the moon. There is nothing between us and the moon at the time of an eclipse. The light has merely been turned out. The computation of a lunar eclipse is not at all complicated. These computations are made in advance and are publisht in the American Ephemeris and Nautical Almanac, Washington, D. C.

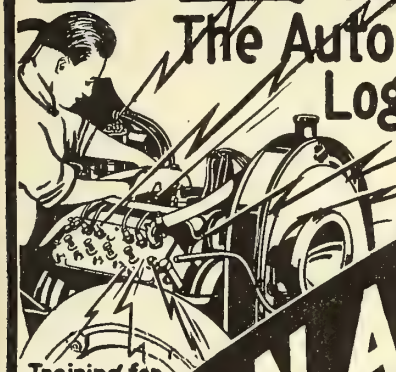
As the moon moves around the earth it cuts out the sunlight from a certain portion of space. That is, it has a shadow which moves along with it, remaining always on the opposite side of the moon from the sun. The average length of the moon's shadow is 232,150 miles. However, since the moon is not always at the same distance from the earth, this length varies from 228,000 miles to 236,000 miles. The average distance of the moon from the earth is 240,000 miles. Its shadow will, therefore, usually not reach the earth, *altho it may sometimes reach* 18,000 *miles beyond the earth's surface!* When it does reach the earth, those of us who happen to be in the shadow see a *total eclipse of the sun.*

(*Continued on page* 524)

DETROIT

The Auto Center is the Logical Place To

LEARN AUTOMOTIVE ELECTRICS



Training for Head and Hand

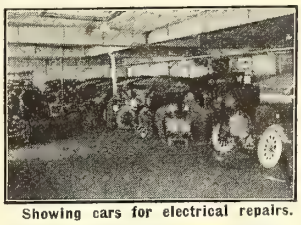
MEN WANTED

Factories, service stations, repair shops and garages are calling for automotive electricians and mechanics faster than we can supply them. In addition to the handsome salaries and quick advancement offered by employers there is a wide-open opportunity to start a business of your own. Ten million or more automobiles, trucks and tractors throughout the United States and Canada have created a tremendous demand for service stations, repair shops and garages — thousands of openings in good territory are awaiting you. Very little capital is required—but, of course, it is absolutely necessary that you know your business. Train in 10 to 12 weeks at the M.S.A.S.

WHAT WE TEACH



Showing part of electrical dept.



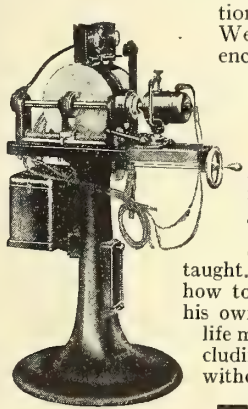
Showing cars for electrical repairs.



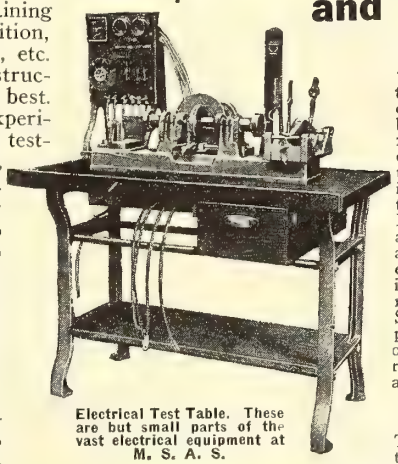
Showing corner in block test dept.

AUTOMOBILES AND TRACTORS

WE teach the automobile and tractor business from A to Z. Very thorough and complete training is given in electrics, starting, lighting, ignition, wiring, testing, repairing, including batteries, etc. Our equipment and instruction are positively the best. We give actual factory experience in assembling, block testing, bearing scraping, valve grinding road testing, etc. LIGHTING PLANTS, TRACTORS, BRAZING AND WELDING AND TIRE REPAIRING are also thoroughly taught. The student learns how to conduct a business of his own successfully, and is a life member of the school, including all service privileges without any extra charges.



One of the Electrical Test Tables used at M. S. A. S.



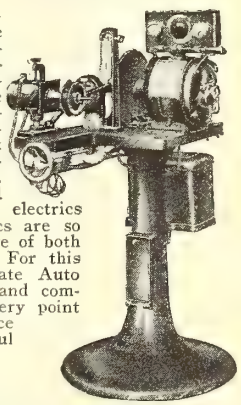
Electrical Test Table. These are but small parts of the vast electrical equipment at M. S. A. S.

LEARN THE AUTOMOBILE and TRACTOR BUSINESS

PUT your electrical experience to work in the world's greatest industry. Automotive electricians are the most valuable men in the automotive field. They earn the largest salaries. The importance of electrical work in the automotive industry is well recognized. Every electrician is well aware that automotive electrics and automotive mechanics are so entwined that a knowledge of both is absolutely necessary. For this reason the Michigan State Auto School gives a thorough and complete course covering every point of knowledge and practice required of a successful automobile expert.

EQUIPMENT

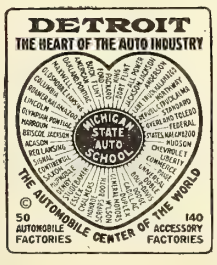
The M. S. A. S. is by far the best equipped school in America. Get our Free Catalog.



Electrical Test Table from M. S. A. S. Electrical Dept.

TRAIN IN DETROIT

Train in Detroit, the Heart of the Automotive Industry. You get a training here that is not possible elsewhere. More than 180 of the leading automobile and accessory factories are located in Detroit. 94% of all automobiles are manufactured within a radius of 100 miles around Detroit, and 71% are made right in this City.



The greatest automotive experts in the world are in Detroit and they helped outline our courses for you. The latest and best equipment is here.

All leading manufacturers endorse our school. Many of the leading manufacturers in each line assisted in outlining our Course and they give our students the fullest co-operation possible. They have placed their machines in our school for students' instruction. They are constantly calling on us for graduates because they know the type of men we turn out. Everywhere in the automotive industry M. S. A. S. graduates are given the preference because ours is the Factory Endorsed School.

FREE: BIG 124-PAGE CATALOG

Send the coupon today for big 124-page illustrated catalog and copy of latest "Auto School News." They tell about Courses—show more than a hundred pictures of equipment—give letters from big Factories and tell of successful graduates and point out opportunities for you. Use coupon now.

MONEY-BACK GUARANTEE

We guarantee to qualify you for a position as chauffeur, repair man, demonstrator, auto electrician, garage man, automobile dealer, tractor mechanic and operator or farm lighting expert, paying from $1,500 to $5,000 a year or refund your money.

Many of our graduates are making twice our guarantee.

SEND THIS COUPON TODAY

MICHIGAN STATE AUTO SCHOOL
668 Auto Building, 687-89-91 Woodward Ave.,
DETROIT, MICH.

Gentlemen: Please send me absolutely FREE New 124-page Illustrated Catalog, "Auto School News," and information as checked below.

[ ] Auto and Tractor Course
[ ] Tire Repairing
[ ] Brazing and Welding

(Mark each course you are interested in.)
Or, better still, you can expect me about

.....

Name .....

Street .....

City..... State.....

MICHIGAN STATE AUTO SCHOOL

"The Detroit Auto School" — *"Endorsed by all Leading Manufacturers"*

668 Auto Building
687-89-91 Woodward Ave. **Detroit, Mich., U.S.A.**



Choose as Your Profession
Electrical Engineering

Electricity offers a brilliant future to the young man who is about to choose his career. Never before has there been such wonderful opportunity in this great field. Big paying positions in electrical work the world over are open to trained men — men who possess specialized, practical knowledge. Come to the School of Engineering of Milwaukee — the largest and best equipped electrical school in America. Here you are trained in both theory and practice by a faculty of over 90 experts. You learn in large, finely equipped laboratories.

B. S. Degree in 3 Years

If you have 14 high school credits or equivalent, you can become an Electrical Engineer with a Bachelor of Science degree in 3 years. If you lack these credits they can be made up in our Institute of Electrotechnics in a short intensive course.

Earn While You Learn

By our special system you may earn your way while learning. Our Employment Department will secure you a position to which you may devote a part of each day, spending the remainder at the school. This plan both solves the students' financial problems and provides splendid experience at the same time. Low tuition fee and Fraternity House for all students who wish to secure board and room **at cost.**

Fall Term Begins October 1st

Write for Catalog

Write today for our free, illustrated catalog. Read about this wonderful institution and the great opportunities that lie before you. Find out about our specialized method of training and the details of our "Earn While You Learn" plan.

SCHOOL OF ENGINEERING OF MILWAUKEE
Dept. 1-J—373 Broadway, Milwaukee, Wis.

School of Engineering of Milwaukee,
Dept. 1-J—373 Broadway, Milwaukee, Wis.

Please send me your free illustrated catalog on Electrical Engineering and give me full details of your "Earn While You Learn" plan.

Name .....
Address .....
Town..... State.....
Age..... Experience.....

Send To-day for the
"Electrical Worker's Friend"

An electrical book of 66 motor drawings with complete instructions for rewinding and reconnecting A.C. motors. **Special at $4.00**
Or write for full particulars of this valuable book

SMITH & SMITH PUBLISHING CO.
Dept. B. 1524 Lowrie St., N. S., Pittsburgh, Pa.



Big Band Catalog sent free

Whatever you need—from a drumstick to the highest priced cornets in the world. Used by the Army and Navy. Send for big catalog; liberally illustrated, fully descriptive. Mention what instrument interests you. Free trial. Easy payments. Sold by leading music stores everywhere.

LYON & HEALY 62-86 Jackson Blvd. Chicago

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only 85 cents Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah

Eclipses—How Caused

(*Continued from page* 522)

It is evident that an eclipse of the sun is something entirely different from an eclipse of the moon. In the case of a *lunar eclipse* the moon is in the earth's shadow and we cannot see it, altho there is nothing between us and the moon. In the case of a solar eclipse we are in the moon's shadow and we cannot see the source of light, the moon being between us and the sun. When one thoroly understands the reason for an eclipse of the sun he cannot help but laugh at the following "headline" which once appeared in a daily paper of wide circulation on the day after a solar eclipse: "The moon casts its shadow on the *sun!*"

To the average person the sun and the full moon appear about the same size. This is due to the fact that, altho the sun is 400 times as large as the moon, it is 400 times as far away. Consequently, when the moon gets between us and the sun it is usually just large enough to cover the face of the sun and, since it is moving very rapidly, the sun is not hidden very long. In fact, the moon's shadow passes an observer near the equator with a velocity of 1,000 miles per hour. The speed is much greater in higher latitudes.

Since the moon is sometimes closer to the earth than at other times, it will sometimes appear larger than the sun. In this case a total eclipse may last longer than usual. For an observer near the equator an eclipse of the sun may remain total for seven minutes and 58 seconds, while in latitude 36° it cannot last longer than six minutes and 30 seconds.

If the moon is so far from the earth at the time of a solar eclipse that it is not large enough to hide the face of the sun, a *ring of light* will be left around the edge of the moon. This comes from the part of the sun which is not covered up. An eclipse of this nature, which is more frequent than a total eclipse, is known as an annular, or ring-shaped, eclipse. The eclipse of November 22, 1919, was an annular one. For an observer near the equator an annular eclipse may last for 12 minutes and 24 seconds. The duration of the annular eclipse of November 22 was almost up to the maximum.

The cross-section of the moon's shadow at the place where it strikes the earth is generally less than 150 miles in diameter. As has already been stated, everybody within the narrow strip where this shadow traverses the face of the earth will see the moon pass across the face of the sun. That is, they will see a total, or an annular eclipse, according as the diameter of the moon is or is not, large enough to cover the face of the sun. Everyone within 2,000 miles on either side of this strip will see a partial eclipse of the sun. That is, as the moon passes between them and the sun, its center will pass to one side of the center of the sun, leaving one limb of the sun visible all the time. Those observers who live near the narrow strip will see the eclipse almost total, or annular, while those 2,000 miles away will scarcely see any of the sun's disk covered up by the moon. In the case of the solar eclipse of November 22, 1919, the shadow strip began near San Antonio, Texas, and ran thru the Gulf of Mexico, along the northern boundary of South America, across the Atlantic Ocean, and ended in Africa. Everyone in this strip saw an annular eclipse. Those of us who were not fortunate enough to live in this strip saw the eclipse as partial, provided we were not living so far west that the eclipse ended before sunrise.

Altho it is possible for a year to pass without a single eclipse of the moon, the orbits of the earth and moon are so constructed that there must be as many as two solar eclipses every year and there may be as many as five. A year with five solar eclipses must have two lunar eclipses. Consequently there may be as many as seven eclipses per year. This will happen next in 1935. In the year 1917 there were seven eclipses, four of the sun and three of the moon. The most unusual number of eclipses per year is four and, as we have seen, the least possible number is two, both of the sun, and the largest possible number is seven, five solar and two lunar, or four solar and three lunar. In the year 1920 there will be four eclipses, two of the sun and two of the moon.

If the whole earth be taken into account there are more eclipses of the sun than of the moon. That is, the shadow, or the shadow produced, of the moon traverses some part of the earth more often than the moon goes into the shadow of the earth. The ratio is approximately three to two. However, if any given place on the earth be considered, the result is entirely different. The reason for this will be perfectly obvious after a little reflection. Let us remember that the full moon is visible from half the surface of the earth. Then everyone on one side of the earth will see it go into the shadow and since the earth is rotating rapidly on its axis many other observers who did not see it go in, will see it come out. Thus every lunar eclipse is visible from more than half the surface of the earth.

On the other hand, a solar eclipse is total, or annular, only for those who live in the narrow strip mentioned above. Suppose some inhabitant of Mars should reach his arm across the intervening space, and with a brush 150 miles wide, paint a streak at random across the face of the earth as it spins rapidly on its axis. What is the probability that your house would be painted? And you would not see the eclipse as total, or annular, unless your house *was* painted. In fact, unless you were close enough to smell the paint you would not even see a partial eclipse. That is, you could not tell by looking at the sun that anything was happening.

It is obvious that an eclipse of the sun can occur only when the moon is between the earth and the sun; that is, at the time of new moon. The solar eclipses in 1920 will occur at the new moons (May 17 and November 10) following the full moons (May 2 and October 27) at which the lunar eclipses occur.

The eclipses in any year always take place at two opposite seasons, which are called the eclipse months of the year. The eclipse seasons for the year 1920 are May and October-November. After the eclipse of November 10 there cannot be another for about six months.

Eclipses are periodic; that is, they occur at regular intervals. The period is 18 years and 11⅓ days. This period, which was known to the ancient Chaldeans, is called the Saros. All that has been said with reference to eclipses applies not only to us but also to the inhabitants of other heavenly bodies. It is rather unfortunate for those of us who are interested in eclipses that we do not live on Jupiter or Saturn. Each of these planets has nine moons which furnish a great variety of eclipses. These moons move around their primaries (worlds) so rapidly that eclipses of the sun occur every day or so and undoubtedly interfere with business if any business is transacted on these worlds.

Let us suppose that we live on the moon. Then when the moon goes into the shadow of the earth we would see an eclipse of the sun. Why? Because the earth would be between us and the sun. This eclipse would be very interesting since it might last as

(*Continued on page* 526)

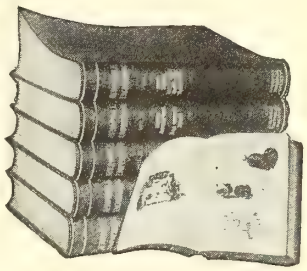
12 WAYS to Earn Bigger Pay

Look over the twelve wonderful home-study sets listed below. One of the twelve is YOUR BIG OPPORTUNITY FOR SUCCESS! Each set was prepared by the country's foremost authorities, written especially for you in the kind of language that you best understand. The first idea in the minds of the men who prepared these books was to help you make MORE MONEY. So they put into them everything that would help you, photographs, diagrams, complete descriptions; all the knowledge that you need to give you surest success.

The books are handsomely bound, some in half Morocco, library style; others in American Morocco, flexible handy style. All stamped in gold. Pick out the set that is meant for you; examine it FREE. If you are satisfied pay the special bargain price, on terms of 10c a day. If not satisfied, return the books.

Invest 10c a Day in Your Brain

Jump at this big opportunity. You will never miss the 10c a day, (less than cigar money). These volumes bring you the greatest opportunity to invest in your brain—in knowledge that will double or triple your earning power. If you expect to make bigger money, you must **feed your brain**, give it a chance to grow. These great volumes are **brain food** for **you.** Pick your set now and examine it free.



Send No Money

Don't send any money. Examine the books first. If satisfied pay for them on terms so easy that you will never miss the money. You take no risk. The books must show you that they will work for you, train you for a better, bigger-pay job. Fill out the coupon now. Pay only the very small shipping charges when the books arrive. If you mail the coupon at once we will give you FREE a year's Consulting Membership in the American Technical Society. This allows you to consult our corps of experts on any problem you may have. Ordinarily this membership costs $12. It is yours free if you act promptly. Mail the coupon before you turn the pages—before you can forget.

American Technical Society

Dept. X256
Chicago, U. S. A.

Carpentry and Contracting

Five volumes, 2138 pages and more than 400 illustrations. Prepares for Contractor, Building Superintendent and Carpenter Foreman. Regular price, $37.50. Special price, $24.80.

Civil Engineering

Nine volumes, 3900 pages and 3000 illustrations, plates and diagrams. Prepares for Civil or Structural Engineer, Transitman, Estimator, Designer or Chief Draftsman. Regular price, $67.50. Special price, $39.80.

Telephony and Telegraphy

Four volumes, 1728 pages and 2000 illustrations, plates and diagrams. Prepares for Telephone Engineer, Wire Chief, Exchange Manager, Trouble Man or Telegrapher. Regular price, $30.00. Special price, $19.80.

Mechanical and Architectural Drawing

Four volumes, 1578 pages and more than one thousand illustrations. Prepares for Architectural or Mechanical Draftsman. Regular price, $30.00. Special price, only $19.80.

Electrical Engineering

Eight volumes, 3000 pages and 2600 illustrations, plates and diagrams. Prepares for Electrical Engineer, Power Plant Superintendent, Substation Operator or Electrician. Regular price, $60.00. Special price, $34.80.

Fire Prevention and Insurance

Four volumes, 1500 pages and 600 illustrations, diagrams, forms, etc. Prepares for Counterman, Rate Clerk, Inspector or Agent. Regular price, $30.00. Special price, $19.80.

Automobile Engineering

Five volumes, 2400 pages and 2000 illustrations. Prepares for Garage Foreman, Automobile Mechanic or Chauffeur. Invaluable to car owners. Regular price, $45.00. Special price, $29.80.

Machine Shop Practice

Six volumes, 2300 pages and 2500 illustrations. Prepares for Machine Shop Superintendent or Foreman, Foundryman, Pattern Maker, Tool Designer or Tool Maker. Regular price, $45.00. Special price, $29.80

Sanitary, Heating and Ventilating Engineering

Four volumes, 1454 pages and more than 1400 illustrations, etc. Prepares for Sanitary Engineer, Heating and Ventilating Engineer, Master Plumber or Plumber. Regular price, $30.00. Special price, $18.80.

Steam and Gas Engineering

Seven volumes, 3300 pages and 2500 illustrations, plates, diagrams, etc. Prepares for Stationary, Marine or Locomotive Engineer or Fireman. Regular price, $52.50. Special price, $29.80.

Law and Practice

(with Reading Course in 25 bound pamphlets). Thirteen volumes, 6000 pages and 24 illustrations. Prepares for all Bar Examinations. A wonderful aid to business men. Regular price, $90.00. Special price, $49.80.

Accountancy and Business Management

Seven volumes, 2700 pages and 2000 illustrations, forms, etc. Prepares for Certified Public Accountant, Auditor, Office Manager, Accountant, Credit Man or Bookkeeper. Regular price, $52.50. Special price, $29.80.

American Technical Society,
Dept. X256, Chicago, U. S. A.

Please send me set of ..... for **7 days'** examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3.00 each month, until I have paid the special price of $..... If I decide not to keep the books, I will return them by express at your expense. Title not to pass to me until the set is fully paid for.

NAME .....

ADDRESS .....

REFERENCE .....

BE AN EXPERT IN
Automotive Electricity

Every auto repair shop, today, needs expert electricians to care for and repair the complex and important starting, lighting and ignition systems, as well as batteries. For the electric repairs on autos, trucks, etc., constitute 75% of all service work today.

BIG PAY

There are twice as many jobs as men. This insures steady work and big wages to trained men. They are the aristocrats of the auto field.

8 WEEKS COURSE

A course of 8 weeks of 44 hours each, at this institute—the only school teaching automotive electricity exclusively—you learn all the theory and actual practice of the complex electric systems of autos, etc.
In class room, laboratory and shop experience, electrical engineers train you in every detail.

LIMITED CLASSES

To insure individual instruction classes are limited to 20 men each. A new class starts every two weeks, and they are filling weeks in advance.

ENROLL NOW

Get started early—the demand for trained men is tremendous.
Lest you be disappointed in getting into the class you want, we urge you to get your reservation in at once. Write to Administrative offices for terms and dates of classes open.

AMBU ENGINEERING INSTITUTE
C. J. BUCKWALTER, President
R901-1603 S. Michigan Ave. CHICAGO

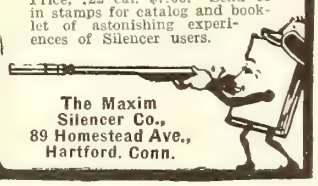
AMBU AMBU AMBU AMBU AMBU

Shoot Without Noise

Avoid disturbance, also flinching. Enjoy quiet shooting, anywhere, anytime. Use a

MAXIM SILENCER

Price, .22 cal. $7.00. Send 6c in stamps for catalog and booklet of astonishing experiences of Silencer users.



The Maxim Silencer Co.,
89 Homestead Ave.,
Hartford, Conn.

Discover Your Talents!

Why is it that some men make a success of everything they touch while others work their lives out, and remain failures?
Why is it that some climb to the heights with little effort while others plod along for a lifetime in the same old rut?
It's not luck, nor pull—it's knowing how to direct your energies most effectively. It's discovering where your talents lie, and putting all your efforts along the lines where you can succeed.
Don't struggle along any longer, **against your own personality.**
Let Dr. S. S. George, the eminent psychologist and former U. S. Army expert, help you discover your talents. Dr. George has made his lifework the analysis of men's abilities.
His mental and vocational analysis course with 1,500 vocations classified, will be mailed to you on approval. Don't wait a single day. Get in touch with your abilities. This service may be worth thousands of dollars and invaluable happiness to you. Send only $3.00 for complete course and lists.
MONEY REFUNDED IF NOT SATISFIED
At the end of 5 days, if you are not completely satisfied, we will refund your money in full.
Vocational Guidance Institute, 2255 Broadway, N. Y.

FREE TO PHOTOPLAY WRITERS

A wonderful book, illustrated with 100 potographs, of stars, directors, producers, scenes in the filming, studio interiors and exteriors. Literally takes you on tour of the great Motion Picture Studios.
It tells how Adrian Johnson, author of 300 produced photoplays by formulating a simple, practical, followable system of screen writing, has brought this fascinating profitable profession to your very door.
It is a system for persons of average intelligence. You need not be a "genius" to master it.
Send no money. Get this beautiful souvenir book today, for the asking.

The Adrian Johnson Photoplay System
111 American Theatre Building, New York, N. Y.

Eclipses—How Caused

(*Continued from page* 524)

long as two hours. Suppose, on the other hand, that the moon's shadow traverses the earth. Then we would see an eclipse of part of the earth. That is, we would see the moon's shadow pass across the earth at the enormous speed of 1000 miles per hour.

It may be of interest to mention some of the eclipses which have occurred since the dawn of history and to see how they were regarded by man and how they influenced his conduct.

One of the earliest eclipses of which we have any record is mentioned in the Old Testament. Joel (ii, 30, 31) makes the Lord say, "I will shew wonders in heaven and earth, blood and fire and columns of smoke; the sun shall be turned into darkness and the moon into blood." The reddish color which the moon assumes during a total eclipse seems to give rise to the expression "to turn the moon into blood." The phophet Amos (VIII, 9) says, "And it shall come to pass in that day, saith the Lord God, that I will cause the sun to go down at noon, and I will spread darkness over the earth in the clear day."

Again, Job (V, 8) says, "Seek Him that maketh the seven stars and Orion, and turneth the shadow of death into the morning, and maketh the day dark with the night."

Schiaparelli, in his interesting book *Astronomy in the Old Testament,* calls attention to the fact that total eclipses of the sun were visible in Palestine on the following dates: August 15, 831 B. C., April 2, 824 B. C., and June 15, 736 B. C. He also mentions the fact that both the eclipse of 831 B. C. and that of 824 B .C. occurred during the lifetime of Joel and Amos, and that the moment of greatest darkness in 831 B. C. occurred in southern Judaea at noon. The two prophets seem to have written of a phenomenon which both of them had witnest.

Several of the later prophets referred to eclipses of the sun. However, in view of the fact that there were no eclipses of the sun visible in Palestine between 763 B. C. and 586 B. C., it is very probable that they obtained their ideas from the earlier prophets. We quote three references.

Micah III-6: "And the sun shall go down over the prophets, and the day shall be dark over them."

Jeremiah XV-9: "Her sun is gone down while it was yet day."

Isaiah XIII-10: "The sun shall be darkened in his going forth, and the moon shall not cause her light to shine."

There are several other references to eclipses of the sun and the moon in the Old and New Testament. For example, Job V-14: "They meet with darkness in the daytime and grope in the noonday as in the night." Matthew XXIV-29: "Immediately after the tribulation in those days shall the sun be darkened, and the moon shall not give her light."

Herodotus tells us that during the sixth year of the war between the Medes and the Lydians, while the armies were in the midst of the combat, the day suddenly changed into night; whereupon the combatants stopt fighting and establisht peace. Astronomers tell us that this eclipse occurred on May 28, 585 B. C. This eclipse was predicted by Thales of Miletus, one of the Seven Sages, who had obtained his knowledge of astronomy from the Egyptians.

Pericles understood the nature of eclipses and, when an eclipse of the sun threatened to interfere with one of his expeditions, he managed to convince his soldiers that they had nothing to fear.

Christopher Columbus used his knowledge of eclipses to free himself and his companions from the American Indians, who held him prisoner and had reduced him almost to starvation. He happened to remember that an eclipse of the moon was due to occur on March 1, 1504, and he told the Indians that he would cause the moon to go out if they did not bring him food. They paid very little attention at first but when the moon disappeared they brought him plenty of food and worshipt him as a "God."

What's Wrong with the Motor Car

By H. WINFIELD SECOR

(*Continued from page* 479)

fact that you are wont to tear along the road at a speed of from 30 to 50 miles an hour, which is the common one with fast Flivver drivers, you must pay for the fuel and burn the energy and enough gasoline to develop 20 to 25 horse-power!

"And what else can I do?", you will ask. Here is what can be done, and just exactly what is being done, in many European countries which are yet smarting under the terrible lash of the World War and its aftermath. In Germany and several other countries, particularly in England, there have been developt several very interesting and thoroly practicable types of *lightweight,* low powered vehicles.

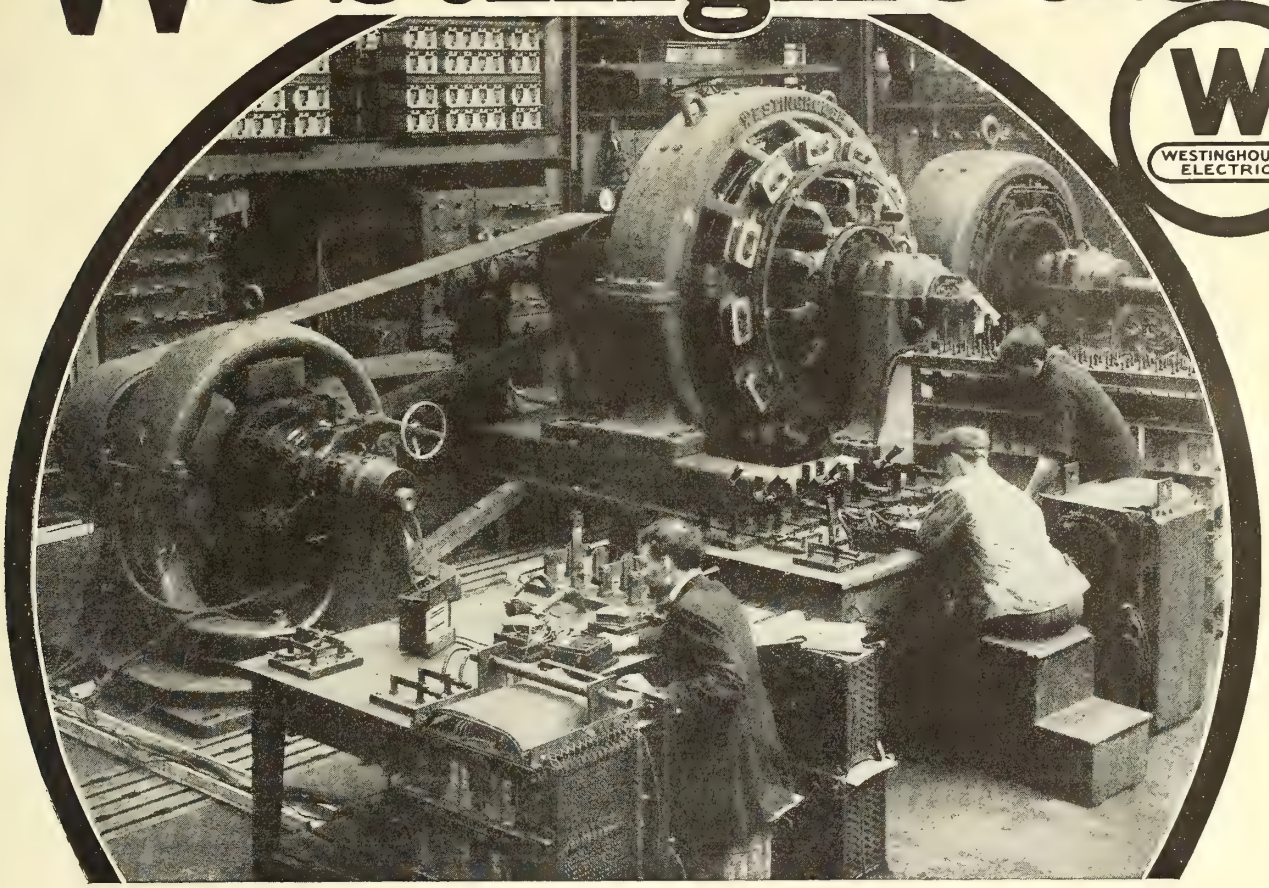
WHY 15 TO 20 MANEUVERS TO DRIVE YOUR MOTOR?

Another important principle and fact which is apparent even to the casual observer if he stops to look at an up-to-date motor car, is the very *complicated procedure* required in handling the vehicle. We do not see many women drivers—only now and then. Why is this, do you suppose? Not necessarily because the gentler sex is afraid of the noise or anything else, but simply because women like to have things (especially machinery of any kind) operate as *safely* and as *simply* as possible; and they have a perfect right to expect this!

The accompanying illustrations show some of the almost unbelievable maneuvers and movements which the modern motor car driver often has to go thru in order to properly drive an automobile of the average type. This is not exaggerated or especially gotten up for the purpose of making a story, either. The writer checked up this matter carefully by referring to standard automobile text-books, and some of the well-known makes of cars in which the devices to be operated by the chauffeur or driver, vary from 10 to as high as 20 and more different parts, such as the Cadillac, the Packard, and several others; but you don't have to pick out any particular car; simply walk up to the first one you see on the street and look it over.

One of the latest inventions of present interest and demonstrated at the last New York Auto Show, was a fluid turbine drive or transmission which eliminates all gears and gear shifts, permitting all speeds and any variety of them to be obtained by the manipulation of a *single lever!* It can be fitted on any car and relegates the gear box and 4 or 5 position lever quadrant to the scrap pile, where it belongs. All you need is a speed control lever, steering wheel and one foot pedal for the brakes.

Westinghouse



An Unusual Opportunity For An Electrical Career

Earn While You Learn

To the electrically or mechanically inclined high-school graduate, The Westinghouse Company offers NOW—

An opportunity to secure technical training in the atmosphere of industry, under the guidance and instruction of experienced electrical engineers.

Instruction in the construction and application of electrical apparatus, generators, motors, transformers, electric railway equipment or instruments.

An opportunity to earn while you are learning. To choose that phase of work, engineering or commercial, to which you are naturally inclined and fitted. To qualify for a responsible position in the field of engineering with the Westinghouse organization.

A class of thirty selected men will begin September 1. If you are interested in electricity and have not been able to go to college, this is your opportunity.

Apply in your own handwriting for further information to

THE EDUCATIONAL DEPARTMENT

Westinghouse Electric & Mfg. Company

East Pittsburgh, Pa.



A Big Raise in Salary

Is Very Easy to Get, if You Go About It in the Right Way

You have often heard of others who doubled and trebled their salaries in a year's time. You wondered how they did it. Was it a pull? Don't you think it. When a man is hired he gets paid for exactly what he does, there is no sentiment in business. It's preparing for the future and knowing what to do at the right time that doubles and trebles salaries.

Remember When You Were a Kid

and tried to ride a bike for the very first time? You thought that you would never learn and then—all of a sudden you knew how, and said in surprise: "Why it's a cinch if you know how." It's that way with most things, and getting a job with big money is no exception to the rule, if you know how.

We Will Show You How

Without loss to you of a single working hour we can show you a sure way to success and big pay. A large number of men in each of the positions listed are enjoying their salaries because of our help—we want to help you. Make check on the coupon against the job you want and we will help you to get it. Write or print your name on the coupon and send it in today.

AMERICAN SCHOOL OF CORRESPONDENCE
Dept. G-626 CHICAGO, ILLINOIS, U. S. A.

American School of Correspondence, Dept. G, 626 Chicago, U. S. A.
I want job checked—tell me how to get it.

....Architect. *$5,000 to $15,000*	....Lawyer. *$5,000 to $15,000*
....Building Contractor. *$5,000 to $10,000*	....Mechanical Engineer. *$4,000 to $10,000*
....Automobile Engineer. *$4,000 to $10.000*	....Shop Superintendent. *$3,000 to $7,000*
....Automobile Repairman. *$2,500 to $4,000*	....Employment Manager. *$4,000 to $10,000*
....Civil Engineer. *$5,000 to $15,000*	....Steam Engineer. *$2,000 to $4,000*
....Structural Engineer. *$4,000 to $10,000*	....Foreman's Course. *$2.000 to $4,000*
....Business Manager. *$5,000 to $15,000*	....Photoplay Writer. *$2,000 to $10,000*
....Certified Public Accountant. *$7,000 to $15,000*	....Sanitary Engineer. *$2,000 to $5.000*
....Accountant and Auditor. *$2,500 to $7,000*	....Telephone Engineer. *$2,500 to $5,000*
....Draftsman and Designer. *$2,500 to $4,000*	....Telegraph Engineer. *$2,500 to $5,000*
....Electrical Engineer. *$4,000 to $10,000*	....High School Graduate. *In two years.*
....General Education. *In one year.*	....Fire Insurance Expert. *$3,000 to $10,000*

Name.....Address.....

"Liquid Air"

By PROF. T. O'CONNOR SLOANE, PH. D.

(*Continued from page* 474)

liquefaction of air has led to the discovery of the rare gases of the air, neon, cription, xenon and niton.

EATING LIQUID AIR

When liquid air is poured out into the atmosphere, as over the hand, it produces a sort of smoky vapor. This is due to the condensation of the moisture of the atmosphere and it may be of carbon dioxide, jroducing quite a striking effect. It may be taken into the mouth, when the cloud of condensed water vapor is still more pronounced. It is said that it has even been swallowed without permanent ill effects. It must have been rather inflating to say the least.

If placed in unsilvered vacuum receivers, a considerable ebullition will first be observed, and the outer vessel will soon become clouded with water from the air which eventually freezes, giving a coat of hoar to the glass.

It may be placed in a vessel which is then tightly corked. In a short time the air will blow the cork out with any degree of violence, according to how tightly it was forced in.

A test tube full of mercury freezes solid after a short immersion in liquid air and can be taken in a wooden test tube holder and made to drive a nail. The old trick done in the arctic regions by natural cold may be done here *by freezing a bullet of mercury in a mould and firing it thru a board.*

A soft lead wire is wound into a spiral. When cooled to liquid air temperature it is highly elastic and supports a weight as if it were brass or steel. But if warmed by standing in the air or by blowing upon it, the elasticity disappears and the wire straightens out.

Iron becomes brittle. An iron flask which has been chilled by it can be broken by a hammer as if it were glass.

A kettle of liquid air will boil slowly in the air; to make it boil violently it may be placed on a lump of ice.

Liquid air makes india rubber brittle. A piece immersed in it becomes like glass and can be fractured by a blow. A piece of beefsteak can be treated in the same way and will break into fragments.

If an iron or other ball of metal is dipt into liquid air and kept in it until it attains the temperature of the air and is then placed in a Bunsen burner gas flame it will precipitate a cloud of carbon dioxide and of water vapor from the products of combustion of the gas notwithstanding the heat of the flame.

Oxygen is strongly magnetic; the liquid can be attracted like iron filings by a powerful magnet; air will act in the same way when liquefied, on account of its oxygen constituent. If the temperature of the air is reduced so as to freeze the nitrogen, a magnet will draw the liquid oxygen out of the partly frozen mass.

Electrical Machinist

By H. WINFIELD SECOR.

(*Continued from page* 508)

noise. A very important thing to watch in this connection and a problem which should be checked whenever possible by means of an angle gage, calibrated in degrees, is the *pitch* of the blades.

"What to do when the armature strikes the field poles,"—is often a serious question. There is one correct remedy for this trouble, and that is to rebush the bearings or else replace the old worn bearings with new ones, so that the armature will rotate in its exact central axis, between the field pole.

Figure 3-A shows an armature placed in the lathe and driven by a dog in connection with the face plate, tooling off a fine cut with a diamond point steel tool.

One of the simplest remedies resorted to when the bearing plates seem to lock the armature, preventing its free rotation, when they are clampt into place on the field frame, is to use two or more metal *shims* placed behind one side or the other of the bearing plate or plates, as occasion may demand, so as to get the bearings into alinement in order that the armature shaft can rotate freely. This is simply a case of "cut and try" until you can make the shaft rotate with the minimum degree of friction.

Learn Electricity



In the Great Shops of COYNE

IN 3½ MONTHS

Thousands of Electrical experts are needed to help rebuild the world. Come to Chicago to the great shops of Coyne and let us train you quickly by our sure, practical way backed by twenty-one years of success. Thousands of our graduates have become experts in less than four months. *You* can do the same. *Now* is your big opportunity. Come—no previous education necessary.

Earn $150 to $500 a Month

in the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position.

Electro Automotive Training Included

Our big new electrical course now includes a complete training on the electrical systems of automobiles: Lighting, starting, ignition and storage batteries. We have complete automobile chassis, motors on the block, thousands of dollars' worth of magnetos, lighting, starting and ignition systems. Every department has been enlarged.

Earn Your Way

Hundreds of our students every year work in their spare time and earn their living expenses. Others work in the day time, earn all their expense and attend our evening school. Our employment department will help you without charge.

Day or Evening Courses

Don't worry about the money. Anyone with ambition can learn here. Our tuition is low with small easy payments if desired. All tools and equipment furnished free. Our students live in comfortable homes in the best section in Chicago—on the lake—just a few minutes' walk from our school.

Drafting
Motion Picture Operating

We also teach these professions quickly and in such a thorough, practical way that when finished you are ready to step right into a position of responsibility and big pay.

Send Today for Big Free Book

Write today, *now*, for the book. It tells what Coyne graduates have done. What you can do. Fill in the coupon, check the trade you are most interested in or send a postal card, do it *now*.

Learn Drafting

Our electrical course includes drafting, but if you want to specialize in this big profession you can do so.

The country is crying for skilled draftsmen in all lines. Thousands of positions open with princely salaries. We give you the advantage of our big shops. No other school can do this. Now is the time to get into this big field. Experts train you under practical working conditions, no books and theory go here. Check drafting on the coupon below and mail it *at once* for full particulars.

BENNETT W. COOKE, *President*
COYNE TRADE AND ENGINEERING SCHOOLS
Dept. 29 39-51 E. Illinois Street, Chicago, Ill.

MAIL THIS COUPON NOW!

COYNE TRADE AND ENGINEERING SCHOOLS
Bennett W. Cooke, President
Dept. 29, 39-51 E. Illinois St., Chicago, Ill.

Please send at once your big Free Book—I am interested in
[ ] Electricity [ ] Drafting
[ ] Motion Picture Operating
(Check trade interested in)

Name.....

Address.....

The Magic That Makes Men Earn More

HERE is the new edition of Practical Applied Electricity—The eight famous books that put the big pay in the pay envelope. Chuck full of the latest methods and discoveries in this fascinating field. They were written by some of the greatest electrical engineers and experts in the business just to help you men who are interested in electricity realize your ambitions.

Not one man's ideas and experience but the combined knowledge of the world's master electrical minds—everything you need know about electricity is explained in plain everyday English that anyone can understand. Eight big books — more than 4,000 pages — over 3,000 blueprints, pictures and diagrams. See the partial list of subjects covered, below, the list of big paying jobs that are open to men who "know how" and our FREE offer that puts a whole set in your home for a week without your sending us one cent.

Big Pay For Trained Men

Jobs paying from $2,000.00 to $5,000.00 yearly are waiting for men who can qualify as Electrical Engineers — Substation Operators — Trouble Men — Switchboard Operators — Dynamo Tenders — Electricians. Even salaries as high as $150.00 a week are not uncommon.

Practical Knowledge Always in Demand

If you are trained in some branch of electricity like you can train yourself with these books you will never have to look for a job. The job and the big pay that goes with it will be looking for you. You can't dodge a good job if you have the "know how" under your hat. Don't go along year after year depending on a small raise now and then. It takes a lifetime to get you ahead that way. Learn electricity and jump ahead. Let these 27 great engineers help you on your way with their books. Sending the coupon on the opposite page is your first jump on the road to real success.



Vol. I. Principles of Electricity; Static and Current Electricity; Circuits; Dynamos and Motors; Telephones; Construction, Operation and Repair of D. C. Dynamos and Motors; Storage Batteries.

Vol. II. Alternating Current Machinery; Construction, Operation and Repair; Switchboards; Synchronizers.

Vol. III. Dynamo Designing; Armature Winding; Design of Motors; Construction and Operation of Transformers.

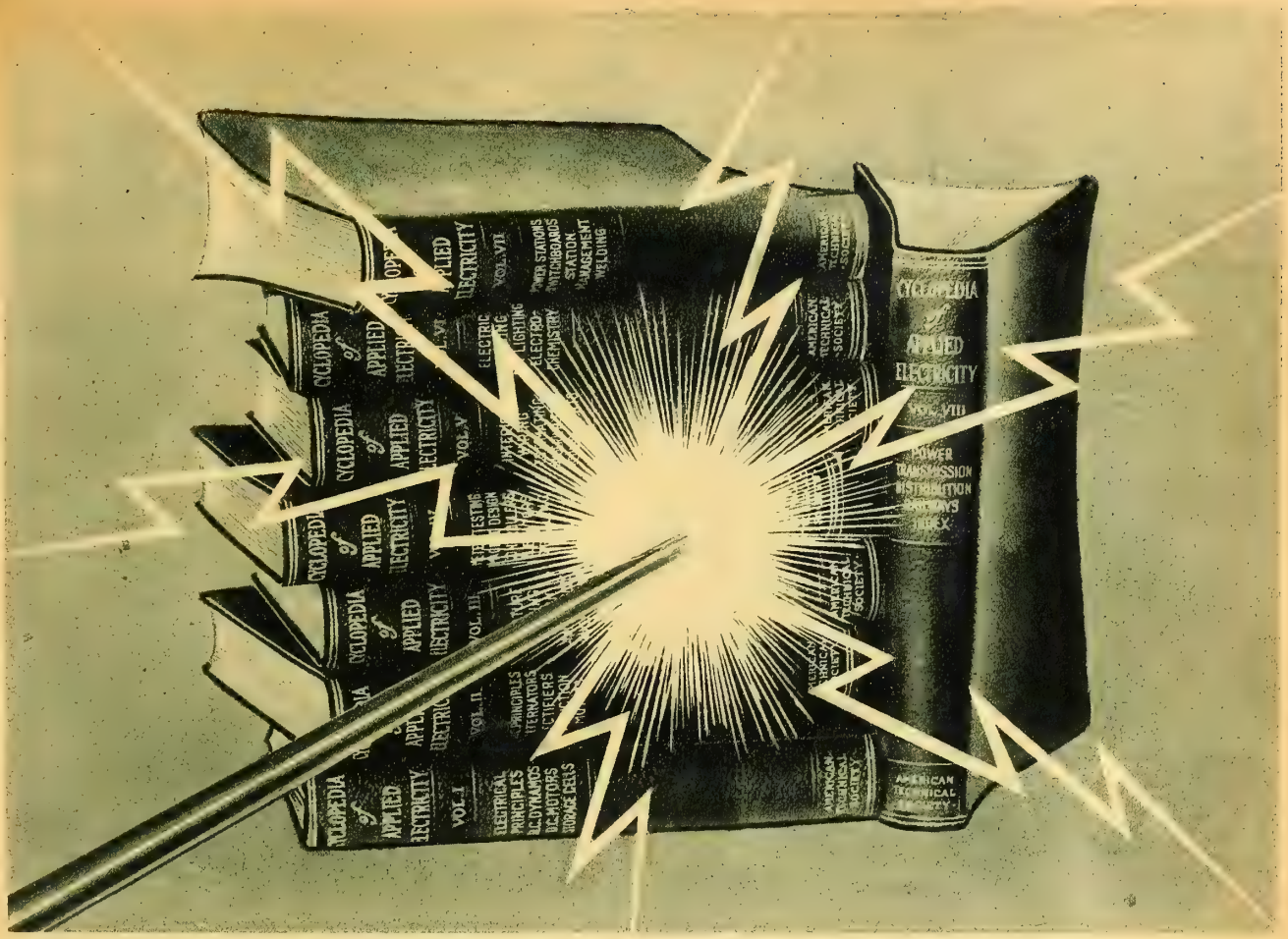
Vol. IV. Electrical Measurements; Measuring Devices and How to Read them; Electromagnets and Induction Coils; Controllers; Electric Elevators; Railway Signaling.

Vol. V. Interior and Exterior Wiring; Materials and Methods Used; Underwriters' Requirements.

Vol. VI. Systems of Electric Lighting; Planning Systems; Estimating; Contracts and Specifications; Maintenance of System; Applied Electrochemistry.

Vol. VII. Power Stations; Modern Equipment, Operation and Maintenance; Installation of Switchboards; Wiring Diagrams; Management of Dynamos and Motors; Electric Welding.

Vol. VIII. Electric Transmission Lines; Construction and Maintenance; Distributing Systems; Electric Railways; Construction of Power Plants; New Electrical Devices.



FREE Examination No Money Down

You can have this wonderful library to use in your own home or shop for a whole week FREE. It won't cost you one cent. DON'T SEND ANY MONEY. Just fill out and mail the coupon today and the entire set of eight volumes will come to you by express collect. You be the judge and find out for yourself what the books will do for YOU. Use them as you please. Go into every volume thoroughly. Show them to your friends and get their opinion. Then, if you have any doubt about their value, send them back at our expense, you won't owe us anything. If you like the books after a week's examination, you pay us only $2.80 and send $3.00 every month until $34.80 is paid. This is only 75 cents a week or a dime a day. Most of us waste more than this every day of our lives. Can you afford to pass up a better job and higher wages when it costs only 10 cents a day for a short time to get it? Of course you can't. **Mail the Coupon Now—TODAY.**

Mail Coupon today

Special Offer!

A membership in this Society costs $12.00 a year, but we will give a one year membership FREE to everyone who buys a set of these books. This gives you the right to consult the engineers the Society retains on any electrical subject at any time. Write as often as you please. Ask as many questions as you please.

AMERICAN TECHNICAL SOCIETY
Dept. E-256, Chicago

AMERICAN TECHNICAL SOCIETY Chicago
Dept. E-256

Send me the eight volume library of PRACTICAL APPLIED ELECTRICITY for a week's free examination by express collect. I will either send you $2.80 within a week as first payment and $3.00 each month until $34.80 is paid, or return the books at your expense. If I keep the books I am entitled to a one year membership in your Society free.

Name .....

Address .....

Reference .....
(Please fill out all three lines.)

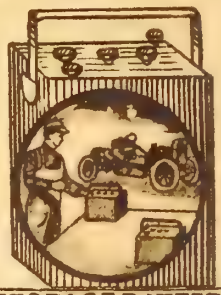
Let Me Send You a Valuable Electrical Outfit FREE!



A. W. WICKS
ELECTRICAL ENGINEER



METERS



STORAGE BATTERY

This outfit consists of the same type of standard electrical tools and instruments that I have used in my work as a practical Electrician and as an Electrical Engineer.

Mail the Opportunity Coupon below and I will send you full particulars about this remarkably liberal offer explaining how you can get this standard, working electrical outfit, absolutely free. I will also tell you how you can

Learn Electricity

I Will Teach You Myself—By Mail

I am a practical Electrical Engineer of twenty-five years' experience. From this practical experience I have prepared a thorough, up-to-date course of home-study instruction which is easy and quick to learn. **I teach you myself.** You are under my personal guidance throughout the entire course. I do **not** turn any part of the instruction of my students over to assistants or employees. And to master this course requires no sacrifice on your part. You don't even need to give up your present job.

By devoting a part of your spare time to pleasant study and practical experimenting right in your own home you should very quickly prepare yourself for a good electrical position or for a business of your own. I have already helped hundreds to get out of small-paying, no-future jobs. C. A. Walker says: "Offered a fine position." J. Obeslo says: "Have a chance to run city electric plant." E. Vogel writes: Successfully installing electrical systems."

I taught and advised **them.** I can give you the same kind of personal instruction—and am willing to boost **you** to a better job and bigger pay just as I have helped and am helping others. Just a little determination on your part, backed up with earnest effort. That's all you need. I'll then see to it personally that you get just the kind of practical instruction that an electrician **must** have in order to succeed. The cost is small—the terms are easy.



LIGHTING



HEATING

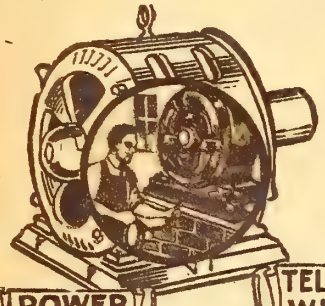


TRANSFORMER INSTALLATION

Here Is the Opportunity

LOOK AT MY RECORD—Think of what it means to have **An Electrical Engineer** teach you personally—a man who has been through the mill and knows just what you need to win such success as his from years of actual experience in the electrical industry. He knows, too, what points employers are looking for in their men and he tells you how to develop these points.

Here is a certain way to win promotion and big pay: Just spend one hour, at home, each evening with this "easy-to-learn" practical course. You can prepare yourself to operate lighting and power plants, direct electrical construction, install dynamos, motors, switchboards and other types of electrical systems.



POWER



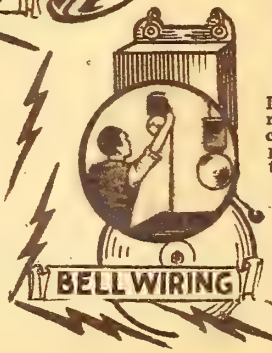
TELEPHONE WIRING

Unlimited Consulting Service—FREE

You can call on me for advice at any time and I will gladly furnish it—free. I will work with you for your success not only while you're my student, but as long as you are in the electrical business. I will help you in landing a job. If at any time you want to go into the electrical business on your own hook I will show you how to go about it—give you pointers on how to pick out a good location, the equipment you will need, how to train men under you, how to figure on contract work and solicit business personally and by mail. In short, I will stand by you to WIN.



SWITCHBOARD



BELL WIRING

WRITE!

This is your chance for a successful future. Don't pass it up. Act. Take the first step toward real success **now.** Mail the coupon or a post card for my free book—it tells all. Also get full particulars about my remarkable Free Electrical Outfit offer. No obligation on you. Act today.

A. W. WICKS, Electrical Engineer
President and Director
Wicks Electrical Institute
431 S. Dearborn St., Dept. 2996, Chicago



A. W. WICKS, Electrical Engineer
President and Director
WICKS ELECTRICAL INSTITUTE
431 S. Dearborn St., Dept. 2996 Chicago

Without any obligation on me, please send me your Free Book explaining the opportunities in Electricity; also particulars about your Course and Free Electrical Outfit offer.

Name.....

Position..... Age.....

Street No.....

City..... State.....

What to Do with Your Old Phonograph—Contest

(*Continued from page* 499)

We have given these examples simply to w what can be done. Of course there thousands of other good ideas and we ve no doubt that our readers will think many good ones.

We will give three prizes as mentioned ewhere. The first prize being for $25.00, second for $15.00 and the third for .00, for the best ideas submitted. Please e that the judges will take into con- eration *the utility of the device.* In er words the chances are that the idea t is really useful, will win the first prize. o remember that the idea must be of h a nature that it does not interfere with operation of the phonograph.

Suppose we publish such a device or such idea thru our columns. The chances are t if the thing is good a manufacturer of h novelties will not be slow in seeing a ge financial benefit from the manufacture the device. Our readers should always r in mind that when a device or idea is olisht the originator has *two years in ich to patent his device.*

This contest will close on September 10th l the prizes will be announced in the vember issue. Address all letters to *itor Phonograph Prize Contest,* c/o this olication. In the event of a tie for any ze an identical award will be given to h tying contributor.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page* 503)

eath. Place on the table, sensitive side a photographic plate wrapt in heavy ck paper. On this plate lay a book con- ing a key, a coin or some other dense ect. Then start your coil and allow the ays to penetrate the book and plate for eral minutes. Then stop the action of tube, remove the plate and by the light a ruby lamp develop and fix it in the al way. The result will be a *Radio-ph.*

ext instalment will appear in the October number.)

How We "Taste"

By JOSEPH H. KRAUS

(*Continued from page* 478)

been benumbed by imbibing a salt solu- , such as ordinary table salt, distilled er will taste sweet. For the same rea- ordinary water tastes sweet after ex- ive salt water swimming, a fact which yone has noticed but hardly ever in- igated perhaps.

f course, the taste areas in the tongue localized in certain regions. The *tip* react more easily to sweet and sour stances than the *back,* which is more itive to the bitter sensations. Even the inctive cells will react differently. A ture of quinine and sugar if applied to papillae will excite a bitter taste, where- n adjacent papillae may give us chiefly veet sensation. If all these papillae are painted with cocaine, the first effect be the diminution of pain sensibility, nce the application of an acid will evoke ry sour taste without the ordinary as- gent or stinging sensations normally ned.




Plant Supt.


Plumber


Shop Supt.


Surveyor


Designer


Auto Expert


Building Supt.


Aero Expert


Contractor

A Bigger Job For you

The very day you are proficient in any branch of engineering, you will find scores of concerns ready to pay you the full value of your services. Never before such a demand for good technical men as now. Not nearly enough men are prepared for the good jobs that are waiting. And—in the hours you ordinarily waste you can soon equip yourself for a big pay job. Don't put this off—at least send for information about Chicago "Tech" training. Let us give you the facts about the branch you would like to take up. See coupon below. Mark, sign and mail it now.

Master a Paying Profession

By Home Study

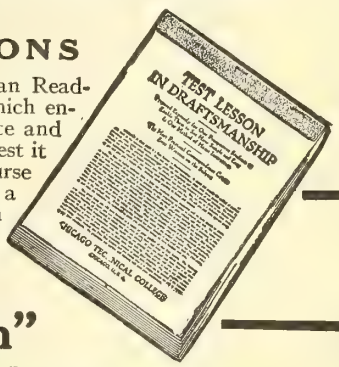
No longer is it necessary to spend years at college to get a technical education. Home study under the Chicago "Tech" experts will give you the practical training which is wanted in great manufacturing concerns—in engineering and architects' offices—by railroads and contractors—it will make you proficient in the shortest practicable time. Look into this now. Get the facts. Let us tell you about our method and how we can give you the training which means largely increased earning power. Send the coupon—now.

$60 to $150 a Week

"We want the men—and we'll pay all they're worth" is what employers say today—and you know what engineering specialists are making. How better could you use your leisure hours than to get in line for one of these high-class positions that are actually begging for good men?

FREE TEST LESSONS

If you select Draftsmanship or Plan Reading we send you *free,* a test lesson which enables you to see how simple, complete and thorough our instruction is and to test it out before you enroll. Whatever course you ask for information on, you get a complete, plainly written catalog which explains every detail. No obligation on you for asking this. Just send the coupon.



Chicago "Tech" Training Will Make You Expert

By the Chicago "Tech" method you train under practical engineers, contractors and experts—men who teach you the methods used in actual work. No time wasted on unnecessary studies. And you get the same courses by mail that you would get if you came to the College. Every lesson is taught, every exercise is read and every examination is corrected individually by members of our faculty. You are kept on the right track, steadily advanced and prepared to take your place among experienced, technically trained men.

NOW! Learn about this home study method which has put hundreds and hundreds of ambitious men in high positions. Just put X in ☐ opposite the name of the one you want the facts about—and sign and mail the coupon. This simple act may mean a turning point in your career—the start toward bigger things—a better job—a higher position. It costs nothing to get this information—so act now—today.

Chicago Technical College, 945 Chicago "Tech" Bldg., Chicago, Ill.

Without obligation on my part, please send free and post-paid, instructions on how I can become an expert in subject marked below:

☐ Architectural Drafting
☐ Machine Drafting
☐ Electrical Drafting
☐ Structural Drafting
☐ Sheet Metal Drafting
☐ Topographic Drafting
☐ Surveying
☐ Designing
☐ Contracting—Buildings
☐ Auto. Engineering
☐ Aero. Engineering
☐ Gas Engines
☐ Plan Reading—Buildings
☐ Estimating—Buildings
☐ Plan Reading—Machinery
☐ Plumbing—Estimating
☐ Heating and Ventilating
☐ Steam Engineering

Name.....

Address.....

Post Office.....State.....

Free Trial Lesson Included when inquiry is for Draftsmanship or Plan Reading

Mail this Coupon Today

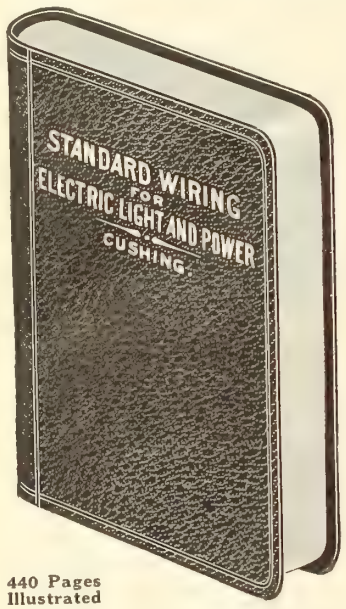
LEARN TO BE A

WIREMAN

AND EARN

$75 a Week

This year's Edition will make you an Expert



440 Pages Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. Electrical Units and their Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve your wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges.
Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.
12 W. 40th Street New York

The continued use of this drug shows us that the bitter sensation of taste will disappear first, then the sweet and then the sour, and lastly, an affected taste will remain, namely, that of salt. Various other drugs can command control of the taste sensations, so that any combination can be obtained and salt and sweet eliminated or other combinations, just as desired.

There is not the slightest doubt but that the chemical composition of the substances acting on the taste-buds and nerves, is chiefly the active ingredient, determined by the presence of "H" ions in acid and "O H" ions in alkaline liquids. This is definitely proven by the fact that acetic acid, for instance, has a much stronger sour taste than mineral acid, even tho the latter are stronger chemically and capable of causing more violent actions from which fact we can conclude that the greater the number of "H" ions present, the greater the sense of predominating acid taste, altho, as yet, we do not understand the law which determines whether any given substance shall have a taste at all or what its taste should be. The nerves of taste are chiefly branches of the 5th, 7th, and the 9th nerves—Cranial nerves—(man has twelve). Most of the so-called "tastes," however, should in reality be designated as *flavors*, and are not dependent upon the stimulation of the taste nerves, but upon the sense of *Smell!* It has been found that *if the latter is destroyed, very little difference is distinguished between an onion and an apple;* and hence, if we did not know of the difference in appearances of the two "fruits" the forbidden fruit of Adam and Eve, could readily pass as society's ostracized fruit, the onion.

But, do not tell an epicure that he can only realize six tastes and that he *smells the rest of the tastes* as you are quite sure to be the victim of a "red-hot" argument in a few moments. Nevertheless, this is quite true and you would be correct, for during an attack of grippe or influenza,—when we no longer can smell well—even the most delicious aromatic viands are practically tasteless. (Foods are also rendered practically tasteless after some nasal operations.)

Identical with the other *senses*, the *taste stimulation* is announced in the *Brain;* perhaps thru a chemical action or change in the nerve itself, or perhaps because of an electrical announcement to the main switchboard. In the latter case, inasmuch as the nerve terminates around the cell, in fine tree-like branches, a condenser-like action probably takes place.

Electricity, or electrical impulse has been demonstrated to exist whenever a nerve acts, by means of extremly sensitive instruments, and it may be that electricity is the predominating feature in all nerve-responses; so nearly completed is the proof of this statement that it will be but a matter of a short time before some great neurologist announces this discovery to the world.

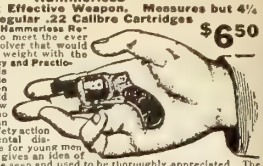
This much is known about the nerves. Each nerve is covered by a sheath known as *Krause's membrane* which sheath is broken up into portions. If this sheath is destroyed, nerve action is seriously upset. The sheath itself it quite an insulator to electric "juice" and it may be that the sheath exhibits a condenser-like action, much the same as the action believed to take place between sense cells and the terminal arborization of the nerves.

Another feature in favor of the *electronic theory*, is that electricity generally concentrates upon points or projections and terminal nerves invariably project in the form of countless minute points; thus making it easy enough to put two and two together.

So when a cell is stimulated the action upon the nerve surrounding it could well resemble the condenser action of radio; particularly sensitive would be the other plate, with fine points to catch even the very slightest effect.

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures but 4¾ Inches Long. Takes Regular .22 Calibre Cartridges



The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability.** It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard 22-calibre cartridge obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. The price of the Baby Revolver is only **$6.50** sent by mail, p.pd. to any address.

$6.50

JOHNSON SMITH & CO., Dept. PM25, 3224 N. Halsted Street, **CHICAGO**

AGENTS WANTED



Cut Your Own Hair WITH THIS **Only 50c** Extra Blades, 5c

SAFETY HAIR CUTTER Can cut your own hair with this marvelous invention. Cuts the hair any desired length, short or long. Does the job as nicely before your own mirror. You can cut the children's hair at home in a jiffy. Can be used as an ordinary razor to shave the face or finish around temple or neck. Sharpened like any razor. Saves its cost first time used. **3 for 15 cents.**

JOHNSON SMITH & CO., Dept. PM 25, 3224 N. Halsted Street, **CHICAGO**

INVISIBLE INK



The most confidential messages can be written with this Ink, for the writing **MAKES NO MARK.** It cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private memorandums away from prying eyes. Great fun for playing jokes. **Only 25c Bottle.**

VANISHING INK



Writing written with this remarkable ink vanishes entirely in a few weeks (sooner if desired), leaving the paper QUITE BLANK. **25c per bottle.**

Dissolving Ink

Writing appears or disappears at will, a secret with each bottle. Very remarkable. **25c.**

JOHNSON SMITH & CO., Dept. PM25, 3224 N. Halsted Street, **CHICAGO**

MAGIC FLUTE

Wonderfully Sweet Toned and Musical



The Magic Flute, or Humanotone, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it, which when once acquired after a little practice, will enable you to produce very sweet music that somewhat resembles a flute. There is no finer one you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is so charming as to be surprising.

Post Paid **25c**

Good Luck Ring



Quaint and Novel Design

A VERY striking and uncommon ring. Silver finish, skull and crossbone design, with two brilliant, flashing gems sparkling out of the eyes. Said by many to bring Good Luck to the wearer, hence its name, **Good Luck Ring.** Very unique ring that you will take a pride in wearing. **ONLY 25 CENTS.**

JOHNSON SMITH & CO., Dept. PM25 3224 North Halsted Street, **CHICAGO**

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in perfecting that remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light,** rendering it **perfectly visible** in the dark. **THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use, anyone can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles, make your own Luminous Crucifixes, Luminous Rosaries, etc. Small bottle, **price 25c** Larger sizes, **50c** and **$1** postpaid. Johnson Smith & Co.

Mystic Skeleton



A painted figure of a skeleton 14 in. in height will dance to music and perform various gymnastic movements, while the operator must be some distance from it. **10c pd.**

Serpent's Eggs



Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most lifelike manner. **Price per box, 15c ppd.**

JOHNSON SMITH & CO., Dept. PM25, 3224 North Halsted Street, **CHICAGO**

All the Latest Surprising and Joke Novelties

"Chicken Inspector" Badge	15c	Luminous Skull	25c
Crying Cat in Bag	20c	Field Glasses	$10.00
Midget Bible (size of stamp)	15c	3 drawer Telescope	$1.75
Anarchist Bombs (Express only)		Invisible Ink (secret writing)	25c
8 boxes for	$1.00	Vanishing Ink	25c
Book on Ventriloquism	35c	Lover's Lockets	15c
Thurston's wonderful Trk Cards	10c	Fish Lure (catches fish)	25c
Box of Wire Puzzles	25c	Moving Picture Machines	
Conjurer's Casket of Magic Tricks	75c	$3.00, $7.50 and $12.00	
Watch Camera	$3.50	Nail Klippers	35c
Films for Watch Camera	25c	Exploding Matches (Express only)	
Exploding Cigarettes, box	50c	8 box for	$1.00
Weather Cottage	$1.50	Stage Money, 50 bills	25c
Scrlack-macopo: see behind you!	25c	False Mustache	10c
Amateur Electrician Book	15c	Inkless Pen, writes with water	15c
Firecracker's (Express only)		Exploding Fountain Pen	50c
10 pkts for	$1.00	X-Ray Novelty	15c

JOHNSON SMITH & CO., Dept. PM25, 3224 North Halsted Street, **CHICAGO**

Bound Volume No. VII

of Electrical Experimenter

Just Completed

Specially offered at only

$2.00

(One-third Less than the actual subscription price)

These volumes comprise the issues of May, 1919, to April, 1920, inclusive. Attractively bound, stamped in gold—they are a welcome addition to any library. They contain valuable ideas and scientific information that would cost thousands of dollars to assemble in any other form, even if it were procurable elsewhere. Here you are offered the opportunity to secure a copy of the first edition of these splendid volumes at less than the actual subscription price.

Send us your remittance today for $2.75 plus postage for eight pounds and your copy of Volume VII will come forward by return mail.

Experimenter Publishing Company
236 Fulton Street. New York, N. Y.

$90 TO $125 PER WEEK

Earned By Burgess-Trained Men

ELECTRICITY

TAUGHT BY A PRACTICAL MAN



BURGESS STUDENTS ARE IN DEMAND

Over 90% Now Actually Engaged in Electrical Work

BEGINNERS GET EMPLOYMENT AFTER TAKING THE BURGESS COURSE A SHORT WHILE

JUST A LITTLE OF YOUR SPARE TIME AT HOME BETWEEN YOU AND SUCCESS

BURGESS-TRAINED MEN are not only getting $90.00 to $125.00 per week, **but they are earning it.** We do NOT promise you will do it, because a good bit depends upon you alone, but the opportunity is there and it is up to you to make the best of it. The Burgess Policy is truthfulness in advertising and to give an honest and satisfactory service. Therefore we offer **no free inducements,** but depend rather on telling just what Burgess Men are doing. This we find is one of our strongest endorsements.

We DO say that if you have an earnest desire to succeed we **know** our Fifty-Fifty Plan will help you. *It has helped hundreds of others who have been placed in better positions, at better salaries, by BURGESS SERVICE.*

THIS IS OUR PLAN

You make moderate monthly payments for what you get, **and you get what you pay for.** Your payments stop any time you are not satisfied. **It's up to you.**

BURGESS SERVICE BRINGS SUCCESS TO MEN AND YOUNG MEN—IT IS REAL SERVICE

The Burgess Service is based on the personal experience of Yorke Burgess, for nearly a quarter of a century in practical Electrical work. Starting at the bottom, himself, and finishing at the top, he **knows** the needs of the **very Beginner** as well as the experienced man. He simplifies the principles and practice of Electricity. The electrical laws, formulas, methods of calculation and the daily problems that come up in Electrical work are made **plain** and **clear.** No frills, just simple, everyday English that anyone can understand and remember. He gives you his personal and individual attention—**and he does not sign his name with a rubber stamp.**

This Man Made Good—So Can You

(Mr. Engleman, now an Electrician in the Ritz Carlton Hotel, New York City, was formerly a waiter in the same hotel.)
Here are Engleman's three letters.

"Your first installment on the electrical course received, and I like the method of your instructions very well. You will find the answers to the examination questions attached to this letter. I AM OCCUPIED AS A WAITER AND WOULD BE ONLY TOO GLAD TO MOVE INTO A REAL TRADE."

From the Same Man Two Months Later

"In the book review of the Electrical Experimenter, I saw a description of the Burgess Blue Book, which I would like to possess and wish you would mail me a copy. I HAVE GIVEN UP MY POSITION AS WAITER, AND AM NOW EMPLOYED AS ELECTRICIAN in the Ritz Carlton Hotel and so far like the work very much."

The Burgess Name Your Guarantee

"Your lessons together with your Blue Book received and I thank you very much, and I think it is like everything else that is connected with your name, really 'A No. 1.' MY WORK in the hotel CONSISTS OF WORK ON MOTORS, DUMB WAITERS AND ELEVATORS and from time to time I do repair work on small apparatus."

Hundreds of other letters like these from Beginners who have made good.

FROM CHIEF ELECTRICIAN OF A BIG COAL MINE

Dear Mr. Burgess:
I am Chief Electrician for this Company and I feel that I need the instructions in your course more today than I did when I first commenced working with electrical appliances.
If there is any electrician today who feels that he cannot gain anything by taking a BURGESS COURSE send him to me and I will soon convince him that he is wrong.
If I should live to be one hundred years old, I will continue to preach every place I go, THE BURGESS ELECTRICAL SCHOOL. I wish I could come face to face with the great number of young men of today. I believe I could convince them in a few minutes that they are missing one of the greatest opportunities by not taking this course and sticking to it.

Very sincerely yours, J. L. KNIGHT, Glen White, W. Va.

If you have any desire to learn all about this service that is helping so many make good in a big way—

Send For
"ELECTRICITY BOOK 9."

Forty-eight pages of Success in various lines of Electrical work told by Burgess Students themselves together with valuable information by Yorke Burgess. This book should be in the hands of every Beginner interested in Electricity or Experienced Men in any branch of Practical Electrical Work.
"Burgess Bulletin"—issued for the benefit of Burgess Students—contains Articles on Electricity, Problems, Diagrams, Positions Open, Electrical Information,. News, Advice, etc.
Fill out coupon below and these will be sent you prepaid. They cost you nothing.

BURGESS ELECTRICAL SCHOOL

(Endorsed by Electrical Experts)

WRITE YORKE BURGESS **personally—or use coupon**

The Burgess Company Educational Division,
Yorke Burgess, Supt.
745 East 42nd Street, Chicago, Ill.

Please send me prepaid "ELECTRICITY BOOK 9" and the "Burgess Bulletin," without cost or obligation.

Name .....

Address .....

Burgess Electrical Hand-Book

(called THE BURGESS BLUE BOOK, originally in blueprint form)

Short Cuts and Time Savers

PREPARED in pocket size especially for practical men and those taking up the study of electricity. Contains drawings and diagrams of electrical machinery—over 200 formulas for calculation and problems worked out showing how formulas are used. From the personal note book of Yorke Burgess while on all different kinds of electrical work covering a period of nearly a quarter of a century.
Electrical laws, formulas, methods of calculation, etc. Simplified and made easy to understand and remember. Easy to apply in practical work. **Many valuable stunts not to be found in any other book.** Of value to any electrical man, whether Technical Graduate, Electrical Engineer, Student or Practical Man.
Electricians all over the world are sending for this book. **The most complete and valuable book of its kind published. Nothing else like it.** If you have never seen this book it is impossible for you to realize what you have missed.

Price $1.00

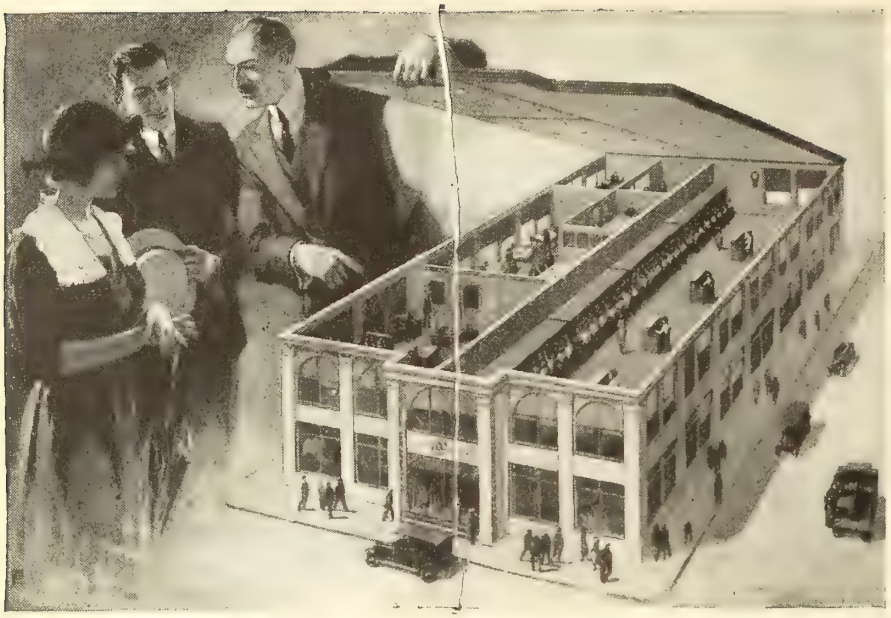
Send dollar bill, money order or check. You take no chance—money back ANY TIME if not satisfactory.

THE BURGESS COMPANY

Consulting Electrical Engineers

Yorke Burgess, President

Engineering Division (Department 109), 750 E. 42nd St. Chicago, Illinois, U. S. A.



The Public Confidence

An important part of the management of the Bell System is to keep the public informed concerning all matters relating to the telephone.

We consider this an essential part of our stewardship in the operation of this public utility. It is due not only the 130,000 shareholders, but it is due the whole citizenship of the country.

We have told you of new inventions to improve service, of the growth of service, of problems involved in securing materials, employing and training workers, of financing new developments, and of rates necessary to maintain service.

You have been taken into our confidence as to what we are doing, how we do it, why we do it. You have been told of our efforts to meet unusual conditions; of how we have bent every energy to provide service in the face of storms, floods, fires.

It is an enormous task today to provide adequate service in the face of shortage of workers, raw materials, manufacturing production and transportation.

Nevertheless the service of the Bell System has been improved and extended this year. Over 350,000 new stations have been put into operation. And the loyal workers of the Bell System are establishing new records for efficiency and will establish new records for service.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

TIRE PRICES CUT
FROM OUR FACTORY TO YOU
6000 MILES GUARANTEE



Our double tread reconstructed tires save you time, energy and money and do away with tire troubles. Our tires cannot be compared with ordinary double tread or triple fabric tires of inferior make. Our reputation and success is due to the fact that we spare no time or money to make our tires excel in quality and durability. Our tires are used from Coast to Coast. Ask your banker about us. Reliner Free with every Tire. Tubes are guaranteed fresh stock.

Size	Tires	Tubes	Size	Tires	Tubes	Size	Tires	Tubes
30x3	$6.00	$1.75	32x4	$8.75	$2.60	36x4½	$12.00	$3.40
30x3½	7.00	2.00	33x4	9.00	2.75	35x5	13.00	3.60
31x3½	7.25	2.10	34x4	9.25	2.85	36x5	13.25	3.70
32x3½	7.50	2.25	34x4½	10.50	3.00	37x5	13.50	3.75
31x4	8.50	2.50	35x4½	11.50	3.15			

Send $2 deposit for each tire and $1 for each tube ordered, balance C. O. D. Tires shipped subject to your examination. State whether S. S., C. L. (Q. D.) plain or N. S is desired. All same price.

NATIONAL GOOD-WEAR TIRE CO., 1113 Washington Blvd., Dept. 220, CHICAGO

Timing Sunlight for Plants

(*Continued from page 477*)

showed no tendency to blossom as late as February 12, 1920.

IMPORTANT INFLUENCE ON CROP YIELDS.

The influence of this discovery on crop yield is likely to be of no little importance. The length of day is proved to be the most potent factor in determining the relative proportions between the vegetative and fruiting parts of many crop plants. Indeed, fruiting may be completely suppressed by a day either too long or too short. The advance in agricultural practise which may come thru this new discovery will have to be brought about largely by plant breeders and other crop specialists. For instance, it will prove of material significance in the future planning of cropping systems for different regions, especially where consideration of new crops from different latitudes is necessary.

This new principle undoubtedly explains the erratic behavior which has been observed with many crops when they are shifted to different latitudes, and may also clear up the conflicting results of variety tests and field tests conducted with the same crops but in different regions. The experiments have shown, for instance, that ragweed requires for flowering a stimulus that is afforded by the shortening of the days and lengthening of the nights. It does not come into flower until the period of daylight falls below 15 hours. In the latitude of Washington, that comes about July 1. But if ragweed seed should be taken to northern Maine and planted, the plants would not experience a length of day below 15 hours until about August 1. Therefore, they could not come into flower until after August 1 and, tho the vegetative growth might be very rank, they could not mature seed before killing frosts intervened. The long days, therefore, make it impossible for ragweed to perpetuate itself in that latitude. On the other hand, plants that get their flowering stimulus from a long day could not perpetuate themselves thru seed formation at the equator, where the day never exceeds 12 hours.

EXPLAINS LUXURIANT GROWTH IN NORTHERN LATITUDES.

This principle affords the clue to the fact that many plants grow most luxuriantly near the northern limit of their range. The long northern day allows them to attain their maximum growth before the shorter day intervenes to check vegetative growth and start the reproductive process.

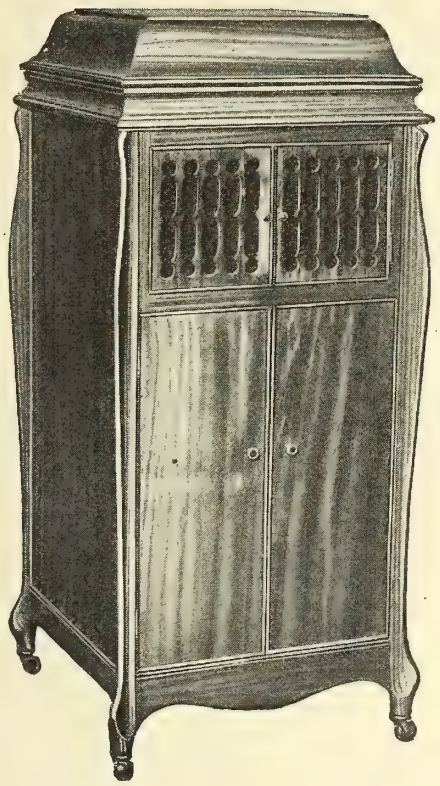
It may be found eventually, say the men who worked out the principle, that the animal organism, also, is capable of responding to the stimulus of certain day lengths. They believe that the migration of birds may be an illustration. Direct response to such a stimulus, they say, is more in line with modern teachings of biology than theories which assume that birds migrate as a matter of instinct.

WIRELESS PHONE IN IRELAND.

In consequence of the frequency with which telephone and telegraph wires in Ireland are being cut, the Government has decided on an extensive use of wireless telephony there.

Naval signal men are being employed to start the system, and it is intimated that portable telephones with a radius of about thirty miles are being employed in transmitting messages from one police station to another, or between adjacent towns.

It is asserted that the system has proved satisfactory.



You Can Build this *Phonograph* EASILY

Tremendous Saving in Cost

A FEW hours, pleasant work—some simple tools found in any man's home—and

Our Simplified Plans

IT'S an easy and interesting job to build this fine, sweet-toned cabinet instrument by our system. We furnish blueprints, diagrams, motors, tone arms and all other metal parts together with knockdown cabinet and ready built horn all complete. You do the assembling and finishing at a saving of more than one-half the retail cost. You can't go wrong if you follow our instructions. There's a model and price for every taste and purse. Your choice of four beautiful models.

Everybody who has built a Makafone has found it much easier than he first thought. You will find it so too.

Read What Satisfied Builders Say

"I have built my phonograph that I purchased from you and it is a dandy. I am well pleased. I had a neighbor in to look at it and he thinks it is nice. I think that he will buy one."—Crawford, East Peoria, Ill.
"I received everything O.K. and I have already built and enjoyed it for two weeks and I am very much pleased with it."—Bieschke, Chicago, Ill.
"I have the model No. 1 set up and in fine running condition and would not sell it unless I could get another one like it. It is equal to any I ever saw. I have finished it in natural wood and all that have seen it say that there is not a finer machine in any store in town."—Corbin, Vancouver, Wash.
"Have just finished the cabinet and believe me she sure does look swell. I can guarantee you several more orders very soon."—Armhein, Milwaukee, Wis.
"I am well pleased with the MAKAFONE I ordered from you some time ago and am now placing another order for a No. 4 machine."—Hysong, Covington, Ky.
"I received my MAKAFONE and have built it and find it a dandy. I will send an order for a No. 3 machine in the very near future."—Bank, Sanatobia, Miss.

Get Into the Phonograph Business for Yourself

No experience is necessary under our plan. Hundreds have gone into the business of building Makafones which they sell to their neighbors and friends at a clear profit of not less than $50.00.

"I received the outfit in good shape. Am perfectly satisfied that the machine plays well and it was sold right away. Please send more price lists and order blanks, as I want to order a No. 5 outfit right away."—Schettling, Kansas City, Mo.

Gentlemen:
I have the phonograph finished, ordered from you some time ago. The music reproduced on this instrument is better than any I have ever heard. This machine is now sold and I soon will be able to take advantage of your discount for ordering six outfits at a time. J. A. Devenny.

Many of these people have come from clerical or other non-mechanical vocations. *And they are all making good.* Why not you? We shall be glad to give you full particulars so send in this coupon today.

Modern Phonograph Supply Co.
325 Springer Bldg., 313 So. Clinton St., Chicago, Ill.

Fill Out This Coupon And Mail Today

MODERN PHONOGRAPH SUPPLY CO.
325 Springer Bldg., 313 So. Clinton St., Chicago, Ill.

Gentlemen:—Please send me full particulars of your "Build Your Own Phonograph" proposition, without obligation to me.

Name .....

Street Address.....

City or Town.....State.....

Learn How to Write Successful Letters

THE MASTER LETTER WRITER, a 976 page Instruction Course, including 500 Successful Letters, by Ad-Man Davison, the highest paid letter writer in the world



THE most authoritative work of this kind ever written. Contains 976 pages. Part I embraces 351 pages on how to appeal to every class of reader; also Routine Correspondence: order letters, answer-to-order letters, complaints, letters of inquiry, contract and credit letters. These with the typographical arrangement of letters, including a section on Typography of Letters and Business English. *A section of 100 Collection Letters for individuals, firms and collection agencies, is included.*

PART II contains the 500 Master Business Letters from the private portfolio of Ad-Man Davison, "the scribe supreme of Advertisingdom."

In this remarkable collection are endless new word-pictures to help you revivify your business story. Uncommon phrases of pith and power. Warm, winning, human arguments that compel action.

The collection includes direct merchandising letters, advertising letters, sales managers' letters, letters to dealers, to agents, letters selling service of every kind, instruction-by-mail, advertising space; order getting letters, accountancy, insurance, investment and real estate letters; letters applying for positions as executive, salesman, correspondent, secretary, stenographer, bookkeeper, typist; soliciting and sales letters for every business.

THE MASTER LETTER WRITER is conveniently classified and indexed. Beautifully bound in rich blue extra cloth, with gold top and gold lettering. Sent postpaid on receipt of price, $5.

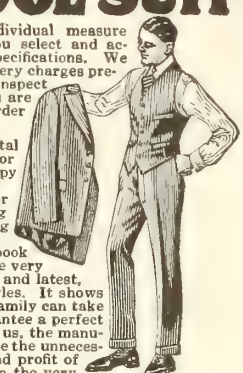
If you want quicker results, larger sales, more remittances, if you want a better salary, swift promotion, Success—here are all the Success Secrets of the master writer—MAKE THEM YOUR OWN—order this great Course and Collection to-day. Address Desk 74.

OPPORTUNITY PRESS, 681 Fifth Avenue, New York

48-page Booklet mailed Free.

$25.00 FOR THIS MADE TO YOUR MEASURE ALL WOOL SUIT

Every suit made to individual measure from the exact fabric you select and according to your exact specifications. We ship it on approval, delivery charges prepaid, for you to try on, to inspect and examine. Unless you are well pleased your trial order will not cost you a cent.



BIG CATALOG FREE Send postal today for copy of our big catalog and style book with 52 cloth samples of the very finest, high grade fabrics and latest, New York and Chicago styles. It shows how any member of your family can take your measures. We guarantee a perfect fit. By dealing direct with us, the manufacturers, you save the unnecessary expense and profit of agents and obtain the very highest grade of tailoring at a saving of 25% to 40%. Write today for catalog and information.

The BELL Tailors

THE BELL TAILORS

Adams at Green Street, Dept. 911 Chicago, Illinois



Are You Flat Chested? Are Your Lungs Weak? Do You Lack Vitality? Is Your Carriage Faulty?

If any of these conditions fit your case you urgently need my book.

CORRECT BREATHING and CHEST EXPANSION

Each one of these conditions can and should be remedied. My book will teach you how. Send for it now before you forget. **25c coin**

PROF. ANTHONY BARKER, D. C.

127 W. 42nd St., 3562 Barker Bldg., New York

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. Guarantee Bond for 8000 Miles. (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.

901 Oak St. Kansas City, Mo.

Plant or Animal—which?

By WILLIAM M. BUTTERFIELD

(*Continued from page 475*)

whip-tail and adopt true animal movements. The bodies after a time collect in clusters, and unite into one body to form a young inert jelly-like mass.

In the end they ultimately form a *creeping* jelly-like mass of individuals, thus combining acts for the time as an independent organism. It often takes on the most brilliant red, yellow, purple, orange, green or similar shades, according to species. Soon it penetrates the substances of dead wood or spreads over the surface of dead leaves, bark, etc., in a network of veins, taking a somewhat fan-shaped outline. The more fluid matter in the interior of the veins streams constantly thru them, like the blood in the veins of man; the current continuing in one direction for a certain period, usually a minute and a half, when it stops—and after a moment's pause, reverses its course, flowing the opposite way for about the same length of time, but rather longer in the direction in which the jelly-mass is moving.

It is by this means that the mass creeps forward, the object being, it would appear, to obtain food—the kinds of food required for some of the species at this state of development being well known by investigators who have cultivated the varieties.

After a spell of creeping about in this fashion, which may extend over a period of weeks, months, or even in one known instance a year, the mass concentrates first compactly as shown in Fig. 8; then, in the case of *comatricha obtusata*, Fig. 9, the individuals prepare to form again into independent centers, finally dividing into thirty or forty masses. Within an hour or two these have risen to form pear-shaped bodies as seen at Fig. 10.

In six hours the black hair-like stalk has grown to its full length and bears at its summit the young ball-like spore-pod, which now consists of a white globule of viscous protoplasmic cells, with a diameter of about one-fifth of the length of the stalk.
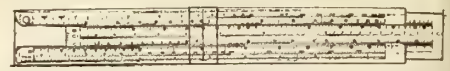
A pink flush now begins to pervade the seed-receptacle, caused by the formation of the dark branching threads (Fig. 14) of the capillary stems. The nuclei still presents the same appearance as when observed in the streaming jelly-mass; in an hour they show the beginning of a kernel-moving division, and the cells soon become separated into masses of two spore capacity; an hour later the final division has taken place.

Now as the dark spore-walls are produced, the color of the spore-pods rapidly darkens, and about twenty hours after their first construction the groups stand in regular order on the wood.

The fungi have constructed before our very eyes a miniature forest of peculiar appearing plants with the pod of each filled with seeds. Before the seeds were formed, you remember, each fungi constructed a scaffolding of hairs joined together in meshes and forming an elastic net, lying with its strands surrounding the seeds as they finally mature. This net which is called *capillitum* serves the purpose of protection during growth, and from its peculiar construction making it writhe and twist with the least change of moisture at the time when the seeds are ripening, thus separating and loosening them; it also springs out (Fig. 14) like a jack-in-the-box when the delicate membranous covering of the spor pod burst under its strain, scattering seeds in every direction.

It would appear, in reviewing the cycle, that there really is *no difference between an animal and a plant.*

RICHARDSON'S POLYPHASE SLIDE RULE



has the regular A, B, C, and D Scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book which teaches all there is to know about slide rules, is sent with each order.

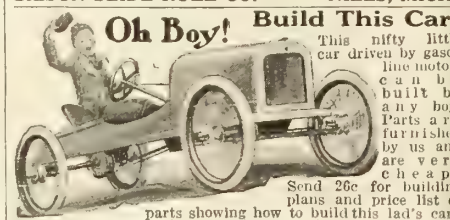
Price of the Richardson's Polyphase Slide Rule, in case with 100 page Instruction Book $2.00.

An ideal Slide Rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10. each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO. NILES, MICH.

Oh Boy! Build This Car.



This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 26c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO., 156 Sypher Bldg., Toledo, Ohio

The Seneca MOTOR CAR Built for the Owner $1185



Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. **Comfortable E-Z riding**

4 cyl. - 27 H. P. 108 in. wheel base

Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. **Write or Wire NOW.**

THE SENECA MOTORCAR CO., 49 Seneca Factory, FOSTORIA, OHIO

Every Bicycle A Motor Cycle by using a STEFFEY ATTACHMENT.



Thoroughly **PRACTICAL** and **SUCCESSFUL.** In use over 20 years. Fits double-bar, Arch or diamond frame.

Send stamp for circulars.

STEFFEY MFG. COMPANY

Dept. E 5025 Brown St. Phila., Pa.

GET BIG BUSH OFFER

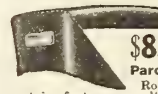
We do not deal through distributors but County Agents only. GET OUR BIG MONEY CATALOG TODAY. Don't wait! Learn how you, in your spare time can make Big Money, introducing Bush Cars in your County. The cars with Money-Back guarantee. Bush light four and De Luxe six. Don't wait. Write today!



Big Money-Making Offer for County Agents Only

BUSH MOTOR CO., Chicago, Illinois, Dept. K-15 Bush Temple

You Can Save $50.00



$8.46 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

DENINGER WILL SAVE $40

BIG MONEY SAVINGS FOR YOU

Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.



Send for catalog

Deninger Cycle Co., Rochester, N.Y.

YOU 25 TO 50 DOLLARS

SEX BOOKS

For Teachers, Students, Physicians, Jurists, Lawyers, Social Workers, Clergymen, Priests, Professional and Advanced Adult Readers Generally.

Send for List

THE MODERN BOOK SOCIETY

5 Hanson Place, Desk 55, Brooklyn, N. Y. City

"Books for Intelligent People"

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address **The Veritas Science Institute, 1400 Broadway, New York, Desk 15.**

WE BUY STAMPS

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. **Only 10**

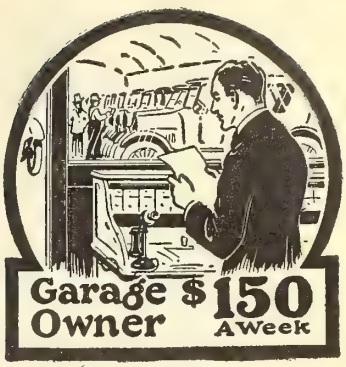
Finest Approval Sheets 50% to 60%. AGENTS WANTED. Big 72-p. Lists *Free.* **We Buy Stamps.** Established 25 yrs.

Hussman Stamp Co., Dept. 67, St. Louis, Mo.









Take Your Choice of These Big Paying Jobs

THOUSANDS of men like you are wanted to fill these big-paying jobs in the automobile engineering field. Thousands of places are open, too, for chauffeurs and garage managers. It's easy to get one of these good jobs and to prepare yourself to hold it. You don't have to go to school. You don't have to serve an apprenticeship. Spare time only is needed. These great automobile books will teach you everything you need to know. Fifteen of the greatest engineers and experts in the business wrote them in simple language that anybody can understand.



Auto Books

6 Volumes Shipped Free

Just off the press—the 1920 model—an up-to-the-minute six-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Packed full of advance information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or the owner or prospective owner of a motor car ought to know. Anybody can understand them. Tastefully bound in American Morocco, flexible covers, gold stamped, 2650 pages and 2300 illustrations, tables, blueprints and explanatory diagrams. A library that cost thousands of dollars to compile but that comes to you free for 7 days' examination. Over 50,000 sets of previous editions have been sold.

Partial Contents

Automobile Motors; Welding; Motor Construction and Repair; Carburetors and Settings; Valves, Cooling; Lubrication; Fly-Wheels; Clutch; Transmission; Final Drive; Steering Frames; Tires; Vulcanizing; Ignition; Starting and Lighting Systems; Shop Kinks; Commercial Garage; Design and Equipment; Electrics; Storage Batteries; Care and Repair of Motorcycles; Commercial Trucks; Gas Tractors.

128 Blueprints of Electric Wiring Diagrams

Only 10c a Day!

Not a cent to pay in advance. First you see the books in you own home or shop. Just mail coupon and pay express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books, send only $2.80 in 7 days and $3 a month until the special introductory price of $29.80 has been paid. (Regular Price $45.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.) This part of our offer will be withdrawn when the membership is filled. Mail the coupon without delay.



Don't Send Money Now!

Don't take our word for it. **See the books without cost.** Here is a chance for you to get a real man's job with a man's size pay. Don't waste a minute in sending the coupon. **Put the coupon in the mails today. Send no money—just the coupon!**

American Technical Society, Dept. A-256 Chicago, Ill.

FREE Examination Coupon

American Technical Society, Dept. A-256 Chicago

Please send me the 6-volume set of Automobile Engineering for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within 7 days and the balance at $3 a month until the $29.80 has been paid. Then you send me a receipt showing that the $30 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after 7 days' trial, I will notify you to send for them at your expense. [*Please fill out all lines.*]

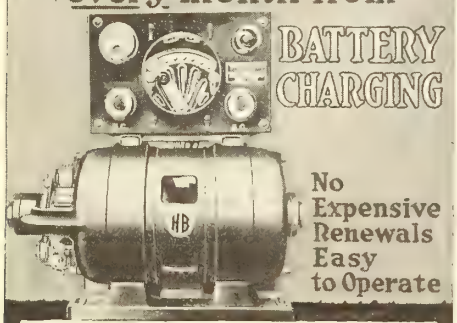
Name .....

Address .....

City ..... State .....

Reference .....

You can make
$200 to $350 PROFIT
every month from
BATTERY CHARGING



No Expensive Renewals Easy to Operate

The Road to Big Profits Is Open Before You

No big capital is required to start this great, money-making HB Battery Charging business. A small cash payment brings you any HB Charger, and you have almost a year to pay the balance on easy monthly terms. That is an absolute guarantee of HB Chargers, because we could not sell on such terms unless **every outfit absolutely made good.**

Your Profits Will Easily Pay for Your HB Charger

It costs 10c to 15c each to charge batteries of any voltage. Customer pays 75c to $2.00 each. **Figure those profits!** And that's **NET PROFIT,** too, because HB Chargers have no burn-outs, no expensive renewals, nothing fragile to wear out or break down. They are sturdy, reliable and dependable, and therefore, are permanent money-makers for all HB users. They will make **BIG, STEADY PROFITS** for you, right from the start.

There Is an HB Charger for Any Size Battery Business

No matter how large or how small a battery business you have, **there is an HB Charger exactly suited to your needs.** They charge 6-volt, 12-volt or 24-volt batteries all at the same time. That's a big advantage. Every day you wait means lost profits in battery charging. Don't delay, act NOW, and start your own business. Remember, it takes only a small payment to start you, and the profits easily pay the rest. Write at once for information on the HB Charger you want. Sizes to charge 8, 16 or 32 batteries at one time. Pick the size that suits your requirements. **Write us today.** Send this ad with your letter.

HOBART BROS. CO.
Successful Manufacturers Since 1893
Box 97 E **Troy, Ohio**



OH, YOU SKINNY!

Why stay **thin** as a rail? You don't have to! And you don't have to go through life with a chest that the tailor gives you; with arms of childish strength; with legs you can hardly stand on. And what about that stomach that flinches every time you try a square meal? Are you a pill-feeder?

Do you expect Health and Strength in tabloid form—through pills, potions and other exploited piffle?

You can't do it; it can't be done. The only way to be well is to build up your body—all of it, through nature's methods—not by pampering the stomach. It is not fate that is making you a failure; it's that poor emaciated body of yours; your half sickness shows pain in your face and the world loves healthy people. So be HEALTHY — STRONG — VITAL. That's living. Don't think too long; send three 2c stamps to cover mailing expenses of **Special Information on Thinness** and my book **"Promotion and Conservation of Health, Strength and Mental Energy,"** written by the strongest physical instructor in the world.

STRONGFORT
The Perfect Man

LIONEL STRONGFORT
Physical and Health Instructor
1415 Strongfort Institute **NEWARK, N. J.**
Founded 1895



Let Us Send You this Suit

Made to your measure, payable after received

Perfect fit, fine goods and tailoring, $20 saving, *all guaranteed or no pay.* **Samples Free.** Every man wanting to dress well and save money should write at once for our beautiful free book of cloth samples and correct fashions, explaining everything. Write letter or postal, just say "Send me your samples" and get everything by return mail free. Important to every man. Write today sure.

PARK TAILORING COMPANY
Dept 214 **Chicago, ILL.**

"Movie" Camera Copies Books and Legal Papers

By O. C. ROOS

(*Continued from page* 489)

switches, and whenever anyone was thru reading a projected exposure, for instance, a translation comparing it with the original source in a hotly contested case, he'd simply press his particular switch. *The last man to press his own switch would complete the circuit,* and the automatic projector would show the next exposure and the switches would all be *reset* again."

Promoter—"That's something which would be good for *family study,* perhaps!"

First Lawyer—"Yes, back in 1919 some people became interested in eliminating the weariness suffered by one member of a family reading to many. They knew that all the ingredients of a successful system were present in the *set-up* mechanisms of many inter-communicating telephones, and so they made inquiries along these lines."

Engineer—"I'll wager they found plenty of reasons urged against the system. There are just natural born vicious-minded people, you know. James might call them 'tender-minded,' but I prefer 'mulish.'"

Promoter—"Yes, I know what you're driving at. They want a 'praying' market. On its knees, as it were, for some one's pet product."

Engineer—"You can scarcely convince such people that demandor and demandee react, and irritate each other into growth. The presence of the new apparatus is like what our chemical friends call a 'catalyzer.'"

Promoter—"What's that?"

Engineer—"Why, it's the mental business minister who marries the transmitter idea to the receiver, in developing ideas. In chemistry, a third substance often unites two others, and itself comes from the process scot-free of any evidence of collusion or collision."

Promoter—"Oh! I see. Now, let's hope that the churches, colleges and schools are getting as much good out of this as the professionals, like you chaps. Why, I can see lots of ways for a business man to get into this thing."

Second Lawyer—"I've been listening attentively for some time and I've got this to say: There is more studying to be done by lawyers, doctors, engineers and in students' 'quiz' time around examination periods than you fellows even dream of. That's because a projector costs less than $25.00 per person, for even small groups, and you saw today how cheaply we got off at the library on *film expense.* There's no fire risk whatever and I've watched them go back and forth by electrical means over disputed texts 400 pages long, without even touching the projector. Even in 1920 a 1000 watt lamp, I'm told, would not damage the film during the wait necessary while several persons were engaged in reading a page of script projected on the screen."

Engineer — "Let's begin. (Presses a special switch by his seat on a small panel giving main control.) Oh! There's Fig. No. 1. You see in this 60 foot room how easily the text is read. There you see 75 lines, but we could project and make out clearly 100 lines if necessary."

First Lawyer—"I've read projected small type letters ¾ inch high easily at 100 feet with a good 1000 watt lamp. I think that a 40-foot throw and ⅝-inch letters, with a 400 watt lamp is very good. Now let's all make notes on this first page, and then everyone will press his particular *series key.*" (They all finish in about 15 minutes and the next two pages of the patent are then suddenly flasht on the screen.)

Engineer—"I'll turn off the projection

(*Continued on page* 564)

½ SAVED
GET OUR BIG BOOK



BURN LESS COAL

With an improved, all-cast pipeless furnace you can cut your coal bills in two. This efficient, basement installed heating plant heats and ventilates the entire home. It burns any grade of coal more economically than a stove. It needs no expensive piping or other equipment. Anyone can install it in a day. They are described at our wholesale prices in our Handy Man Book. Send for it.

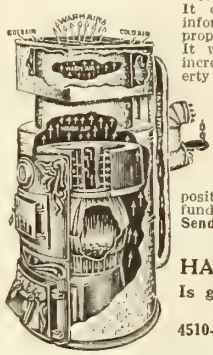


Do Your Own Plumbing and Heating by the Cut-to-Fit Method.

By our new plan anyone can install a complete plumbing or heating plant in his own home. Send us a rough sketch with measurements. Our Engineers will draw your plans, furnish information and see that the supplies you order come **CUT-TO-FIT** your needs. No waste of time, labor or unused material. Only a few simple tools necessary. **Send for**

The Handy Man Book

It will show you how. It will tell you just what to order and what it will cost at our wholesale prices. It contains plans and useful information for every builder, property owner or contractor. It will convince you. It will increase the value of your property 50%. You can do the work yourself.



We have spared no effort or expense in the preparation of this valuable book. To keep from sending it broadcast to uninterested persons we request a temporary deposit of 25c which will be refunded with your first order. **Send for it Today.**

The Service of
HARDIN-LAVIN CO.
Is guaranteed by 40 years' business at
4510-20L Cottage Grove Avenue
CHICAGO



Be an ELECTRICAL SIGNAL ENGINEER

FREE BOOK TELLS HOW

Big positions open now for Signal Engineers. You can qualify for this fascinating, highly-paid work in your spare time at home. Railroads everywhere need men who understand Signal Engineering and electrical safety devices.

$2500 to $5000 a Year

Earn a big salary right from the start—enjoy quick success and swift promotion. We train you in every branch of this great profession, including a complete course in

Practical Electricity

Write today for handsome FREE Book on Signal Engineering and details of our amazing Free Signal Engineers' Outfit. Address

DEPARTMENT OF SIGNALING, DEPT. 1796,
1924 Sunnyside Avenue, Chicago, Ill.



Be a Finger Print Detective

Earn Big Pay

Get into this fascinating new profession. Big salaries, rewards and fees are paid in this work. Finger Print experts needed by governments, corporations, police departments, and other institutions. Learn in spare time at home to fill one of these big jobs or go into business for yourself as a Finger Print Detective.

Book FREE Write quick for big, fully illustrated Finger Print Book. Tells all about this wonderfully interesting work and how you can easily qualify. Right now we are making an amazing special offer of a **FREE COURSE** in Secret Service

UNIVERSITY OF APPLIED SCIENCE
Dept. 1796, 1920 Sunnyside Ave., Chicago, Ill.



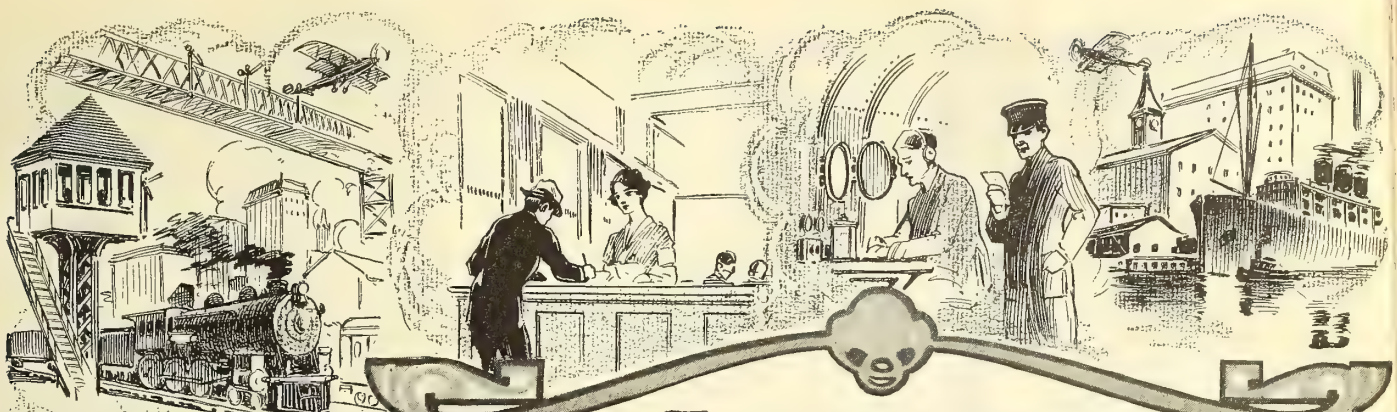
Cleartone Phonographs

$4.00 to $200.00 Retail

Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B East 12th Street, N. Y.



LEARN WIRELESS

At Home Quickly and Easily

WIRELESS is the hinge upon which swing the doors to success. It is the very foundation of the road which leads to many professions, vast in scope, big in responsibility, satisfying in progress and salary.

A trained Wireless Operator with initiative and ambition can easily fulfill his ideals for a successful future; one including a position filled with vital enterprise, adventure, and financial success.

Attractive Work—Alluring Salaries

Radio offers interesting work in pleasant environment, besides substantial salaries. Radio Operators' salaries start at $125 a month with all living expenses—board, lodging, laundry, etc.—paid. When totalled and added to salary, it means $200 or more a month, at the very start. Advancement to higher positions with bigger pay is readily accomplished.

Travel Without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs, wireless offers unequalled opportunities. On shipboard you are rated as an officer, living and eating with the officers, and mingling with the passengers. All without one cent's expense to you! Land Wireless positions are just as attractive if you prefer them.

Instrument Furnished Every Student

We furnish all necessary books and equipment *with our course.* Our famous Natrometer—automatic transmitting and receiving set—is among this outfit. This instrument sends you messages at varying speeds just as you would receive them from distant wireless stations—and is operated entirely without the use of "aerials".

BOOKLET FREE—It explains how we helped hundreds of ambitious men and women, and how we can give you a thorough Wireless training in your spare time, at home, by mail, and help you secure a worth-while position.

NATIONAL RADIO INSTITUTE
Dept. 279 14th & U Sts., N. W., WASHINGTON, D. C.

SEND THIS COUPON TODAY

NATIONAL RADIO INSTITUTE
Dept.279 14th & U Sts., N. W., WASHINGTON, D. C.

Send me your FREE book "Wireless The Opportunity of Today". Tell me about your Home Study Course in Wireless Telegraphy and Telephony —the free post-graduate course—and your Special Instrument Offer.

Name .....

Age ..... Address .....

City ..... State .....



"Another $50 Raise!"

"Why, that's the third increase I've had in a year! It just shows what special training will do for a man."

Every mail brings letters from some of the two million students of the International Correspondence Schools, telling of advancements and increased salaries won through spare time study.

How much longer are *you* going to wait before taking the step that is bound to bring you more money? Isn't it better to start *now* than to wait for years and then realize what the delay has cost you?

One hour after supper each night spent with the I. C. S. in the quiet of your own home will prepare you for the position you want in the work you like best.

Yes, it will! Put it up to us to prove it. Without cost, without obligation, just mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6249, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.



SAVE OVER HALF

Write Today for Our Free Blue Print Offer

Agents wanted for our ready built phonographs

Choraleon Phonograph Co.
807 Choraleon Bldg., Elkhart, Ind.

YOU NEED LOCOMA

—an interesting, inspiring, instructive MAGAZINE, dealing with the serious side of *Personal Subjects*—LOVE, MARRIAGE, DIVORCE, BIRTH CONTROL, EUGENICS, SEX HYGIENE, etc. 15c. a copy, $1.50 a year, 8 months trial 50c.
100 E. E. & M. Bldg., Farmington, Michigan.

Undersea Amusement Park

By F. E. LOUDY, A.E.

(*Continued from page 482*)

dersea amusement palace are multifarious and vari-colored in the extreme. Those who have seen large electrically illuminated fountains in operation at night, such as that at Willow Grove Park, near Philadelphia, will have some idea of the wonderful opportunities here presented to the illumination specialist charged with the task of working out a suitable lighting scheme for the resort. Searchlights or powerful nitrogen filled incandescent lamps, or argon filled incandescent lamps will vie with myriads of small incandescent tungsten lamps. Searchlights or else powerful flood lights of the gas filled type, will project beams of varying colors and of changing hues from the inner side of the breakwater.

These lamps are maintained and supplied with current over heavily insulated wires passing down thru small vertical shafts built in the concrete wall, in the manner shown in the illustration. In the event that it is necessary to repair part of the structure or for other reasons, it may be desirable or necessary to empty the water out of the basin in which the resort is situated, suitable high powered motor driven pumps will be available to pump the water back into the sea.

When the basin is to be refilled, it is only necessary to open the sea valves and the water will then run into the basin.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc., required by the Act of Congress of August 24, 1912; of ELECTRICAL EXPERIMENTER, published monthly, at New York, N. Y., for April 1, 1920.

State of New York, County of New York, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of the ELECTRICAL EXPERIMENTER and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Experimenter Publishing Co., 233 Fulton St., New York City; Editor, Hugo Gernsback, 233 Fulton St., New York City; Managing Editor, Harry Winfield Secor, 233 Fulton St., New York City; Business Manager, Hugo Gernsback, 233 Fulton St., New York City.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) Experimenter Publishing Co., 233 Fulton St., New York City; Hugo Gernsback, 233 Fulton St., New York City; Sidney Gernsback, 233 Fulton St., New York City; Mrs. K. Hymes, 233 Fulton St., New York City; Harry Winfield Secor, 233 Fulton St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, give the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

H. GERNSBACK.

Sworn to and subscribed before me this 5th day of April, 1920.

Beatrice K. Owen, Notary Public, New York County, New York; New York County No. 57; New York Register No. 1129. (My commission expires Mar. 30, 1921. (Seal.)

STUDY WIRELESS in BOSTON

The Center of Education, under former U. S. Radio Inspector for N. E. at

18 BOYLSTON STREET

Fall classes begin September 13th. Send for free literature. Enroll today.

MASSACHUSETTS RADIO AND TELEGRAPH SCHOOL
Arthur Batcheller R. F. Trop
G. R. Entwistle
Tel. Beach 7168

Learn the Sign-Show Card Business



Big field—unlimited possibilities—Increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.

EARN $25. TO $75. WEEKLY

You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.

DETROIT SCHOOL OF LETTERING, 688 D.S.L. Bldg. Detroit, Mich.

Learn Watch Repairing

Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates.

Ask for our Free Book. It explains our system and terms.



THE DeSELMS WATCH SCHOOL
720 Perry St., ATTICA, IND.

ARTIST'S OUTFIT FREE



Write quick for our remarkable offer. Learn NOW at home, in spare time, by our new instruction method. Commercial Art, Cartooning, Illustrating, Designing. Delightful, fascinating work in big demand. $50.00 paid for one drawing. Handsome book free explains everything. SEND FOR IT TODAY.

WASHINGTON SCHOOL OF ART, Inc.
1012 H Street, N. W. Dept. 1531 Washington, D. C.

You can be an ACCOUNTANT

Get the facts about the most successful home study course ever prepared. Absolutely different in both material and method. C. P. A. instructors in personal charge of every student. Opportunity to specialize in any desired line. Moderate fees; easy terms. Interesting books free. Address

International Accountants Society, Inc.
Dept. 942 2626 S. Michigan Ave., Chicago, Ill.

Small Steam Engines and Boilers



Gas and Gasoline Engines, ⅛ H. P. up; Tanks, Pumps, Gears, Model Maker's Supplies. Get our Big Catalogue sent postpaid for 15c (coin preferred) or stamps. Refunded first order. 192 Pages—over 200 Illustrations.

MODERN ENGINE & SUPPLY CO. 346 Monadnock Block, CHICAGO.

MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE
Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.

Chicago Medical School

Offers Accredited
DAY AND EVENING COURSES
in medicine and surgery leading to the degree of DOCTOR OF MEDICINE. Also offers through its affiliated college opportunity to complete premedical credits. WORK YOUR WAY PLAN.

Address REGISTRAR
3832 RHODES AVE. ● Dept. 7 CHICAGO

DEAFNESS IS MISERY



I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my sworn statement of how I recovered my hearing.

A. O. LEONARD
Suite 369, 70 5th Avenue New York City



As a matter of fact

Your first R-E-A-L cigarette pleasure will come with Camels!

YOU'LL swing into the Camel procession as easily and as delightedly as any of the thousands of smokers who have found these cigarettes an absolute revelation in quality, in refreshing flavor, in mellow mildness and in body!

Camels are unlike any cigarette you ever puffed. They are a creation—an expert blend of choice Turkish and choice Domestic tobaccos. As sure as you are a foot high you will prefer Camels blend to either kind of tobacco smoked straight!

Camels fit in with your cigarette desires just one hundred per cent! The satisfaction they impart to smokers is simply joyous.

Camels will not tire your taste! And, Camels leave no unpleasant cigaretty aftertaste nor unpleasant cigaretty odor.

You'll prove out our enthusiasm when you compare Camels with any cigarette in the world at any price!

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes for 20 cents; or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.

Camel
CIGARETTES

R. J. Reynolds Tobacco Co., Winston-Salem, N. C.



Be an Automotive Electrical Expert

$50 to $100 a Week

For Specialists in Starting, Lighting Ignition and Storage Batteries

YOU can qualify quickly for a big paying position as electrical expert on automobiles, motor trucks, tractors, motorcycles, aircraft, farm lighting plants, etc. Men are needed at once to specialize in this clean, interesting work.

There are high salaried jobs open everywhere with automotive manufacturers, service stations and garages. Our Free Employment Bureau helps you to a good position just as soon as your training is completed. Or you can go into business for yourself supplying motorists with electrical repair service.

In Three Months You Can Master

all systems of starting, lighting, ignition and storage batteries. Come to America's greatest institution of electrical education and learn by practical work on actual models of automotive electrical equipment in our splendid big laboratories. Personal instruction by well-known experts.

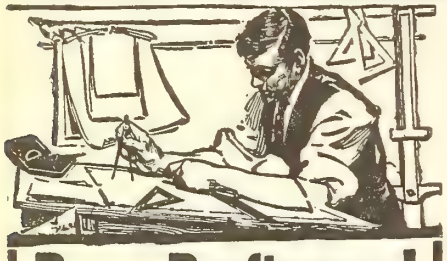
EARN WHILE YOU LEARN

Twelve weeks' intensive, full-time training makes you a thorough master of all types of Automotive Electrical equipment. Or you can earn your own way while you are learning by devoting half time to a well-paying position which we will secure for you. Low tuition fee; dormitory and other special privileges.

Big Book Free Write today for handsome, illustrated Book telling all about the great opportunities for Automotive Electrical Experts, our quick, intensive method of training you and our Earn While You Learn plan. Do not miss this splendid chance to step into a $50 to $100-a-week position. Send postcard or letter today.

SCHOOL of ENGINEERING of Milwaukee

Dept. 1-AJ—373 Broadway, Milwaukee, Wis.



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

75c a Week Only $3 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership **given free** with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-256 Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D-256
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $3.00 a month until $19.80 is paid, or notify you and hold books subject to your order. Title not to pass to me until fully paid.

Name .....
Address .....
Reference .....

The Whirling Eye

By THOMAS W. BENSON and CHARLES S. WOLFE

(*Continued from page 487*)

profession, and I dared not take up the defense, for if Mehlman still retained command of the faculty that had made him the terror of many a college professor, his logic would make short work of any case I might make.

For Mehlman had been my chum and room-mate at college. He had gone in for engineering, and he certainly was one of the most promising men that had ever graduated from our *alma mater*. I had lost track of him after he had gone down to South America to build railroads, and to find him in a patient's cell in an asylum was to see the impossible realized.

I dropped into the one chair in his room. "For the love of the Lord, Mehlman, what did you do that they sent you here?"

He grinned again. "Fell in love with a Venusian," he returned coolly, and the curve of his sensitive mouth was half humorous, half sad.

"A Venusian!" I echoed blankly.

"A Venusian," he replied emphatically. "An inhabitant of the planet Venus! It isn't being done in the best circles, you know!"

I turned to scrutinize him thoroly, and my slight move did not escape his keen eyes. He laughed with the greatest good nature in the world. "Now you know I'm crazy, eh?" he bantered playfully.

"Circumstances alter cases, Fred," I rejoined, slowly and gravely. "That statement, made in earnest by most anyone but Fred Mehlman, would be sufficient evidence of a positive nature for me. But you know that you have a prejudiced judge before you, old man, and I reserve judgment until I've heard more of this tale. Suppose you unburden yourself to your old pal, Fred, freely and fully, and if there is anything that I can do for you, old boy, you know that you can count on me."

Silently he held out his hand, and I wrung it until he winced. For a moment he sat lost in thought. Then he looked up and said abruptly, "There's one thing you can do, Jack, that I'll appreciate beyond words."

"And that is—?"

"Give me a smoke," he sighed wearily. "If there's one complaint I have to make against my keepers, it is that they have set an infernally long interval between smokes."

I rose and raised the window a trifle. "I'll violate the rules," I laughed, proffering my cigarette case and holding a match for him, "and join you. Now let me have the details of this horrible mess you've gotten yourself into. What's all this nonsense about the planet Venus?"

And then, sitting contentedly on the bed and swinging his feet, pausing now and then to puff deeply on his cigarette, he told his story, told it calmly and without a trace of irrationality or betraying excitement. I quote it practically verbatim in order that you may draw your own conclusions.

"It began down in South America," Mehlman said slowly. "Another chap and I were out on their God-forsaken prairies for months on end, with only the motley labor gang for company. You've no idea how tired of each other two people can get if they are thrown in each other's way every hour of the twenty-four for months that way. To keep from going mad and killing each other we had to devise something to pass our time with besides endless conversation.

"We turned to astronomy. Why? Well, for one thing, it was the easiest thing

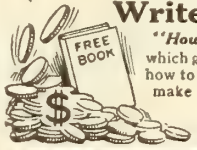


Go in Business for Yourself

Be independent—make more money—be your own boss Open a Tire Repair Shop. Complete equipment costs less than $100. No experience necessary. We teach you the Shaler System free.

Millions of tires need repairing. Hundreds of shops make $25 to $50 a day clear profit. Many make much more. Big capacity Shaler Shop Vulcanizer, all necessary tools and repair material with instructions costs less than $100.

Write for Free Book



"How to Open a Tire Repair Shop" which gives complete information. Tells how to start—how to get work—how to make perfect repairs. Write now

C. A. SHALER COMPANY
2208 Fourth St., Waupun, Wis.

BE AN EXPERT



Auto and Tractor Mechanic Earn $100 to $400 a Month

Young man, are you mechanically inclined? Come to the Sweeney School. Learn to be an expert. teach with tools not books. Do the work yourself, that's the secret of the

SWEENEY SYSTEM

of practical training by which 5,000 soldiers were trained for U. S. Government and over 20,000 expert mechanics. Learn in a few weeks; no previous experience necessary.

FREE Write today for illustrated free catalog showing hundreds of pictures men working in new Million Dollar Trade School.

LEARN A TRADE

Sweeney

SCHOOL OF AUTO-TRACTOR-AVIATION
66 SWEENEY BLDG. KANSAS CITY, MO.



VEST POCKET BLOW TORCH **$1**

The handiest tool on the market. The most business-like little thing you ever saw. Instant intensive heat. Sootless flame. Useful for

Electricians,
Machinists,
Automobilists,
Vocational Schools,
Home Tinkering.

REO SPECIALTY CO.
6381 Woodbine Avenue
Philadelphia, Pa.

Book on Law Free



Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.

Write Today—now while we are making a special reduced price offer.

American Correspondence School of Law
7446 Manhattan Bldg. Chicago, Illinois

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 770 Bogue Bldg., Indianapolis

within reach. Lying on our blankets at night, we would stare up at the constellations in the Southern sky, picking out and identifying a star here and there and the groups. We began with the naked eye, and it was surprising what a lot we could locate after we got the swing of the thing. Then we followed their movements and began making calculations. Astronomy is fascinating, Jack, even here in the flesh-pots, where there are a thousand and one other things to divert you from the contemplation of the universe.

"We grew quite wrapt up in our game and began writing to the States for textbooks and literature. Most of it took months to arrive, and when it did reach us we fairly ate the stuff up.

"Quite naturally, we outgrew the limitations imposed by our eyes, and on one of my rare trips to the outside I packed in a modest three-inch refractor.

"Of course, this telescope broadened our field and opened up new wonders for our contemplation. We would be at it late into the night, and thru the day, when not actually at our posts, we'd indulge in endless discussions.

"Now, here's the funniest part of the whole business. Being engineers, you'd think that the purely mathematical side of the thing would have claimed the greatest part of our attention, wouldn't you? The calculations of orbits and transits and eclipses and things like that. Well, it didn't. Neither of us ever devoted much time to that sort of thing after the first few months. No, sir. How, didn't concern us very much. Why and what were the big questions for us.

"We fell to speculating. Were any of those twinkling little fellows that defied our lenses inhabited? If they were, what type of creatures would be on them? Did they breathe the same kind of atmosphere that we did? Maybe they lived and had their being in water like the fish, eh?

"After a few months of this kind of stuff that railroad seemed a mighty little thing to us. In fact, the whole blamed earth and what we are pleased to call its momentous affairs became trivial as we strained our gaze out into the infinite and tried to read God's riddle.

"Warped? Monomania? You begin to think I'm in the right boarding house? Well, maybe. But, man, man, it takes a supreme egoist to imagine for one little minute that out of all those millions of globes hanging out there in boundless space our own particular little fly-speck should have been singled out by the Creator as the one suitable abode for an intelligent and creating race. The man who believes that must necessarily also believe that all those stars were hung out there for adornment or for our amusement. For, unless some of them are thriving, inhabited worlds, they are the most useless things we know anything about.

"I'm crazy, according to folks who should know, but it seems to me that any one who can imagine that God Almighty hung the stars up there just for the fun of the thing will stand a little investigating himself.

"That's a trifle off the main theme of my yarn, of course, but I mention it to you to show you our viewpoint. Logically, after having reached the unanimous conclusion that many of the stars were dwelling places of animal life, we were quite frantic to get a glimpse of some of these creatures.

"In this frame of mind, we soon grew dissatisfied with our poor little three-inch refractor. We began to speculate on the possibility of getting a close enough glimpse at the face of some planet to settle the question beyond peradventure.

"We dwelt on this subject until it became an obsession. It carried us far into the theory of telescope construction. We even

LEARN WIRELESS AT HOME

The Demand for Wireless Operators Far Exceeds the Supply

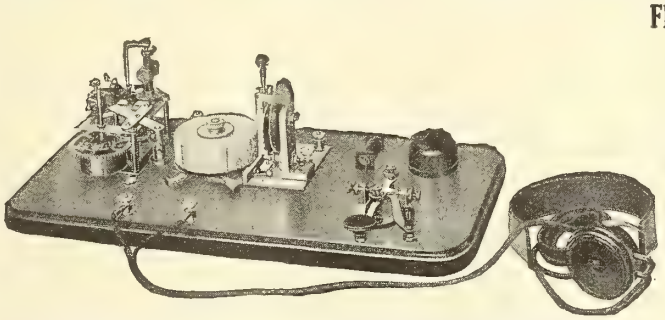
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, Chief Radio Inspector, Bureau of Navigation, N. Y. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way, will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free,* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do,* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* **This set is not loaned, but *given* to all students completing the Course.**

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph,* place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—*but do it today.*

NEW YORK WIRELESS INSTITUTE
Dept. 12, 258 Broadway
New York City

New York Wireless Institute
Dept. 12, 258 B'way, N. Y. City

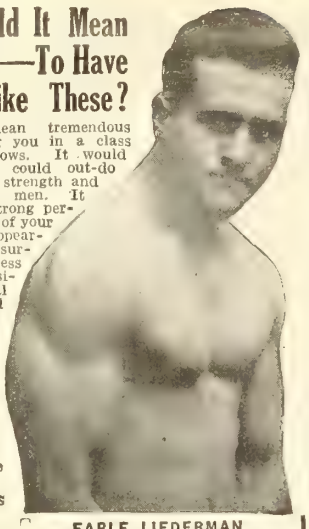
Send me free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your *Free Instrument Offer.*

Name .....

Address .....

City or Town.....State.....

What Would It Mean —To YOU—To Have Muscles Like These?



It would mean tremendous strength, putting you in a class above your fellows. It would mean that you could out-do them in feats of strength and be a leader of men. It would mean a strong personality because of your commanding appearance, thereby assuring you of success in both the business and social world. It would mean added lung power, unlimited vitality and perfect health; removing all fears of indigestion and disorders which undermine the average man and make him old long before his time.

All These Things Are Yours

EARLE LIEDERMAN
The Acme of Physical Perfection

I absolutely guarantee to do all this and more for you. I have found the short cut to physical perfection and applied it on my own body, proving its results. I have personally trained many of the world's strongest men by this same method. Why waste your time and money with old-time worthless methods? If you are desirous of being a real robust man, follow the path of those who have already made a success. Come now, get busy, for every day counts.

Send for My New Book, "Muscular Development"

It tells the secret. Handsomely illustrated with 25 full-page photographs of myself and some of the world's best athletes whom I have trained. Also contains full particulars of my splendid offer to you. The valuable book and special offer will be sent on receipt of only 10c, stamps or coin, to cover cost of wrapping and mailing.

Don't miss this opportunity. Sit right down now and fill in the coupon. The sooner you get started on the road to health the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon to-day.

EARLE E. LIEDERMAN, Dept. 209, 309 Broadway, N. Y.

EARLE E. LIEDERMAN, Dept. 209, 309 Broadway New York City.

Dear Sir:—I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development."

Name .....

Address .....

City ..... State .....

Play the Hawaiian Guitar

Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs, and other effects that make this instrument so delightful.



The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Your tuition fee includes a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 complete lessons and pieces of music.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK

I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc., etc.

NAME .....

ADDRESS .....

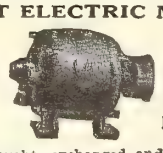
TOWN .....

STATE .....E.E.

Please write name and address Clearly.

REBUILT ELECTRIC MOTORS

General Electric
Westinghouse
Crocker-Wheeler
Emerson
Century
Wagner
etc.



All Motors Guaranteed For One Year

Motors bought, exchanged and repaired
ELECTRICAL SUPPLIES
Wholesale Prices
Sockets, wire, tape, loom, fuses, switches, cut outs, etc.
New illustrated catalogue free. Satisfaction guaranteed or money refunded.
HYRE ELECTRIC CO.
631 S. Dearborn St. Chicago, Ill.

considered constructing one out there in that abominable scrub. Indeed, we went so far as to turn over methodically all the problems which we must solve out there in order to be successful. I believe we could have done it, too, but another and more serious problem arose, which seemed unsurmountable.

"Know anything about telescopes? Not a whole lot, eh? Well, I'll give you the pith of the matter briefly. There are two classes, the *refracting* and the *reflecting*. You look straight thru the refracting kind, like field or opera glasses somewhat, while in the reflecting you have a shallow, concave mirror, like a dish, with which you gather as much light as possible, depending mostly on the size of your mirror. Then you bring all the light rays to a focus at a point away up near the top of your tube, at which point it forms a minute image of the object from whence the light is being reflected. This image you view thru magnifying eye-pieces.

"Well, we learned that the world's biggest refractor measured some forty inches across the lens. That is, that was the diameter of the field lens. And that is about the limit, too. It won't make a whole lot of difference, so far as our problem is concerned, if they made it fifty inches. And the reason that this is the limit is a simple one. A moment's reflection will show you that, inasmuch as you look thru the glass, the thing must be supported on its edges, its weakest point. As a forty-inch lens weighs into the tons, you see that they cannot do much more in that direction.

"The world's biggest reflector, on the other hand, is at Mt. Wilson, right here in the U. S. A., and represents about the limit in that direction. That mirror weighs some thirteen ton, and the difficulty of getting a flawless piece of glass much larger than that is enormous, to say nothing of the grinding, figuring and polishing, if they do get them bigger.

"Now, the point of all this is this: With the biggest they've got they are not getting down to the surface of any of those other globes. About the best they can do is a rather vague picture of the moon's surface, showing us a few mountains and leaving all the big, vital questions unanswered.

"Well, that's where we stalled. Undoubtedly we could build a telescope out there larger than the one we had, but it was equally true that we could not hope to anywhere near equal the world's best, and these were not good enough for our purpose.

"So we contented ourselves with mapping out a campaign to be fought out when we reached civilization once more.

"Many a night we planned and discust. We soon realized that if we would accomplish our end we must find some instrument radically different from what was in vogue.

"And once we admitted this, we were forced to admit that we had about exhausted the possibilities of glass. Some other medium we must find in order to outdo the work of the Mt. Wilson telescope.

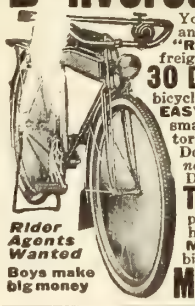
"I can't tell you which one of us struck the idea first. I guess that we are both entitled to an equal share of whatever credit there is in our find. For the idea just grew out of our endless councils. Anyway, we had a beautiful little scheme all ready for a tryout when we could get back to the States."

Mehlman paused to gaze reflectively out into the dark night. Absently his fingers groped into his pocket, and then, remembering himself, he flushed. "Give me a cigarette, old man," he said, apologetically.

In silence I proffered my case, and he continued the narration.

"Poor Jackson didn't come back to the

Delivered TO YOU FREE



Your choice of **44 styles**, colors and sizes in the famous line of **"RANGER"** bicycles. We pay the freight from Chicago to your town.

30 Days Free Trial allowed on the bicycle you select, actual riding test.

EASY PAYMENTS if desired, at a small advance over our Special Factory-to-Rider cash prices.

Do not buy until you get our *great new trial offer* and low Factory-Direct-To-Rider terms and prices.

TIRES LAMPS, HORNS, pedals, single wheels and repair parts for all makes of bicycles at half usual prices. **SEND NO MONEY** but write today for the big new Catalog.

Rider Agents Wanted
Boys make big money

MEAD CYCLE COMPANY Dept. W-107 CHICAGO



Phonograph Owners, Attention—The **Ear-O-Phone** when placed over the ear, collects a musical tone and brings it to the ear in an **intensified** form, **clarifying** it so that it sounds more **natural** with increased **volume**. You get a strong **overtone** too. Only 3 by 2 inches in size. (State for which ear it is intended.) Made in **Oak, Walnut** and **Mahogany**, price $3.50 postpaid. Send P. O. or Exp. money order. Address

THE EAR-O-PHONE
1413 North Broadway
Los Angeles, Calif.

Handwriting Tells You Secrets

Be successful. Find out what holds you back. Send us an ink specimen of your handwriting and $1.00. Our expert Graphologists will tell you your faults, virtues, talents, etc. Your $1.00 back if you are not satisfied.

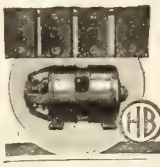
ROBERT R. ROSS, 110 West 40th St., N. Y.

Fun, Magic and Mystery!

56 Feats in Magic, 250 New Jokes, 21 Puzzles, 1 Fortune Telling Tablet, 52 Money-Making Secrets, 15 Card Tricks, 71 Toasts, 58 Verses in Comic Poetry, 10 Funny Readings, 41 Epitaphs, and 11 Parlor Pastimes. You get all the above-mentioned and our big illustrated Catalog of 125 Magic Tricks for only 10 cents. Write today.

DETROIT TRICK & NOVELTY CO.
454-456 Dix Avenue Detroit, Mich.

$100 to $350 Monthly Profit



This HB charger recharges 1 to 32 6-volt batteries, or equivalent, for 10c to 15c each. Customer pays 75c to $2.00. HB Chargers are sturdy and reliable—no repairs—no expensive renewals. Small cash payment, balance easy monthly terms. Absolute Money-Back Guarantee. Write to Box 93-E Troy, Ohio

HOBART BROS. CO.

Learn to Dance!



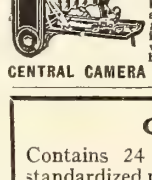
You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful **Peak System** of Mail Instruction.

New Diagram Method. Easily learned; no music needed: thousands taught successfully.

Write for Special Terms. Send *today* for FREE information and surprisingly low offer.

WILLIAM CHANDLER PEAK, M. B.
Room 236 • 621 Crescent Place—Chicago, Ill.

SAVE 25% to 60%



on slightly used
GRAFLEX-KODAKS

Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. **All goods sold on 10 days' Free Trial.** Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.

CENTRAL CAMERA CO., Dept. 119 124 S. Wabash, Chicago

CATALOG J.

Contains 24 pages of reliable apparatus, standardized parts and raw materials. Complete line switch points, knobs, switches, rod, aerial wire, etc.

Send 5c in stamps for your copy today.

Shotten Radio Mfg. Co., P. O. Box 3, Scranton, Pa.



Send for a Complete Catalog of
MASONIC BOOKS
Jewelry and Goods
REDDING & CO.
Publishers and Manufacturers
Dept. 5 200 Fifth Avenue, N. Y.

States. A snake bit him out there on the Pampas. They have the damnedest snakes. So I arrived alone and set about constructing the thing we had worked out between us.

"Of course, I kept the thing a secret. Months of star-gazing, even, had failed to iron out of my nature that cute little trait of mankind—selfishness. Also, it just about broke me to construct the thing. I don't care—it was worth it.

"*I built my five-hundred-inch reflector.* How did I do it? Oh, I'll give you all the details. The selfishness thing is all out of me now. I gave the alienists the details, too, and this is where it brought me. You see, my instrument had been destroyed by fire, and I couldn't back my statements.

"*I made that reflector out of mercury.* Yes, that was the whole trick, that and the apparatus I had to build to handle it. I won't bore you with the mechanical details of the thing—an outline ought to do. You see, if you take a pool of mercury in a pan and whirl it, when you get sufficient speed up several natural forces act to shape the mercury into the form of a speculum.

"And there, without tedious months of casting and grinding and polishing, I had my reflecting mirror, the largest the world had ever known.

"Of course, I had many little problems to work out. To get the necessary smoothness of surface of *the whirling mercury pool,* for instance, the pan must be tremorless. The slightest tremor will ripple the whole surface, which would destroy its value as a reflector. The pivoting arrangement and the driving mechanism cost me much labor, but Jackson and I had already worked them out on paper down in South America.

"Another bothersome obstacle was the focal length of the thing. That is, the rays came to a focus so far above the surface of the mirror that the tube for the telescope would have been a discouragingly huge affair. To overcome this I resorted to an arrangement of prisms and lenses worked out by poor old Jackson, and when I got the whole thing completed the tube of my telescope was only twenty feet above the floor of my modest little observatory.

"I find it hard to tell the rest of my story calmly, Rose, and if you are going to judge me by my manner from now on to the end of the yarn, I fear that you are going to have plenty to be suspicious of.

"I ask you to put yourself in my place. After years of patient toil and waiting I was about to gaze into the most powerful tube yet devised by man. Do you wonder that my nerves gave way to the strain? And I confess to you that as evening slowly approached on that fateful day I went about my preparations gibbering to myself in a fashion about as bad as anything you have here, I guess.

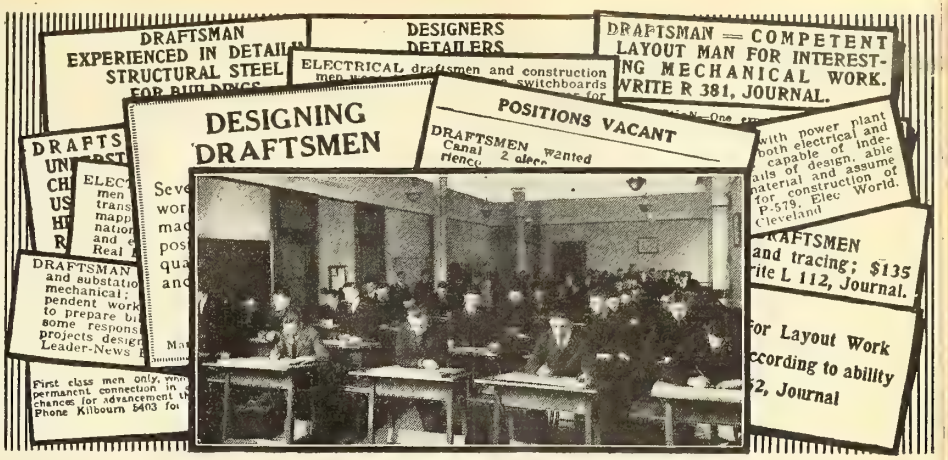
"I'll pass that part. There are minutes that I don't like to think of myself, minutes full of foreboding that, after all, the thing would not work. At those times I lost control of myself altogether and just raved.

"The moment came when I trained the tube on the moon's surface. My motor was purring contentedly and my stabilizer was functioning as smoothly as a nicely balanced stop-watch. The surface of the mercury was perfect. Whirling in the thousands of revolutions a minute, that pool seemed as still as this floor.

"I trained the range-finder on our satellite, started the mechanism which follows the motion of the object observed and keeps the telescope trained and applied my eye to the Huyghenian eye-piece.

"I was looking onto the moon's surface.

"For a long time I gazed, enraptured. One of our great questions had been answered to my satisfaction. Rose, the moon



Learn Drafting!

Mechanical — Electrical — Architectural — Structural

TODAY everything is built by plan. In the factories, large and small, no new product is made, not even a change is made in an old design, but that a new sketch, worked out to the finest detail is first prepared. New buildings are constructed according to the architect's cleverly-drawn plans. Great bridges, tunnels, reclamation projects are first schemed out on paper—by draftsmen! So we find every industry, in every land throughout the world in great need of skilled draftsmen. These men must be trained to take plans in the rough and draft them into workable, accurate graphs to guide the workmen. For this work handsome salaries are paid. But the men who earn the really big pay are the men who have been properly trained in the principles and practice of advanced draftsmanship.

Every Industry Needs Draftsmen

Railroads, steel mills, factories, ship yards, electrical concerns, contractors, construction engineers and companies, car shops, architects and hundreds of other concerns need and must have skilled draftsmen. In every industry thousands of draftsmen are daily required. The services of the man who is properly trained in this important work are always in great demand. Why don't you get into this fascinating profession?

Become an Expert in Six Months

Practical Men Prepare You

Come to the School of Engineering of Milwaukee to learn *right* the science of *Drafting.* You will learn quickly and thoroughly here, from men who are recognized experts. No special ability or "drawing talent" is necessary. With the desire to learn and the will to win you can here quickly qualify for a responsible well-paying position in this fascinating field of work. Here you learn in large, airy, well-lighted drafting rooms. Skilled instructors, who are practical experts, train you step by step. Working models, machine parts, intricate electrical apparatus—the most thorough complete equipment for learning every phase of drafting is provided by School of Engineering. With this wonderful training you can become an expert Draftsman in six months.

Earn While You Learn

By our special system you may earn your way while learning. Our Employment Department will secure you a position to which you may devote a part of each day spending the remainder at the school. This plan both solves the students' financial problems and provides splendid experience at the same time. One week of practical employment and one week in the drawing room permit you finishing this full course in one year. Low tuition fee and Fraternity House for all students who wish to secure board and room at cost.

Earn $150 to $400 a Month

In this fascinating profession each man is paid according to his skill and worth. Expert Draftsmen with specialized training such as School of Engineering offers can easily earn $150 to $400 a month. Expert Designers who have had drafting experience enjoy incomes up to $10,000 a year and more. Salaries of over $5,000 are often paid to Chief Draftsmen and Engineers. Train now for one of these splendid positions. With six months of special, intense instruction here, you will be started with a good work that will quickly put you into the big-pay class.

SEND FOR NEW FREE BOOK

CLASSES NOW ORGANIZING

Mail the coupon now and get full information. Now is the ideal time to come to School of Engineering of Milwaukee. Here, on this breeze-swept shore of Lake Michigan, you will enjoy cool weather while you are learning. And there is every facility for recreation. The school is located in the heart of Milwaukee, a large up-to-date city with the added attraction of bathing and boating on beautiful Lake Michigan and other lakes in the surrounding country. Our students engage in baseball and other sports. You will enjoy your training at School of Engineering and your time here will pay you golden dividends all the rest of your life in increased earning power and bigger opportunities. It will mean thousands of dollars to you to mail the coupon **NOW.**

SCHOOL of ENGINEERING of Milwaukee

15th Successful Year Begins Sept. 1st

1-BJ-373 Broadway Milwaukee, Wis.

School of Engineering of Milwaukee
1-BJ-373 Broadway, Milwaukee, Wis.

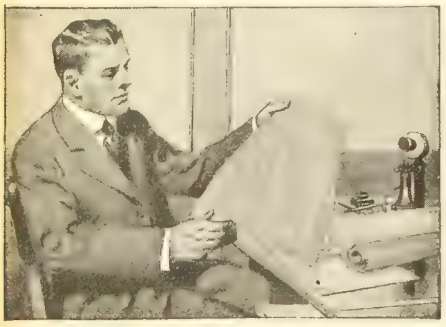
I want full details and new catalog of the Electrical & Mechanical DRAFTING Course FREE!

Name.....

Address.....

Age..... Education.....

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6247 SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ELECTRICAL ENGINEER
- Electrician
- Electric Wiring
- Electric Lighting
- Electric Car Running
- Heavy Electric Traction
- Electrical Draftsman
- Electric Machine Designer
- Telegraph Expert
- Practical Telephony
- MECHANICAL ENGINEER
- Mechanical Draftsman
- Ship Draftsman
- Machine Shop Practice
- Toolmaker
- Gas Engineer
- CIVIL ENGINEER
- Surveying and Mapping
- MINE FOREM'N OR ENG'R
- ARCHITECT
- Architectural Draftsman
- PLUMBING AND HEATING
- Sheet Metal Worker
- Navigator
- CHEMICAL ENGINEER
- SALESMANSHIP
- ADVERTISING MAN
- Window Trimmer
- Show Card Writer
- Outdoor Sign Painter
- RAILROADER
- ILLUSTRATOR
- DESIGNER
- BUSINESS MANAGEMENT
- Private Secretary
- BOOKKEEPER
- Stenographer and Typist
- Cert. Pub. Accountant
- Traffic Management
- Commercial Law
- GOOD ENGLISH
- STATIONARY ENGINEER
- CIVIL SERVICE
- Railway Mail Clerk
- Textile Overseer or Supt.
- AGRICULTURE
- Poultry Raising
- Automobiles
- Spanish
- French
- Italian

Name_____

Present Occupation_____ 7-28-19

Street and No._____

City_____ State_____

Electrical Engineering men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete

In One Year



Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 28th year opens Sept. 29, 1920
BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER OVERLAND, MO.

is devoid of life such as we know it. A few crawling things there are and some sparse vegetation, but no race, no development, nothing like this sphere. But, man, man, *there has been!*

"*There are ruins of cities on the moon.*

"Next I trained the tube on Venus. This planet was poor old Jackson's favorite, and how I wished that he might have been with me at that moment.

"How shall I describe to you what lay before my eyes? The cloudy mist that astronomers notice surrounding the face of that planet will not bother the telescopes of tomorrow.

"And, Rose, those people are centuries ahead of us," his voice sank to a whisper. "Rose, night after night I watched them, night after night I followed them thru the streets of their cities, at their daily tasks, as they assembled in their big open-air auditoriums. They have mastered death up there, Rose. Physical death, I mean, of course, and if we ever come to it, I'll tell you now that the apparent problem of a teeming universe will not be hard.

"And, Rose, there's a 'girl' up there I want. I never had one down here, you know. I only hope that I'll be able to make my way up to her. And somehow, I feel that I will. And my telescope's gone, and I haven't the money to build another, nor the freedom to build it, for that matter. And—"

His voice trailed off into nothing, and he shook himself as a man does who tries to get himself awake. Finally he gained control of himself. He grinned at me sheepishly. "There! Now you know I'm crazy, don't you?" he asked, with a kind of a sob.

I regarded him soberly. "God knows, old man," I replied; "I can't tell you. I don't know what to do. I don't know what to say."

He laughed with forced cheerfulness. "Do? Why, you solemn old goose, what is there to do? Figure out a way to turn me loose, and then have your conscience working overtime for you because of it? Nothing doing. I have no desire to get loose, Rose. If I was out, I'd only try to raise funds to begin the whole business over again, and I've about figured out that the peep I got behind God's veil is about all I'm entitled to this side of Eternity. I'm content to wait until the time comes. So all I ask of you is an occasional smoke. And thanks for the patient listening to my . . ."

The sentence remained unfinished. He suddenly stiffened up as if struck by an apoplectic fit. He reeled and fell heavily over his cot just as I rushed to his assistance. I placed him tenderly upon his bed and tried to revive him. But it was useless. He had died almost instantly.

An autopsy was performed at my suggestion. The physician's report read:

Frederic Mehlman, age 42. Single. Cause of death, cerebral trombosis (blood-clot of the brain).

[THE END.]

VOICE RECORD BY RADIO.

Experiments which have been carried out in London, England, have resulted in the making of a talking machine record on wax of a voice transmitted by wireless telephone forty miles away.

While an experimenter was speaking at Chelmsford, in the county of Essex, where there is a high-power instrument capable of transmitting the voice many hundreds of miles, the equipment at the receiving plant in the Strand, London, was attached to a recorder, which engraved the messages in soft wax, following the process of manufacture of an ordinary talking machine disc.

The record when produced was perfectly audible, tho a trifle "patchy." With larger amplifiers the result, it is said, would have been louder, tho rather hoarse in its effect.





A pretty big load

—yes, but a mighty easy one for the **Auto-Wheel**. You may not want so many to ride, but you can be sure the **Auto-Wheel** will haul them safely. When the boys see the **Auto-Wheel** they'll want a ride.

Seasoned ash, steel tires and axles, and the best of workmanship make **Auto-Wheel** wagons the finest in the world. We use them to haul 1000-pound loads. Get an

Auto-Wheel Coaster
or an
Auto-Wheel Convertible Roadster

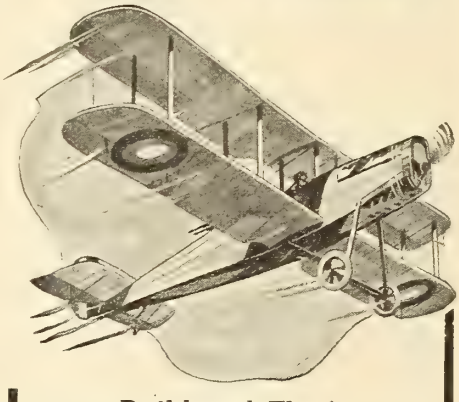




"Organize an Auto-Wheel Club. "The Auto-Wheel Spokesman," a magazine for live boys, tells of our prize contests. Send names of 3 coaster dealers, telling which ones handle the wagon with the name **"Auto-Wheel"** on the sides. We'll put you on the mailing list for six months, FREE.

The Auto-Wheel Coaster Co., Inc.
Formerly the Buffalo Sled Co.
163 Schenck Street,
N. TONAWANDA, N. Y.
In Canada: Preston, Ont.
Export Office:
365 W. 23rd St., New York City.

Auto-Wheel



Build and Fly A Model Aeroplane This Summer!

Build a real, flying model of any of the famous Aeroplanes listed below. IDEAL Scale Drawings and Building and Flying Instructions show how you can build 3-ft. models of real 'planes.

Send now for drawings and instructions for the one you want to build.

Curtiss JN4D-2 Training 'Plane (Just Out)
NC-4 Naval Seaplane
DeHaviland Battle 'plane

35c EACH POSTPAID

Curtiss Military Tractor
Bleriot Monoplane
Nieuport Monoplane
Taube Monoplane

Catalogue of IDEAL Model Aeroplanes and Supplies 5c, if you write at once; regular price 10c.

Ideal Airplane & Supply Company
Making Model Aeroplanes since 1911
159-161 Wooster St., Cor. West Houston St.
New York City

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**



Wrestling Book FREE
Be an expert wrestler. Learn at home by mail. Wonderful lessons prepared by world's champions **Farmer Burns and Frank Gotch. Free book** tells you how. Secret holds, blocks and tricks revealed. Don't delay. Be strong, healthy. Handle big men with ease. Write for free book. State age. **Farmer Burns,** 1256 Ramge Bldg., **Omaha, Neb.**



"Find the Man!"

"We'll pay him $5,000 a year. Go over our list of employees—pick out those who not only have been doing their work well, but have been studying in spare time getting ready for advancement. That's the kind of man we want for this job and for all of this firm's responsible positions."

Employers everywhere are combing their ranks for men with ambition, for men who really want to get ahead in the world and are willing to prove it by training themselves in spare time to do some one thing well.

Prove that you are that kind of man! The International Correspondence Schools are ready and anxious to help you prepare for advancement in the work of your choice, whatever it may be. More than two million men and women in the last 29 years have taken the I. C. S. route to more money. More than 110,000 others are getting ready right now. Hundreds are starting every month. Isn't it about time for *you* to find out what the I. C. S. can do for you?

Here is all we ask: Without cost, without obligating yourself in any way, simply mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6250, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electric Lighting and Railways
- ☐ Electric Wiring
- ☐ Telegraph Engineer
- ☐ Telephone Work
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Machine Shop Practice
- ☐ Toolmaker
- ☐ Gas Engine Operating
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREMAN OR ENGINEER
- ☐ STATIONARY ENGINEER
- ☐ Marine Engineer
- ☐ Ship Draftsman
- ☐ ARCHITECT
- ☐ Contractor and Builder
- ☐ Architectural Draftsman
- ☐ Concrete Builder
- ☐ Structural Engineer
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Textile Overseer or Supt.
- ☐ CHEMIST
- ☐ Navigation
- ☐ SALESMANSHIP
- ☐ ADVERTISING
- ☐ Window Trimmer
- ☐ Show Card Writer
- ☐ Sign Painter
- ☐ Railroad Trainman
- ☐ ILLUSTRATING
- ☐ Cartooning
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Public Accountant
- ☐ TRAFFIC MANAGER
- ☐ Railway Accountant
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ Teacher
- ☐ Common School Subjects
- ☐ Mathematics
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ AUTOMOBILE OPERATING
- ☐ Auto Repairing
- ☐ AGRICULTURE
- ☐ Poultry Raising
- ☐ Spanish
- ☐ French
- ☐ Italian

Name_____

Present Occupation_____ 7-28-19

Street and No._____

City_____ State_____



FOR SALE AT ALL NEWS STANDS

ARTISTIC TWO COLOR COVER

"THE 100% WIRELESS MAGAZINE"

Partial CONTENTS OF SEPTEMBER ISSUE:

Radio Frequency Amplification
By A. S. Blatterman

"Wired Wireless" in the U. S.
By John W. Kearn

"Wired Wireless" in Germany
By Dr. Alfred Gradenwitz

Loud Talker for Radio and Telephone Signals
By H. Winfield Secor

"One of the Gang"
By Miss Marianne C. Brown

A Trans Oceanic Receiver
By Frederick J. Rumford

Radio Telephony Simplified
By H. L. Bedenbender

Ideas—Sixth Spasm
By Thos. W. Benson

What "Radio News" Is:

RADIO NEWS now in its second year holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO NEWS leads all other wireless magazines. The August issue had 72 pages; there are seventy-four separate purely radio articles and 107 illustrations. *Over forty thousand copies were printed and circulated.*

Each issue of RADIO NEWS contains 72 pages (or more) and an artistic cover in two colors. The illustrations average 120 every month and there are from 60 to 80 up-to-date articles, some by our greatest radio scientists, in every issue.

THIRD $100.00 RADIO PRIZE CONTEST

A new radio contest. The third one offering $100.00 in prizes began in our May issue.

72 PAGES
120 ILLUSTRATIONS

20c The Copy
$2.00 A Year
Canada and Foreign $2.50 A Year

SEND 20c FOR SAMPLE COPY TODAY

SPECIAL OFFER

Gentlemen:
Please enter my subscription for RADIO NEWS for the term of one year for which I enclose herewith $2.00. As a special offer you will also send me for 25c extra your great Wireless Course containing 160 pages, 350 illustrations, size 6¾ x 10" with fine flexible cloth cover. I have written my name and address in margin below.

EXPERIMENTER PUB. CO., 231 Fulton St., New York City



Go as High as You Like

No Limit to Salaries in Aviation

No other industry offers the wonderful chances for big money-making that the Airplane Industry offers to ambitious men today. Trained men are needed immediately to fill big paying jobs. The airplane has come to stay—it will soon be a part of our everyday life. The men who get in now are the ones that will cash in big. Look at the "big fellows" in the automobile game today. They represent power and wealth because they got in early—you can do the same in aviation and you have an advantage because you can be trained before you start.



Delivering Newspaper "Extras" by Airplane



A New Seven-Passenger Airplane



A New Job—The Aerial Postman



View in an Airplane Factory

Thousands of Airplane Mechanics Needed

Airplane factories are being built by the dozens. Transportation, passenger carrying, and mail carrying lines are being opened up everywhere. This means men, men, men. Trained men only are wanted—men who know what's what. Ten times the number of men now engaged in this work are needed. Jobs with big pay are waiting for men to fill them just as soon as they are trained. Why don't you prepare for one of these big jobs now?

Here Are a Few Jobs That Will Pay $50.00 to $250.00 a Week:

Aeronautical Instructor · Aeronautical Engineer · Aeronautical Contractor · Airplane Repairman · Airplane Mechanician · Airplane Inspector · Airplane Salesman · Airplane Assembler · Airplane Builder

Learn at Home In Your Spare Time

Keep right on with the work you are doing now. A little of your spare time is all you need. Our Special Course is simplified for home instruction and is endorsed by airplane manufacturers, aeronautical experts, aviators and the leading aero clubs. Any man that can read English can understand it. The Lessons are self-explanatory and are made plain as day with Blueprints, Diagrams, etc. Our Advisory Council and Instructors are behind you all the time giving you everything you must know. The entire field of Practical Aeronautics and Science of Aviation is laid right before your eyes. You are bound to succeed with this training. This means for you a man's size job with a man's size pay.



Big Book of Opportunities FREE!

Send for our big free book showing just what is going on in the Airplane Industry. It also shows what other men have done in this fascinating field and what you can do, too. It gives a list of some large manufacturers and dealers in airplanes and some of the jobs that are open to trained men. With the book we will send you a special offer that you will be glad to know about. This special offer may be withdrawn at any time without notice. *Send the coupon now and take advantage of this offer.*

American School of Aviation
Dept. 7446 - 431 S. Dearborn St., Chicago

Mail This Coupon For FREE BOOK

AMERICAN SCHOOL OF AVIATION
Dept. 7446
431 S. Dearborn St.
Chicago

Without obligation on my part you may send me your book entitled "Opportunities in the Airplane Industry" and your SPECIAL Limited offer.

Name .....

Address .....

City ..... *State* .....

Chemical Laboratory



$6.00

No. 4889

We present herewith to our friends our **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform real chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

DESCRIPTION OF THE OUTFIT:

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars! The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The Instruction book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the Elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English System and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the **100 Experiments** are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and Smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make Chemical Colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

Price $6.00. Shipping Weight 10 lbs. (Can be shipped by Express only.)
Immediate Shipment

The Boy's Electric Toys



"THE BOY'S ELECTRIC TOYS" contains enough material TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size over all of the outfit is 14 x 9 x 2¾. Shipping weight, 8 lbs.

No. 2002 "The Boy's Electric Toys," outfit as described.....$6.00
IMMEDIATE SHIPMENTS

$6.00

No. 2002

"The Livest Catalog in America"

IN this cyclopedia you will find all about radio. One of the greatest catalogs of its kind in print.

You will find in it dozens of wireless instruments of the famous E. I. Co. make.

Other things you will find listed in this catalog: Electrolytic Interrupters, Bulldog Spark Coils, Chemical Outfits, Code Practice Sets, Primary Batteries, Storage Batteries, Hydrometers, Volt and Ammeters, Batterymeters, Electrolytic Rectifiers, Rheostats, Tesla Coils, Microphones, Loud Talkers, Electro-magnets, X-ray Tubes, Telephones, Magnetos, Low Tension Transformers, Books, etc., etc. IN A WORD THE MOST COMPLETE CATALOG IN PRINT.

FREE with this wonderful cyclopedia —20 coupons for our 160 page Wireless Course in 20 lessons. 350 illustrations, 30 tables. Catalog explains how you can get this Course absolutely free.

The Electro Importing Co.,
231 Fulton Street New York

"Everything for the Experimenter"

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

I enclose herewith 6 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 22 as described.

NAME .....

ADDRESS .....

STATE.....S.&I. 9-20

The Unknown Avenger

By HAROLD F. RICHARDS, PH. D.

(*Continued from page* 483)

forefinger the little notched wheel and applied the blue flame to the heap of papers. The three then warmed their hands over the flame, which leaped briskly in the cold air, while Kelly stood erect in the background, his inscrutable expression giving no indication that he had played a dangerous game—and lost.

When the fire had burned itself out, von Hernholtz motioned Kelly into the gasoline launch, whose nose touched the rock on which the party stood. The three conspirators followed, the engine chugged and soon they had reached the yacht. The launch was hoisted to its place and the great yacht steamed away due north. Kelly judged that they must be fifty miles north of Iceland, when a stop was made in mid-sea. The launch was lowered again into the water. Von Hernholtz addrest Kelly:

"Will you be kind enough to descend into the launch?"

Kelly, still well trussed up, complied. Resistance was useless. A heavy wooden mast had been securely erected in the center of the open launch. While Lendorff covered Kelly with a revolver, von Hernholtz deftly untied his bonds. Then his left arm was tightly bound to his side, while a heavy leather thong was securely fastened to his right wrist. The thong was then passed thru a pulley fastened to the top of the mast, and Kelly's arm was steadily drawn over his head until his heels left the floor of the boat, so that he was trussed up on tiptoe. The thong was made fast to the top of the short mast, and Kelly remained in this stretched position. He uttered no word. His face bore a look of calm resignation, as of a good poker player who has risked his pile on a single deal and lost. Again von Hernholtz spoke:

"Mr. Kelly, in recognition of your devoted attention we have decided to make you a present of this launch. It is in perfect condition, as you can tell by listening to the smooth purring of the motor. There is an ample supply of fuel, and the automatic feed insures that the engine will require no attention from you. For your further convenience we have equipped the craft with one of the new gyroscopic controllers, so that the boat will follow a straight line without any hand at the wheel. I think that you had better take the course due north, as there will then be no danger of collision with any steamers. The fuel will undoubtedly last for at least fifty miles, so that your excursion will be uninterrupted. I sincerely trust that you meet no icebergs."

"My God, Hernholtz," groaned Kelly, as the full import of their plans forced itself upon his unwilling understanding. "Why can't you shoot me?"

"My dear Kelly, such an action would be extremely indelicate, and furthermore we feel that your distinguished services merit a more worthy reward. We wish you a happy voyage."

Standing on the rope ladder, von Hernholtz pusht with a long staff the clutch of the engine, and the launch darted off with its lone passenger, due north. Von Hernholtz, Lendorff and Madame Elaine Holt lighted each a gold-tipped Egyptienne and puffed calmly as they watched the launch skim over the water with the figure of Kelly, stretched up at the mast, showing plainly against the horizon.

* * * * * *

One year later a group of sinister-faced men in evening clothes were in session in a luxurious office on the twelfth floor of New York's greatest building. The directors of the Murder Syndicate were holding

A Sensational Feat



like the one shown in this picture attracts and amuses theatre goers, but the development and strength of the man who performs the feat are even more interesting than the feat itself. We remember the symmetrical development and strength of the performer long after the feat is forgotten.

Walking with a weight of 500 lbs. in the manner shown above requires strength in every part of the body. That this man has strength is shown by his broad shoulders, deep chest, and magnificently muscled arms and legs. He is one of our pupils—a man who obtained all his development through the practice of progressive bar bell exercises. Yet when he enrolled for our course of instructions he did not even have ordinary health and strength. He will give you a good idea of what you may expect to accomplish through our system of exercise.

Do You Want Strength?

You may not be particularly interested in developing enormous strength—most of our pupils exercise only for better health, with its many advantages. But like everyone else, you want to enjoy perfect health, and to have a well developed figure that will give you sufficient strength for your daily needs and a surplus of energy and vitality for emergencies. Many men have been content to be physical weaklings because they thought it impossible to better their physical condition. What about you?

Are you content to remain a man in name only? Why not give yourself a chance to succeed? You can not do it with a weak, undeveloped body. It will be a constant handicap to you, dragging you down when you are most in need of the strength and vitality afforded by a strong constitution. Don't let them tell you it can't be done. During the past eighteen years we have handled thousands of cases just like yours, and have never had a failure!

No matter how weak or undeveloped you may be, if you are normal in other respects, we can help you. We do not merely promise results, we guarantee them. If you are going to exercise at all, why not go after results? The system of exercise which produces men such as the one shown in the picture above, can do something for you. Send for our Illustrated Catalog and Folder No. 17, describing our system of exercising. Both Free.

The Fountain of Youth

"The Fountain of Youth and How I Found It," by E. F. Dilks, in the September issue of Strength, should be read by every man and boy who is desirous of bettering his physical condition. It is the story of a boy who was a physical weakling, and who as a result was a pitiful coward—afraid of his own shadow. He did not think of trying to better his physical condition—he knew it couldn't be done.

Even at the age of thirty he was a man in name only, without sufficient courage to claim what was justly due him. There are thousands of men in a similar position who despair of bettering their physical condition. Is there any hope for them? In this article Mr. Dilks tells how the weakling developed himself into a real man. It's his own story. Don't miss it.

This is only one of the many articles in the September issue of Strength. All the others are equally good, and are handsomely illustrated with pictures of some of the strongest and best developed men in the country. An inspiration to all seekers after good health. A limited number of copies have been printed. Send in your subscription today.

SEND FOR { Our Illustrated Catalog and Folder No. 17, describing our system of exercising. } BOTH FREE

The Milo Bar Bell Co.

Physical Culture Specialist and largest manufacturers and distributors of bar bells, dumbbells and kettle bells in the world. Publishers of "Strength."

Dept. 8, Diamond and Third Sts.
Philadelphia, Pa.

SUBSCRIPTION BLANK

Date.....

MILO BAR-BELL CO.
Diamond & Third Sts.
Dept. 8, Philadelphia, Pa.

I herewith enclose One Dollar and Fifty Cents ($1.50) in payment for one year's subscription to "STRENGTH." ($1.75 Canada and $2.00 foreign countries).

Name.....

Street Address.....

City or Town..... State.....

HUDSON RIVER NIGHT LINES



Daily Sailings from Pier 31, N. R., (at Desbrosses St.) weekdays 6 P. M. & 7 P. M., Sundays and Holidays 6 P. M. and 9 P. M.

West 132nd St., half hour later (Daylight saving time)

Due Albany 6 o'clock following morning. From Troy 8:00 P. M., from Albany 9 P. M. & 11 P. M., due New York 6 o'clock following morning.

Direct rail connections to all points. Express freight service. Autos carried.

HUDSON NAVIGATION COMPANY

Spirit Return

How Much is True? How Much False? Have You Mediumistic Power Yourself?

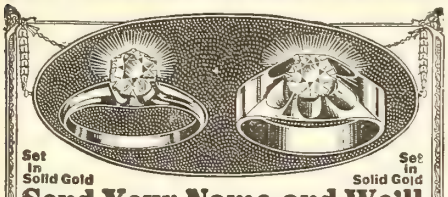
Read

YOUR PSYCHIC POWERS:

And How to Develop Them
By Hereward Carrington, Ph. D.

Illustrated, $3.00. Sent on approval. Mention Science and Invention.

DODD, MEAD & COMPANY
445 Fourth Avenue New York



Set in Solid Gold Set in Solid Gold

Send Your Name and We'll Send You a Lachnite

DON'T send a penny. Just send your name and say: "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will send it prepaid right to your home. When it comes merely deposit $4.75 with the postman and then wear the ring for 10 full days. If you, or if any of your friends can tell it from a diamond, send it back. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.

Write Today Send your name now. Tell us which of the solid gold rings illustrated above you wish (ladies' or men's). Be sure to send finger size.

Harold Lachman Co., 12 N. Michigan Av. Dept. 1256 Chicago

S T U R D Y



Bang-proof, knock-proof, weather-proof, thief-proof—that's what you'll say when you see this handy compact

UNION GARAGE TOOL CHEST

Union Tool Chests are durable, handsome, of the best workmanship and finest material. There are 24 sizes and styles to choose from—an economical chest for every mechanic's needs. Sold on "Satisfaction or Money-Back" guarantee.

WRITE FOR FREE CATALOG

and let us tell you more about Union Tool Chests.

UNION TOOL CHEST CO., Inc.
36 Mill Street Rochester, N. Y.

UNION TOOL CHESTS

a midnight meeting. Professor Hopkins rose to address the members and took his place behind a mahogany table which was covered with a strange assortment of apparatus. Batteries, Leyden jars, electroscopes, a huge induction coil and many other pieces of apparatus strewed the table.

"Gentlemen, I feel that the experiments which I am about to perform will open a new era in the art of successful removal. As we have found in the course of our operations last year, this art has not advanced with the other sciences. Of course, electrocution and over-doses of ether are far superior to the methods of the Spanish Inquisitors, who assiduously stuck stubborn victims full of burning matches, yet the slow poison of the ancient Arabs seems still to be as effective as any of the modern methods, so far as immunity from detection is concerned. I firmly believe that the latest discoveries in radiation will furnish methods which will enable us to operate in perfect safety and give us an immense advantage over our competitors. I shall first perform for your benefit some experiments which will reveal the wonderful power of the substance contained within this tiny glass capsule.

"You will note upon the curtain the projected image of the gold leaf of this electroscope. You see that it remains stationary so long as I keep the glass capsule inside this heavy lead box. I raise the lid of the box, and you see the gold leaf collapse instantly, showing that the electrical charge has been removed from the instrument. Will somebody kindly turn off the lights? Thank you. Now note the brilliant flashes of light which this capsule causes on the screen of zinc sulfide. Now I will put this induction coil in operation and draw the spark-points apart until the spark no longer passes. I bring up the capsule and you hear the electric crash produced."

The eight listeners had followed the Professor with close attention, but their faces bore an expression of query, as if they wondered what bearing these experiments could have upon their business. But they watched eagerly as Professor Hopkins placed a guinea pig upon the table.

"You will note," the Professor continued, "that the pig starts back when I bring a lighted match near its eyes. This shows that it is not blind. I will now insert the glass capsule in a pocket in the blinder which I have prepared and place it over the right eye of the animal. In two minutes we will see the result."

The little audience waited tensely until the two minutes had past. The Professor removed the blinder and held a lighted match near the right eye of the pig. The lack of reaction showed that the right eye was blind. An excited murmur ran thru the gathering.

"If you will come to the table and examine the back of this pig you will see that the hair has been removed from a considerable portion of the back, and that in its place there is a deep, red, festering ulcer. That is caused by one day's exposure to this glass capsule."

The Professor placed on the table a glass jar, and withdrew from the alcohol which it contained a grewsome thing, resembling a bladder.

"This, gentlemen, is the stomach of a guinea pig which I caused to swallow the capsule with which I have performed these experiments. The pig died, and if you will examine this stomach you will see that its walls have been perforated by a cancerous lesion. The capsule contains twenty-five thousand dollars' worth of radium, and I think that you can readily see that with this intensely powerful agent we are now in position to proceed with many of those delicate commissions which our patrons have placed in our files. And remember, please, that this radium leaves no trace, so that foul play will never be even suspected. We can operate in perfect safety."

NUXATED IRON

FOR RED BLOOD STRENGTH AND ENDURANCE

OVER 3,000,000 PEOPLE USE IT ANNUALLY

PROSPECTIVE STUDENTS

B. C. N. will give you your N.D. degree in two years, day and night classes. This institution teaches Electrical Therapeutics, Static, High Frequency, Violet Ray, Galvanic Current, X-Ray, Osteopathy, Orthopaedics, Chiropractic, Psychology, as embodied under the Triplicity of Sciences known as **Natureopathy.** The field is unlimited right now for Natureopathic Physicians. Our experienced faculty of fourteen practical physicians will guide you surely and carefully to attain success. Earn while you learn if you so desire. Graduates of single branch schools who are here now say that the Blumer System is the most wonderful drugless healing system in existence. Write today for our catalogue. Start right. Address Executive Secretary,

BLUMER COLLEGE of NATUREOPATHY
97 Ann St., Dept. H., Hartford, Conn.

15 cents postage will bring to you "The Scientific Natureopath." Address Publicity Dept. of the above college.

What 15 Cents Will bring You From the Nation's Capital

The little matter of **15 cts.** in stamps or coin will bring you the Pathfinder **13** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for the Nation; a paper that prints all the news of the world and tells the truth and only the truth; now in its **27th** year. This paper fills the bill without emptying the purse; it costs but **$1** a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, briefly—here it is. Send **15c** to show that you might like such a paper, and we will send the Pathfinder on probation 13 weeks. The 15c does not repay us, but we are glad to invest in new friends.

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, Box 1275 Washington, D. C.

You can be a DRUGLESS PHYSICIAN

A well-paid profession is open to you. The field beckons to both men and women. Combined home study and college course. Heal without drugs. Free catalog. International College of Drugless Physicians, Dept. F.F. 9 4200 Grand Blvd., Chicago.



$4 AND $5 WILL BUY
A Beautifully Reconstructed
TYPEWRITER
With Every Modern Writing Convenience
a month

WRITE TODAY FOR ILLUSTRATED CIRCULAR Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

BE AN EXPERT
Penman

Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. Complete outline FREE. Write C. J. Ozment, Dept. 44, St. Louis, Mo.

One of the auditors walked slowly to the front of the room and faced the members of the Murder Syndicate. His face was dead white and seamed with deep lines that appeared to be the tracks of an experience too harrowing to relate. He held up the handless stump of his right arm and requested attention.

"Gentlemen," he began, "one year ago I joined this syndicate. You will remember in what condition you first saw me. You have never heard how it happened. One day I was turned adrift in the ocean north of Iceland and left to starve or freeze, whichever might come first to relieve my sufferings. It does not matter now that a steamer out of its course finally rescued me from the launch in which I was prisoner with my right hand stretched up for days, lashed to a wooden post. Ever since that terrible experience my single purpose has been to take a suitable revenge upon the three who sent me to those indescribable sufferings. For a year I have watched the operations of this company, but not until hearing the revelations of Professor Hopkins this evening have I felt that the time was ripe to take my just revenge. You have often told me how greatly you value my services. Gentlemen, I ask permission to use the resources of this company to avenge my sufferings and the loss of my right hand."

As one man the strange company rose to give assent.

Kelly and Professor Hopkins were very busy for the whole of the following week. While Kelly was absent upon certain errands in which his experience in the Secret Service was of great assistance, the Professor worked diligently in his laboratory. Madame Elaine Holt was delighted with the veil which an unknown friend sent her by mail, and constantly wore it gracefully drooping from her hat, so as to cover only the upper half of her face, in the style so popular among New York's beauties. The eminent scholar Lendorff was much irritated to be unable for a whole day to find his huge, horn-rimmed spectacles, but resumed work upon his beloved manuscripts the following day, when he found the glasses in the pocket of an unused coat. Von Hernholtz continued to increase the huge fortune which he was amassing as head of a great steel factory.

Two months after Hopkins and Kelly had been so busily engaged in the laboratory, a note, signed with the peculiar mark which agents of the German government obey so implicitly, brought together in a room of a New York hotel the three valued servants of Germany. While they sat discussing what matter there was now to be attended to, the door opened and a distinguished looking man entered, accompanied by a haggard man whose right hand was missing. The three sprang to their feet as the latter quietly locked the door, but resumed their seats when Kelly covered them with an automatic. Kelly addrest himself to his companion:

"My dear Professor, do you remember the story of the man who was sent into the northern seas with his right hand lashed to the top of a mast? I see you do. Sit down there, Hernholtz; you seem to be troubled. What, my dear Professor, do you think should be done to the heartless criminals who could treat a man in such a manner?"

The Professor smiled and waited for Kelly to proceed.

"My dear Madame Holt, would you mind raising that heavy veil? By the way, how long have you been wearing such a heavy veil? Really, it hides your astonishing beauty. Please accommodate me by lifting it. You seem to be reluctant. I should not like to be forced to use this."

Kelly toyed with the pistol and Madame Elaine Holt, the celebrated beauty, raised the heavy veil.

LEARN DRAFTING

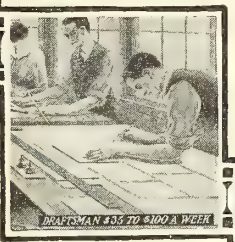
At Home—In Spare Time
as you would in actual practice

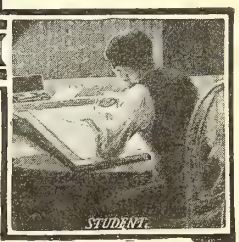
Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed, by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher, especially qualifies him to give you the training you need to become a successful Draftsman.





Draftsmen Get $35 to $100 a Week





Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field paying as high as $50,000 a year.

Become a Specialist

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.

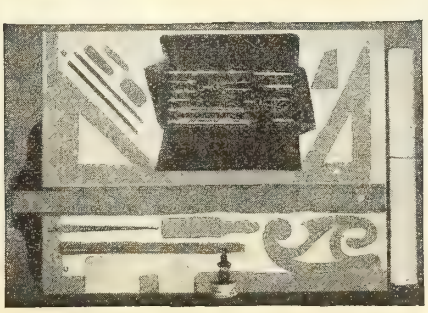
Draftsmen are needed in greater numbers, and receive better salaries than ever before.

How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions now open. Here is what "Columbia" training is doing for some of our graduates: Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.

This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



Big Concerns Employ "Columbia" Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them.

Send This Coupon Today

Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write today to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1157, 14th & T Sts., N. W., Washington, D. C.

COLUMBIA SCHOOL OF DRAFTING,
Roy C. Claflin, President
Dept. 1157, 14th & T Sts., N. W.
Washington, D. C.

I am interested in your practical training in Mechanical Drafting. Please send me Free, your illustrated book of particulars, testimonials, terms, etc. I am also interested in the special post-graduate course checked below:
(Mechanical Drafting, or Machine Drafting is the foundation course and is complete in itself.)

Architectural Drafting...	Ship Drafting .....
Automobile Drafting.....	Statistical Drafting .....
Electrical Drafting	Radio Drafting .....
Aeroplane Drafting	Automotive Drafting ....
Special Machinery Drafting	Hydrographic Drafting...
Sheet Metal Drafting....	Machine Design .....
Structural Drafting	Tool Design .....
Highway Drafting	Shop Mathematics ....
Patent Drafting	Builders' Course .....
Topographical Drafting..	

Name.....
Age..... Address.....
City..... State.....



LEARN

Armature Winding

Motor and Generator Repair and maintenance

In 6 Months

in the fully equipped shops and laboratories of the School of Engineering of Milwaukee.

Prepare quickly and efficiently to fill the constantly growing demands for *trained* men in this remunerative profession. You can

Earn While You Learn

if you like. Actual practice under wage-earning conditions will train you most successfully.

Send now for bulletin and full particulars *FREE!* Clip the coupon today.

School of Engineering of Milwaukee

1-CJ—373 Broadway Milwaukee, Wis.

CLIP HERE

School of Engineering of Milwaukee,
1-CJ—373 Broadway, Milwaukee, Wis.

Gentlemen:
Please send me full information concerning your Armature Winding and Motor Generator Course.

Name .....
Address .....
Age..... Education.....

DIAMONDS WATCHES ON CREDIT

Send for FREE Catalog





All the new fancy engraved and pierced Diamond Rings are shown in our Catalog.

We are offering wonderful values in Diamond Rings, in all the popular mountings, plain and fancy engraved, special at **$40, $50, $75, $85, $100, $150,** and up. **EVERY ARTICLE IN OUR CATALOG** is priced **unusually low.** Whatever you select will be sent prepaid by us. **You see and examine the article right in your own hands.** If satisfied, pay one-fifth of purchase price and keep it, balance divided into eight equal amounts, payable monthly.

WATCHES, Guaranteed 25 years, on terms as low as $2.50 a month. **LIBERTY BONDS ACCEPTED.**

LOFTIS BROS & CO. ESTD 1858 **The National Credit Jewelers**
Dept. D 22 108 N. State St.
CHICAGO, ILL.
STORES IN LEADING CITIES



Navigation
Taught by Mail

Be a ship officer in merchant marine—earn big money — see the world. Captain Warren Sheppard's Course on Ocean, Coast and Lakes Navigation ready. Officially adopted by the U. S. Navy. Endorsed by Merchant Marine. Merchant ship officers earn up to

$412 per month and expenses

Whether you are on the sea or intend to go, enroll now. Send today for valuable illustrated booklet, "Your Future is on the Seven Seas." It is free.

WORLD TECHNICAL INSTITUTE
Dept. "E", Fuller Building, Jersey City, N. J.

"Truly, Madame Holt, it is too bad that your countenance is becoming so severely lined. Would you mind stepping forward, so that the Professor can examine your beauty more closely?"

With an air of haughty dignity Madame obeyed the injunction.

"Professor, do you notice that heavy red line which extends from ear to ear across cheeks and nose of the dear Madame? It seems to be a sort of cancer. It is a shame that her beauty should be thus ruined. Professor, is there any cure for such a cancer? None at all? Well, really, that is most unfortunate."

Then he continued, addressing his remarks to Madame Holt:

"My dear Madame Holt, all the time during the last two months that you have been visiting your physician regarding that strange ever-growing line across your cheeks you have been wearing that pretty veil which just covered the half of your face. I thought you would like it. It was a very valuable veil, too. Cost me twenty thousand dollars. It had a hemful of radium. Don't know where it is now, do you? I really hated to take it away, but you know we had to recover the radium. Here it is, if you want it for a souvenir. You will notice that the hem has been cut off. We needed that."

During the strange monologue of Kelly, Madame Holt had listened with an expression which gradually changed from one of defiant disinterestedness to one of amazement. As his final words brought to her a full realization of what had been done, a frightful grimace of horror and rage distorted her countenance, now so sadly disfigured with the radio-ulcer extending from ear to ear, and she shrieked an hysterical cry of rage. Suddenly she sprang at Kelly, clutching with tense fingers at his eyeballs, but he placed the muzzle of his automatic against her breast and she stopt, sinking to the floor with hysterical sobbings. Kelly smiled grimly and remarked to Professor Hopkins:

"Too bad that Madame will have to wear a heavy veil all her life. New York's gatherings will regret the loss of one of their loveliest women."

The scholar Lendorff had been strangely restless while Kelly had been talking to Madame Holt. Kelly now addrest his remarks to him:

"I hear that you can't read any more, Lendorff. That's too bad. It really is a great affliction to lose one's sight. By the way, did you get your glasses back? I had to take them the other day in order to recover a few thousand dollars' worth of radium, which was in the rims. You know, you really shouldn't have worn them at all after the day you thought you had lost them. Radium rays have a very harmful effect upon the optic nerve. Isn't that so, Professor?"

Lendorff said not a word, but tears rolled from his unseeing eyes. He sat humped over in his chair, a picture of abject despair.

"What are you thinking about, Lendorff?" inquired Kelly, pleasantly. "A cruise thru the northern seas on a launch with an automatic feed and a gyroscopic steering control? Well, that will be a pleasant way to pass your time, now that you can't read."

Thruout the whole conversation or rather monologue von Hernholtz had sat nervously in his chair, looking momentarily as if he would spring upon Kelly, and upon his face grew a look of horror and apprehension, as he listened to the fate which had befallen his comrades in crime and wondered what was in store for him.

"What are you so nervous about, Hernholtz? Stomach isn't bothering you, is it? What, have I hit it right? I'm afraid those pink pills that you've been taking haven't done you much good. Remember that one, a little larger than the others, that you

Ten Points

allowed our graduates toward experience, on government examination.

To Your Benefits
we have

Modern Equipment, Special Short Course, Individual Instruction, Finest Staff of Teachers available.

Dormitory, Swimming Pool.

CALL OR WRITE FOR ILLUSTRATED BOOKLET

Y. M. C. A. RADIO SCHOOL

152 East 86th Street, New York, N. Y.

"Best Radio School in the East"

Take a Dollar Bill,

Pin it to the attached coupon, write your name and address plainly and mail it to the Electro Importing Company, 231 Fulton Street, New York City, and by return mail you will receive your





SKINDERVIKEN TRANSMITTER BUTTON

Most sensitive microphone known

Electro Importing Co.,
231 Fulton St., New York.

Gentlemen:—Enclosed please find One Dollar. Ship *at once* one Skinderviken Transmitter Button to

Name .....

Address .....

swallowed about two months ago?"

Von Hernholtz started and stared at his tormentor with a look of agonized apprehension. He leaned forward, as if the better to catch the words upon which he hung.

"I'll tell you how that pill was made, Hernholtz. The Professor and I took a little glass capsule, the size of a pea, and then adjusted an oxyhydrogen flame to a tiny point. With this we melted the glass in several spots, and really we manipulated the flame very cleverly, so that the melted glass, starting to run, hardened into little sharp points. The capsule became covered with short, sharp curved projections, like hooks for goldfish. Then we carefully broke off all of these hooks and fastened them back on with a cement that dissolves in forty-eight hours. You see, we really went to a great deal of trouble on your account."

Von Hernholtz groaned again, with the direst forebodings of evil. Lendorff was crumpled in his seat, sobbing softly, while Madame Holt still lay on the floor, no longer crying hysterically, but in a half-dazed manner running her delicate fingers over and over the long red line deeply engraved in the soft flesh of her once-beautiful face.

"Then," continued Kelly in the same even voice, "we covered the whole capsule with a smooth coating of gelatine that dissolves in lukewarm water in one minute. That was to allow the capsule with its hooks to slip easily down your throat.

Von Hernholtz's eyes were starting from their sockets.

"You can readily see, Hernholtz, what would happen. As soon as the outer coating of gelatine dissolved, the tiny hooks fastened the capsule securely to the nice, soft, pink lining of your stomach. There it remained until the cement holding the hooks dissolved; that is, for about two days, and then the capsule past on with the food. Oh, I nearly forgot to mention that the capsule contained about twenty thousand dollars' worth of radium. You see how deeply interested we were in your stomach. Don't you think that that was a very clever way to obtain a localized source of murderous rays? Really, the Professor and I were immensely pleased with our ingenuity. I believe that the stomach cancer with which you are now suffering will last about two months—and by a strange coincidence you will last about the same length of time. Don't you think so, Professor?"

Professor Hopkins nodded assent, but Kelly was busy covering von Hernholtz with his revolver. The latter had sprung to his feet with a roar like that of a hamstrung elephant, but half way to Kelly he had collapsed to the floor in a dead faint.

"These cancerous patients can't stand much excitement, can they, Professor?" remarked Kelly, softly.

Together the two walked to the door. As they left they turned for one last look at the suffering criminals. Von Hernholtz had immediately come out of his faint and knelt on the floor, groaning miserably. Lendorff was silent, hunched over in his chair with one hand covering his eyes. The once-beautiful Madame Elaine Holt was still lying prostrate on the floor, her fingers mechanically tracing and retracing the deep red furrow which ran unbroken across the soft pink velvet of her cheeks.

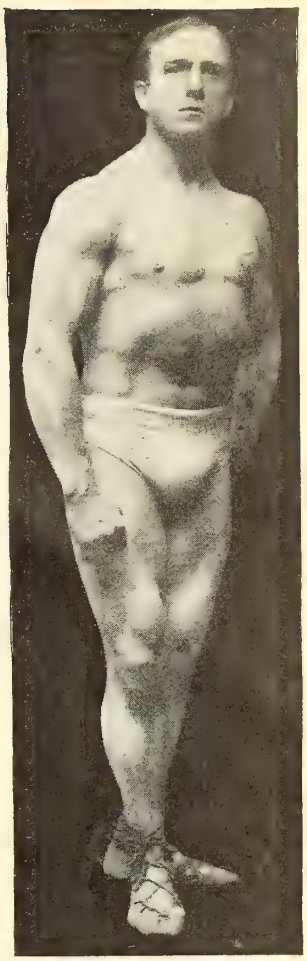
[THE END]

Are You a MAN?



WHY stay thin as a rail, a laughing stock to every man or woman who sees you? You don't have to. You don't have to go through life with arms of childish strength; with legs you can hardly stand on; with a chest and figure your tailor has to pad out to make you look anything like a real MAN.

And what about that stomach of yours, which flinches every time you eat a square meal? Are you trying to make it do its work and to gain Health and Strength in tabloid form—through pills, poisons and other exploited piffle? You can't do it. IT CAN'T BE DONE.



LIONEL STRONGFORT
Dr. Sargent, of Harvard, declared that "Strongfort is unquestionably the finest specimen of physical development ever seen."

Make a Man Out of Yourself

The ONLY way to gain Health, Strength, Energy, VITALITY, is to build up your body—all of it—**through Nature's methods;** NOT by pampering your stomach and giving it extra work to do trying to digest a lot of patent medicine quack "remedies." **Don't be a pillfeeder.** And don't make the mistake of thinking Fate is making you a failure. The chances are 99 to 100 that the real REASON why you don't succeed lies in your poor, emaciated body, in your half sickly condition, which shows in your face, in your unhealthy skin, in the way you walk and talk and do things. The world loves WELL, STRONG, HEALTHY men and women; it has no use for the weak and sickly, nobody wants to have them around.

Build Up Your Body

A man's happiness largely depends upon his Vital Power; his success in social, domestic and business life all centres around this. If he is not virile, he is not magnetic, forceful or attractive; neither is he sought after—his very strength is the axis upon which all else relating to him, revolves. Men become weak through overwork, worry, and bad habits and gradually lose their strength and manhood. When they reach the stage when they find their strength on the wane, it is the forerunner of failure and domestic happiness is then soon upset. Young men become listless and purposeless; their brain power decreases as their manhood fails. Strongfortism strengthens the internal muscles which are responsible for general health and physical strength; and the most obstinate and long standing cases give way, in a short time, to its internal action.

Strongfortism

The principles of Strongfortism are based upon my discovery—that internal muscular activity governs Health, Strength and Life itself. Most forms of disease are caused from the muscles losing their power of rapid contraction. As these muscles are responsible for holding the internal organs in position, when they are relaxed, the organs gradually fall out of their place and rest upon other organs, upsetting their functioning and causing almost every known form of disease. Strongfortism gives contractile power to these muscles and quickly makes them normal and so draws the sagging organs back to their position.

I have spent my lifetime studying the action of these forces and their application to weak, sickly, anemic men and women. I built myself up through their operation until I am called today the strongest man in the world. Through my system of **STRONGFORTISM** I have taught pupils in every part of the globe how to free themselves from miserable ailments that were making a nightmare of their waking hours; how to build themselves up and regain their lost health, strength, elasticity, youthful vigor and the full power of enjoying life.

Let Me Help You

What I have done for thousands of other weak, ailing, discouraged men and women, **I can do for YOU.** There isn't the slightest doubt of it; Nature's Laws operate alike for all ages and both sexes. No matter what your present condition is; no matter if it was caused by early indiscretions and excesses of your own, I GUARANTEE to improve you 100 PER CENT, if you will follow my directions for a few short months.

Remember, there's no medicine of any kind in Strongfortism; there's no expensive gymnastic apparatus required; there's no interference with your present business, work or occupation. Fifteen to twenty minutes a day in the privacy of your own bedroom, devoted to Strongfortism will work wonders for you, and you will notice your improvement within a few days after you begin the course

SEND FOR MY FREE BOOK

"Promotion and Conservation of Health, Strength and Mental Energy" will tell you all about Strongfortism and PROVE to you that it can and will do for YOU what it has done and is doing every day for other men and women who have **turned to Nature** for the restoration of the vitality they have lost. BE HEALTHY—STRONG—VITAL—THAT'S LIVING.

Send for the book NOW; don't put it off. IT'S FREE, but it's worth good money to any man or woman in any state of health. Fill out the coupon below and enclose it with three 2c stamps to cover packing and postage and I will mail you with the book a special letter on the subject or subjects in which you are particularly interested.

LIONEL STRONGFORT
Health and Strength Specialist
4 STRONGFORT INSTITUTE
NEWARK, N. J.

FREE CONSULTATION COUPON

Mr. Lionel Strongfort, Newark, N. J.—Please send me your book "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY," for postage of which I enclose three 2-cent stamps. I have marked (X) before the subject in which I am interested.

..Colds	..Stomach Disorders	..Despondency
..Catarrh		..Round Shoulders
..Asthma	..Constipation	..Lung Troubles
..Obesity	..Biliousness	..Increased Height
..Headache	..Torpid Liver	..Stoop Shoulders
..Thinness	..Indigestion	..Muscular Development
..Rupture	..Nervousness	
..Lumbago	..Poor Memory	..Great Strength
..Neuritis	..Rheumatism	..Advanced Course
..Neuralgia	..Bad Habits	..Weight Lifting
..Flat Chest	..Weaknesses	..Many Weight Barbell
..Deformity (describe)	..Impotency	..Professional Training
..Insomnia	..Gastritis	..Youthful Errors
..Short Wind	..Heartweakness	
..Flat Feet	..Poor Circulation	
	..Skin Disorders	

Name.....

Age..... Occupation.....

Street.....

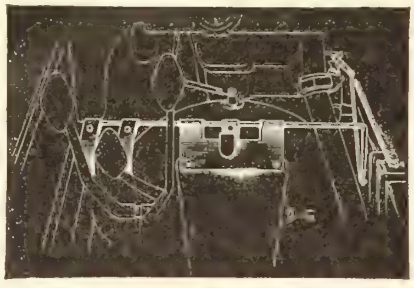
City.....State.....

S.&I. 4.

AGENTS--SALESMEN
SALES MANAGERS
EXCLUSIVE TERRITORY ON NEW INVENTION

Will you listen when opportunity knocks? Fortunes have been made in new automobile inventions. **Grab this one quick.** Your minutes are like dollars—don't waste them now. **Read—investigate—then act.** The Speederator for Ford cars is a new invention **so good** that 17 officials of the Ford Motor Company use it on their machines. **Makes any Ford run like a Packard.** Stops **stalling, bucking and motor racing.** Gives a smoothness to Ford driving that is wonderful. And just think—**Speederator** is put on **without boring holes** or special tools of any kind. Any Ford driver can put one on complete in **twenty minutes.** Never wears out—never needs attention—**operates automatically. Sells like lightning.** Old Ford drivers say best and only necessary Ford part. **Get full information.**

The Greatest Ford Invention



Used By 17 Ford Officials

LISTEN This is not a ready made fortune but it is the opportunity to secure the **exclusive sales agency** for this new invention. Don't take our word—get the proofs. Just be honest with yourself and **investigate.** Let the **money you make talk** from now on. Smashing records of success will show the way: **Helton, Utah,** sold six hundred in five weeks—**profit $1,800.00. Crist, N. Y.,** sold 23 first day—said would have sold more if he had had them—now averages more than 400 a month—**profit $1,200.00. McAllister, Ills.,** says sold four first afternoon. He is now using 100 a week. These straight-from-the-shoulder facts point the way. **Hoover** down in **Ohio** sold 29 one day, **profit $87.00. Benke, Mo.,** averages 200 a month. **Campbell, Tenn.,** 1000 a month. **Crandall, Iowa,** put on thirty sub-agents in one week. **Dryden, Calif.,** sold 150 in ten days. **Grace, Hawaiian Island,** 200 in two weeks. **Teeters, Mich.,** first three dozen in ten days. We say you can make

$55.00 TO $300.00 WEEKLY

selling the **Speederator.** Best article to advertise itself you ever saw. Once on a car the driver will never let you take it off. Sales are made fast and furious. **Boyer, Penna.,** made $72 first day. **Cook, N. Dak.,** 150 sold first two weeks. **Cahan, Ariz.,** 72 in two weeks—$216.00 clear. Join the ranks of successful men in this work.

NO EXPERIENCE NECESSARY

Just show us that you mean business and are ready for business and **we will show you how.** But first, **make us prove these facts.** We have nothing to apologize for. The **Speederator is a grand success**—you can make money fast if you have the territory—so get busy now. Write today for the necessary information and see for yourself. Don't delay—**plenty of good territory left**—if you are a hustler you can have money in the bank in a few weeks. **Just write—now—to**

THE PERRIN METAL PARTS CO.
1068 HAYWARD BUILDING
DETROIT, MICH.

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.
Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. **Guaranteed by the maker.** Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness Sent by mail or express, safely packed, prepaid, for only **99 cents.** Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope **just** as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.
EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.



HERE IT IS
A sign for your den. Exceedingly attractive. Printed in bright red on white cardboard. No electrical bug should be without it. 7¼" x 11¼". 10c each in coin ONLY. Send stamp for postage.
LEONARD BECK, 1298 Carroll St., Brooklyn, N. Y.

STAMMER
If you stammer attend no stammering school till you get my big new FREE book and special rate. Largest and most successful school in the world curing all forms of defective speech by advanced natural method. Write today. **North-Western School for Stammerers, Inc., 2331 Grand Ave., Milwaukee, Wis.**

The Romance of Tungsten

By E. W. DAVIDSON

(*Continued from page 492*)

He was the first man to find a way to "work" this most brittle of metals. He made it *ductile* and thereby hangs this tale.

For about 100 years tungsten had been known before it was put to any use whatever, even as a mere alloy. Its presence was first noticed by Scheele and Bergman in 1781. They found traces of it in a metal called scheelite and coined the name "tungsten" for it from the Swedish "tung" meaning weighty and "sten" for stone. In 1783 three Spaniards discovered tungsten in the mineral Wolfram. To this day there is little tungsten taken from any other minerals. It is found in small quantities in Cumberland, England; Limoges, France; and in parts of Connecticut and North Carolina, but most of it comes from Colorado, and China.

Extracted from these minerals and pulverized, tungsten was found useful in certain steel alloys. Mixed with an adhesive it was made into lamp filaments that were efficient but exceedingly fragile. However no metallurgist was able to discover a way to work pure tungsten. This was because in pure metallic form *it is absolutely brittle!* It confounded all experts with its utter intractability. The establisht processes in working other metals proved useless with tungsten.

Perhaps it was this very thing which finally brought about the harnessing of this valuable metal. Dr. Coolidge with the instinct of the true scientist pioneering in untrodden fields, tried ways that any metallurgist would have thought an idle waste of time. The result was that after long effort and many failures he finally made tungsten ductile and workable so that it could even be drawn like wire down almost to the gossamer fineness of spider's web and still be strong enough to permit its winding and curling into almost any shape. When he had done that he had conquered tungsten and made possible many devices which could never have been built without ductile tungsten.

DIFFERENCE BETWEEN TUNGSTEN AND OTHER METALS.

The radical difference in workability between tungsten and normally ductile metals the difference which nonplust the scientific world for more than a century may be explained thus:

Pure tungsten prest into bars is brittle after the very treatment which makes other metals most ductile. It differs from all other ductile metals in that when composed of grains it is extremely brittle at "room temperature," but is ductile at this temperature when fibrous.

Many an experimenter had sought to work tungsten mechanically. But none had ever succeeded in getting this intractable metal into a form suitable for mechanical working. Moissan, by an electric furnace method, obtained tungsten in a porous condition which could be slightly comprest and the pores closed up by hammering when hot. However nobody in the world suspected at that time that if tungsten could be obtained and put into suitable condition and then mechanically worked at suitable temperature, its inherently brittle nature would gradually disappear. But nobody knew how even to make a start upon the problem of working tungsten.

To make any ordinary metal soft it is heated above its annealing point and then cooled down to room temperature. *Doing this to tungsten however left it as brittle as ever!*

Violating all metallurgical rules and working for years with utmost patience, Coolidge discovered the astonishing fact that the only way to make tungsten ductile was to mash tungsten's grains out into fibrosity and thus make the metal ductile cold, and this he did by first heating it to a degree *below* its annealing point and then mechanically working it with infinite pains at a variety of heats, each cooler than the one before, until the metal got down to room temperature. A similar treatment, if applied to ordinary metals would destroy their ductility.

He worked out a process which, if followed without the slightest deviation, stretched the grains out, thus attaining ductility. But if the working varied from his process, failure resulted. The tungsten would smash to flinders at a stroke when it got cold.

This elaborate and delicately measured system of working tungsten is a scientific triumph. Thus was tungsten finally made ductile.

TUNGSTEN FOR LAMP FILAMENTS.

The greatest immediate use for it was in the making of electric lamp filaments. Previously the best filament was made of fine tungsten powder, mixed with a binder into a plastic mass which was squirted thru fine dies to produce fragile "wire."

This was an enormous improvement over the old-style carbon filament, thanks to the facts that tungsten, with a melting point of 3,350 degrees Centigrade will stand more heat than other metals and its vapor tension is so low that even under tremendous heats its volatile decomposition is slow. Tungsten even in this form made so good a lamp that it saved the American public a billion dollars a year on its electric light bill.

But filaments of those days could not withstand the slightest jar during the process of manufacture. They necessarily could not be strongly mounted in lamps.

Pure tungsten on the other hand drawn into filaments can stand almost anything. For one thing it is heavier than any other metal. Whereas wrought iron weighs 490 pounds per cubic foot, and lead 708 pounds, tungsten tips the beam at 1,193 pounds. Its tensile strength is startingly high. After it has been worked down to drawn wire of about a thousandth of an inch diameter, its tensile strength is no less than 600,000 pounds per square inch of cross-section. This is greater than the best piano wire!

To use tungsten in lamp manufacture, it is dried, mixed with thorium nitrate solution and then thinned with water into a batter. This is dried and heated at 2,000 degrees Fahrenheit for an hour in a silica or fire clay crucible to agglomerate the fine particles into coarser ones. This mixture is reduced by hydrogen at 1,800 degrees Fahrenheit into tungsten metal powder.

The reduced tungsten powder is poured into a steel mold which is a slab whose face bears a groove a quarter of an inch wide and deep. Under hydraulic pressure of 16 tons per square inch this groove full of powder is pressed into an ingot 16 by ¼ by ¼ inches. The pressure has been exerted on the sides of this ingot not the ends. The ingot at this stage is too fragile to handle.

The slug next goes into an electric furnace where it is baked at about 2,400 degrees Fahrenheit. Now it is strong enough to handle. It is then sintered in a hydrogen atmosphere the bar being heated for 10 to 15 minutes to about 5,000° Fahrenheit by the passage of an electric current thru it.

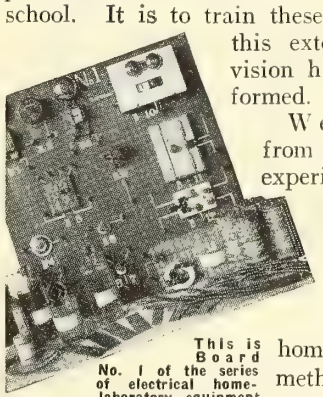
The bar tho brittle when cold is ready to be worked. It is heated to about 2,800 degrees Fahrenheit, and past thru the revolving dies of a swaging hammer which reduce its size and produces it in rods grow-

Learn Electricity This Wonderful New Quick Way

At Home in Your Spare Time

EVERY year hundreds of young men from all over the world come to the residence school of the School of Engineering of Milwaukee to learn electricity in all its phases. Yet we know that there are thousands of ambitious men everywhere who aspire to big jobs in the great field of electricity, but who cannot conveniently leave their present work to attend a residence school. It is to train these men that this extension division has been formed.

Just Like Going to School



This is Board No. 1 of the series of electrical home-laboratory equipment the free use of which is given every student. (Size 24 by 24 inches.)

We knew from our long experience that the ordinary plan of teaching electricity by home-study methods would not measure up to the high standards set by the School of Engineering of Milwaukee. And so, this unique, new plan of giving each student free use of a complete home-laboratory system of actual working electrical equipment was conceived. We know that it is the only practical way to learn electricity at home!

America's Greatest Electrical School Brought to Your Home!

On this plan you can now secure almost every advantage of America's Greatest Institution of Electrical Education right in your own home! In this way this famous school now gives the most thorough practical intensive home-study course in electricity ever offered! It is a specialized, graded course built up on the most advanced ideas of electrical instruction. Thorough, yet simple texts—graphically illustrated give the electrical principles which logically parallel the practical experience gained in using the instrument boards. This amazing new method of extension instruction quickly makes any ambitious man a high-salaried, electrical expert!

Free Use of This Fine Electrical Apparatus

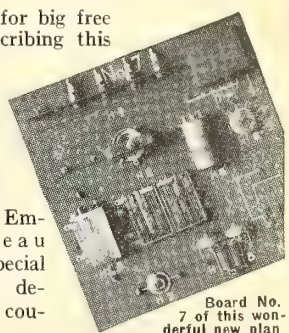
These wonderful, cleverly constructed instrument boards—equipped with actual, practical electrical apparatus—are furnished absolutely free to each student while studying. These laboratories are not toys—but include the same instruments and devices which the electrical man meets with in every day work.

You Can Fill One of These Big Pay Jobs

The field of opportunity for the well trained electrical man is practically unlimited. Billions of dollars are invested in this great industry. Thousands of men are employed in it—but the demand today is for men who are *trained specialists.* These men command handsome salaries—$2,500 to $6,000 and up to $10,000 a year and more. Why don't you get into this fascinating, highly paid field of work?

Write Quick for Big FREE Book

Write quick for big free book fully describing this astonishing new plan. Tells also about Consultation Privileges with our great staff of over 90 experts. Free Employment Bureau and other special service. Don't delay! Mail the coupon Now!



Board No. 7 of this wonderful new plan of studying electricity at home.

EXTENSION DIVISION
SCHOOL of ENGINEERING of Milwaukee
19, 373 Broadway, Milwaukee, Wisconsin

Extension Division,
School of Engineering of Milwaukee,
19, 373 Broadway, Milwaukee, Wisconsin.

Please send me free and without any obligation on my part full details of your special new home-study course in Practical Electricity.

Name .....

Address .....

City ..... State .....

Age ..... Education .....



NEW MOTORS

FACTORY GUARANTEED
ALL SIZES
PROMPT DELIVERY

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

8 v. 10 amp.	$19.50
15 v., 10 amp	$26.50
40 v. 6 amp.	$31.50
110 v, 2½ amp.	$31.50
110 v, 5 amp.	$52.50
40 v, 12 amp.	$52.50
110 v, 9½ amp.	$67.50
40 v, 25 amp.	$67.50
110 v, 18 amp.	$116.50
40 v., 50 amp.	$116.50
110 v, 26 amp.	$156.50
110 v, 50 amp.	$238.50
Moving Picture Arc Generator 60 v., 35 a.	$116.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R. P. M., Complete with base and pulley

½ H. P.	$46.50
1 H. P.	$66.50
2 H. P.	$86.50
3 H. P.	$98.50
5 H. P.	$116.50
1 H. P. Special Grinding and Bulfing Motor	$106.50

Direct Current Motors
110 or 220 volts, D. C., shunt wound, 1750 R. P. M. With base pulley and starting box.

¼ H. P. Washing Machine Motor	$28.50
¼ H. P., 32 v. Washing Machine Motor	$28.50
½ H. P.	$58.50
1 H. P.	$82.50
2 H. P.	$124.50
3 H. P.	$142.50
5 H. P.	$218.50

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

¼ H. P., 220 v. induction Washing Machine Motor	$28.50
¼ H. P., 110 v. grinding bulling motor	$28.50
½ H. P. induction, full load start	$46.50
½ H. P. repulsion induction For compressor service	$54.50
1 H. P. repulsion induction, Special Garage Motor	$74.50
2 H. P. repulsion induction with sliding base	$126.50
3 H. P. repulsion induction with sliding base	$146.50
5 H. P. repulsion induction with sliding base	$188.50

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL 1/4 H.P. 110 volts A.C., 60 c S. P., 1750 R.P.M. Complete, cord, plug and pulley



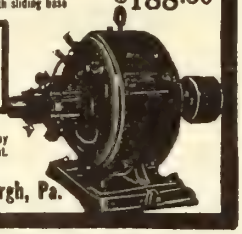
WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $26.50 Each Reg. Val. $34.50

MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

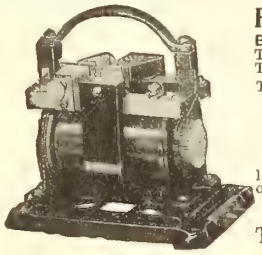
MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 12, West End, Pittsburgh, Pa.



CHARGE YOUR OWN BATTERY AT HOME FOR 10c.

Few new auto purchasers realize to what extent the satisfactory performance of their cars depends on the storage battery, but experienced motorists know that if a car is to perform at 100% efficiency, its starting and lighting system must have a 100% energized storage battery.



F-F BATTERY BOOSTER

Bantam type 6-6 amp .6 v. battery. $15
Type 16-8 amp. 6 v. battery.... 24
Type 166-12 amp. 6 v. battery.... 32
Type 1626-12 or 7 amperes in combination for both 6 and 12 volt batteries.. 48

or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current.
Bantam type 12-5 amp. 12 v. battery. $20
Type 112-6 amp. 12 v. battery... 24
Type 1612-7 amp. 12 v. battery... 32

Shipping weight complete with Ammeter and Battery Clips. 11 to 15 pounds.
All outfits do the same work except as to time to complete a charge.
Include postage and insurance with remittance for parcel post shipment.
Ask for bulletin No. 12 describing these and other F-F charging apparatus of larger capacities and of other voltages and cycles; also Boosters that operate on Farm Lighting Plants and Direct Current.
Write for Bulletin No. 12

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

WIRELESS TELEPHONE COURSE

Covering Theory and Practice of Electricity—Radio—Blue Print Reading and Wireless Telephony. 4 in 1 Course. Our easy payment plan places this course within reach of anyone who wishes to better themselves. Immediate action will assure you of a good future. Don't delay.

FREE Audion tube, experimental electrical outfit, and other apparatus furnished each student, FREE. Write TODAY to

CHICAGO ELECTRICAL ENGINEERING CO.

Dept. W. 1000 Diversey Parkway Chicago, Ill.

SUCCESS OPPORTUNITY

UTTMARK'S NAUTICAL ACADEMY RADIO SCHOOL

8 State St., New York, N.Y.
Phone Bowling Green 8079

Complete instruction in radio operating in all branches for Merchant Marine, Ocean Steamships, Telegram Service. Special course in Vacuum Tubes and Radio Telegraphy. Preparing for Government Examinations.

Elementary and Advanced Classes
Day and Evening Classes

Write for Circular.

10¢ OR 25¢

Anti-Kamnia TABLETS

AK

FOR HEADACHE, NEURALGIA, INFLUENZA AND ALL PAIN

Ask For A-K Tabs



"Lighting Fixtures"

Ready to Hang
(Direct from Manufacturers)
Completely wired, including glassware. New designs.
Send for catalogue No. 18
ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

The ROGERS
Violet Ray, High Frequency Generator
Does not burn out. No sparking—therefore all shocks are eliminated. An ideal outfit, fully guaranteed as to material and workmanship.

PRICE COMPLETE With One Surface Applicator $25.00

Send for free descriptive Booklet

The Rogers Electric Laboratories Co.
Dept. B, 2056 E. 4th St., Cleveland, Ohio

ing smaller and smaller and necessarily longer and longer as the metal goes thru one swaging after another, until it gets down to a diameter of three hundredths of an inch. It is now a metal that is ductile and its strength has increased with leaps and bounds so that at a diameter of three hundredths of an inch it can stand a pull in the proportion of 215,000 pounds per square inch of its diameter!

But it is still too large for lamp filaments tho wound on drums it appears hardly coarser than linen thread. So it starts into the process of being drawn down by successive stages thru diamond dies of smaller and smaller sizes, to any degree of fineness needed. On the drawing machines it unwinds from the feeding spool, passes thru a lubricant, runs thru a small gas furnace to attain red heat, negotiates the infinitesimal "eye" in the fragment of diamond clamped in its course, and is wound on a *receiving spool* ready for use.

Various of these fine sizes of tungsten wire are used for lamps over a wide range of powers, the finest of them all being used for the tiniest of lamps such as "bug-lights" on automobiles and in flashlights. The diameter of this is 0.004 of an inch. *It is six times finer than human hair.* The original prest ingot 16 inches long would produce more than 250 miles of such wire!

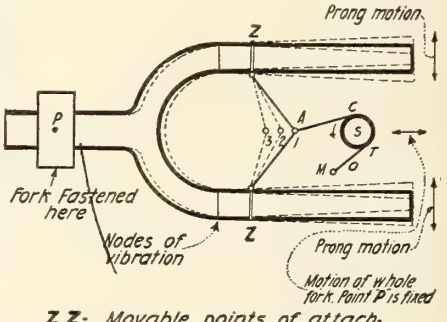
The "Vibro Whip"

By O. C. ROOS

(*Continued from page* 509)

It is not difficult to get proper speeds for phonographs by the use of this apparatus and by fastening the driving bands near the nodes of the fork the speed is reduced but the torque is increased and the "slip" is reduced.

Fig. 5 shows one electrical method of driving the fork. It is self-explanatory.



ZZ- Movable points of attachment of driving belt which moves point A from 1-3 as fork vibrates.

Fig. 4

Fig. 4—This Shows One of the Developments of the Vibro Whip Motor Principle—the Belt Around the Shaft "S" Being Given Alternating Pulls of the Desired Magnitude by the Two Prongs of a Tuning Fork, the Fork Being Electrically Driven.

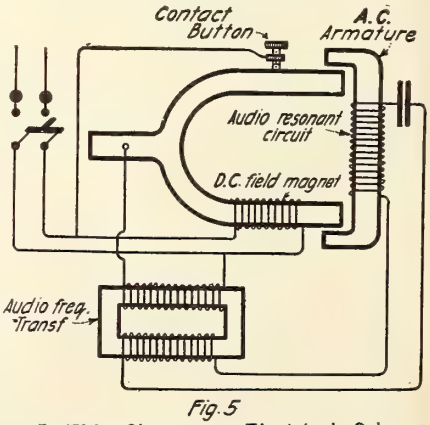


Fig. 5

Fig. 5—This Shows an Electrical Scheme For Driving the Tuning Fork of a Vibro Whip Motor, Which Is Self-Explanatory.

Synthetic Ammonia

By LUCIEN FOURNIER

(*Continued from page* 493)

Upon the pressure and temperature depends the *speed of reaction.* Also from the speed of reaction depends equally the product of ammonia. By operating, at a temperature of 600 deg. C., uniformly maintained, it is possible at the cost of 100 cubic meters of gas mixture for each quart of catalyzer in one hour, to obtain the combination of 40% of gaseous mixture. This figure corresponds to the production of 6 kilograms of ammonia per hour and per kilogram of catalyzer. On the other hand the *Badische Anilin* process obtains but 500 grams of ammonia under similar conditions with a pressure of 200 atmospheres. These 500 grams correspond to the liquefaction of 10% to 12% of the mixture sent to the catalyzer. From this it is evident that in order to secure the combination of a total mixture of nitrogen and hydrogen, it is essential to return the remainder of the 88% or 90% gas thru the circulating system or to install from 8 to 10 catalyzer elements in series one after the other. On the other hand Georges Claude with his arrangement, states that 40% necessitates but 2 or 3 elements in order to terminate the total combination.

DETAILS OF THE PROCESS.

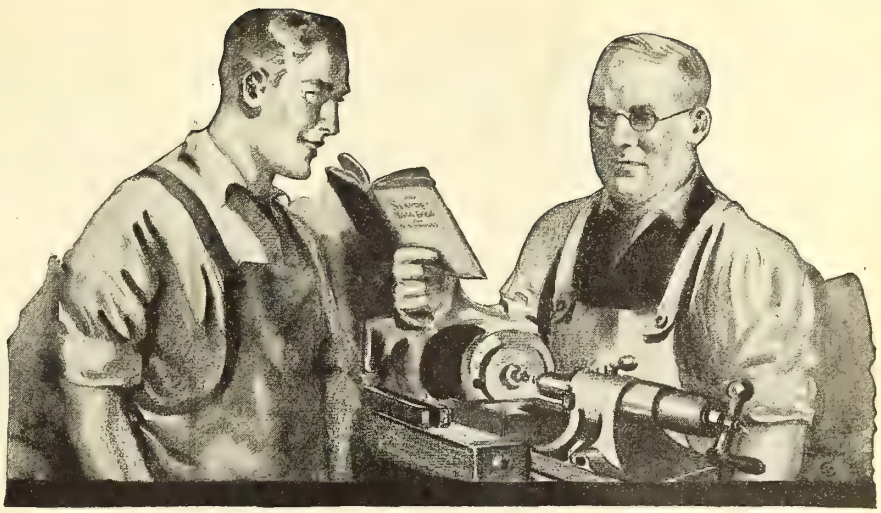
By studying the accompanying schematic diagram it is a simple matter to follow and understand the process which produces synthetic ammonia by the Georges Claude method. Nitrogen and hydrogen are first introduced into an initial compressor represented by A, from which it is led to a second compressor, B, where the mixture is directed to the super-compressor C, which further sends it to a purifier D, placed at the bottom of a specially prepared well or pit and next to the tanks containing the catalyzers. The purifier cleans the mixture of all trace of oxygen and then passes it on to the catalyzer where is effected the combination that we have already explained under the double action of the pressure of 1000 atmospheres and a temperature of 600 degrees.

The ammonia vapors are then past thru the serpentine coils of a refrigerator and thus cooled by a simple circulation of cold water. (In the *Badische Anilin* process the temperature necessary for this cooling process must be 40 degrees below zero). After this point the liquid ammonia passes thru a closed gage and thence to a distributing system where it is bottled in large stone jugs.

The remaining 60% of uncombined gas is taken up at a certain section of the gage and directed into a second catalyzer element I, where 40% of this quantity is again transformed into ammonia and condensed thru a second condenser K. As previously mentioned the ammonia escapes to L, and the remaining 20% of the mixture can be returned to the compressor A or be forced to pass thru the cycle of a third catalyzer element.

Thus we have the general explanation of the system entailing the actual problem concerning the synthesis of ammonia as it is accomplished by Georges Claude and by the *Badische Anilin Werke.*

In conclusion we may add that French science has considerably increased the transformation of ammonia not thru the form of sulfate of ammonia, but thru that of *chlorhydrate of ammonia,* which can be obtained in a much more economical manner than the former by the simple process of utilizing the chlorine lost in the soda industry by the Solvay process.



Starrett Books ~ Vol. II

75¢



"What you want to know is right here"

That's why machinists are buying the Starrett Data Book. It's practical. Just the things you want to know—and *only* those things—ready for use *when* you want them. Information about cutting speeds, change gears, drill and tap sizes. Screw and gear cutting, decimal equivalents, etc.—all in a handy book that you can keep in your kit or carry in your pocket, ready for constant reference.

Bound in red Atholeather, 180 pages. Size 4½ x 7. Price 75c at your hardware dealer's or direct from us. Ask for Catalog 21 "LE" too, it's free.

THE L. S. STARRETT COMPANY

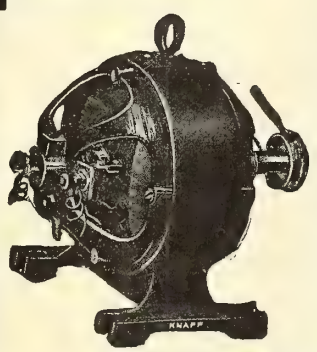
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled

ATHOL, 42-70 MASS.

Use Starrett Tools

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

Motors, Electrical Toys and Specialties Are Best



Knapp Goods have stood the test for 29 years. No detail in construction has been spared to make them the best that money can buy. The complete Knapp line includes Toy and Power Motors, Generators and Dynamos. Specialties and Novelties that amuse and instruct. Fans, Rheostats, Compasses, etc. And Knapp prices are always lowest. Always insist on Knapp Goods.

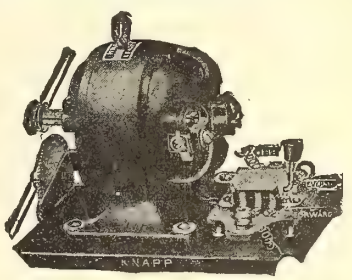
KNAPP DYNAMO MOTOR

Will electroplate, charge storage batteries, run lamps, motors, train of cars, induction coils,—in fact, the number of experiments it can be used for is unlimited. Runs on 4 to 6 Volts or can be connected to run on 110 Volts through a transformer.

Price, Complete, $9.00

KNAPP "LEADER"

An efficient and reliable motor that greatly resembles the big motors of real power plants. Drives from either pulley. Two speeds and reverse. A motor that you will be proud to own and one that will give you unlimited service.



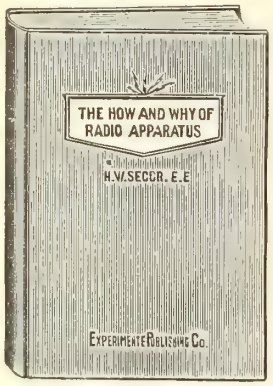
Price, Complete, $5.00

Order to-day. Or your dealer can secure them for you. DESCRIPTIVE CIRCULAR and CATALOG of celebrated KNAPP MOTORS *and Electrical Specialties from 10c up mailed FREE on request.*

KNAPP ELECTRIC & NOVELTY CO., 523 West 51st Street, New York City

SPECIAL VACATION PREMIUM OFFER

With a Year's Subscription to Science and Invention (Electrical Experimenter) or Radio News



This newest of Radio works, bound in flexible velum and hand sewed, has 160 pages. Size of book 6 x 9 inches.

Offer A
Science and Invention (Electrical Experimenter) for one (1) year with The How and Why of Radio Apparatus

REG. PRICE
$3.00
$1.75
$4.75

Offer C
Science and Invention (Electrical Experimenter) for one (1) year with A Thousand and One Formulas

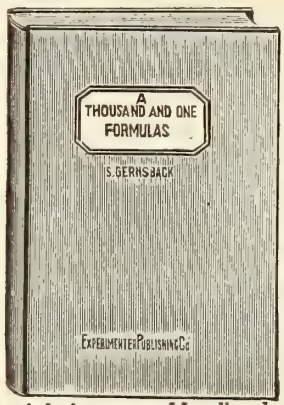
SPECIAL PRICE OFFER, A or C, $3.75

Offer B
Radio News for one (1) year with The How and Why of Radio Apparatus

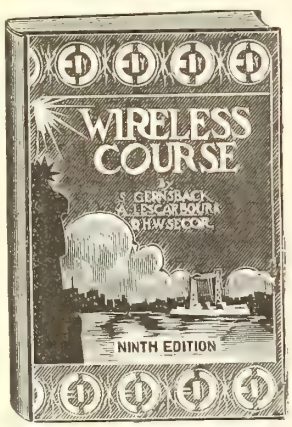
REG. PRICE
$2.00
$1.75
$3.75

Offer D
Radio News for one (1) year with A Thousand and One Formulas

SPECIAL PRICE OFFER, B or D, $2.75



A Laboratory Handbook for the Experimenter. Bound in flexible velum. 160 pages. Size 6 x 9 inches.



Book is bound in flexible Velum; has 160 pp. Size 7x12 inches.

Offer E
Science and Invention (Electrical Experimenter) for one (1) year with Wireless Course in 20 Lessons

REG. PRICE
$3.00
$1.25
$4.25

Offer G
Science and Invention (Electrical Experimenter) for one (1) year with Experimental Electricity Course

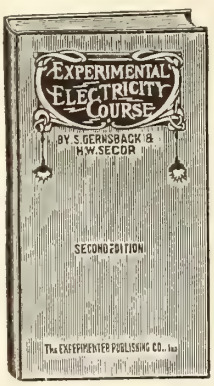
SPECIAL PRICE OFFER, E or G, $3.50

Offer F
Radio News for one (1) year with Wireless Course in 20 Lessons

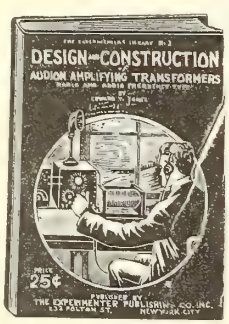
REG. PRICE
$2.00
$1.25
$3.25

Offer H
Radio News for one (1) year with Experimental Electricity Course

SPECIAL PRICE OFFER, F or H, $2.50



Book is bound in flexible Velum; has 160 pp. Size 5x9 in.



Printed on heavy paper, paper bound. Size 5 x 7 inches. Fully illustrated. The latest book out.



Book has 100 pages. Size 5 x 7 inches. 88 illustrations. Paper cover printed in two colors.



Book has 100 pages. Size 5 x 7 inches. 90 illustrations. Paper bound, in two colors.

	Reg. Price	Special Price to you
Offer K Science and Invention (Electrical Experimenter) for one (1) year with Design and Construction of Audion Amplifying - Transformers. How to Make Wireless Sending Apparatus. How to Make Wireless Receiving Apparatus.	$3.00 .95 $3.95	$3.25
Offer L Radio News for one (1) year with Same Books as Offer (K)	$2.00 .95 $2.95	$2.25

EXPERIMENTER PUBLISHING COMPANY, Inc.,
233 Fulton Street,
New York City, N. Y.

Dear Sir:

I accept your offer .....Enclosed find $..... in payment of premium and one year subscription.

Name.....

Address ..... Town..... State.....

Archimedes—The World's First Great Inventor

(*Continued from page* 480)

Astronomy. Compared to the present knowledge of the heavenly bodies, but precious little was known in those days. However, it redounds to the credit of this master genius and inventor of antiquity that he at least produced several instruments for demonstrating and measuring a number of astronomical quantities, such as the angle of the sun and other heavenly bodies with relation to the earth; the apparent diameter of the sun, etc., and the angles subtended by them at the eye, and he also produced a marvelous instrument in the form of a sphere, or rather several spheres, operated by water power, which was so constructed as to duplicate the motions of the sun, the earth, the moon and five planets then known of the heavens.

Cicero actually saw this contrivance and has provided a brief description of it, stating that it demonstrated the motion of the moon and the apparent motion of the sun with such accuracy that it would show the eclipse of both the sun and moon. It was said by Macrobius that Archimedes discovered the distance of the planets, and in the sand-reckoner apparatus Archimedes himself describes the apparatus by which he measured the apparent diameter of the sun, or the angle subtended by it at the eye.

DEATH OF ARCHIMEDES.

Finally, after leading a life of the highest scientific endeavor and having contributed some of the first and most important mathematical and scientific literature in the history of the world, he came to a sudden end. History tells us that the life of the world's first inventor ended when the Romans captured Syracuse; and that he died as he had lived—intensely absorbed in mathematical contemplation. It is stated by Livy that, following the capture of Syracuse, Archimedes was found intent on some figures which he had drawn in the sand, and when he did not answer his questions he was instantly killed by a Roman soldier, who did not know who the master was.

According to history, it is said that Archimedes had requested his friends and relatives to place upon his tomb a monument in the form of a cylinder circumscribing a sphere within it, and bearing the inscription giving the ratio which the cylinder bore to the sphere. From this we may infer that Archimedes himself probably regarded the discovery of this ratio as his single greatest achievement.

When Cicero was quaestor in Sicily (in the year 75 B. C.), he found the tomb of Archimedes near the Agrigentine Gate overgrown with thorns and briers. "Thus," says Cicero, "would this most famous and once learned city of Greece have remained a stranger to the tomb of one of its most ingenious citizens had it not been discovered by a man of Arpinum."

It is to be regretted that we do not have a better and more complete history of the life and of the works and inventions of the Great Archimedes, but, altho some of his useful and important works may have perished, it is quite probable that these cover mostly details of his various mathematical and practical devices; and it is thought that all of his most valuable mechanical discoveries have been preserved down thru the ages.



"Good Bye, Boys!"

"Today I dropped in for a last word with the boys at the office. And as I saw Tom and Dave there at the same old desk it came to me suddenly that they had been there just so the day I came with the firm four years ago.

"When I started here I was put at a desk and given certain routine things to do. It was my first job and I took it as a matter of course. But after a few months I began to realize that I was nothing but a human machine—doing things that anyone could do and that I couldn't expect to advance that way.

"So I had a talk with the manager and I'll never forget what he said. 'If you want to get ahead, put in some of your spare time getting special training along the line of your work. We want men who care enough about their future not only to do their work well but to devote part of their spare time to preparation for advancement.'

"That very night I wrote to Scranton and a few days later had started studying evenings at home. Why, do you know, it gave me a whole new interest in our business? In a few months I was given more important work and more money. Since then I've had three increases, six months ago I was put in charge of my department, and now my big chance has come—I'm to be manager of our Western branch at $5,000 a year!

"Tom and Dave could never see any sense in my studying nights—they said eight hours a day was enough for any man to be bothered with business. They had the same chance I had—they could have been big men in the firm today. But they stood still while I went up to one of the best jobs in our business. It just shows what spare time training will do."

Every day men who have let the International Correspondence Schools help them are moving up to more responsible positions and bigger salaries. Clerks have become advertising, sales and business managers; mechanics have become foremen, superintendents and engineers; carpenters have become architects and contractors; men and boys have risen from nothing at all to splendid positions of responsibility—because in spare hours at noon and night they have learned to do some one thing well.

If *you* want to make more money, show your employer you're trying to be *worth* more money. If you want a bigger job, show him you're willing to *prepare* for it.

There's a simple easy way to do it. For 29 years the International Correspondence Schools have been training men and women right in their own homes whenever they had a little time to spare. More than two million have stepped up in just this way. More than 100,000 are studying now. Ten thousand are starting every month.

Can you afford to let another priceless hour pass without finding out what the I. C. S. can do for you? Here is all we ask—without cost, without obligating yourself in any way, mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6246, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Car Running	☐ Outdoor Sign Painter
☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ BOOKKEEPER
☐ Mechanical Draftsman	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Ship Draftsman	☐ Traffic Management
☐ Machine Shop Practice	☐ Commercial Law
☐ Gas Engineer	☐ GOOD ENGLISH
☐ CIVIL ENGINEER	☐ Common School Subjects
☐ Surveying and Mapping	☐ CIVIL SERVICE
☐ MINE FOREM'N OR ENG'R	☐ Railway Mail Clerk
☐ ARCHITECT	☐ STATIONARY ENGINEER
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____

MODEL AIRPLANE SUPPLIES

Build and fly Model Airplanes

Send 5¢ for catalog of complete and knocked-down scale models of new machines, parts, fittings, and supplies.

Wading River Mfg. Co. 672 Broadway, Brooklyn, N.Y.



$100.00 EARNED BY YOUNG ARTIST IN 2 DAYS

Conscientious, careful training by members of our Faculty made this possible. You, too, should succeed.

Earn $50, $75, $100 a week *and more*

The business world pays big prices for good designs and illustrations. Learn to draw during your spare time by the "Federal" home-study method—endorsed by high authorities. **Easy to learn, easy to apply.** Send 6c in stamps today for "Your Future," a beautiful new 56-page book which explains every step. State age and occupation.



Federal School of Commercial Designing, 528 Warner Bldg., Minneapolis, Minn.

No Money Down

Elgin Watch



14-kt. Gold-Filled Case 20-year Guarantee

On 10-Day Trial

Now, thin model Elgin watch, warranted movement in 14-kt. gold-filled case, 20-year guarantee.

Decide for yourself. If you keep it, this beautiful high class watch may be paid for at less than 7 cents a day.

Chain and Knife FREE

A 14-kt. gold filled knife and chain absolutely free with this offer. State if you wish a Waldemar, (shown in cut), Dickens, or vest chain.

Less Than 7c a Day

If you are pleased when the watch comes send only $3.50 as first payment. Then wear the watch for ten full days. If you do not consider it the greatest value in America, return it at our expense and your deposit will be refunded immediately. If you decide to buy, send $2.00 a month until $22.60 is paid.

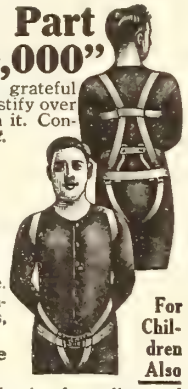
Order Today —On Trial

Remember, you are not obligated to buy when you order on trial. Just send your name and address. No red tape or annoyance. State which chain you wish. This offer limited. Act now. Send your name to Dept. 88-G.

Our 128-page catalog shows more than 2000 bargains in Diamonds, Watches and Jewelry. Write for it NOW.

J. M. LYON & CO., 1 Maiden Lane New York, N. Y.

"I Would Not Part with it for $10,000"



So writes an enthusiastic, grateful customer. In like manner testify over 100,000 people who have worn it. Conserve your body and life *first.*

The Natural Body Brace

Overcomes WEAKNESS and ORGANIC AILMENTS of WOMEN AND MEN. Develops erect, graceful figure.

Brings restful relief, comfort, ability to do things, health and strength.

Wear It 30 Days Free at Our Expense

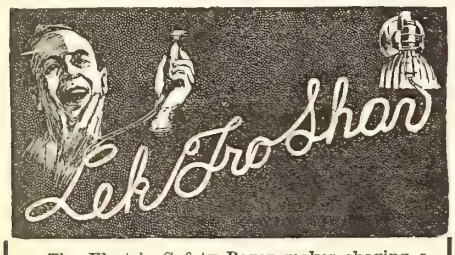
For Children Also

Does away with the strain and pain of standing and walking; replaces and supports misplaced internal organs; reduces enlarged abdomen; straightens and strengthens the back; corrects stooping shoulders; develops lungs, chest and bust; relieves backache, curvatures, nervousness, ruptures, constipation. Comfortable and easy to wear.

Keep Yourself Fit

Write today for illustrated booklet, measurement blank, etc., and read our very liberal proposition.

HOWARD C. RASH, Pres. Natural Body Brace Co.
286 Rash Building SALINA, KANSAS



The Electric Safety Razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."

A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.

Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

VIBRATING ELECTRIC RAZOR CO.
Dept. 122, Council Bluffs, Iowa

"Movie" Camera Copies Books and Legal Papers

(*Continued from page* 540)

lamp while we compare notes. There are miniature spotlights at your elbows on each chair for *note reading* during the projection of the exposures. If you want the first two pages again we can have them instantly. In this way we can study all the work simultaneously, instead of successively, and save valuable time." (The four work for an hour, doing everything that two men, with craned heads and cricks in their necks, not to mention a mounting irritation in their hearts, would have done at 10 per cent efficiency, at the public library in one-half day. They are all relaxed bodily, but alert mentally and away from the maddening and unwashed crowd.)

* * *

The above is not pure imagination, but is based on actual apparatus on the market, in 1920, which, with a little modification and a real service system, combined with a wide-awake propaganda, can be made into a revenue-producing *service bureau.* Such a bureau would supply homes and societies with direct copies of sketches, views, colored or uncolored, of rare or *out-of-print* objects, documents, clippings, etc., in the first place. Second, a résumé service would furnish valuable material accumulated during a business deal by technical men, or in the case of students, during the college term. In the latter case at least 25 per cent of the students disarrange or lose their notes. For "quizz" and "cram" work, or for just plain review lecture, its advantages need not be dwelt upon further.

Third, prevent the rush in libraries for really important patent evidence by putting on the market at 48 hours' notice *any out-of-print* patents.

Fourth, would flatter authors of rare and privately circulated books by multiplying their circulation tenfold. It is necessary today to take the Touriscope, Movette, Pathéscope, Aminatograph, or other apparatus using film instead of glass slides and adapt it in a special manner for rapid step-by-step photo and projecting work with small clichés, 20 by 16 millimeters. The large size has no particular advantages for this kind of work, at least on documentary comparisons.

When one witnesses the fact that six seconds, and this is A1 service today, are necessary for a single photostat copy, costing 20 cents to 40 cents a page, and mentally compares it with the above outlined possibilities, it brings a picture of very attractive future developments to the mind in the way of improvements inevitably on their way to accomplishment.

Who will reap the intellectual, cultural and financial harvest from this seed?

AIRMEN TEST FIREPROOF AIRPLANE.

Turning themselves into a flaming comet, Aviators Kerwood and Campbell gave delegates attending the Third Pan-American Aeronautic Congress at Atlantic City a thrill in testing a new preparation for fireproofing airplanes.

The two flyers donned special suits painted with the preparation, and then permitted mechanicians to spray them with gasoline. They climbed aboard and then the airplane, similarly "drest," was touched off with matches at the same time flame was applied to the aviators.

The plane was then sent careening into the air and for five minutes anxious spectators watched the blazing ship shooting like a star until the flames had burned themselves out. When the descent was made neither the aviators nor the machine had sustained any damage except for the soot.

Banner Storage Batteries

Mean less initial expense and real guaranteed service. It is essentially important to dealers as well as automobile owners to select a dependable battery. Our batteries are positively new and guaranted in writing for 18 months, which means that you get that much service or we will repair same free of charge. We offer you economy and service. Compare our prices with others and be convinced of a saving of 50%.

6 volt, 9 plate 60 amps.	$18.00
6 volt, 11 plate 80 amps.	$22.00
6 volt, 13 plate 100 amps.	$26.00
12 volt, 7 plate	$30.00
12 volt, 9 plate	$35.00

Shipments made within three hours of the receipt of order. Deposit required to defray shipping expenses. 2% discount if remittance in full accompanies order.

Battery Supplies and Equipment. Write for Catalog. Discount to Dealers.

BANNER BATTERY CO., INC., 1219 So. Wabash Ave. CHICAGO, ILLINOIS

Packard



Put the proper power and pressure back of your wireless outfit by installing the PACKARD. Built and designed like our large power transformers to give continuous service. Distances of 450 to 900 miles are common among PACKARD owners.

High voltage is one of the reasons for PACKARD performance. Make it work for you.

Write us about your wireless problems and for illustrated Transformer Bulletin.

The Packard Electric Company WARREN OHIO

Wireless Transformer.

LEARN ENGINEERING

Regular Year Term Starts September 15th

Expert electrical engineers are being paid fabulous salaries—thousands needed today. We give you personal and thorough training—practical, technical courses 3 months to 2 years under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. **Not a trade school.** Training is condensed—if your time is limited, come to the **Finlay Engineering College**—only one of its kind in the West. Day and night sessions—enroll anytime. Write for FREE catalog, a post card will do.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.

Learn Autos and Tractors



Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O.

VIOLINISTS!

NEW DISCOVERY STARTLES WORLD. Learn easily how to make a violin actually **talk.** Greatest opportunities, for this is **absolutely new.** Travel and teach others. Results positively **guaranteed.** Price of complete instructions, **"How to Make a Violin Actually Talk,"** reduced, for a very **limited** time only, to **$1.00.** Send your order now—**today,** before my regular price ($5.00) goes into effect again. Address:
LEO J. AWAD, SHENANDOAH, PA.

PIGEONS PAY



They build their own nests and work for you 11 months in the year. A few good pair of pigeons now will bring you a good sized, profitable squab farm next season.

Write today for circular.

PIGEON SUPPLY HOUSE. P.O. Box 251. Hanover, Pa.

SELENIUM CELLS

Made by entirely new process. Highly sensitive and quick-acting. Suitable for all experiments. From $5 up.

Write for Catalog

Selenium Laboratories
Good Ground, Long Island, N. Y.

TELEGRAPHY

(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.

DODGE'S INSTITUTE **A Street, Valparaiso, Ind.**



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

IMPORTANT NOTE TO CORRESPONDENTS

We receive from thirty to fifty letters requesting advice on patents every month. Due to lack of space, even tho condensing this department into the smallest type, we can only publish from eight to ten letters, with their answers, monthly. Obviously we are falling back further and further, and it looks as tho we will never be able to publish all the requests.

For this reason we would urge correspondents to avail themselves of our special service, as outlined above. In that case an immediate answer will be assured.

EDITOR.

PHONOGRAPH.

(405) Roy M. Weaver, Ashtabula, Ohio, says:

Enclosed is a diagram of an idea which came into my mind when trying to regulate the volume of the sound on our phonograph which now has no way of doing it.

The idea is to have a sort of damper, such as you would find in a stove pipe. E is that part of the arm which fastens to the sounding box. D is the movable arm.

B is the damper or shut off. A is a small knob for turning the shut off. C is the shaft which has on that end a washer and lock nuts. F is a spring used for holding the shut off from jarring. When the shut off is open it will set as shown in the drawing. When closed it will be flat side up and thus shut off the sound.

A. There are four or five phonographs on the market at the present day incorporating the same idea which you suggest. One phonograph having practically the same identical thing suggested in your letter.

Another company, the Aeolian Co., making one having a flexible cable leading to the damper, by means of which the intensity of the sound can be regulated eight to ten feet away from the instrument itself.

The device itself is by no means new, and we do not believe that you could obtain the patent on the same.

DRAWING PAPER.

(406) Lewis H. Phillips, Highlands, N. J., writes:

I am greatly interested in the department, "Patent Advice," and below describe a new kind of drawing paper on which I would like to have your advice as to its patentability.

The average drawing paper has a plain edge. If a draftsman wishes to draw a straight line down the centre, he must first measure in from the edges. Now, with a busy draftsman, time is quite valuable. My suggestion is—have the ends and edges divided into inches and fractions of inches. Now, for instance, a draftsman wishes to draw a parallel line three inches from the edge. Instead of measuring from the edge all he has to do is to set his T square on the 3 inches and draw. Therefore you can readily see that if this idea is patentable it would be a great timesaver.

A. Your idea is a good one and really practical. Whether or not a patent would be granted on the same is hard to say, as ruled paper of all kinds have been patented and patents on the same have long expired.

Thus, square paper marked off in inches at both ends and ruled with light yellow rulings needs but to have a plain ruler in order to get squares and other lines either at right angles to each other or on the oblique of 45 degrees. We believe it would pay, however, to have a search conducted.

BILLIARD CHALK.

(407) H. A. Griffin, Akron, Ohio, says:

In poolrooms and clubs, etc., where billiard and pool tables are, I have noticed that chalk can never be found readily and when it is finally found oftentimes it is on the floor in a crushed condition. My idea is to have a little chalker to be either placed on the ceiling or it can be placed on the wall at about a 30° angle with same. Now, the shaft or plunger which turns the chalk is simply the same thing as you see in these screwdrivers that turn upon being pushed; the spring pushes the chalk down again after it has reached the extent of its travel. The chalk which is to be used must be round and the little clips that hold the chalk work eccentric, and the edges that bear in the chalk are sharp. All the dust that falls off the chalk drops to the bottom and this can be removed when new chalk is put in. This is a feature that makes for cleanliness of both the floor and your self and would be appreciated in the private home.

A. Altho your idea seems very feasible and practical, we do not believe that the exploitation of the same would net a material income for the simple reason that the cost of manufacture would be greatly prohibitive when other similar devices now on the market are taken into consideration.

One device which we refer to consists of a little holder into which the chalk is inserted. This holder is suspended from the ceiling by a little-reel-like mechanism so that when the chalk is released the reel rolls up again replacing the chalk to its former suspended position. The advantage of this device is that the individual can move about the table still holding on to the chalk, which obviously in your case he could not do.

In addition, a pool player likes to wiggle the chalk around on the end of the cue, another feature which your device would not permit. In this manner perfect chalking of the edge at the end of the cue is insured in the regular way presently in use, whereas your device would not permit this.

Thirdly, we do not see how your device would prevent the chalk from falling to the floor if the same were screwed into a low ceiling, as all cues are not the same size, and the opening in funnel end would have to be large enough to accommodate the thickest cue and when a thin cue was placed into the opening the chalk would nevertheless fall to the floor.

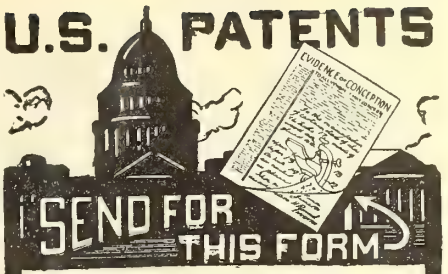
The inserting of the chalk is likewise quite bothersome, making it impractical for poolroom use as invariably something is desired which is instantaneous in its action. Because of these reasons we would not advise a patent on this device.

STAIR MOTOR.

(408) Ernest M. Fletcher, Montreal P. O., writes:

I have always thought that it was almost impossible to get something for nothing; today I read three articles in one of the ELECTRICAL EXPERIMENTERS on that old gag, "perpetual motion"; a thought came to me. Why not make use of the stairs that are climbed by so many people—make

U.S. PATENTS



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.

"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg.
Pittsburgh Offices: 514 Empire Bldg.
Philadelphia Offices: 135 S. Broad St.
San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name ..... *Address* .....

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—**"Inventions and Trade Marks, Their Protection and Exploitation"** and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. **A postal will do—it is free.**

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

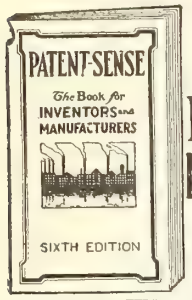
Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

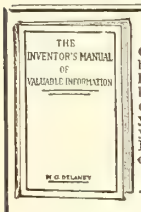
Published for the man with an idea. Send for free sample copy. One year's subscription 50c.



"The Book for Inventors and Manufacturers"

SIXTH EDITION

By return mail FREE. Write LACEY & LACEY Dept K. Washington, D.C.



Get This Book!

Contains first hand, practical advice by an experienced inventor. NOT on how to get your inventions patented, but how to dispose of them after patented with the greatest advantage to you; what kind of agreements protect you; contracts and offers to avoid. Full of valuable pointers; every page one of interest and advice.

$1.50 will bring you a copy of THE INVENTOR'S MANUAL OF VALUABLE INFORMATION

G. E. Perry Company, Publishers
Dept. 20 1328 Broadway New York

PATENTS & TRADE-MARKS

—FREE BOOKLET ON REQUEST—

MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES —

WARNER I. CUBBERLEY—PATENT ATTORNEY
22 NATIONAL UNION BUILDING
WASHINGTON D.C.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, **HOW TO GET YOUR PATENT.** Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.

Dept. 172 Washington, D. C.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

them do a little useful work besides getting to the top or bottom. Get something out of them for nothing.

Enclosed is a rough sketch which will give you my idea.

Take four steps for an example. Each step can sink one inch but is returned to its original position by springs supporting it after the weight is released. As the step No. 1 sings it pushes on a lever. This works a ratchet which turns a shaft geared to a motor which supplies the battery with current. Likewise the same on the other steps.

So we have, if a person of 144 pounds weight ascends

$$\text{Step 1} = \frac{144}{12} \times 8 = 96 \text{ ft. lbs.}$$

$$\text{Step 2} = \frac{144}{12} \times 6 = 72 \text{ ft. lbs.}$$

$$\text{Step 3} = \frac{144}{12} \times 4 = 48 \text{ ft. lbs.}$$

$$\text{Step 4} = \frac{144}{12} \times 2 = 24 \text{ ft. lbs.}$$

$$240 \text{ ft. lbs.}$$

If 500 people went up the steps in a day, making the return trip, that would make $240 \times 500 \times 2 = 240{,}000$ ft. lbs, representing practically 8 H. P.

If more steps were connected up to other levels, say, only 20 steps in all, that would mean 40 H. P.

40 H. P. for nothing on a small scale all gone into the batteries. Could be used to advantage. What do you think?

A. In the December (1916) issue this magazine issued a *"phoney patent"* on the self-same device which you have just described. The idea is quite clever, but we would ask you whether you would like to travel up 40 steps ten times a day, making 400 steps. Then again, each of these steps would carry your weight downward two inches, making you climb a total of 800 inches more than necessary. If each step were 8 inches high, you have climbed 100 more steps than you would otherwise, and if you knew that someone also were deriving power by you having expended 100 steps more per day, like the old treadmills, we are quite sure you and everyone would object. Outside of this, the up-and-down motion while climbing such stairs would be very fatiguing and extremely annoying.

Here is another scheme similar to yours. In the large department stores we have moving stairways. Why not just put a governor on this stairway and have it on very good rollers so that a person standing upon it would carry the stairway down with his own weight. Of course, it could not run more rapidly than the governor would allow. This device could be coupled to a generator. All this energy could be put into storage batteries to operate other electric motors about the store.

STREET CAR INDICATOR.

(409) L. J. Klink, Valparaiso, Ind., says:

In your opinion would a device that indicates the next stopping place of a street car be worth developing and patenting?

What I have in mind is a sign placed in a conspicuous place in the front of the car telling the block number, street or important establishment (like Union Station) that the car will stop at next. For instance, if you were going south on a Broadway car in St. Louis and wanted to get off at Pine St., after the car started from Olive (the first street north) the sign would indicate "Pine St." You would have a whole block to ring and get to the door.

While living in St. Louis I have noticed much uneasiness among the passengers to know just where they were and when to get off. In fact, I have been "carried by" very often myself. The conductors are supposed to call the name of the street but they seldom do and are not always understood when they do.

Such a device can readily be developed that will always indicate the correct place regardless of the irregularity in the length of the blocks or distances between stops or whether the car passes stops or stops at every corner.

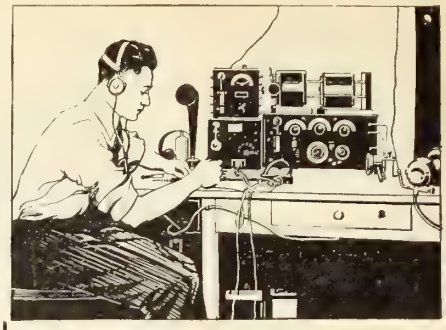
I do not know whether a device of this character was ever placed on the market or not. How could I find out.

Kindly give your opinion as to the commercial aspect of such a device.

A. Your idea is a very old one and several hundred patents have been issued on such devices. If you can overcome the following objections which have been placed upon similar appliances of this nature by the traction car companies, you will have a valuable invention.

The device must not be manually operated, but must be *entirely* automatic. It must not have a trip on the streets or something similar hung beside the overhead conductor or the underground conductor. No changes must be made in present rail installments. It obviously will not work if geared to the wheels, as many times in starting the wheels slip considerably. Rain, snow or sleet must not interfere with the operation of the device.

If your device can live up to the objections just given, we do not see why the same could not be patented and be accepted immediately.



FALL TERM

BEGINS SEPTEMBER 13.

Registration now open for complete standardized course, preparing you for first grade commercial license and best paying positions. Individual instruction in classes of limited size.

Not merely a school, but a real home for the out-of-town student. Comfortable dormitory rooms, modern gymnasium and swimming pool.

Write for descriptive booklet A

Y. M. C. A. RADIO SCHOOL

Marcy Avenue Near Broadway
Brooklyn, N. Y.

Tel. Williamsburg 3800

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out? Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.
1926 Broadway, New York

WILLIAM C. LINTON

Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.

OFFICES

364 University St. Montreal, Canada

919 F St., N. W. Washington, D. C.

PATENTS

C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The **Scientific American** should be read by all inventors.

MUNN & CO., 622 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 622 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

MEN

Intensely interesting booklet free.
Wonderful results.

Winslow H. Chase, Washington, D. C.

A Giant Radio Central Station

(*Continued from page* 511)

supported on self-supporting steel towers, each 400 feet in height, with the wires suspended at the top between 150-foot cross arms. Each of the six antennæ will have twelve towers, forming, so to speak, the spokes of a giant wheel fashioned out of seventy-two miniature replicas of the famous Eiffel Tower in France. Five of these antennæ spokes will be used for regular service, while the sixth is reserved for emergency operation.

Far more impressive than physical appearance, however, will be the things the eye cannot encompass. Appreciate, that in the wires forming each spoke of the gigantic wheel there will be generated a power equal to the greatest of present day transoceanic wireless stations; then comprehend, if you can, the fact that all five of these powers can, if desired, be combined into one, for signaling. A telegraphic signal created out of such tremendous electromagnetic energy could encircle the entire globe!

RADIO TELEPHONE AS WELL AS TELEGRAPH.

But that is not all. The apparatus and system which will be installed for each of the five units will be the same as that at present in the New Brunswick (N. J.) station, from which the voice of Secretary of the Navy Daniels was carried to President Wilson when he was at sea aboard the U. S. S. *George Washington.* In a number of experimental tests the voice has been carried by this radio telephone over distances of 2,500 miles from complete success. This leads us to state very definitely that before long a direct wireless telephone service will be established with foreign countries.

The generation of the energy required to span thousands of miles will be effected by Alexanderson alternators, which have made it possible to carry the radio signals thru space by continuous wave trains, instead of by the interrupted or discontinuous waves, generated by systems using the old-time "spark discharge" apparatus. So efficient and reliable has the Alexanderson 200-kilowatt alternator installed at New Brunswick proven itself that leading radio experts of Europe have made special trips of investigation to the United States to view its performance.

TEN 200 KILOWATT ALTERNATORS TO BE USED.

Now this already famous single machine is to be duplicated and installed in the New York Radio Central Station; but this time there will be two 200-kilowatt machines for each transmitting station—ten in all. The achievement, from a radio engineering standpoint, has nothing approaching a parallel; ten alternators, 2000 kilowatts, 3000 horse power—an astounding force to concentrate in realization of a dream to transmit messages over the world to all points of the compass from a single source!

Mr. Nally emphasized another forward step in engineering which will be incorporated in the super station. "We will utilize what is termed a multiple tuned antenna, which," he explained, "materially reduces the wasteful electrical resistance of the long, low, flat-top aerials formerly used. A great saving in power is thus effected; in fact, for the same power input formerly used for a single station, six times the effectiveness at a distance is obtained. In other words, we obtain with this antenna the same effect at a distance with 200 kilowatts input, as would be obtained from the old type of antenna with 1200 kilowatts

CONNECTICUT RADIO



Strong Signals

Signal strength and selectivity are outstanding advantages of the CONNECTICUT Variable Condenser, because of the low effective resistance of this Condenser.

Laboratory tests have shown the efficient resistance of the CONNECTICUT Condenser to be only a few tenths of an ohm, as against from two to fifteen ohms resistance in the ordinary commercial Condenser (rotary type).

This difference would result in a signal strength from the CONNECTICUT Condenser fully ten times as strong as from the ordinary types.

These and many other advantages of the instrument are described fully in our new booklet. Send for a copy.

Mention Your Dealer's Name

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut

RADIO CLUBS TAKE NOTICE

Buy Where You Can Get A Discount and Get What You Want—
A Most Complete Line of Radio Apparatus and Parts

We have all the Radio Books & Magazines. Get your "Hookups" from them.
Add the list below to the ones given in previous issues.

Hotshot Batteries, 6 Volt, $2.70. Storage Batteries, 6 V-60A, $16.00, (Marko), $19.00. Eveready "B" Batteries, $3.25. Cyclone, $2.20. Standard Variable, 3.25—these batteries have 14 amp. Small "B" Batteries, 22 Volt, $1.00. Special Pittsfield Spark Coils, without vibrator, $2.00; postage 23c. Special Shocking Coils, 50c; worth double. We have about 200 going at that price. Motors, the kind for your rotary gap, $10.00. Monicoil Motors, 49c, work on dry cell. Hoyt Volt Meters, 0-3 & 0-5 volts, $6.50. Pocket type Volt & Amp. meters, $1. Roller-Smith Ammeters, Special, D. C. 0-1 & 0-2, $6.90. Westinghouse Ammeters, Navy Type, D. C. 0-3 & 0-5, $10.00. Large type, $6.00. Small Sterling Type Volt Meters, projecting or flush, Special Price $4.00. Small Sterling Type Ammeters to match the above, 0-35, Special Price $4.00. Variometers, $4.50. Grebe Type, $6.50. Variometer Coupler, $4.50. Primary Switch, Wilcox type, 75c. Rotary Switches, $20c, 30c, 35c, 40c, 50c, $1.00. Spark Gap Stands without the electrodes, 2 to a set, 40c. White Metal Dial, 3" dia. with navy type knob, 70c. Brass scales, 45 degrees, 10c. Hook-Ups, the kind that will make any set work, 14 of them for 75c. We have all the parts for the amateur to build his set as he likes De Forest and our own Catalog sent upon request and 10c.

AMERICAN ELECTRO TECHNICAL APPLIANCE COMPANY
235 FULTON STREET, DEPT. E. NEW YORK CITY

SUPERIOR MIGNON SYSTEM APPARATUS

MIGNON
UNDAMPED AND REGENERATIVE RADIO APPARATUS

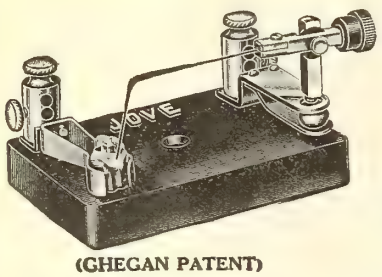
(MIGNON AND ARMSTRONG PATENTS)

Endorsed by Radio Department of D., L. & W. R. R. Co.

Write for Literature

MIGNON MFG. EXPORT CORP., NEWARK, N. J.

AUTHORIZED AGENTS { The Northern Radio Laboratory, Clyde, Ohio
Canadian Radio Mfg. Co., Beinville, Quebec, Canada



(GHEGAN PATENT)

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

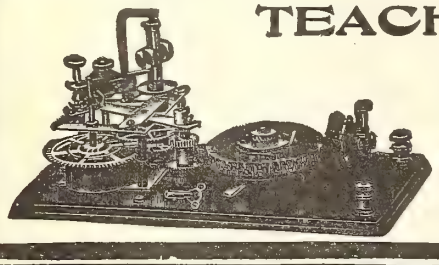
Send stamp for new edition 42E Catalog.

J H. BUNNELL & CO., 32 Park Place, New York

"THERE'S MONEY IN IT"

LEARN TELEGRAPHY AT HOME AT HOME
MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter. THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
26 L Cortlandt St. New York

AUTOMATIC FIBRE LIMBS



Easy Payments—Do Nature's Work. AGENTS WANTED who wear leg. Good Pay. FREE Fibre Sample.
Describe Stump to
WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

input! This new type of antenna is the equivalent of six independent radiators, all operating in unison at the same wave length, and for the complete station with its five antennæ units, the power required will be less than 20 per cent of that formerly necessary. The project, however, contemplates additional possibilities. To illustrate: We may, in many cases, utilize but one-half of a single spoke of the antenna system for communication service to a certain point. On this basis, the Long Island Station will ultimately permit simultaneous transmissions to a maximum number of ten points in the world, thus doubling the communication facilities originally planned."

STATIC ELIMINATION.

"The receiving aerials are of a new type, too; they have been designed for operation with the Weagant system of "static" elimination, which, by a combination of opposed electrical circuits, nullifies the long-dreaded effects of atmospheric electricity and makes possible uninterrupted reception from foreign countries under all weather conditions. We break away from precedent once again, in locating our receiving units only eighteen miles from the multiplex transmitting equipment, instead of following the former practise of establishing one transmitter and one receiver in one locality and restricting the service of the circuit to one overseas destination."

Electrical Meals

By JACQUES BOYER

(*Continued from page* 476)

ner. Thus, persons who live a sedentary life, and who consequently accumulate flesh reserves which are not used up, will be made to perform *ergotherapic exercises.* On the other hand, those whose organisms spend more energy than they are able to produce will likewise resort to the diathermic treatment which will electrically furnish them without any effort on their part whatever the required additional energy in the form of heat. To effect a reducing cure according to the Bergonié method is therefore as easy as partaking of his "electricity meal."

JAPAN ERECTING RADIO STATION AT FUKUSHIMA.

The Japanese Government is erecting a powerful wireless station in tne prefecture of Fukushima for the purpose of relieving congested communications between that country and the United States. The Emperor has conferred upon John R. Geary, general manager for the General Electric Company at Tokio, the Order of the Rising Sun, Fourth Class, in recognition of his services for the development of Japan's electrical industries.

NEW YORK SUBWAY ASKS FOR ONE-MAN TRAINS.

The Interborough Rapid Transit Company has applied to the Public Service Commission for permission to install the multiple unit door control which the company has been testing for several months.

The device, if installed, will make it possible for one man to operate all of the doors on a subway train, thus greatly reducing the cost of operation. It was described in the April issue of the ELECTRICAL EXPERIMENTER—Science and Invention. The commission will hold a public hearing on the application next Tuesday. In the meantime the commission's engineers are investigating the device.

AUDIO TRON

The Original Tubular Vacuum Detector, Amplifier, Oscillator

NOW FREE FROM ALL RESTRICTIONS

AUDIOTRONS, recognized as the most sensitive detectors ever produced, are now licensed under Fleming Patent No. 803684 to be used only for amateur and experimental uses in radio communication. They are no longer limited to audio frequency and can now be used as detectors and oscillators as well as amplifiers.

All patent questions have been definitely settled. Vacuum tube patents are basic and have been sustained by the Federal Courts. Be sure to get genuine AUDIOTRONS. They outclass any other form of detector and are absolutely free from all legal restrictions or difficulties. These new uses make it even more necessary to insist on the genuine. You can always tell a real AUDIOTRON by the name stamped plainly on the glass.

Insist on the name AUDIOTRON on every tube you purchase. Fully guaranteed by the AUDIOTRON Mfg. Co. (Read the guaranty).

Your Last Chance To Get An AUDIOTRON *double filament* DETECTOR

Manufacturing reasons make it impossible to continue the present hand made AUDIOTRON.

This type has a double filament of special thorium tungsten and the operating life is over 2,000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40.

The few thousand that will still be produced will be of the same standard of excellence that has characterized every AUDIOTRON. Already recognized as the most sensitive detector on the market, these few that still remain, with all restrictions on amateur use lifted, are undoubtedly the greatest opportunity ever offered to amateur radio operators.
See your dealer at once or order direct. Be sure to benefit by this last opportunity to secure a hand made super-sensitive double filament AUDIOTRON Detector, Amplifier, Oscillator.

$6.00 each **(no increase in price)**

The AUDIOTRON exclusive guarantee

Each and every AUDIOTRON is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge. The only tube satisfactory enough to stand a guarantee.

Dealers: Get in touch with the AUDIOTRON Mfg. Co. at once. We will give you full information about settlement of all patent difficulties. *You will also be interested in our new proposition for wide awake dealers. Write us today for full details.*

AUDIOTRON MFG. COMPANY (*Successors to the AudioTron Sales Co.*) **Dept. A, Lick Bldg., San Francisco, Cal.**

Be a Movie King

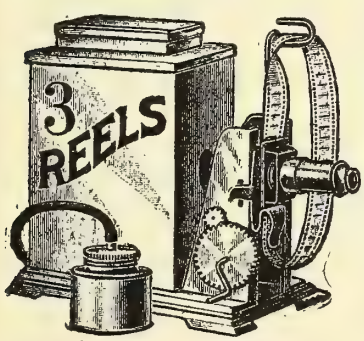


OH BOY. SOME SPORT

Surprise the Bunch—Have a Barrel O' Fun!

OWN A GENUINE MOVING PICTURE MACHINE

Here's what you've always wanted—a Genuine Moving Picture Machine—a machine that uses **STANDARD FILM**—like the **BIG** theatres show—at a price you can easily afford to pay. This is the **BIG** opportunity—don't **MISS** it. Read every word—then act quick. Several swell models to select from. Each the best of its kind. **ALL REAL** moving picture machines—not toys or magic lanterns—but **REAL MOVIE** Machines, that throw a big, broad, brilliant circle of light on the screen many feet away, and show a picture three to seven feet in width. One or more reels of **REAL FILM** come with each machine **FREE,** and the minute you get your machine you can start right in and give a "bully" exhibition. The "fellers" and girls and the grown ups, too, will sit spellbound, or roar with laughter, at the wonderful, lifelike, real movies you can show them.



Latest Model Cinematograph

Show Real Moving Pictures Like the Big Theatres

The New Model This is a beautiful, high-class Moving Picture Machine. Made of sheet iron with wood base. Finished in black or battleship grey with handsome red stripe trimmings. Solid and substantial construction. Size, 12x7½x5½. Uses **STANDARD FILM** same as the big machines, and throws a **BIG** picture many feet in diameter. **TWO TYPES**—Electric and Gas. The electric machine is equipped with plug and cord, complete. Gas machine has its own generator and makes its own light. The gas machines can be used anywhere and will be sent unless Electric type machine is specially ordered. Remember this and be sure to specify "electric" if you desire this type. Sent securely packed in special shipping case, with full instructions and one **STANDARD FILM FREE,** by express, for $7.50; or by Parcel Post, to any address in the world, for $8.00.



New Model

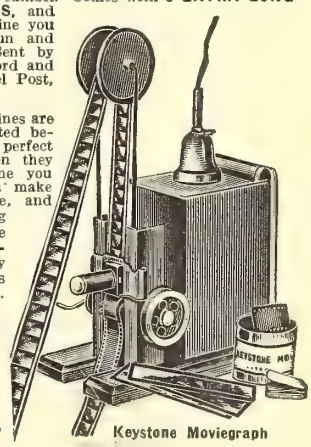
STANDARD SIZED FILMS, 3 FINE SLIDES, and admission tickets—all **FREE.** Here is a machine you will be proud of. You can have endless fun and amusement, and **MAKE MONEY** with it. Sent by express, with full instructions and extra long cord and plug, securely packed, for $12.00; or by Parcel Post, to any address in the world, for 75c extra.

SPECIAL. Order from this Ad. Our machines are absolutely as described and thoroly inspected before they are shipped. We guarantee them perfect and complete and all ready to use when they arrive. Make sure of getting the machine you want—order now—from this Ad. We can make immediate delivery now—so order at once, and avoid disappointment. Prices are going up all the time and you may never have a chance like this again to buy a Genuine Moving Picture Machine at the very low prices quoted here. You've always wanted a real Moving Picture Machine. Make sure to get it **NOW.**

Charlie Chaplin Films—25c each

Keystone Moviegraph

This is our largest and finest machine. A regular beauty and all complete, ready for you to use the minute it arrives. Hang up a sheet, put on a reel, turn the crank, and you're off—that's all there is to it. Nothing to get out of order. Made of metal throughout with heavy base casting. Finely adjusted mechanism, easily operated. Equipped to show slides as well as Real Moving Pictures—just like the big machines. 12x9½x6. Made to operate with electric light **ONLY.** Simply screw in the plug and you are all ready for an exhibit. Comes with **3 EXTRA LONG**



Keystone Moviegraph

BIG BARGAIN OFFER

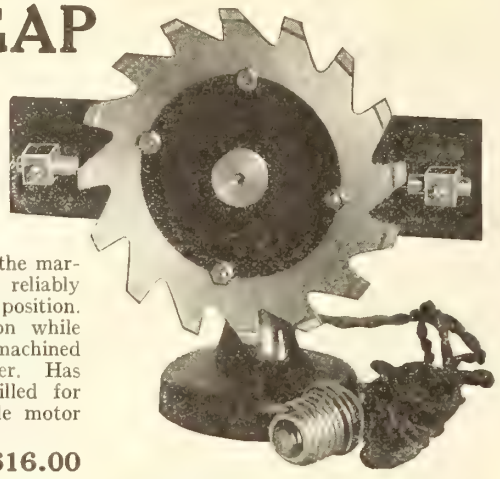
3 Reels Free Here is an astonishing bargain. Our latest Model Cinematograph is a whirlwind value. At the price it has everything beat you ever heard of. Here is a genuine Moving Picture Machine—made of metal—solidly constructed—and put together by expert workmen—that you can buy at a price that will simply astound you—knock you plumb off your feet. This machine throws a brilliant beam many feet. Comes equipped with a **SAFETY** Carbide Gas Generator, and can be used to show moving pictures anywhere. The mechanism is scientific and simple and can be operated by anyone. This is the greatest value in a Genuine moving picture machine ever offered at the price. Think of it! a genuine moving picture machine—that uses **STANDARD FILM**—by express, charges collect—with **3 REELS FREE**—for only $3.00; or by Parcel Post to any address in the world for only $3.25!

FILMS **All the films you want. Splendid subjects—15c each; Doz., $1.50 (postpaid). Extra long films, 3 for $1.00; Charlie Chaplin films—side-splitters—famous favorites, 25c each. Lantern Slides (least sold)—6 for 75c.**

JOHNSON SMITH & CO. **Dept., P.M. 25, 3220-3224 N. Halsted St. CHICAGO, ILL.**

ROTARY GAP

Cat. No. YM1



A new development in the rotary line has been made expressly for Young & McCombs. Improvements on the well known saw tooth rotary wheel, make this gap the equal in tone and efficiency to any selling for twice the money. It is the only gap on the market which will run smoothly and reliably in either a horizontal or vertical position. Can be run in a vertical position while screwed to the wall. Rotor is machined cast aluminum with formica center. Has liberal sparking space and is drilled for either 1-4 or 3-16 shaft. Variable motor speed switch in base.

Price, complete - $16.00

ROTORS ONLY

YM1a—Rotor and standards only.....$7.00
YM1b—Standards with base and binding posts 2.50

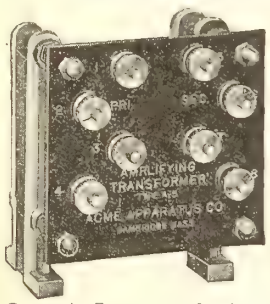
ROTORS AND STANDARDS

YM2—Plain rotor, as illustrated.....$4.50
YM3—Saw-tooth rotor, designed for Harmonic Chord tone..... 4.75

Send 4c in stamps for 50-page Catalog

Young & McCombs
L. P. BEST PRES.
ROCK ISLAND, ILL.

Address Orders to Dept. 67



ALL TUBES ARE NOT ALIKE

For successful amplification the impedance of the windings of an *Amplifying Transformer* should equal that of the tube circuits.

Our A-5 type of *Amplifying Transformer* has several ratios of impedance and transformation allowing the operator to use the correct values irrespective of the tube used.

Your dealer can supply you

ACME APPARATUS COMPANY 28 Windsor Street Cambridge 39, Mass.

TRANSFORMER AND RADIO ENGINEERS AND MANUFACTURERS

ANNOUNCEMENT—BINDING POSTS FREE!

To care for our business in the eastern section of the country we are opening a branch at 20 N. Ninth St., Philadelphia, Pa. We are placing a complete stock of radio equipment in this office and will be ready to care for the local and mail order trade with even more dispatch than formerly.

As a special introductory offer with each order of $5.00 or over bearing the postmark of any date in July, we shall give one dozen of binding posts free of charge. These binding posts ordinarily sell for 6c each and are one of our best values.

Our 64-page catalogue is now on sale at 15c which amount will be deducted on your first order for $1.50 or more.

ELECTRICAL SPECIALTY CO., Dept. E. 48-50 SO. FRONT STREET COLUMBUS, OHIO

Dependable Radio Apparatus

A new Tuner and a new Short Wave Set have joined the DEPENDABLE FAMILY

Catalogue Mailed for 10 Cents in Stamps

DORON BROTHERS ELECTRICAL COMPANY
Hamilton, Ohio

Insure your copy reaching you promptly each month. Subscribe to SCIENCE AND INVENTION—$3.00 a Year.

Collision of Earth with Heavenly Bodies

By ISABEL M. LEWIS, M.A.

(*Continued from page* 501)

fraction minutes), or a total of ten thousand tons per square mile, during the period of encounter.

A fall of *five pounds* of meteoric matter per second entering the atmosphere with a velocity of twenty miles per second over each square mile of the earth's surface would supply a quantity of heat equal to that received from the sun over the same surface in the same time. So for a brief period of forty minutes one hemisphere of the earth would receive about eighteen hundred times as much heat from the collision as from the sun!

To get some faint idea of the effects of such an encounter consider the effect of an actual fall of about *one-third of a ton* of meteoric stone at Estherville, Iowa, which occurred May 10, 1879, at 5 P. M. The meteorite, according to the account, was plainly visible in daylight and the sounds produced were louder than those of the largest artillery and were recorded as "terrible and indescribable, terrifying people and scaring cattle over an area of many square miles." There were two explosions attending the fall, one at great height scattering several large fragments over an area of four square miles, and a second close to the ground scattering many small stones. The largest fragment of the fall weighed over four hundred pounds and embedded itself eight feet in stiff clay. In all about 740 pounds of meteoric stone were collected,—mostly in the form of small stones, fragments of a larger mass shattered by explosions.

Needless to say, the effects of a head-on collision of the earth with the head of a comet possessing one hundredth millionth part of the mass of the earth would produce most disastrous results to all life upon the surface of one-half of our planet earth. Instead of a fall of a third of a ton producing such effects as we have mentioned above, there would be a fall of ten thousand tons per square mile in about forty minutes.

Imagine the cannonading of the Great War spread over every square mile of half the earth's surface at *maximum intensity for one hour*, to form an idea of the effects of such a collision!

If the quantity of matter in the nucleus and head of the average comet approaches any such value as one hundred millionth part of the mass of the earth, and if the individual particles average hundreds of pounds in weight, we have reason to be pleased at the thought that the chances of a head-on collision of the earth with the head of a comet is, according to Babinet, *about once in fifteen million years!*

The earth has frequently past directly thru the tail of a comet. At its last apparition we past thru the tail of Halley's comet and no one was any wiser for the fact, yet the difference in density between the nucleus and tail of a comet may be, and probably is, very great.

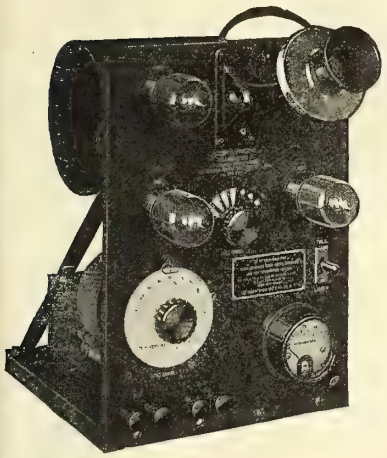
As a whole, the earth would go on undisturbed by its head-on collision with the head of a comet which has a mass equal to only one hundred millionth part of its own, owing partly to the briefness of the encounter (the effect of the great heat would hardly be felt before it would be over) and partly due to the fact that the mass of the comet, tho imposing enough in *tons*, would be so insignificant *compared to the earth's mass* that it could no more retard the motion of the earth than the firing of a few rifle shots could slow down the speed of a locomotive.

DE FOREST

Announcing

The DeForest Portable Buzzer "Radiophone"*

Type O. T.—5



DeForest Portable "Radiophone" Transmitter Buzzer Type O. T.-5
*"Radiophone" Name Copyrighted.

THE latest development of the famous DeForest Oscillion Transmitter (Wireless Telephone). For Automobiles, Motor and Sail Boats, Camps, Surveying and Exploring Parties, Forest Patrol, Farms, and all isolated places, this new "Radiophone" Set offers sure, quick, practical word-of-mouth communication. Operates on two 6-volt storage batteries; no "B" battery or other outside source of high potential is required. Can be easily transported; entire Transmitter, including batteries, weighs less than 60 pounds. Range on ordinary Amateur aerial is 5 to 10 miles, and can be materially exceeded under proper conditions. Operates with any suitable type of Receiver and Audion Detector; with or without an Audion Amplifier, depending on the range to be covered and loudness of reception desired.

Price Without Storage Batteries Including Vacuum Tubes **$135.00**

F. O. B. New York

Investigate this new DeForest production now. Order at once to insure early delivery; either thru your regular dealer or direct from us.

DE FOREST RADIO TELEPHONE AND TELEGRAPH COMPANY

Inventors and Manufacturers of High Grade Radio Apparatus

1415 Sedgwick Avenue New York, N. Y.

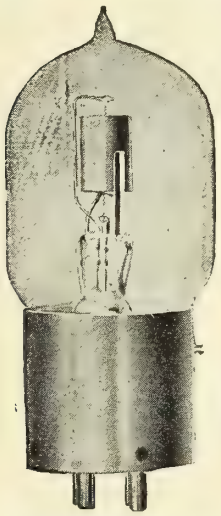
Lee DeForest, Inc., 451 Third St., San Francisco, Western Distributors

DE FOREST

THIS VT AMPLIFIER - OSCILLATOR

OF ALL VACUUM TUBES HAS THE HIGHEST

AMPLIFICATION CONSTANT



THE AP-VT AMPLIFIER-OSCILLATOR

The A-P Amplifier-Oscillator is the Navy type SE 1444 "hard" tube, designed and manufactured expressly for amplification and oscillation purposes. Because of its exceptionally high vacuum and correct electrical and mechanical design this tube has the highest amplification constant of any tube known to the radio art. Recent tests by the United States Navy have established this fact. (See April, 1920, Prec. I. R. E.)

Used in conjunction with the A-P VT Amplifier-Oscillator is our A-P Electron Relay, the original tubular vacuum valve brought out by our Laboratories in 1915, but now supplied with the SHAW standard four-prong base for convenience. Of all vacuum tubes the A-P Electron relay is the most efficient spark receptor. A combination of two or more VT tubes as amplifiers with an Electron Relay as the initial detector is the *ideal receiving combination* for long distance amateur or long wave reception. In ordering ask for—

THE A-P PERFECT VACUUM TUBE COMBINATION

DEALERS *Write for prices and particulars*

The A-P Electron Relay — price $6.00 each
Immediate deliveries. Order from your dealer or write direct.

The A-P VT Amplifier Oscillator—price $7.00 each.
Immediate deliveries. Order from your dealer or direct.

AMATEURS *Write for descriptive literature*

These tubes were manufactured under the DeForest Audion and Fleming Patents

ATLANTIC RADIO SUPPLIES CO., KIRK PLACE, NEWARK, N. J., Phone, Market 1575
PACIFIC RADIO SUPPLIES CO., 638 MISSION STREET, SAN FRANCISCO, CAL.

SOLE DISTRIBUTORS FOR MOOREHEAD LABORATORIES, Inc.

Reference—The American National Bank—San Francisco

MURDOCK No. 55



2000 OHM SET.....$4.50
3000 OHM SET..... 5.50

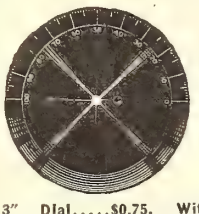
That these Murdock No. 55 Sets have earned a nation-wide reputation for value, is due, not so much to the fact that they are, without question, the best low priced receivers obtainable anywhere, as it is to the recognized fact that they closely approximate in operation the sensitive performance of the most expensive sets.

The customary assurance of "Satisfaction or Money Back" affords the opportunity of proving the exceptional value of these 'phones at no risk to you.

Other instruments — MURDOCK MADE—of recognized merit at equally reasonable prices are illustrated in Bulletin 19B, a copy of which will be mailed on request.

WM. J. MURDOCK CO.
55 Carter St.
CHELSEA (BOSTON 50) MASS.
509 Mission St. San Francisco, Calif.

NEW DIAL INDICATOR



Fits standard ¼" Shaft. Made of same quality as our smaller dial. Black composition. White filled engraving. Bevelled edge.

3" Dial.....$0.75. With Knob.....$1.30 Postpaid
3⅞" Dial..... 1.00. With Knob..... 1.70 Postpaid

Moorhead Electron Relay New Style....$6.00
Moorhead V.T. Amplifier..... 7.00
Moorehead Extra Hard V.T..... 7.50

Shipping weight 1 pound. Guaranteed. Licensed under Fleming and De Forest Patents.

Our new Catalog now ready, send 10c for it.

For sale at all RADISCO Agencies and by

A. H. CORWIN & CO.
4 West Park St., Dept.E-1, Newark, N. J.

Building "Your Own" Phonograph

(*Continued from page* 506)

ELECTRIC MOTOR DRIVES.

Fig. 4 shows two ways in which electric motor drives for phonographs can be used. The first method involves the connection of the electric motor to the gear train directly, with the use of the usual speed governor and regulator. The second method is a pure friction drive and this has been used to some extent commercially with very good success. The periferies of the friction pulleys may be covered with leather or they may be fiber pulleys, etc. Needless to say, the three-ball governor should be linked up with the driving train at some point, so as to keep the speed even and also to regulate the speed to the desired value.

Fig. 5 shows several stages in making your own turn-table. The standard turn-table is formed of prest steel about 3/64th inch thick, the edge being rolled over about 7/16th"; the top of the turn-table is covered with a piece of green or other colored felt glued to the metal, and at the exact center a brass or iron hub is riveted or screwed to the steel table. The hub is usually turned up from a piece of iron or brass in a lathe, so as to contain the pin at the center which passes thru the center of the record, while the hole at the bottom of the hub accommodates the driving shaft.

In standard phonographs no set screw is required as this hole in the base of the hub is tapered to accommodate the tapered shank on the upper end of the shaft. In home-made turn-tables, a set screw is invariably threaded thru the side of the hub so as to secure the turn-table rigidly to the shaft. The turn-table can be very well made of wood about one half inch thick and a standard diameter for turn-tables is 12 inches, altho if you have a small motor which will not rotate such a large turn-table a small one, say about 10 inches in diameter, may be used. Some makes of machines employ a cast iron or brass turn-table as shown at Fig. 5, the flat part of the table being cast with a large number of holes over its entire surface to reduce the weight.

For best results and in all first-class machines, the turn-table is *balanced*. This is performed very simply by mounting the table on a shaft which projects thru about four inches on the outer side. Two straight edges, preferably steel knife edges, are leveled up by means of a spirit level *in both directions*, and the turn-table with its shaft then placed on the knife edges. Holes are drilled in the turn-table or else solder placed on the rim, etc., until the table will rest in any position you place it without manifesting any turning effort. In other words, it must stand at any point you turn it to, without moving.

BUILDING THE SOUND CHAMBER.

When it comes to sound chambers there are many varieties of them, but as Prof. Dayton C. Miller, one of the foremost experts in the physics of musical sound in America, recently pointed out to the writer, —what we desire in a phonograph sound chamber (just now we mean the main amplifying sound chamber extending from the base of the tone arm, out to the grill), is an air-tight, solidly built chamber of standard size, so that the column of air within this chamber can be vibrated at any frequency desired, such as by musical vibrations impinged upon it by the phonograph reproducer or sound box.

Looking at Fig. 6, we have the simplest imaginable form of phonograph sound chamber which is not a very remarkable af-

Super-Sensitive Microphone ONLY $8.00



This instrument is offered at an extremely low price. It is excellent for building your own amplifier. Can also be used in many experiments where a sensitive microphone is required.

Detectagraph, $18.00

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

Send for One To-day and Convince Yourself



Detectagraph $18.00



THE $18.00 MICROPHO DEAF-PHONE

is a super-sensitive instrument which has been developed to meet the demands for a practical and efficient hearing device at an extremely low price. It is equal to any $35 instrument made and superior to most of them. The outfit consists of One Super-Sensitive Transmitter with cord connector; One Super-Sensitive Ear Piece with small black cord; One Black Single Headband; Black Case and Two Batteries.

Adjusted Model "B" Horn, with No. 20 High Grade Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete.

Write To-day for Free Booklet



G. BOISSONNAULT CO.
26 Cortlandt St. New York
Makers of Super-Sensitive Microphone Apparatus

RADIO APPARATUS

Distributors of Reliable Radio Apparatus for Experimenters in Every Branch of the Radio Field.

"Pittsco" the Sign of service.

PITTSCO

All we ask is a trial!

HONEY-COMB COILS

LITZENDRAHT WIRE. (While they last.)			
LL-75	330-1030	meters	$1.60
LL-100	450-1460	"	1.70
LL-150	660-2200	"	2.00
LL-200	930-2850	"	2.10
LL-250	1300-4000	"	2.30
LL-300	1550-4800	"	2.50
LL-400	2050-6300	"	2.80
LL-600	4000-12000	"	3.00
LL-750	5000-15000	"	3.20
LL-1000	6200-19000	"	3.50
LL-1250	7000-21000	"	3.90

Note:—These are the genuine De Forest litz coils.

Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.
Dept. D
12 Park Square, Boston 11, Mass.

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 22 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 80 Big Pages, 300 illustrations, 200 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160 - page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 22 measures 6" x 9". Weight ½ lb. Beautiful stiff covers.

WIRELESS

Send 6 cents in stamps or coin for which we will send our latest Cyclopedia Catalog No. 22 as described.

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

"ASK ANYONE WHO HAS USED IT"
USERS ARE PROVERS

"My Brandes sets brought in Coast stations louder and clearer than the other phones with which the station was supplied." (Name on Request.)

BRANDES WIRELESS HEADSETS



"Superior" Set, 2,000 ohms, $7

TRIAL OFFER *Buy a Brandes Superior Headset and use it critically for ten days. Then, if it doesn't come up to our claims or your expectations, return it and your money will be cheerfully refunded. Test it—compare with others—for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphragms toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

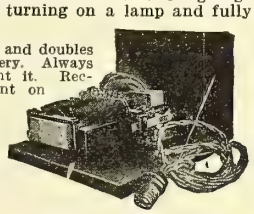
SEND 4c FOR CATALOGUE E

C. BRANDES, Inc.
32 Union Square, Room 814
New York City, U. S. A.
WIRELESS RECEIVER SPECIALISTS

Charge Storage Batteries
For Convenience or Profit

From any alternating current lamp socket with the Cambridge Rectifier. For home or garage use. As simple as turning on a lamp and fully guaranteed.

Quickly saves its cost and doubles the life of your battery. Always ready when you want it. Rectifier Bulletin R sent on request.



Bulletin Y of Wireless Telegraph Apparatus sent for 3 cent stamp.

Clapp-Eastham Co.
131 Main St.
Cambridge, Mass.

The Cambridge Battery Charger, Price **$25**

Arnold Loose Couplers
Combination Loose Coupler Parts and accessories.

Send 3c stamp for literature which is sure to interest you.

J. F. ARNOLD **2082 Lexington Av. N.Y.**
Established 1910

Vacuum Tube Control Cabinets

Beautiful mahogany finished case with handsome grained bakelite panel on which is mounted a standard socket, rheostat, grid leak, condenser and switch for arc and spark reception.

Price $15.00.

Send for our free catalogue of other "Modern" apparatus.

MODERN RADIO EQUIPMENT CO.
Elizabeth, New Jersey

LEARN WIRELESS

At the **OLDEST, LARGEST** and **BEST EQUIPPED** school of its kind in New England. Thousands of satisfied graduates all over the world. Splendid opportunities now in the Merchant Marine. Day and Evening classes. Summer Session. Start any Monday.

EASTERN RADIO INSTITUTE
899 Boylston St. Boston, Mass.

fair it is true, but at least, the writer had the pleasure of building one just like this, out of four wide shingles. And it has served its purpose very well indeed, and in fact is still doing duty in his laboratory phonograph, used for carrying on telephonic and other tests. The reader will see at a glance just how this horn is built—the bottom is a flat shingle cut so as to taper toward the back; the two side shingles were cut straight along the bottom and taper from the outer top end down to within about 2½" at the back, where they run out so as to form a base by which they can be nailed with brads to the lower sides of the wooden throat member. The top shingle is cut tapered on both sides so as to just cover the top of the chamber tightly and rest firmly against the front of the throat chamber. The down-coming throat chamber is built of ⅜" wood (oak in the author's case).

All joints are planed smooth with a carpenter's plane and then glued and nailed with a few small brads. Do not be afraid to use a few brads in building the horn, altho many people will tell you there should not be a brad in it.

The main thing to be observed in building any sound chamber is as aforementioned, that it should be as nearly *air-tight* as possible from end to end, as Prof. Miller pointed out, since if there are any bad leaks or air holes in the chamber, there will be set up false notes or vibrations, or else a weakening of certain harmonics in the vibrations, at the points corresponding to the wave-length location of those air holes or leaks along the chamber.

Be careful therefore in drilling holes in the side of the chamber for the purpose of fitting sound valves and mufflers, etc. If you must do this, make the joint absolutely tight by using brass bushings tightly mounted in the woodwork and a tight-fitting shaft thru these bushings.

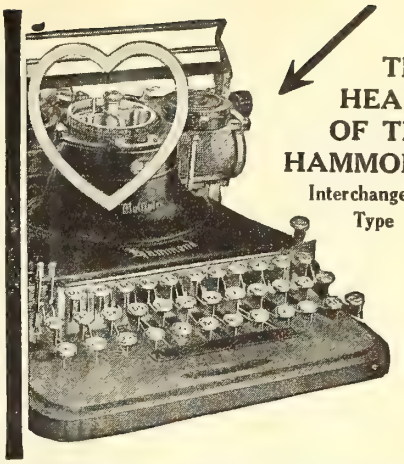
Fig. 7 shows a wooden sound chamber of the type illustrated at Fig. 6, mounted in a cabinet of the table type.

When it comes to building a first-class wooden sound chamber, Fig. 8 shows the "Daddy" of them all. All of the best phonographs have a chamber shaped something after this fashion and of course, it is evident at a glance, that this is an ideal form. The air waves can expand and amplify in this chamber, without having to break around any sharp corners, as the curve is a steady and smooth one. The amateur cabinet maker may find it quite difficult to build a chamber of this form, but it can be built by a cabinet maker or else you can have one made by a carpenter for a nominal sum. The wood used may be mahogany or some other fairly hard wood, about ⅜" to ½" thick, altho many commercial phonographs have sound chambers of this shape built of wood ¼" thick or less. Prof. Miller states that the horn should be built of sufficiently heavy wood, so as not to vibrate but to keep the column of air "rigid," so to speak, in order that only this column of air should be vibrated by the sound waves imprest upon it at its base, by the *reproducer.*

LARGE SOUND CHAMBERS.

When it comes to large sound chambers there are often cases where the reader will like to experiment with this, or one somewhat like it that will produce an extra large volume of sound. Figs. 9 and 10 show two examples of ultra-large sound or amplifier chambers which can be made of metal or wood—the writer prefers wood. The arrangement shown at Fig. 9 is a very clever one and it shows how one phonograph manufacturer has designed his cabinet so as to accommodate an amplifying chamber over four feet long.

(Part II will appear in the October number.)



THE HEART OF THE HAMMOND
Interchangeable Type

One of the Greatest Achievements of Science and Invention.

Hammond MULTIPLEX

"Many Typewriters In One"

For the Mathematician, Engineer, Chemist, Astronomer, Surveyor, Navigator—there is no typewriter like the Multiplex Hammond! The Multiplex does many things that *no other typewriter* can do!

The Mathematical Multiplex contains the characters and signs used for writing in higher and lower mathematics, and for engineering, mechanics, etc., as well as for all the ordinary work that can be done on any typewriter. Just note these fine styles of Multiplex type—

TWO STYLES OF TYPE, or *two to five different languages,* carried on the machine AT ONCE. "JUST TURN THE KNOB" and change *instantly* from Roman Type, to *Italics,* or Miniature Roman, or our Beautiful Script Type, or from English to Greek, Russian, German, French, etc. *Any other type or language can be substituted in a few seconds.*

The above gives a slight idea of the versatility of the Multiplex which has literally revolutionized typewriting—has changed it from monotonous commercial work to the beauty of fine printing and engraving.

SEND FOR FREE BOOKLET showing the many languages and type sets of the Multiplex—Chinese Phonetic and Japanese Kata Kana—the latest in languages to be added to the many already available on the Multiplex.

Fill out the Coupon and mail to us *now*—before you turn this page and possibly forget. You incur no obligation.



Also—an Aluminum PORTABLE Model
For Traveling—for home. Weighs about 11 lbs. Full capacity. Ask for special folder.

THE HAMMOND TYPEWRITER CO.
589 East 69th Street New York City
Name .....
Address .....
.....
Please write your occupation below.

Pedigrees

Have you ever traced your pedigree? If you have, you probably discovered that you are the lineal descendant of some great family or individual whose achievements have stood out in history.

How you swelled with pride when you traced the red blood in your veins, the blood of these wonderfully aristocratic men and women.

Just as you take pride in your pedigree, we take pride in ours, going back to the very beginning of the business world, we find that our pedigree runs to the most royal of all royalty.

The House of Service

From the very start we have devoted our time to "Service". We have breathed it, lived it, talked it and as we grow our ideal grows with us—we uphold our pedigree, our one doctrine to all who will let us.

Not only have we traced our pedigree, but the pedigree of our apparatus.

Pedigreed apparatus i. the best you can buy, no better can be had, old established, tried and true, instruments of quality, that will give you service at all times.

Why not come to us for the next instrument you need and we will show you just what we mean by pedigree.

We list one of the most complete stocks of radio apparatus; which includes every manufacturer of responsibility.

Our special department of small parts, just installed, is unique in the fact that we cater to accessories in radio, every necessary part including contact points, switch points, knobs, switches, bushings, etc., you should not fail to see our special display of these parts, in the first showcase on the right as you enter our showrooms.

You can secure a more comprehensive idea of our service; individual and mail order, by paying us a visit or sending twenty-five cents for catalog, the cost of which will be refunded upon the first order of five dollars.

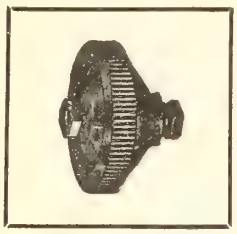
If you are looking for something in electrical apparatus, we have it, including a most complete line of heating appliances.
Watch this space next month for startling announcement of big importance to all radio men.

Our word of honor to you is our guarantee. Let us prove it.

CONTINENTAL RADIO AND ELECTRIC CORP.

J. DI BLASI, Secretary — J. STANTLEY, Treasurer

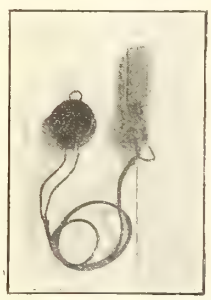
Dept. A.1 — 6 WARREN STREET — NEW YORK



Skinderviken Transmitter Button

for telephone companies, wireless men and experimenters. Over 30,000 sold within last two years. Supersensitive for detectiphones, piano, violin and phonograph; music and speech transmission.

$1.00 each. Circular with instructions free.



Skinderviken Mechanical Stethoscope

detects knocks or defections in running machinery, sensitive as a detectiphone; picks up the sound of your watch; the only instrument for testing the motor of your automobile.

$5.00 each without battery. You can buy flashlight battery at any dealer.

Switchboard key with 20 springs, $1.25; Watchcase receiver, 75 Ohm, $1.25; 5-Ohm, $1.50; Single headband, $1.00; Condensers ½ to 2 mf, 60c; Induction coils, 75c; 1000 Ohm ringers, $1.25; Powerful magnets, 35c; Transmitter complete, $2.00 to $2.50. My advertisements in the last two issues of Electrical Experimenter carried a more complete list of electrical supplies; look them up again.

Orders filled same day they arrive. In remitting send enough to cover postage. Ask for price list.

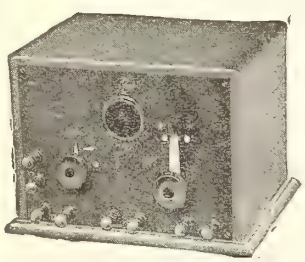
We want representatives in every city in the United States, Canada and Foreign Countries. Intrested parties write for details.

J. SKINDERVIKEN

Inventor and sole Manufacturer

414 BROADWAY — NEW YORK

Audion Control Unit only $13.75



The K & G. Wireless Supply Co., in its efforts to place technically correct and reliable wireless apparatus well within the price reach of critical amateurs, announces its new Audion Control Unit, Type A1. This new unit is absolutely reliable and can be used with every known circuit. It is designed and built for exacting service. It combines the very latest ideas in design with the best of material and workmanship. The cabinet, 8½x6¼x6½, has a highly polished mahogany finish and with its well mounted panel will add much to the attractiveness of your station. The unit contains these instruments: vacuum tube socket (for standard 4-prong tube) filament rheostat (10 ohms), grid condenser, grid leak, and filament switch. Panel has binding posts, suitably marked in white, for secondary, tickler, phones, and filament battery. Whole back of cabinet swings open on hinges and thus permits easy insertion of tube and batteries and complete inspection of the interior. Efficiency guaranteed, or money refunded.

Price $13.75, without tube or batteries. If your dealer can't supply you, order direct. Dealers: Write for proposition.

K. & G. WIRELESS SUPPLY CO.

Dept. 15A, 152 Chambers Street — New York City

READ THE CLASSIFIED ADVERTISEMENTS ON PAGES 580-582, YOU'LL FIND MANY GOOD THINGS THERE.

Audion Poem Award

(*Concluded*)

(*Continued from page* 513)

And glittering like an opal rare,
As dainty as a butterfly,
You'll be the fairest of the fair,
A blazoned jewel in the sky.
And from old "Sparks" a tear will fall
While treading o'er the pearly path,
For one true pal—a crystal ball,
Ever faithful unto death.
Composed by
CLIFFORD P. MORRISON.

7TH HONORABLE MENTION.

Fighter since he learnt to toddle,
Soldier since he got his growth,
Knows the lightning and the static,
For he's fought and licked 'em both.
Not much figure in a dark room,
Not much hand at winning hearts,
Rotten ringer for old Mazda, but
Right there when something starts.
Just a bunch of wire and vacuum,
But you always feel a bit
That he'll get what he goes after
When he starts to hum and spit.

Jupiter found out all about him,
Set a price upon his head,
Then old Neptune's crafty warriors
Nearly kicked him out of bed.
Ocean waves and ocean currents
Tried to cut off his career,
But since first de Forest made him
It has never slipt a gear.
And the souls of all the Amateurs
Give one, big, heart-felt throb
At news that our fragile Audion
Never once threw up the job!
Composed by M. H. CREAGER.

8TH HONORABLE MENTION.
THE SONG OF THE AUDION.

'Oft-times when long I sit watching
That tube with its strange little light,
I fall in a fanciful musing,
Strange visions and dreams meet my sight.

The high-pitched sounds lose their meaning.
I know not what they say.
My eyes grow dim; my senses swim,
And I'm wafted far away.

The sounds change into music.
They sing me a wondrous lay,
And the tiny light before me
Seems the flame of a starry way.

Exultant the song is that's chanted,
Boastful its tone and its key.
Its theme is victory, conquest,
Success and triumphant glee.

It tells of the wonders of Persia,
Of splendors strange and grotesque.
It tells of Scheherezade's stories
And wondrous tales arabesque.

It tells me of strange old inventions,
Of long past glorious ages.
It tells of phenomenal wonders,
The deeds of great men and sages.

And here the song becomes louder.
Pride thrills in the notes of the lay.
For it tells of a far greater triumph
Of our own most glorious day.

Then at last the music grows fainter,
Stilled its victorious glee,
And in proof of the song that was sung me
I hear voices across the sea.
Composed by NASON KENNEY.

Radio Diagrams and Formulae in Loose Leaf Form

The publishers of the CONSOLIDATED RADIO CALL BOOK have completed the preparation of diagrams and instructions on:—

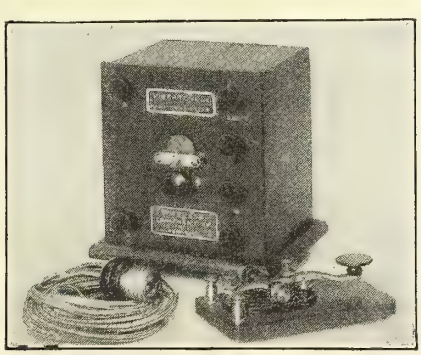
Measurement of Capacity of a Condenser. (Substitution Method.) Calibration of a Variable Condenser. Two Diagrams and Curve.....No. 1
Measurement of Inductance of a Coil or Circuit. Two Methods—Two Diagrams.....No. 2
Measurement of Distributed Capacity of an Inductance. Diagram and Curve.....No. 3
Measurement of Fundamental Wavelength of an Antenna. Three Methods. Three Diagrams.....No. 4
Measurement of Wavelength of Distant Transmitting Station. Two Methods. Calibration of a Receiving Set. Two Diagrams....No. 5
Measurement of Effective Antenna Capacity. Two Methods. Two Diagrams.....No. 6
Measurement of Inductance of Antenna and a Third Method of Measuring Effective Capacity of Antenna. One Diagram.....No. 7
Measurement of Antenna Resistance. Substitution Method.....No. 8
Schematic Wiring Diagram of Regenerative Audion Receiving Set Suitable for Receiving High Power Undamped Wave Stations. Connections shown are those used in most Navy and Commercial Receivers.....No. 50
Table giving the value of LC (Product of Inductance and Capacity) for wavelengths from 300 to 20,000 meters. Inductance in Microhenrys.....No. 100
Table same as above but with Inductance in centimeters.....No. 101
Schematic Wiring Diagram of Signal Corps Type SCR-68 Radio Telephone Transmitting and Receiving Set.....No. 51
Schematic Wiring Diagram of Type CW-936 (Navy Submarine Chaser) Radio Telephone and Telegraph Transmitter and Receiver. No. 52
Schematic Diagram of Type S.E. 1100 (Navy Flying Boat) Radio Telephone and Telegraph Transmitter.....No. 53

These diagrams and instructions are the most CLEAR, CONCISE, COMPREHENSIVE and CONVENIENT form of instruction that has ever been presented. They are printed on pages size 8½ x 11.

Complete Set of 14 Sheets as described, sent postpaid 75c

CONSOLIDATED RADIO CALL BOOK CO., Inc.
41 Park Row, New York, N. Y.

NEW VIBRATONE Jr.
RADIO TRANSMITTING SET



This Set Illustrated Above Operates on
110 VOLTS, D. C. or A. C.
It is absolutely complete as shown. Needs no helix, spark gap, condensers, etc., etc. Simply connect to aerial, ground and electric circuit, and send.

NO BATTERY EXPENSE
Runs all day for 2 cents.
Sends three to five miles.

PRICE $18.00 COMPLETE
With Key, Plug and 8-foot Cord
Send for descriptive circular 148C—To-day

WIRELESS EQUIPMENT CO., Inc.
188 Greenwich St. New York, N. Y.

9TH HONORABLE MENTION. AVE, AUDION!

Trill on; trill on,
Sweet Warbler of the air!
From your vibrant, happy throat,
You bring to me Celestial Note,
On Waves Ethereal.
You sing of Verities Eternal;
Beyond the Dreams of Myth and Creed—
Back to the Dawn of Life's Young Day!
Trill on; trill on,
Sweet Warbler of the air,
At Morn, at Noon—thru dusky Night,
Sing, Sing to me;
And one, anew,
Thy Tomes of Truth and Light.

Shine on; shine on,
Oh, Thou Eternal Sun
Didst Thou not Shine ere Time begun,
Beguiling Sun?
No palsied hand ere stayed Thy course!
What puny hand would dare rob Thee
Of Thy Eternal Glories?
None, none! But hordes have worshipt Thee.
Thy Warmth, Thy Light—Effulgent Rays—
Have been the Glory of Unending Days!
Yea, ever and anon
Didst Thou Shine on,
And Sing—Thy Antiphon!
Hast Thou not been the Light
Which drave the darkness into Day?
Didst Thou not Light the Way,
And burn Thy Rays into the 'nighted brain
Of him whose goods were sterile afterthought?
Shine on; shine on,
Oh, Thou Eternal Sun!
And let this Music thru Thy Radiant Embers run;
Till Men and Minds shall know
That gods were not
Ere Thou didst Sing,
Thy Antiphon!

Flow on; flow on,
Sweet Rivulets and Babbling Brooks!
Flow on, thru your Sequestered Nooks.
Yea, there I fain would steal,
Into your Sodalities Eternal.
Yea, there to be your Seneschal,
That I might lend a list'ning ear,
To catch the strains purloined by you
From primal maid and happy swain.
Sang you not there
The Antiphon—
Romancing with the Audion—
As Sun, and Moon, and Stars looked on—
Sweet Rivulets and Babbling Brooks?
Pray, let me be your Seneschal
For one fleet moment.
Ah! Now I catch your Honest Laugh?
You bid me quaff? Enough!
So, Ripple on,
Sweet Rivulets and Babbling Brooks,
As Perfumed Sepal, bending low,
Catches the Breath of your onward flow.
Envy? No!
But, Hope that in your After-glow,
Your Ripples and your Dulcet Tones,
May e'er Inspire the Human Lyre,
Adown the Vistas of the Years to come,
As you roll on;
And sing, with Audion,
Your Antiphon!

Composed by S. TYSON KINSELL.

SEAPLANE FLIES BY RADIO COMPASS.

Guided entirely by radio compass signals, the naval seaplane F-5-L recently left Norfolk and flew 95 miles on a "bee line" to pick up the battleship Ohio at sea, with no knowledge at the time of taking the air of the vessel's location. The seaplane then navigated its return to Norfolk entirely by radio compass.

Navy Department officials, to whom the flight was reported, said it was the first time radio compass apparatus had been used to direct aircraft to a ship.



HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competion is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

American School of Correspondence
Dept. H-626 Chicago, U. S. A.

American School of Correspondence,
Dept. H-626, Chicago, Ill.

I want job checked — tell me how to get it.

.....Architect $5,000 to $15,000	.....Lawyer $5,000 to $15,000
.....Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Photoplay Writer $2,000 to $10,000
.....Certified Public Accountant $7,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telephone Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....Telegraph Engineer $2,500 to $5,000
.....Electrical Engineer $4,000 to $10,000	.....High School Graduate In two years
.....General Education In one year	.....Fire Insurance Expert $3,000 to $10,000

Name.....

Address.....

Here's How To Get This Great Wireless Book FREE



Follow instructions below and get our new 1920 Wireless Manual. Describes how messages travel, putting up equipment, and all other points. Gives the codes, too. A handy text book and catalog combined — the finest ever published.

Sent for only 25 cents. Ask for Wireless Manual W 12. We credit the 25 cents on first order. Thus, you **get this splendid book FREE.**

Address nearest office,

Manhattan Electrical Supply Co., Inc.

New York Chicago St. Louis
San Francisco

No Seals - No Secrets
—But Service!

Inspection of the interior of any Radio apparatus bearing the mark:

GREBE RADIO

reveals design and workmanship fully in keeping with its outward appearance.

GREBE RADIO apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service. Our interest in the purchaser does not terminate with the sale.

Ask your dealer to show you our line of super-grade apparatus. If he doesn't carry it, write us—mentioning his name—for catalogue.

A. H. GREBE & CO., Inc.,
70 Van Wyck Blvd., Richmond Hill, N.Y.

LET'S FINISH THAT SONG

A ACE E

(Continuation of last month's story)
(Tune—Battle Hymn of the Republic)

First you write a little letter,
It's addressed to Doctor Ace.
You will never find one better
For he always sets the pace.
He will give you all the data
So you may get in the "race".
Then you'll get the signals too.

EXPERIMENTERS. Ask your dealer about our high grade goods including latest C-W Apparatus. DEALERS. You are missing the ACE line if you fail to have our goods in stock. Ace Apparatus sells itself. —REMEMBER—"You may pay more. But you can't buy better."

THE PRECISION EQUIPMENT CO.
CINCINNATI, OHIO
Dept. E 2437 Gilbert Avenue

YOU Can Double Your Ability to Earn Money! Hold Friends! Win Love and Happiness! Our System of Personal Efficiency tells you **how!** Success Studygram and Personality Sketch for 10c and birth date. Thomson-Heywood Company. Dept. 350, Chronicle Building, San Francisco.

The Airplane of the Future

By H. GERNSBACK

(*Continued from page* 485)

York in the morning and return to London on the same day.

As will be noted, the new machine offers hardly any resistance to the air whatsoever and not even a landing gear is exposed. The landing gear in this instance will imitate our birds in flight, which pull in their feet as they fly; this they do simply to cut down air resistance. One of our illustrations shows how the landing gear is pusht thru the bottom of the airplane when a landing is to be made. Otherwise the chassis is drawn within the shell of the airplane and is not at all exposed. A side view of the machine is given in one of our illustrations, as is another view of the machine as it appears in flight when looking toward it. From this view it will be seen that a rib-like bulge runs from nose to end of the machine, the under surface of both sides of the wings being curved, with the curve toward the ground, which is necessary in order to "catch" the air. If the under side of the machine was absolutely flat, there would be considerable air "slippage" and the air would not be caught anywhere as well. In the bottom view of the machine we also see a number of holes thru which the chassis or landing gear is lowered when the machine wishes to alight. Furthermore, on each side of the machine are a number of landing skids, on which the plane rests or slides when making a landing. These skids also retract within the wings of the airplane and are not visible while the machine is in flight, therefore they do not show in our illustration. The small circular holes in this illustration are glass portholes.

The entire envelope of this machine is made of magnesium, a metal 30% as light as aluminum. Indeed, this is the very metal that was used in Mr. Stout's machine. Magnesium is a brilliant white metal and is quite strong as compared to aluminum. The entire machine as a matter of fact can be readily built of this metal, which would give the giant airplane an extraordinary light weight considering its huge bulk. The thousand-foot machine which we show in our illustration can easily transport 1,000 to 1,500 people in addition to a large amount of freight.

The speed of the machine as aforesaid may be 500 miles or more. As a matter of fact, there is nothing to hinder us from making the speed even greater, and we will surely see in the future machines that fly at a speed of 1,000 miles or more. The only drawback to such speeds will be the difficulty in retarding the speed sufficiently in order to make a landing.

Take a machine that flies at the rate of 500 miles an hour; that means over 8 miles a minute! From this it will be seen that when the machine wishes to land it cannot do so instantaneously, but the pilot or captain must start to slow down from five to ten minutes *before* the landing is made. If this is the case, naturally a good deal of the speed or rather the distance covered by the machine will be sacrificed. Of course, the huge 100-foot propellers can and will be reversed in most cases, and this will be about the only way that the speed of the machine can be checked rapidly. Naturally this causes great strains not only upon the propellers but upon the airplane itself and is the one thing that must be contended with when we reach such high speeds.

The next thing is the actual landing of such an aerial monster weighing perhaps 5,000 tons or more. Even a tyro will understand that this task becomes a problem of vast magnitude.

MEMORIZE CONTINENTAL CODE ALMOST INSTANTLY

This method THE short cut to success

Get Wise. Ask for latest reports from Successful, Satisfied, Gratified, Grateful Users, Maine to California — Texas to Canada. Free on request or

COMPLETE CHART
and full instructions 50 CENTS

C. K. DODGE
Box 300 Mamaroneck, N. Y.

Binding Post and Switch Points
Commercial—Standard

SPECIAL—
Binding post made of brass, nickel-plated and polished.
No. 1—size, ¼ in. diam. ⅝ in. high, per doz. $..75
No. 2—size, ⅜ in. diam. ⅞ in. high, per doz. 1.05
No. 3—size, 7/16 in. diam. 15/16 in. high, per doz. 1.10
No. 4—size, ½ in. diam. ¾ in. high, Bunnell Pattern, per doz. 1.75
No. 5—Double Post, 1⅜ in. high, three for. .60
No. 6—Triple Post, 1⅜ in high, three for. .65
No. 7—Contact Points, 7/32 x 7/32 in. head, with 4-36 screw, Brass, 3 dozen for. .60
No. 8—Contact Points, nickel-plated, with threaded shank and nut, same size head as above, 3 dozen for. 1.05

Our new price list of raw materials and parts now ready, sent to any address on receipt of 5 cents in stamps, which will be refunded on first order to the amount of $1 or over.

KEYSTONE RADIO COMPANY
Drawer 307, Greenville, Penn.

Prompt Service

We pay special attention to all mail orders and will send apparatus postpaid anywhere.

	Each
.0005 Condensers Grid } .0013 Condensers Stopping }	$ .35
2.000 Ohm Phones	4.50
3.000 Ohm Phones	5.50
Adams-Morgan Rheostats	1.75

For a more complete list of instruments send 10c for catalog, cost will be deducted from first $1.00 order.

RADISCO AGENTS
Open Evenings until 9.30 P. M.
KELLY & PHILLIPS
312 Flatbush Avenue, Brooklyn, N. Y.

Radio Men

The Mutual Purchasers Association will save you money on all

Wireless Apparatus

Write Dept. E.E. for details.

MUTUAL PURCHASERS ASS'N,
2-4 Stone Street, New York

ARLINGTON TESTED CRYSTALS



Why buy minerals on a gamble? Be SURE when you put a crystal in your detector that it is EXQUISITELY SENSITIVE. Buy Arlington individually tested Minerals. Galena or Silicon, post paid on receipt of price. **35¢**

THE NEWMAN-STERN CO.
Dept. E.E. Cleveland, O.

FREE **Radio Handbook & Catalogue**



Contains much valuable radio information, tables and data. Describes a remarkable line of wireless instruments including "Red Head" 'Phones, Arlington Tested Minerals, DeForest, Murdock and Signal Apparatus. Write for this book today.

The Newman-Stern Co.
Dept. E.E. Cleveland, O.

Red Head Radio Phone



The accepted standard in wireless receivers. If they are not BETTER than anything you've ever seen return them for full cash refund. Our Radio Handy Book and Catalogue, free on request, describes them, and many other instruments.

The Newman-Stern Co.
Dept. E.E. Cleveland, O.

For Homes, Offices, Factories, Farms

Complete Wall Set Magneto Telephone

Western Electric Type



$7

This is a complete commercial telephone station. They were bought from telephone exchanges who put in Central battery types. Slightly used but guaranteed to be in A1 working order. The cabinet is of polished oak, piano finish, within which is contained the powerful magneto, the 300 Ohm polarized ringer, an induction coil. The magneto is exceptionally efficient, being of the two bar type with brass gear transmission. The extra sensitive microphone, mouthpiece and two gongs are mounted on the front of the cabinet, giving the entire instrument that desirable appearance of compactness and efficiency. Guaranteed to work over 20 miles. The telephone receiver is a double poled one, and has a hard rubber case. Seven binding posts are provided for connections.

The instrument is one which we can offer with pride to our patrons at a ridiculously low price. It is unobtainable anywhere else at less than $15.00 and is an instrument unequaled in value for the price we ask. Size over all 11x10x8 in.

Long Distance Telephone Set—
One station.....$7.00
Shipping weight, 15 lbs.

Two stations
Shipping weight, 25 lbs.....**$13.00**

Send 6c in stamps for our big 80 page Wireless and Electrical Catalog No. 22.

The Electro Importing Co.
231 Fulton Street, New York

Make Your Own
ELECTRICAL APPARATUS
with the help of our
RELIABLE BOOKS
Send for price list No. 138
COLE & MORGAN, INC.
Publishers
188-190 Greenwich St. New York

For example. A locomotive is always upon the ground and can easily retard its speed by slipping over the rails; the tremendous friction set up soon stops the train. A steamship is never out of the water, and being in so dense a medium can easily retard its speed by reversing its propellers. But the airplane on the other hand has two entirely different things to contend with. In the first place, it not only must reduce its speed from a high speed to practically nothing before it can make a landing, *but it also must make the transition from one medium to another,* namely, from the air, a very thin medium, to the ground, a very dense medium. When we come to do this with a 5,000-ton weight, it will be readily seen that this becomes a ticklish problem. Off-hand it would seem to be almost impossible to bring so huge a weight safely down to earth without special contrivances not yet invented. Luckily there is one element in landing such a huge machine which has perhaps occurred to few people, and the writer herewith desires to advance it with diffidence.

Due to the very large surface of the machine this makes the landing rather easy for the very simple reason that the machine acts as a parachute, unlike a dead weight that does not displace much air. If the machine is designed right, and if the center of gravity of the machine is correctly calculated, and if the curvatures of both of the undersides are correct, it should be possible to stop the propellers just before the machine reaches the ground. Then by quickly reversing the propellers the huge airplane would then descend not unlike a parachute. In other words, the air between the machine and the ground cannot get away fast enough without acting as a buffer on the airplane, which would therefore descend at a slow speed similar to a parachute.

Therefore, the bigger and larger we make such a flying machine the more safely will it be possible to land it. Of course, it goes without saying that the weight of the machine in proportion to its surface must not reach beyond a certain figure, for if the weight becomes too great gravitation will overcome the parachute effect and the huge craft will come down too quickly. This, however, is a problem for the engineer to work out.

Should it not be possible to land these huge air monsters as advanced above, then perhaps it may be found that it will be safer to "land" them on a sheet of water specially prepared for "landing" purposes. If the airplane of the future is equipt with retractable pontoons, then it would be a simple matter to make a landing on a small natural or artificial lake, which would thus constitute the "Air Port." Perhaps such a landing would be safer and preferable to a ground landing.

IF you should be called upon to-night to resent an improper remark about someone you love, could you play a man's part?

SUPPOSE a ruffian insults you, or worse still, passes a stinging remark about your mother or sweetheart. What will you do? The bully probably knows enough about boxing to give you a good beating. Prudence would tempt you to swallow the insult and slink away. But your pride won't let you do that—you're too much of a man—so to save yourself from disgrace you fight. And if you are like most men who know nothing about boxing, your opponent will give you a sound thrashing.

Or suppose you are waylaid on a deserted street. Unless you know how to overcome your opponent and escape, it is likely that your friends will find you lying unconscious.

Now how much longer are you going to take chances with your helplessness? The excuse that you are too old or too young to learn boxing, that you haven't the time or the money, doesn't hold good. We are teaching boxing to over 7,000 students—some of them old men, some of them boys, and we know from experience that after studying the Marshall Stillman System of Self Defense the majority of them are able to outbox stronger and heavier opponents.

It won't cost you a cent to try this course. We send it on 10-day approval. Practice some of the lessons. If at the end of ten days you feel that we can't teach you boxing and self-defense, return the course. Should you decide to keep it, simply mail $5 in complete payment.

This course is based on the methods used by Professor Mike Donovan, who for years taught boxing at the New York Athletic Club. The lessons take place in front of your mirror. You start with things you already know, such as the breast stroke in swimming, stretching out your hand for a coin, etc. Step by step you are led from these movements to similar movements in boxing and before you know it you find yourself striking powerful blows, ducking, feinting, guarding, side stepping, etc., just as if you had a real opponent in front of you.

When you've mastered the fundamentals—the hit, guarding, ducking, feinting and foot work—you take up shadow boxing, in which we describe and illustrate such blows as the Fitzimmons Shift, the Jack Dempsey Triple Blow, the Mike Donovan Double Blow, etc.

But the course does not stop with boxing. To properly defend yourself under all circumstances you must also know something of jiu-jitsu and bone-breaking holds and releases. After you have mastered these lessons, you will know such valuable stunts as disarming an opponent who holds a pistol, dagger or club, releasing his hold on your throat, freeing yourself from an opponent who has locked his arms around your neck or waist, guarding against a kick for your stomach, etc.

There's also a complete set of daily muscle-building exercises to keep you fit.

And to every student we send a copy of "Boxing Blows and Guards" which shows every good blow and guard known to the ring. There are 175 illustraitons in the entire course.

Hundreds who read this advertisement will send for the course; they will practice a few of the lessons and see immediately that the course is practical, and will go on with it. When they are through they will know how to defend themselves like **real men.** If you want to be one of them, mail the coupon below, to the Marshall Stillman Association, 461 Fourth Avenue, Suite E-109, New York City.

FREE TRIAL COUPON

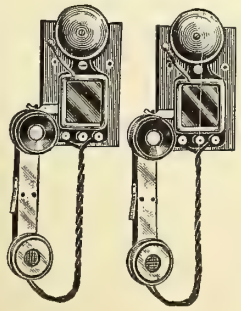
MARSHALL STILLMAN ASSOCIATION
Suite E-109, 461 Fourth Avenue, New York

You may send me on approval your complete course in Boxing and Self Defense as described above. I have always been faithful in paying my obligations and I give you my pledge that you may feel safe in trusting me as agreed and that I will either return the course, or remit $5 (Canada $6, foreign countries $7) in 10 days.

Name .....

Address .....

ORIGINAL **MECANEL** **TELEPHONES**



A highly developed telephone that stands favorable comparison with high-priced commercial telephones. Only two wires are required for the installation, there being no other 'phone on the market that will operate on less than three wires, due to the fact that an entirely new feature is embodied in the MECANEL TELEPHONES. They are ideal time-savers for house, farm, field or office use. By simply lifting the telephone off hook, a REAL BELL will ring at the other end until someone answers. They will operate at a distance of 200 ft. with four batteries and greater distances with additional batteries. Simple diagrams and instructions with each set.

Price $5.00 Postpaid **Money Back Guarantee**

INLAND SPECIALTY COMPANY, 1562 N. Robey St. Chicago, Ill.

Check the Job You Want!

Thousands Men—Boys Wanted

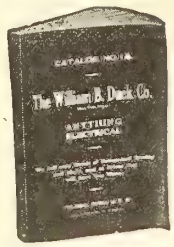
..Railway Mail Clerk	$1600 to $2300	..Customs Positions	$1200 to $1800
..Postoffice Clerk	$1400 to $1800	..Internal Revenue	$1300 to $2000
..Postoffice Carrier	$1400 to $1800	..Stenographer	$1340 to $2000
..Rural Mail Carrier	$900 to $2360	..Clerk at Washington	$1340 to $2000

Name .....

Address .....

Sign your name and address and send us this coupon immediately. We will immediately send you (1) a full description of the position checked, (2) a list of many U. S. Gov't Jobs now open and directions telling how to get free coaching for the position checked.

Franklin Institute, Dept. B101 Rochester, N. Y.



DUCK'S

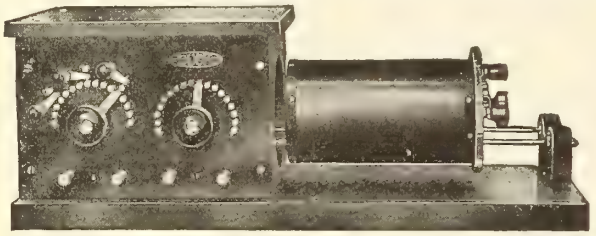
New Big 200-Page No. 14 Wireless Catalog and 100 Page Electrical Catalog

The wireless catalog mailed for 12c and the electrical catalog for 6c. either in stamps or coin, which amount you are privileged to deduct on your first order of $1.00. Catalog positively not sent otherwise.

This edition of our wireless catalog is the most complete and elaborate we have ever put out. It embraces everything in wireless worth while. As an encyclopedia of information it is invaluable. It is printed on excellent paper and with a beautiful cover. Your amateur friend will tell you that there never has been any wireless catalog to take the place of Duck's, and above all that you can absolutely rely on the quality of every instrument listed in this catalog. In a word it is all worth while catalogs in one.

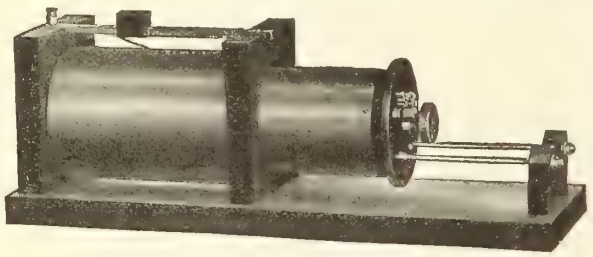
Audio Tron bulbs prepaid $6.00

We discontinued selling Audio Tron bulbs and accessories for a short time but we have again resumed their sale and also panel sets, and can guarantee immediate delivery.



NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER

A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $27.50.



OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

The secondary on our new type Arlington is divided into three sections with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type, permitting a looser coupling. It is a beautifully finished instrument.

Price only $15.00

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio

How to Become a Professional Radio Man

By PIERRE H. BOUCHERON

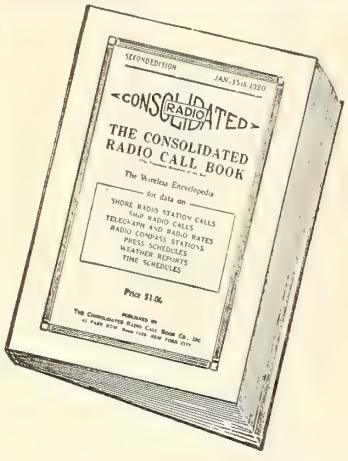
(*Continued from page* 515)

tors and it is hoped that few of this type are at large today. The new element of radio men who go to sea, nowadays, is for the most part above this sort of petty childishness and ill-breeding.

An operator should never fail to remember that altho he may be paid by the radio and not the steamship company, nevertheless, as soon as he has signed the *ship's articles,* he is as much a member of the crew as any sailor or fireman.

Moreover, if an operator is going to conduct his business on the *theory* that the ship's officers have nothing to say or do with him, it is very likely that he is not going to find the business of going to sea very agreeable. There are any amount of shell-backs who will do their level best to make things miserable for "Sparks".

Of course, as in all other walks of life, one will encounter small, mean, narrow-minded seafaring men who have little faith in humanity and still less in radio operators; who are ever-ready to find fault and to make it as uncomfortable as possible for everyone about them. Here I have nothing new or enlightening to offer on the subject of dealing with such persons, but in the long run one will find that even these monsters may be brought around quite nicely by the use of a little tact and patience; otherwise known as "kidding them along". This may even be accomplisht without the slightest loss of personal pride and self-respect, if one is willing to use a little common sense and give in to trifles.



The Second Edition of the

Consolidated Radio Call Book

is the only book in print officially listing all the radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.

ALL AMATEUR CALLS ALSO LISTED

SPECIAL

Given Free With Each Copy

A Wireless Map of the World **in colors** is given absolutely free with each copy. This map shows the locations of all the high powered RADIO stations in the world, including the time signal stations. In addition it tells at a glance how far away any of these stations are. Of greater interest are the time zones, which enable the amateur to compute instantly the correct time for the zone in which he is located from any time signal station.

Price $1.25 Prepaid

Either Direct from us or for sale by the following responsible dealers:

American Electro Technical Appliance Co., 235 Fulton St., New York, N. Y.
Atlantic Radio Co., 34 Batterymarch St., Boston, Mass.
L. Bamberger & Co., Newark, N. J.
J. H. Bunnell & Co., 32 Park Place, New York City
California Electrical Supply Co., 643 Mission St., San Francisco, Cal.
L. W. Cleveland Co., 441 Congress St., Portland, Me.
Cutting & Washington Co., 6 West 48th St., New York City
De Forest Telephone & Tel. Co., 1391 Sedgwick Ave., New York City
Dewey Sporting Goods Co., 268 West Water St., Milwaukee, Wis.
Doubleday Hill Electric Co., 719 Liberty Ave., Pittsburgh, Pa.
A. T. Hovey, 61 Belvidere St., Boston, Mass.
Lester I. Jenkins, 923 Purchase St., New Bedford, Mass.
Klaus Radio Apparatus Eureka, Ill.
Arno A. Kluge, 638 So. Figueroa St., Los Angeles, Cal.
Manhattan Electrical Supply Co., 17 Park Place, New York City; 114 S. Wells St., Chicago, Ill.; 1106 Pine St., St. Louis, Mo.; 604 Mission St., San Francisco, Cal.
McCarthy Bros. & Ford. 75 W. Mohawk St., Buffalo, N. Y.
A. C. McClurg & Co., 218 So. Wabash Ave., Chicago, Ill.
Mohawk Electrical Supply Co., 325 So. Warren St., Syracuse, N. Y.
Newman-Stern Co., 1874 E. Sixth St., Cleveland, Ohio
Nola Radio Co., 134 Chartres St., New Orleans, La.
E. P. Noll & Co., 21 No. 7th St., Philadelphia, Pa.
Pioneer Electric Co., 137 East 5th St., St. Paul, Minn.
F. D. Pitts Co., 12 Park Square, Boston, Mass.
Precision Equipment Co., 2437 Gilbert Ave., Cincinnati, Ohio
Radio Corporation of America (Marconi Co.), Gay and Pratt Sts., Baltimore, Md.
Radio Distributing Co., 4 West Park St., Newark, N. J.
Radio Engineering Co., 827 Madison Ave., Baltimore, Md.
Radio Equipment Co., 630 Washington St., Boston, Mass.
Reuter Electric Co., 34 East 6th St., Cincinnati, Ohio
Rudolph Schmidt & Co., Inc., 51 Main St., E., Rochester, N. Y.
Shaffer's, 107 Granby St., Norfolk, Va.
Shotton Radio Mfg. Co., Scranton, Pa.
Smith Novotoy Electric, Inc., 20 West 5th Street, Charlotte, N. C.
Southern Electrical Co., Third and E Sts., San Diego, Cal.
H. E. Williamson Electric Co., 316 Union St., Seattle, Wash.
Young Men's Christian Association, 715 South Hope Street, Los Angeles, Cal.
Jos. M. Zamoiski Co., Baltimore, Md.
Young & McCombs, Rock Island, Ill.
Geo. S. Saunders, 168 Washington St., Boston, Mass.
Wireless Shop, 511 W. Washington St., Los Angeles, Cal.
Post Office News, 33 W. Monroe St., Chicago, Ill.
Meter Electrical Construction Co., 11 Otter St., Oshkosh, Wis.
United Radio Telegraphers' Association, 505 E. Baltimore St., Baltimore, Md.
American Hardware Stores, Bridgeport, Conn.

Published by

Consolidated Radio Call Book Co., Inc. **41 PARK ROW, NEW YORK CITY**

Many operators step aboard a ship for the first time with the belief that unless they show "some class" they will be made light of. This is wrong; there is never any need of bull-dozing or braggadocio when one would seek to accomplish their means. Rather give in to the little things than dispute anyone's word, particularly with the word of a man who has spent a lifetime at sea and ought to know what he is talking about. Wait until something of vital importance to your welfare or integrity is at stake; then it will be time enough to dispute the rights of an operator. After all, the big things are the ones that count.

THE CAPTAIN.

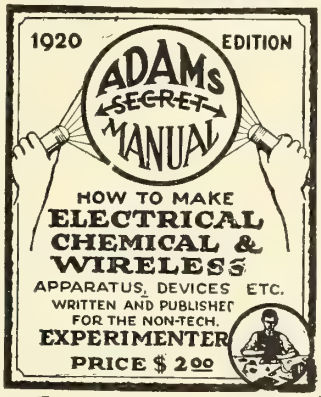
Too much stress cannot be laid upon the importance of respecting and obeying this important personage. Have ever before you the fact that once the ship is outside the three mile limit, the captain is King—he is the law; he is Emperor; he has the last word to say, in fact he is Lord of all he surveys. That little tub splashing about on that mighty expanse of water is under the supreme command of the Captain. Upon him rests the safety and sometimes the destiny of the several handfuls of men as well as women who chance to be on board. *What he says goes.* Usually he is a well-seasoned, conscientious and experienced sea-dog and he will not abuse the authority rested upon him by international mercantile marine laws. There is some sort of an unwritten rule of the sea that in a shipwreck the captain and the wireless operator are the last to leave the ship,—providing they are fortunate enough to reach that point. For that reason as well as many others which the prospective wireless operator will soon learn, it behooves you to keep on the right side of him. In fact the success of your work, the amount of pleasure you are able to secure on various voyages, as well as your personal comfort on board ship depends primarily upon how you impress the captain. Some skippers are often attacked with a reckless desire to curtail many most desirable privileges and liberties.

In a smaller measure the same may be said concerning other high officers of a ship such as the Chief Engineer, the Chief Mate, the Chief Purser, the Chief Steward (your stomach is concerned here) and their various assistants. The real radio operator will do his utmost to please these men and assist them in every way possible, wheether it be the securing of the time signals, daily news, baseball scores, weather reports, positions of other vessels, et cetera. *A word of warning:* don't resort to the time-honored practise of blaming it on "static" when you are unable or have failed to copy "press."

It is the boast of several radio operator friends of mine that they have made the New York to Havana, New York to Galveston, New York to Mexico, New York to Liverpool runs for several solid years without ever once missing the "daily press" items transmitted by the high power stations nightly and which both crew and passengers so eagerly gobble-up the next morning. It is true that there are nights when "static" interference is very severe and it is sometimes very difficult to copy two straight words in succession without missing the next three. Long practise in copying thru all manner of interference and their ability "to patch up" and make sense in broken-up sentences where many words have been "lost", no doubt comes to them in good stead. There is, therefore, no reason why you cannot do the same, once you have gotten into the "swing of it."

(Part II—will appear in the October number.)

ADAMS GREAT SECRET MANUAL



The GREATEST BOOK Ever Issued for Making Electrical, Chemical Wireless Apparatus, Supplies, etc., at little cost

TELLS HOW TO MAKE

Print-O-Graph for 50c prints circulars, letterheads, signs, etc., in one or more colors. Print labels, stickers and envelopes at 25c a thousand.
Wireless Telephone without aerials, easy to make. Materials required are receiver, transmitter, battery and wire. Transmits clearly at any distance.
Burglar Alarm, closed circuit for $1.00. Bell rings automatically when wire or tinfoil is broken. Without relays, electro magnets, buttons, springs, etc.
New Electric Battery for 50c. Charge it at home. Without electricity, wet or dry batteries. This battery produces 12 volts.
Wireless Set for $1.00. No! Will not send 1,000 miles, but is an efficient wireless apparatus that will operate anywhere if instruments are carefully made.
Aeroplane Photography—photograph your town, and make the picture look as if photographed from an aeroplane; tell them you were up and made a snapshot.
Liquid Pocket Flashlight for 25c gives steady light for six weeks with one charge without matches, oil, wicks, batteries, etc., handy and safe as a flashlight.
Hypnotism made easy with this chemical method—anyone can easily be hypnotized; results guaranteed. No high brow language, but plain, simple instructions.
Telegraph electricity free. You can get 7 volts of earth electricity free, anywhere, anytime; never runs down; this electricity operates lines up to 2½ miles.
New Electric Telephone—With only one ordinary receiver at each end of the line you can receive and also transmit with it at any distance.
Catch Fish Quickly—By hundreds or dozens; when this chemical is placed in the water all fish will come to the top intoxicated ready to pick up.
Old coins made visible. Unreadable impressions on any old coins can be made readable again without cost. This secret is indeed valuable.
Midget Ice Plant for 50c. Freezes a daily supply of pure cold ice for a few cents in any season and in any part of the world.
Self Lighting Gas, an inexpensive chemical. Once applied to any gas mantel or burner. Lights the gas instantly, when turned on.
400-Mile Condenser for 25c. Will operate satisfactorily up to that distance. This variable condenser is very simple and easy to make.
Wireless Set without Aerials—How to send and receive messages anywhere, anytime, without aerials, wires, coils, etc.
New Process Embossing, or raised colored letters on stationery, post cards, etc., for 25c a hundred, without presses, dies, etc.
Mysterious Ball. With this homemade ball you can pitch the most peculiar curves, such as no ballplayer can catch.

Actually Tells:

How to Make any phone receive wireless calls.
How to Make genuine stamp photos at 2c a doz.
How to Make an electric walking stick.
How to Make a small hand camera for 25c.
How to Make A. C. Transformers for 10c.
How to Make a small motion picture camera.
How to Make a vest pocket wireless telegraph.
How to Make practical storage battery for 25c.
How to Make unbreakable flexible mirrors.
How to Make 16 x 20-inch photos for 10c.
How to Make rubber bands for 50c a thousand.
How to Make duplicates of old stamps at 2c dz.
How to Make a simple, sensitive radio amplifier.
How to Make a good battery rheostat for 5c.
How to Make an electric gas lighter for 10c.
How to Make an invisible aerial.
How to Make any clock run 2 yrs. with 1 winding.
How to Make or buy moving pictures at ½ ct a ft.
How to Make dry batteries last 3 times as long.
How to Make an experimental battery for 5c.

MAKE A REAL SPEEDY MOTORCYCLE from any old bicycle **in a few hours** with ordinary home tools. Materials and parts are very cheap. You simply attach them to your bicycle and presto—your motorcycle is ready. The price of **Adams Secret Manual** is **$2.00,** but because it is impossible to completely describe it in the limited space available, we are willing to send it anywhere prepaid for **only a $1.00 deposit,** and as a special offer we will also send along material to make a simple, unique

SENDING AND RECEIVING SET FREE

with **key sounder, switches, detector, etc.,** absolutely **FREE.** And still more, you can return the book and material if anything is misrepresented, and your deposit will come back as quick as Uncle Sam can carry it. Otherwise remit the $1.00 balance. Can anything be fairer? **Experimenters, take advantage of this remarkable offer now**—you may never see it again. **SEND THAT $1.00 TODAY. You'll be sorry if you don't—you'll be glad if you do.**

ADAMS **A. F. ADAMS ELECTRIC COMPANY, CHICAGO** ADAMS
ADDRESS—1305 PEORIA STREET

10 Per Cent Discount for Cash in Full With Order and Money Back as Guaranteed



The Alsop-All-Spark Will Keep *Your* Cylinders Free From Carbon, Too

This Test Proves It

During the war, government officers made comprehensive tests with the Alsop-All-Spark. Several automobile motors were filled with oil and run until the cylinders were so heavily coated with carbon that the motors refused to explode. The Alsop-All-Spark was then attached and the cars started at once. At the end of ten minutes, the spark plugs and cylinders were found to be absolutely free from carbon.

An Alsop-All-Spark on your car will do likewise. It will also save gasoline and make new spark plugs unnecessary.

Why don't you try an Alsop-All-Spark Intensifier at our risk? If you find it unsatisfactory from any reason whatever, you may return it and the full amount of your remittance will be refunded.

The four cylinder type sells for $7.50. Decide at once to at least give the Alsop-All-Spark Intensifier an adequate trial. We take all the risk. Or, ask us to send you a complete report of the government tests mentioned above. Mail the coupon today.

ALL-SPARK IGNITION COMPANY, Inc.
13-X Water Street New York, N. Y.



ALL-SPARK IGNITION COMPANY
13-X Water Street, New York, N. Y.

Gentlemen:

☐ Enclosed please find remittance for $7.50 for which please send me one Alsop-All-Spark Intensifier for a four cylinder engine.

☐ Please send me circular describing the Alsop-All-Spark Intensifier and full report of Government tests, at once.

Name .....

Address .....

City..... State.....

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section ten cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the November issue must reach us not later than September 22.

The Circulation of Science and Invention is over 150,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York, N. Y.

Agents Wanted.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, Glen Ridge, N. J.

Agents:—"Stick-On" Locks render open windows absolutely burglar-proof. Sale season now on, act quick. Sample 25 cents. Transo Co., Greenville, Ohio.

Make $30.00 next Saturday. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Michigan.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Would year-round quick seller interest you? Dept. 9, Martinek Company, 405 Lexington Avenue, New York.

Mexican Diamonds flash like genuine, fool experts, stand tests, yet sell for 1-50th the price. Few live Agents wanted to sell from handsome sample case; big profits; pleasant work. Write today. Mexican Diamond Imptg. Co., Box F1, Las Cruces, N. Mex.

Agents—$40-$100 week; free samples; gold sign letters; anyone can put on store windows; big demand; liberal offer to general agents. Metallic Letter Co., 433-Z, N. Clark, Chicago.

Signs for store and offices. Entirely new. $50 week easily made. Chicago Sign System, G-326 River St., Chicago.

$3.30 hourly, selling electromatic plates at 25c. Decker sold 742 in 5 days; made $163.42. Send 2c. stamp for extraordinary sales-plan and free sample. A. F. W. Bowbeer, 947 Fedora, Los Angeles, Cal.

Insyde Tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts; quickly applied; cost little; demand tremendous; profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, Ohio.

Agents Wanted. To sell automobile accessories for four-cylinder cars; quick seller and big profits. No investments required. All-Spark Ignition, 13 Water St., New York City.

Make and Sell Your Own Goods. Formulas by expert chemists. Manufacturing processes and trade secrets. Write for formula catalog. Chapin Mystic Company, Washington, D. C.

$100.00 a Week. For general agents handling our Instant Carbon-Remover for Automobiles. Guaranteed harmless. A rapid seller. Makes permanent customers. Write for particulars and protected territory. Buckeye Product Co., P. O. Box 991, Columbus, Ohio.

Salesmen Wanted.

Salesmen—City or traveling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment services rendered members. National Salesmen's Training Association. Dept. 158M, Chicago, Ill.

Salesmen—Side or main line, to sell low-priced 6,000-mile guaranteed automobile tires, 30x3½ non-skid sells for $13.95; other sizes in proportion. Good money making proposition for live wires. Master Tire Co., 1414 So. Michigan, Chicago.

Motor Engines and Dynamos.

Small motors and generators; ¼ hp. AC $26.50; ½ hp., $38.50; ¾ hp. AC $67.50. Battery charging sets; charging lighting and moving picture arc generators; motors for all phases of current. Prompt delivery; wholesale prices. Write for late catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Motors, 2, 5 and 10 hp. Special prices. Write me. William Hobart, Troy, Ohio.

Help Wanted.

Young men prepare as brakemen, firemen, $180-$250 monthly. Write, Trainmen's Service Bureau, Dept. 2, Jersey City, N. J.

Salaried employees unusual opportunity—Employment Manager will personally post deserving persons, all localities, how to secure better position, more salary, real future in employment qualified and desired. Co-operation nationally known concerns. E. Quinn, 2448 Leland Ave., Chicago.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Detectives Make Big Money. Travel, be your own boss. Either sex. We instruct, small cost. Write Johnson's Detective School, 232 Sheldon Ave., Grand Rapids, Michigan, Dept. A.

Be a Mirror Expert. $3-10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Men-Boys. Become Automobile experts. $45 week. Learn while earning. Write Franklin Institute, Dept. B 806, Rochester, N. Y.

Detectives Earn Big Money. Excellent opportunity. Particulars free. American Detective System, 1968 Broadway, New York.

Hundreds Men-Women, over 17, wanted immediately as Government Railway Mail Clerks. $150 month. Common education sufficient. List positions free. Franklin Institute, Dept. B-26, Rochester, N. Y.

Money in Mirrors. Tells how to cash in big. All or spare time making and resilvering mirrors. Our formula best on market. Booklet free. Wear Mirror Works, Excelsior Springs, Missouri.

Detectives and Investigators are in demand. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. American School of Criminology, Dept. E, Detroit, Mich.

Firemen, Brakemen, Baggagemen, $140-$200, Colored Porters by railroads everywhere. Experience unnecessary. 897 Ry. Bureau, East St. Louis, Ill.

Auto Accessories.

Blueprints. Automobile Armatures. See ad under "Electrical." Charles Chittenden.

Old Tires made like new. Insures double the wear. Satisfaction guaranteed, 25c. Bargain catalog free. Science Institute, E6435 N. Clark, Chicago.

Tires—Direct to you prices. Exclusive representatives wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Bond 8,000 Miles. Sample Sections furnished. Mellinger Tire Company, 980 Oak, Kansas City, Mo.

Auto Motor Supplies—Buick, Michigan, Stoddard-Dayton, Cadillac-Overland, E. M. F. Continental and Buda Motors, all types, $50 each and up. Special high-tension, 2 and 4 cylinder magnetos $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Battery Charging Profits $100 to $250 clear monthly with HB equipment. Your lighting current or engine operates. No expense to you. Easy payment plan lets outfit earn own way. Satisfaction guaranteed. Write Hoberts, Troy, Ohio.

Fords run 34 miles per gallon with our 1920 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all Motors. Runs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee. 30 days' trial. Air-Friction Carburetor Co., 270 Madison Ave., Dayton, Ohio.

Agencies Wanted.

James Orton—Desires sole representations for South America, Casilla 366, Buenos Aires.

Stammering.

St-Stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 105 Potomac Bank Bldg., Washington, D. C.

Business Opportunities.

Start business of your own. 24 plans, $1.00. Joel Tillberg, Proctor, Vermont.

Enter a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

Be Independent—We teach by mail how to manufacture unexcelled toilet goods. Particulars free. School of Cosmetics, Box C, Omaha, Neb.

I Made $30 a Week evenings with a small Mail Order Business Home. Free Booklet tells how. 2c postage. Alex Scott, Cohoes, N. Y.

Patents for sale. To sell, buy or obtain patents write Patent News-309, Washington, D. C.

Any vulcanizer can save $100.00 a week through studying "Vulcanizing Improved and Simplified." Trebles production and saves material. 20 section repairs done by students in one day. Send $5.00 for copy and save two men's wages. Special courses for beginners. Prehn Vulcanizing College, 1554 S. Wabash Ave., Chicago, Ill.

New Auto-Knitter. Half-price. Earn at home. I. D. Matteson, Swansea, Mass.

"Money-Talks." The Business magazine published for progressive people. Send for sample copy. P. O., Box 236-B, Newark, New Jersey.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

Turn Your Spare Time Into Money for that apparatus you want. Start a profitable, permanent home business. Steady weekly income. No investment but your brains and spare time. Positively no soliciting, agency proposition. Write today. Address Opportunity, Box 175, Fredonia, N. Y.

Wanted—Advertising managers everywhere. $50 to $150 weekly. Experience unnecessary; learn in spare time. Details free. Koehler, Dept. 25, 1961 S. Hoover, Los Angeles.

3,384 Moneymaking Plans. Formulas. Trade-Secrets. "Encyclopedia Business Opportunities." 3 volumes $1. Ideal Book Shop, 5501-EV North Robey, Chicago.

New discovery! Establish a good, steady, profitable business of your own. Whole or spare time. No canvassing or mail order proposition. Everything necessary furnished. Write immediately. Ferber Company, 296-C Broadway, New York.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $2,000 necessary. Will allow expenses to Baltimore as explained. Address, Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

Shawnee, Oklahoma, center of a great farming country. Write for free agricultural booklet. Board of Commerce, Shawnee, Oklahoma.

Breed Canaries. Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

Stamping Names.

Make $19 a hundred stamping names on keychecks. Send 25c. for sample and particulars. Ex Keytag Co., Cohoes, N. Y.

Aeronautics.

Aviators make big money. Twenty to forty minutes daily instruction. You can learn in three weeks. Send stamp for illustrated booklet. Tells how. Philadelphia Aero-Service Corporation, Real Estate Trust Building, Philadelphia.

Propellers for aeroplane propulsion. Small propellers for motorcycle driven snow and ice sleds. Road speedsters and hydroplanes, five feet diameter, $12, others in proportion. Can supply hub mountings, bearings, counter shafting and sprockets. Complete pamphlets free. Crawford Motor and Aeroplane Mfgr., 142 S. Rampart St., New Orleans.

Automobiles.

Build your own speedster or racing body. Write today for money-saving pamphlet showing different styles. Floege's System of Body-Building, North Chicago, Ill.

Volume VIII.
Whole No. 90

Science and Invention

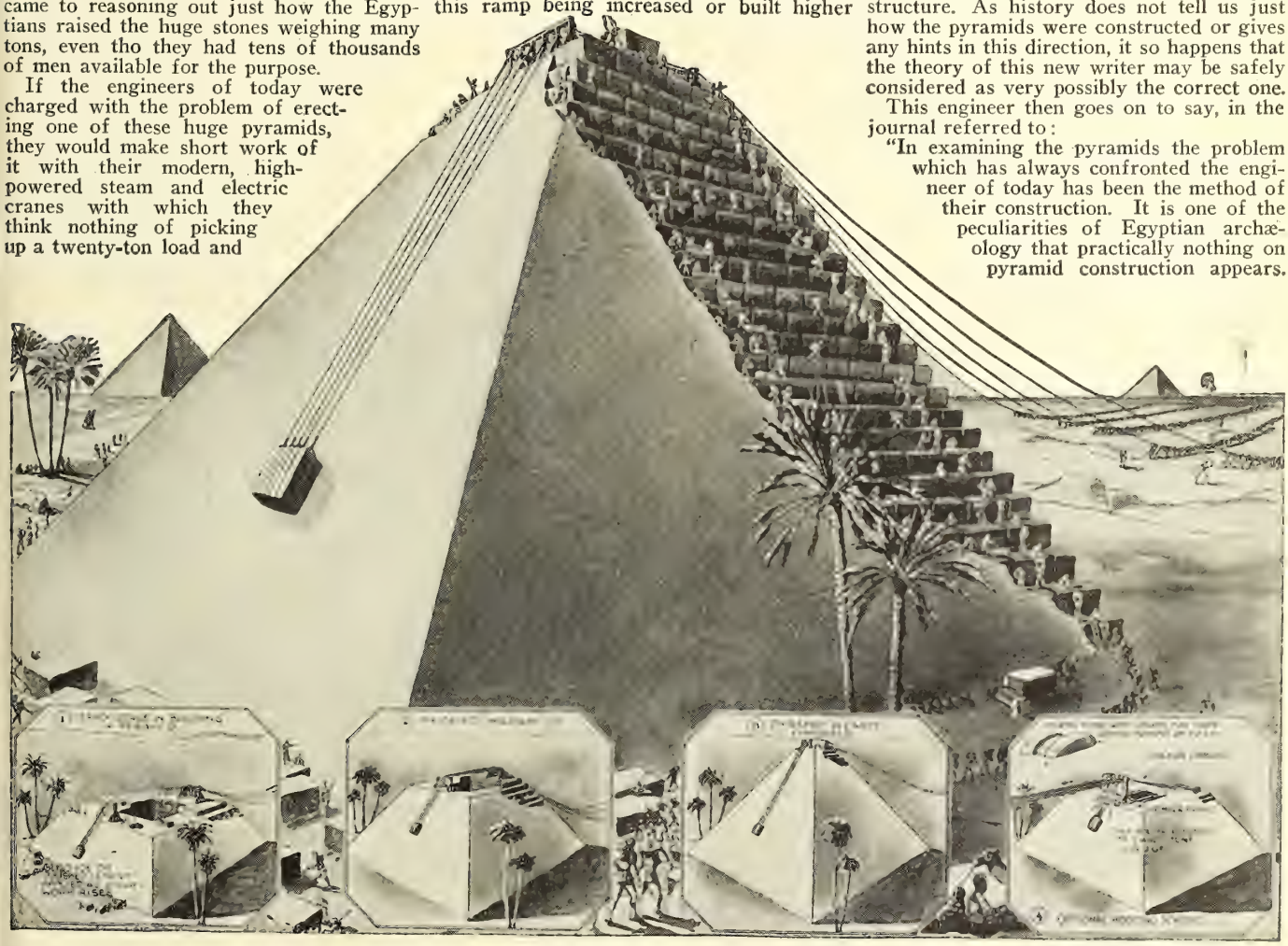
H. GERNSBACK – EDITOR
H.W. SECOR – ASSOCIATE EDITOR

OCTOBER
1920
No. 6

How Were the Pyramids Built?

THOSE of us who have been interested in, or studied the great pyramids of Egypt, particularly that phase of the subject having to do with the erection of these gigantic stone monuments to a worthy but little known people, have undoubtedly been nonplust when it came to reasoning out just how the Egyptians raised the huge stones weighing many tons, even tho they had tens of thousands of men available for the purpose.

If the engineers of today were charged with the problem of erecting one of these huge pyramids, they would make short work of it with their modern, high-powered steam and electric cranes with which they think nothing of picking up a twenty-ton load and swinging it thru the air like a scuttle of coal at the end of a one hundred-foot steel boom. But history teaches us that the Egyptians had no such facilities as those provided by our modern cranes, and even granting that they possest the ingenuity to build cranes, there were no gasoline or steam engines to operate them. And so the problem of how the pyramids were built, as usual, simmered down to the point where we can see in our mind's eye the picture which our historians have drawn for us—of great, long ropes, perhaps a mile or so in length—and ten thousand men pulling on each rope, with one of the rocks or stones sliding slowly and stubbornly up an inclined runway or ramp built of earth, the pitch of this ramp being increased or built higher as the work proceeded.



It Is Thought by a Present Day Engineer That the Great Pyramids of Egypt Were Built in the Manner Illustrated—the Gigantic Stones Having Been Pulled Up the Smooth Surface of the Pyramid, Which Surface Finish of Cement Is to be Seen to This Day on Some of the Pyramids. The Older Idea Involved the Construction of Large Earthen Ramps, Which Had Afterward to be Destroyed.

Altho this is one of the principal methods suggested by students of the subject of how the pyramids were built, a startling new theory, which seems to have considerable essence of logic in it, has been brought forward by a present-day engineer who writes on the subject in the *Indian and Eastern Engineering*, of Calcutta, India. In a few words, the theory of this engineer is that the polisht coating, which still remains on part of the pyramids now standing, served another very important purpose besides that of ornamentation, namely, that of acting as *a runway* up which the giant ten to twenty-ton stone blocks were pulled by ropes past over a series of rollers at the top of the structure. As history does not tell us just how the pyramids were constructed or gives any hints in this direction, it so happens that the theory of this new writer may be safely considered as very possibly the correct one.

This engineer then goes on to say, in the journal referred to:

"In examining the pyramids the problem which has always confronted the engineer of today has been the method of their construction. It is one of the peculiarities of Egyptian archæology that practically nothing on pyramid construction appears. Thus no evidence of any kind has been unearthed to show that they had that profound knowledge of mechanics which would enable the construction and operation of cranes sufficiently large and powerful to swing blocks of stone weighing several tons and place them in position anywhere up to nearly 500 feet in the air. The absence of such proof is only negative; but on

(*Continued on page* 665)

A "Propeller-less" Airplane

By H. WINFIELD SECOR

SINCE the invention of the first airplane, practically every inventor who has evolved new principles for the propulsion thru the air, of a heavier-than-air type of machine, has invariably advocated the employment of some form of air screw or propeller. Every airplane today, used in the armies and navies of the world, uses a propeller rotated at high speed by powerful engines, developing several hundred horsepower.

Wherefore and hence we have with us at present the very latest idea in airplanes, not only for small machines, but for large ones which may eventually be used for transatlantic and transcontinental air travel —*the propeller-less airplane!* One of the main features of the new blower-type airplane, here shown and designed by one J. W. Webb, of Chicago, is the fact that the machine can be elevated vertically from a given spot and does not require an elaborate landing and starting ground of considerable size as at present.

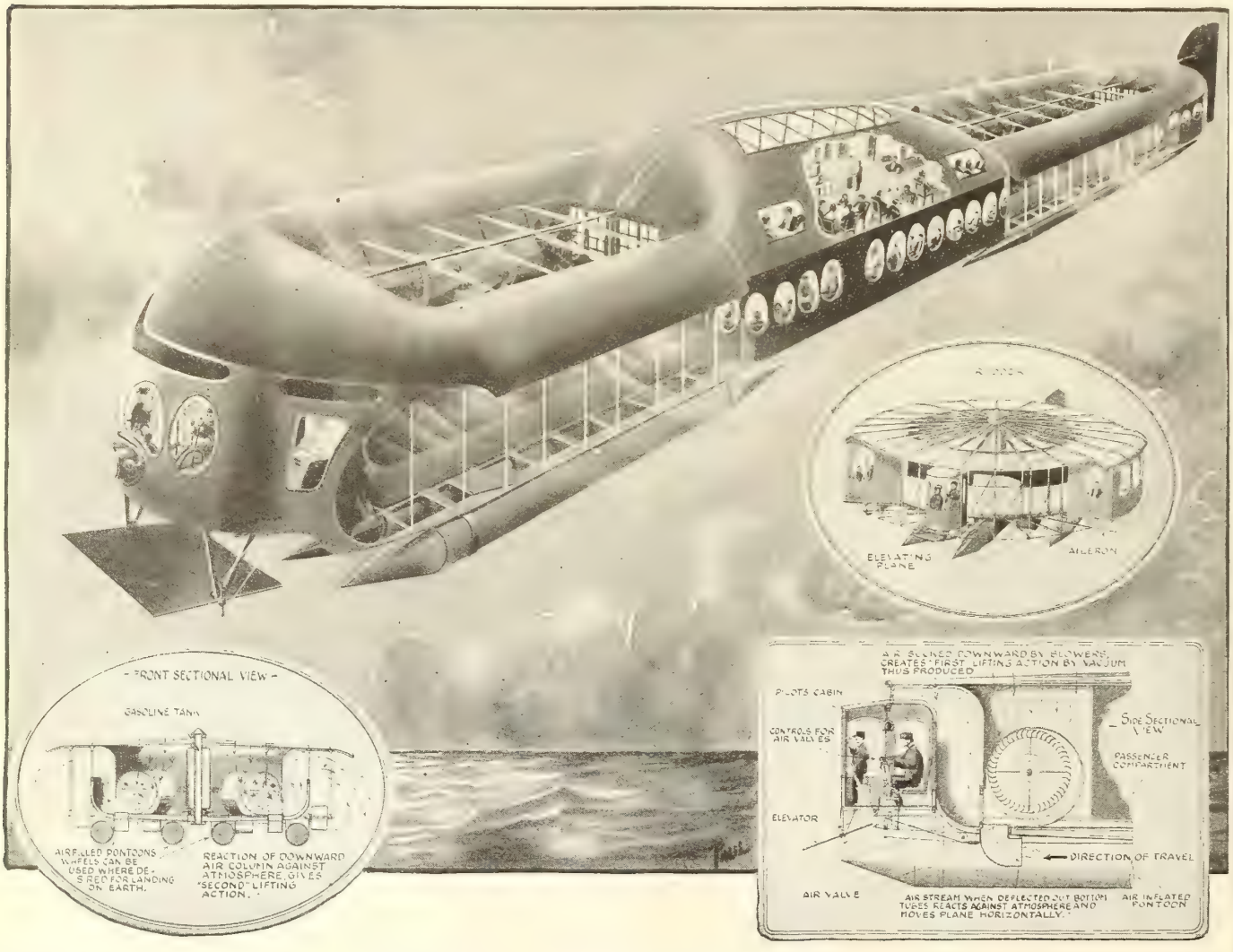
Among the other features claimed for this machine (which employs the resulting effects due to sucking downward a powerful draft of air thru the openings in the top of the machine, and blowing the air out by means of powerful engine-driven blowers from under the wings) are the following: That the machine will be able to sustain a considerable load and ascend vertically to any desired height; maneuver laterally at any desired angle with or against the wind; and, moreover, it is capable of hovering in a stationary or fixt position in any desired point, ascending or descending as may be necessary to avoid air currents or to take advantage of them.

Such a stationary flying craft would be of untold advantage in military maneuvers when used as a wireless station for directing artillery fire, and for numerous other purposes in both peace and wartime.

The inventor of this new propeller-less airplane makes use of several aircraft engines such as the *Liberty*, or other type of gasoline motor, which are directly connected to a series of powerful air *blowers*, enclosed in the usual steel housings, these fans sucking the air downward thru the top of the plane and whirling it around until it attains a high velocity, and then shooting it out thru the funnels, as shown by the arrows in the drawings. The reaction of these multiple blasts of air against the atmosphere causes the plane to rise.

The plane is also caused to rise due to the partial vacuum produced above it when the blowers are started, owing to the powerful suction present. The airplane is directed or steered in any desired direction by deflecting a certain number of blower air streams by means of suitable dampers or valves down thru a series of curved nozzles placed under the floor of the machine. The powerful drafts of air shot out horizontally thru these nozzles react on the atmosphere, causing the plane to move in the opposite direction, as the arrows clearly show. Suitable elevating and rudder planes are provided fore and aft also to help navigate the craft.

This airplane may be fitted with collapsible wheels for use when descending upon land also with pontoons for landing on water. The inventor provides a clever system of inflatable pontoons which are quickly filled with air from a motor-driven air blower. These may be covered with rubber cloth or *doped* airplane fabric and not only may serve as soft cushions in landing the machine, or pontoons for water descents, but also serve as *keels* which assist in maintaining the machine in a true course while flying. The air dampers or valves as well as the elevating and starting rudders are all controlled from the pilot's cabin at the front of the machine. For a circular airplane of this type, 32 feet in diameter, the inventor proposes to use a 400 H.P. engine, driving eight fans or blowers with a capacity sufficient to draw a total of 280,000 cubic feet of air per minute at a velocity of 55 miles per hour.



"Propeller-less" Airplane Devised by Chicago Inventor Which Employs the Usual Engines But Instead of Driving Propellers, They Serve to Rotate High Speed Blowers Which Develop Powerful Drafts of Air. These Rapidly Moving Air Currents Are Deflected Out and Downward from Under the Wing Surface, for Vertical Ascension—and Horizontally, Thru Curved Nozzles, for Lateral Propulsion in Any Direction. The Vacuum Produced at the Top of the Machine Aids in Ascending Vertically from a Given Point.

Top Strip of X-Ray "Movies" Shows Ring Being Placed on Finger. Note the Bones and How Gradually and Accurately the Successive Motions Are Depicted by This Latest Triumph of Science.



Vertical Strip of "Movie" X-Ray Film Shows Progressive Bone and Muscle Actions Resulting From Flexing the Muscles of the Arm. Such Films Are of Untold Educational Value.

X-Ray "Movies"

A PROOF that electricity is well-nigh universal in its applications, and that every phase of human activity is invaded and improved by this potent and benevolent form of energy, is vividly demonstrated in a new one reel educational film "Revelations," just completed by C. F. Bateholts. It deals with the remarkable progress made with the X-Ray outfit, perfected by Dr. W. D. Coolidge. This portable outfit can be taken to the bedside of the patient and attacht to an ordinary electric light socket.

Pictures taken by the X-Ray are not new but a motion picture film prepared by the use of this wonderful machine is something entirely new to science. It is an innovation in the movie field, a thing which had always been considered impossible.

The opening part of this wonderfully interesting film shows a few of the essential operations in the manufacture of the Coolidge X-Ray tube, the device which generates the powerful rays capable of penetrating to the inner structure of opaque objects. By animated drawings the electrical action in producing these rays is shown so clearly, that a child can understand the process.

The next step in the film visualizes the wonderful power of the rays in piercing such objects as wood, steel, cast iron, and even the hidden wheels of a clock. You can follow the workings of every wheel of the timepiece and see just how the second hand moves; you see just how a nail appears in the center of a solid block of wood; how a hole or flaw in steel may be discovered; the composition of a shotgun shell, showing the buck shot, powder and detonating cap.

HUMAN BODY IN ACTION.

The closing part is devoted to X-Rays of the human body, showing the action of the bones of the hand as the fingers are moved, the wrist as it is bent, the elbow as the arm is doubled up and straightened out, the knee and ankle in the same motion, the teeth, showing fillings, the nerves, and an abscess at the root of one and closes with an X-Ray of the entire body—the skeleton of a living person, a picture marvelous in itself.

For years the X-Ray has been the invaluable ally of surgery but until the portable machine was perfected it has been necessary to transport the patient to the hospital. Sufferers whose condition forbade being moved, were thus deprived of the X-Ray benefits with the result that medical skill has been handicapt in diagnosing conditions which otherwise might have been recognized.

The film shows how easily the portable machine may be carried about, the simplicity of its operation and setting up at the bedside of the patient.

All in all it is a wonderful film showing the marvelous things science has been able to accomplish in lessening the sufferings of mankind. —*Photos Courtesy General Electric Co.*

Here At Last!

Amazing Machines

Automatic machinery to overcome the high cost of production is being developt at an amazing rate and with remarkable results. It is evident that a revolution is going on in the science and technic of production. One corporation, for instance, now has under construction machines to weigh the product, fill the box, wrap it and label it; having a capacity of 15,000 finished boxes per day; machines to fold paper napkins, 100,000 per day; machines to wrap sandwiches in a sanitary way without the aid of human touch; machines to make ice-cream cones at the rate of 2,400 per hour without the touch of the hand; machines to pit cherries, to wrap pieces of goods, to sew bags and turn them inside out, to paste labels on phonograph records, to develop films. Machines that will automatically make boxes from sheets of cardboard; put them together, tuck in the bottom end, place jar or bottle with circular or directions therein and then tuck in the top, making a complete cartoned package without the touch of the human hand. Machines that build up a carton or box; weigh and fill the same with powder or a floury substance, place cover on box, then wrap the box completely with a printed wrapper and then place a trademark seal on each end of the package. Machines that will label bottles (120 per minute), bottles fed from magazine and labeled automatically. Machines that will remove a cover from a box, place a product therein, place cover back on box, label the top of the box, place label around the side, and then fold a circular, placing the same around the box, fastening it to box with a tack driven into the box by the machine. Machines ironing and folding sheets, pillow cases, towels, handkerchiefs and napkins. Machines folding and labeling shoe and corset laces automatically; large production per day. Machines that will automatically bind the four edges of advertising glass slides used in moving-picture houses. Machines that will assemble and wrap hard candies, rolling them into a package, producing 25,000 packages in a day. Machines that will automatically wrap in foil, chocolate bars and small candies. Machines that will automatically wrap cigars in paper and foil. Machines that automatically wrap sandwiches or fold paper napkins. Machines that will automatically tie two tapes around piece goods, then wrap in paper, leaving the ticket on the outside of package. Machines for automatically assembling and producing various kinds of buttons and for cracking all kinds of nuts.—*New York Journal of Commerce.*

Sixty Below Zero!

At 60 degrees below every stovepipe throws out a great white cloud of smoke and vapor, resembling a steamboat in its whiteness, and this cloud streams away for from 50 to 100 feet, mingling with the other white-gray mist or haze that remains permanent in the atmosphere of the town like a great fog when it is 40 degrees or more below zero. This white-gray fog is not fog as we know it, but is frozen fog, and every man, woman, child, animal and even the fire that burns is throwing out moisture into the air, which is immediately turned into a cloud of frozen vapor that floats away and remains visibly suspended in the air. Very slowly this settles to earth, and in the morning, about the steps and any protected place, one can see a very fine film of flourlike dust deposited, which is composed of frozen vapor.

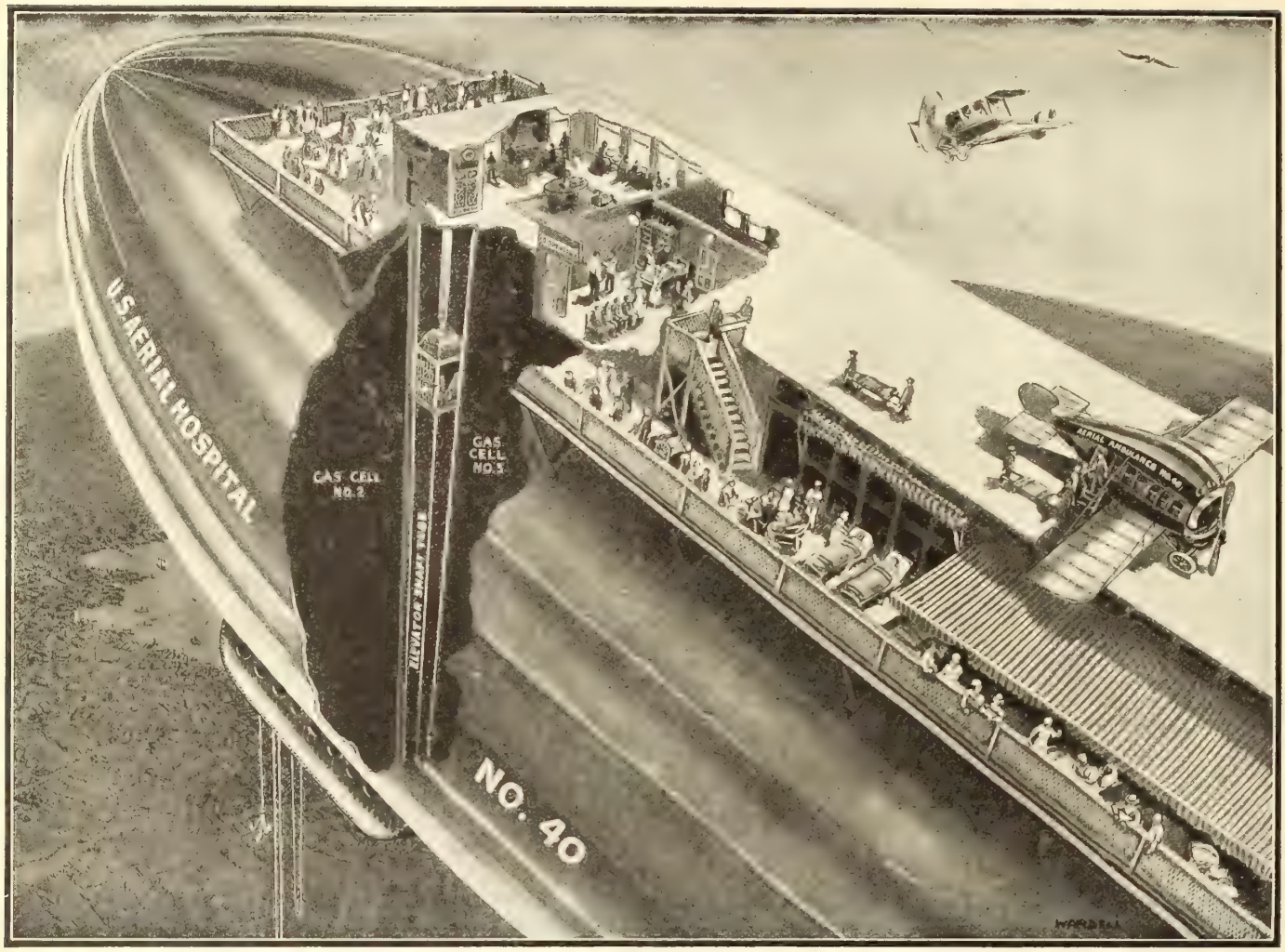
Exposed ears, hands and noses freeze at this temperature in going the distance of about one city square. The breath roars like a mild jet of steam, while a dipper of boiling water thrown out into the air emits a peculiar whistling as its drops circle thru the frosty atmosphere.

Prospectors, attempting to boil a dish of rice or beans upon a camp fire unprotected from the weather, find that the side of the dish that is in the fire will boil, while the part of the dish exposed to the weather has frozen. To remedy this, the dish is set completely into the fire. Edged tools subjected to this temperature become as hard and brittle as glass and will break readily under strain. All vegetables, potatoes, apples, fruit, eggs and the like can be allowed to freeze until they become like bullets. To make ready for use place them in cold water half a day before using, and the frost will slowly withdraw without injury to the food. To attempt to thaw them out by the more rapid process of fire or hot water spoils them for use.

Some remarkable tales are told of thawing out a frozen foot, ear or hand by immersing the member in coal oil for some time—often for several hours.

Iu such temperatures one must be very careful about touching things with unprotected hands. It is dangerous to take hold of a doorknob when it is 60 degrees below zero or thereabouts with the uncovered hand unless one is careful instantly to release his hold, for if he does show this carelessness the inner palm of his hand will be frozen in five seconds. The result is the same as tho he had touched a red-hot stove.

Coal oil begins to thicken at 40 degrees below, and at 60 and 70 degrees below, becomes as thick as lard and looks like it.



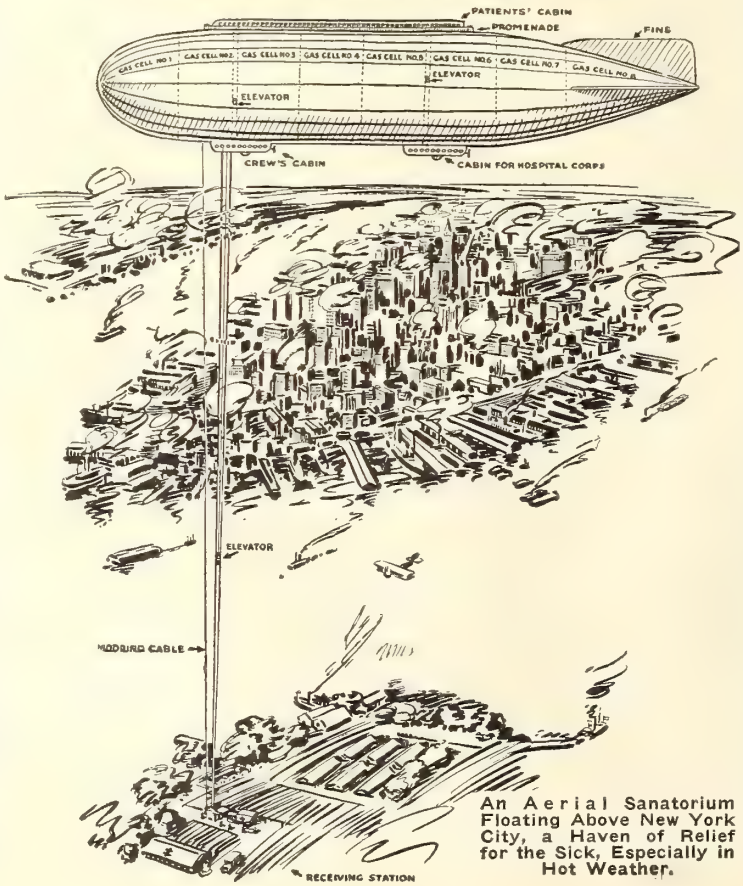
An Aerial Sanatorium

By F. E. LOUDY, AE. E.

TWO things are essential in this world-wide battle against the white plague, sunshine and fresh air. Usually this means a costly trip to Colorado or some other high and dry territory. Instead of transporting tuberculosis patients to the sanatorium we should bring the sanatorium to the patients. This can be done by using giant captive balloons, structurally similar to the great Zeppelins, which can be moored near the large centers of population, like New York and Chicago, where this disease is more prevalent.

These giant airships would be composed of a rigid yet light duralumin structure, containing eight independent helium gas cells. Helium is an inert gas, non-inflammable and while lifting less than hydrogen is quite light enough for good efficiency.

The patients' cabin is located on top of the airship so as to get as much sunshine as possible, while the airship crew occupies the lower forward cabin, and the hospital corps occupies the lower rear cabin. Since this airship is 800 feet long and 100 feet in diameter, it becomes necessary to travel from cabin to cabin by means of an elevator operated by an electric hoist, as shown in the illustration.



An Aerial Sanatorium Floating Above New York City, a Haven of Relief for the Sick, Especially in Hot Weather.

The patients' cabin contains the sleeping quarters, dining-room, galley, library, dispensary, a piano and moving picture outfit. Everything possible is supplied to permit the patients to forget their ills.

The mooring cable, which anchors the airship to the ground, carries with it telephone and electric wires, which means electric illumination and constant telephonic communication.

Food supplies as well as people are conveyed to and from the airship by means of an electric hoist in the forward car or cabin. Patients who cannot stand the elevator trip up to the airship can be carried up by an airplane ambulance in the manner here portrayed, the airplane landing on or hopping off from the giant upper deck easily.

The airship is usually held between 5,000 and 10,000 feet altitude. Here the air is pure and invigorating, and usually cool. There is a promenade around the outside of the patients' cabin where they may sit or walk. Here, everything is restful and quiet. Rain clouds usually form around 5,000 feet, so when they appear the airship is allowed to go above them.

A Universe In Miniature

DR. BIRKELAND, of Christiania, the famous Norwegian physicist and scientific investigator, — well known for his important researches on the phenomenon of the Aurora Borealis, which was described and illustrated some time ago in this journal, by Prof. Lindley Pyle, as our readers undoubtedly recollect,—recently opened up an entirely new line of scientific endeavor by constructing a wonderful *universe in miniature.*

An article recently appeared in the Paris *Temps* in which this latest work of Dr. Birkeland was discoursed on at some length, and the fact brought out that he is a believer, in line with many other scientists of the present era, that electrical phenomena play a most important part in the behavior and functioning of the heavenly bodies. The sun, today, is believed to be like a gigantic dynamo emitting swarms of minute particles of negative electricity, which we are pleased to call *electrons.* These infinitesimal, invisible particles of electrical energy shoot thru interstellar space with the velocity of light itself, and whenever they chance to meet rarefied gases, peculiar luminous effects taking on certain characteristics and forms, are invariably produced similar to those which we see on the interior of exhausted glass tubes and bulbs when charged by an electric current of high potential. These gigantic electrical phenomena are lined up by the present day scientist with the illumination of comet tails, also as aforementioned with the wondrous displays of the Aurora Borealis and, furthermore, the phenomenon known as *magnetic storms,* on which subject Prof. Pyle so interestingly discoursed in the January number of this publication.

To quote the writer in the *Temps,* he says:

"Dr. Birkeland relies for his results more on experiment than on scientific theories. To this end he built his miniature universe of which he himself is the master. This universe has a capacity of seventy liters and is a huge glass bell into which he can introduce various gases and in which he can maintain any degree of vacuum he prefers. In the center of it is a *planet* of eight centimeters diameter (about 3¼ inches), which Dr. Birkeland calls the *terrella* and is actually a copper sphere containing an induction-coil, which can be stimulated by electric currents to reproduce on the *terrella* the equivalent of terrestrial magnetism. On the side is a metallic disk generator of electrons, which represents the *sun.*

"By sending electrical discharges thru the interior of the bell, one produces luminous evidences that vary greatly with the rarefication of the gas, the intensity of the electrical discharges, and the inductivity of the central globe. As long ago as 1908, Dr. Birkeland employed this mechanism for the study of magnetic phenomena and the *aurora borealis,* and he was able to reproduce with astonishing accuracy all the appearances and particularities of the natural phenomena. Last year he took up zodiacal light, the vast and diffused glow which spreads across the solar world lying on the plan of an ecliptic. This time the central globe of his apparatus, the *terrella,* represented the *sun* and became the center for the emission of electrons. Under these conditions a vast luminous ring spread out in the bell around the solar equator. At the same time one could see on the central globe a double band of brilliant points whose distribution reminded one curiously of the spots on the surface of the sun. In the course of these experiences with zodiacal light Dr. Birkeland made an interesting discovery. By diminishing little by little the intensity of the discharge current that traversed his apparatus he saw the large ring representing the zodiacal glow draw itself in and narrow itself until it formed around the equator of the *terrella* a crown similar to the ring of Saturn and formed, as that is, of several zones of different brilliancy. Here one can recognize a dark spot similar to the division of Cassini.

"One must admit the magnetism of Saturn, which is not proved, but which, after all, has nothing of the absurd in it. Above all there is to be explained how these rings of very diluted gas can be at the same time opaque, almost dark, and yet reflective. We know it is true that the tails of comets spread solar light like a trail of dust which is illuminated in a beam of light, but these wandering plumes send forth also a light of

(*Con't on page* 667)

For "November"

Early Inventions of Leonardo da Vinci, by Dr. T. O'Conor Sloane.

Remarkable New Sound-Recording System for Phonographs and Talking Movies, by Eric A. Dime.

Super-Silk Worms and Super-Silk Worm Food—A Silk Worm That Spins Silk in Any Color. By Richard Hoadley Tingley.

Science and the Weather Man—What an Inch of Rainfall Means—How Sunlight and Snowfall Are Measured. All clearly explained in diagram and picture.

Reading Character from the Hand—The Science of Your Hand's Lines, W. de Kerlor.

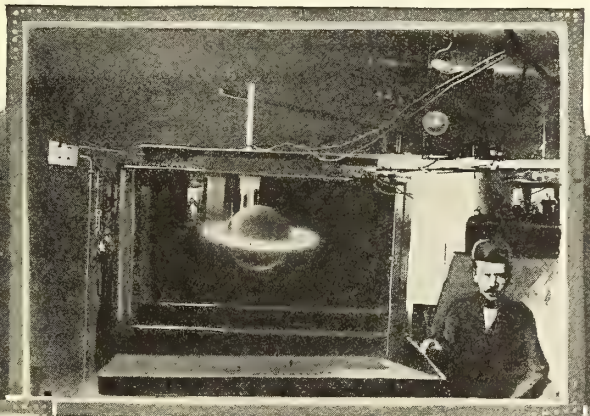
The Velocity of Light, by Prof. James S. Stevens.

New Scientific Story, by Charles S. Wolfe.

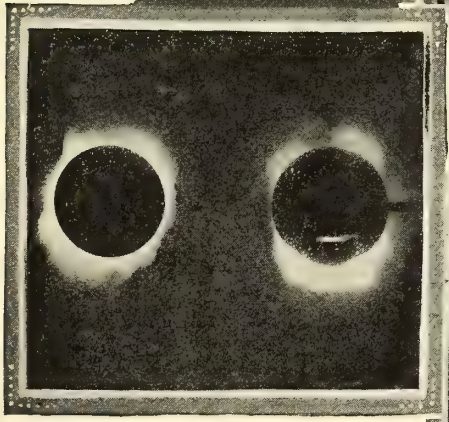
How Radium Is Applied in the Treatment of Cancer and Other Human Ailments. By Joseph H. Kraus.

New Science Tricks in Stagecraft.

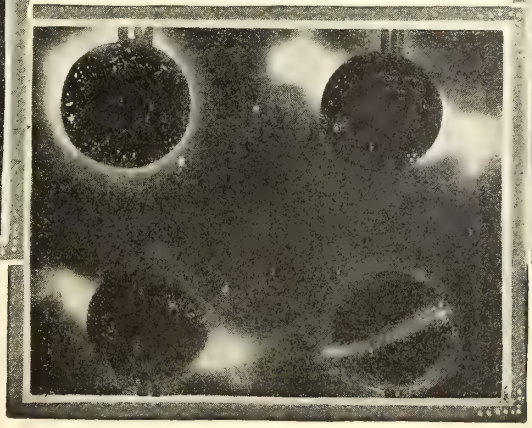
How Colored Magazine Covers Are Made. Illustrated with photographs.

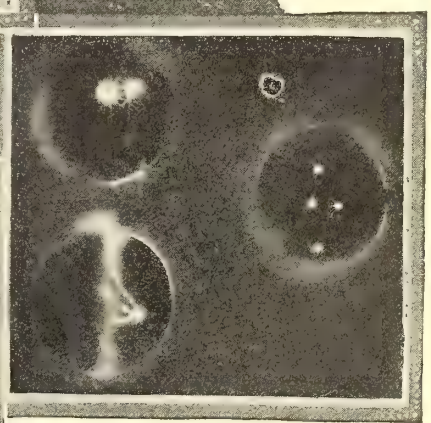


Dr. Birkeland, the Famous Norwegian Physicist, in His Astro-Physical Laboratory Where He Has Duplicated Many of Nature's Mystic Phenomena of the Heavens. The "Rings of Saturn" Are Here Shown, and They Were Faithfully Reproduced Even to the Zones or Bands.



On the Left of the Photo Above Is Shown the Corona Effect During an Eclipse of the Sun; On the Right the Same Effect Duplicated by an Electrified Ball in Dr. Birkeland's Laboratory.



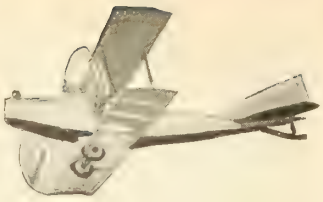


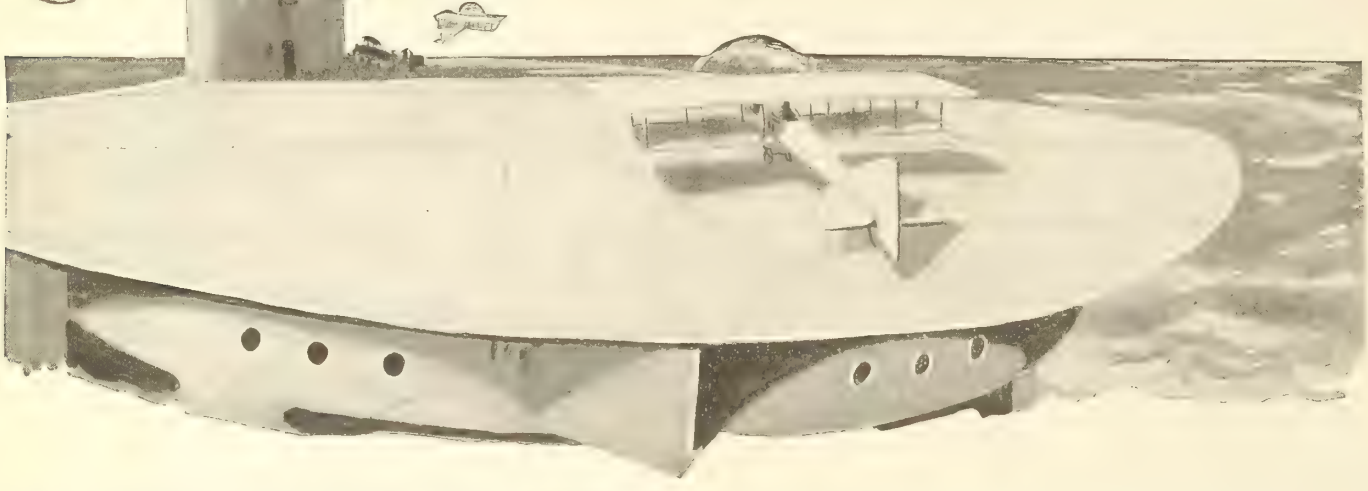
Center and Right-Hand Photos Show "Sun-Spots" Imitated by Means of Charged Metal Spheres in the Laboratory. Halos and Planetary Rings of Various Forms Were Also Reproduced.

New Aircraft Landing Ship

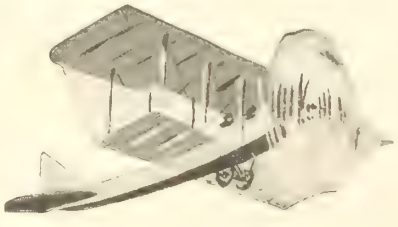
By FRANK BROWN







WHILE many of the world's naval powers are resting on their laurels quietly until another war breaks out and perhaps finds them unprepared, the British navy believes in the old adage, "The early bird catches the worm," and in the accompanying illustrations we behold the latest addition to the English navy, the new naval aircraft carrier, H. M. S. *Eagle*.



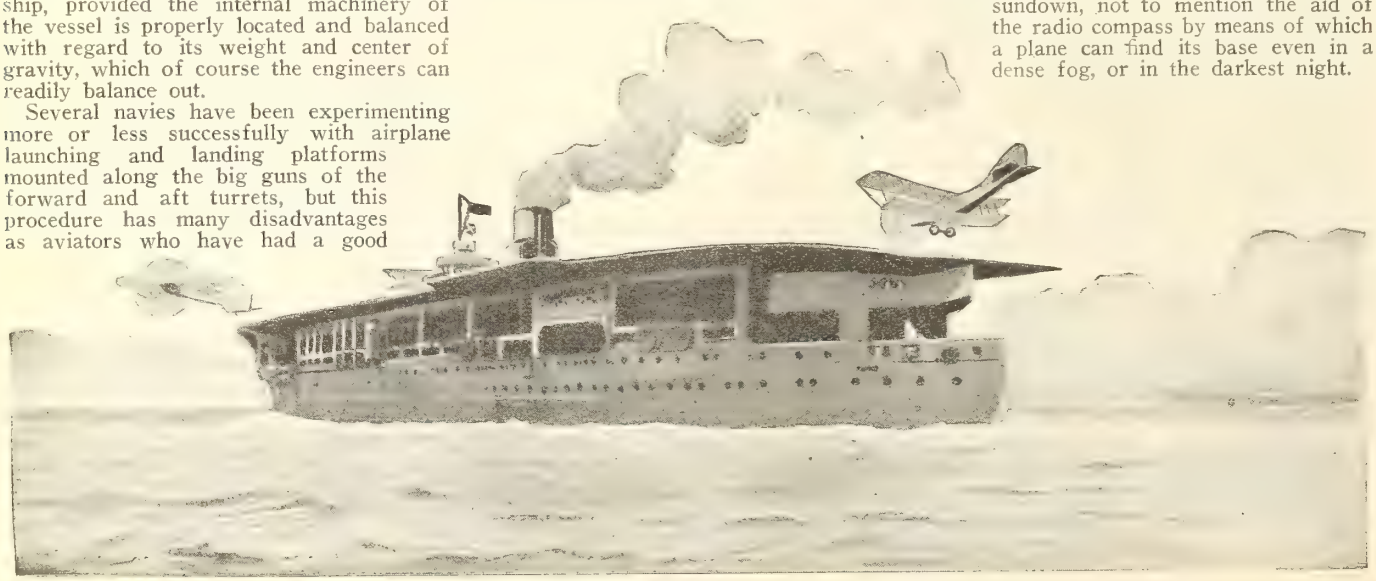
The *Eagle* has been called "The Ugly Duckling" of the British navy, owing to her unsymmetrical appearance, particularly in view of the fact that her superstructure including the smoke funnels, is all placed on one side of the ship. As will be seen from the photos, this gives a very odd effect, but the naval architect who designed this boat knew what he was about. There is no reason at all why the smoke funnels and superstructure, including the bridge, should not be placed to one side of the ship, provided the internal machinery of the vessel is properly located and balanced with regard to its weight and center of gravity, which of course the engineers can readily balance out.

Several navies have been experimenting more or less successfully with airplane launching and landing platforms mounted along the big guns of the forward and aft turrets, but this procedure has many disadvantages as aviators who have had a good bath in the ocean will tell you; and this is not all, for the practise of starting or landing seaplanes from or on such small platforms and which are, moreover, mounted or supported on the big guns of the war vessel, involves one of the most impractical contrivances that has been invented in a long time, for how is a ship going to go into action at short notice, with all of this junk mounted on her big guns?

The best thing yet, in aircraft carriers, undoubtedly is the design followed out in building H. M. S. *Eagle*. This ship has a tremendous, long and perfectly flat deck from, or on, which a dozen seaplanes can ascend or land at a time. This ship has a displacement of 30,000 tons which brings it into the class of real large sea-going vessels. As a general rule, a small high speed seaplane or land plane of today can "hop off" at least within a distance of 100 to 150 feet, and a great deal less in many instances. But with a deck 300 to 400 feet long, it is readily seen that planes can be started or landed in a fractional length of the total deck space available, thus permitting a number of planes to be "parked" amidship, or at one side on the forward or aft deck.

A naval aircraft carrier of this type has, as might be supposed, a perfectly fitted repair factory for the flying boats which she carries. Several machine shops are fitted up complete with lathes and other necessary machinery for the quick overhauling of the intricate machinery of the seaplanes, besides the repair departments for the radio apparatus. There are, besides, commodious, well furnisht quarters for the aviators as well as the crew of the "Ugly Duckling."

In battle practise such a ship as this would, of course, keep out of the range of battle as far as possible. It can be armed, of course, with a fairly heavy battery of 6 to 10-inch guns for defensive operations when hard prest. As the seaplanes have a considerable range of flight, however, it is not necessary that the airplane mothership follow the battleships into action at all; in fact, she can lay back many miles from the scene of action. Attacks from the air by enemy bombing planes would be combated by her own armed seaplanes, several of which would constantly hover aloft when in enemy waters. Electric flash signals would guide the planes back after sundown, not to mention the aid of the radio compass by means of which a plane can find its base even in a dense fog, or in the darkest night.



New Type of Comic "Movies"

By ERIC A. DIME

With the Familiar Distortion Mirror, a World of Fun and Mystery is Provided

IN the good old days when the dime museum flourisht in all its pristine glory one of the chief attractions was the variously curved mirrors which furnisht distorted reflections of the patrons. The dime museum is rapidly passing into oblivion, but these mirrors are still found in penny arcades and in some Turkish baths, where they furnish amusement for the visitors.

Not long ago Peter Orance, an inventor of New York City, visited a Turkish bath in the Metropolis. In these sweat emporiums artificial aids to beauty are stript away and the human frame is left unadorned. Many blooming flowers of the boulevards and the drawing rooms are found to be but rank weeds in the Turkish bath. Therefore, the stark reality is somewhat relieved by distorting the plain ugly into the startlingly grotesque. And it was perhaps for the purpose of injecting a little humor into the prosaic Turkish bath that the proprietor of the establishment in question installed these mirrors of distortion for the benefit of his patrons. The inventor saw other visitors enjoying themselves in this manner and took a good look at himself—and had an idea.

This resulted in the working out of a practical plan whereby humorous films could be produced for entertainment purposes, either still or motion picture films. Mr. Orance perfected an apparatus, which consists chiefly of two mirrors. The act is staged along ordinary lines in front of the first mirror and the light rays are deflected into another and smaller mirror and thence into the lens of the still or motion picture camera. These mirrors may be either concave, convex, or in various compound forms. The entire apparatus is small and inexpensive, and it is not too much to predict that this invention may be made wide use of in the not distant future. The mirror arrangement may be attacht to ordinary cameras, offering wide commercial possibilities, as well as opening up an unlimited vista in the motion picture world.

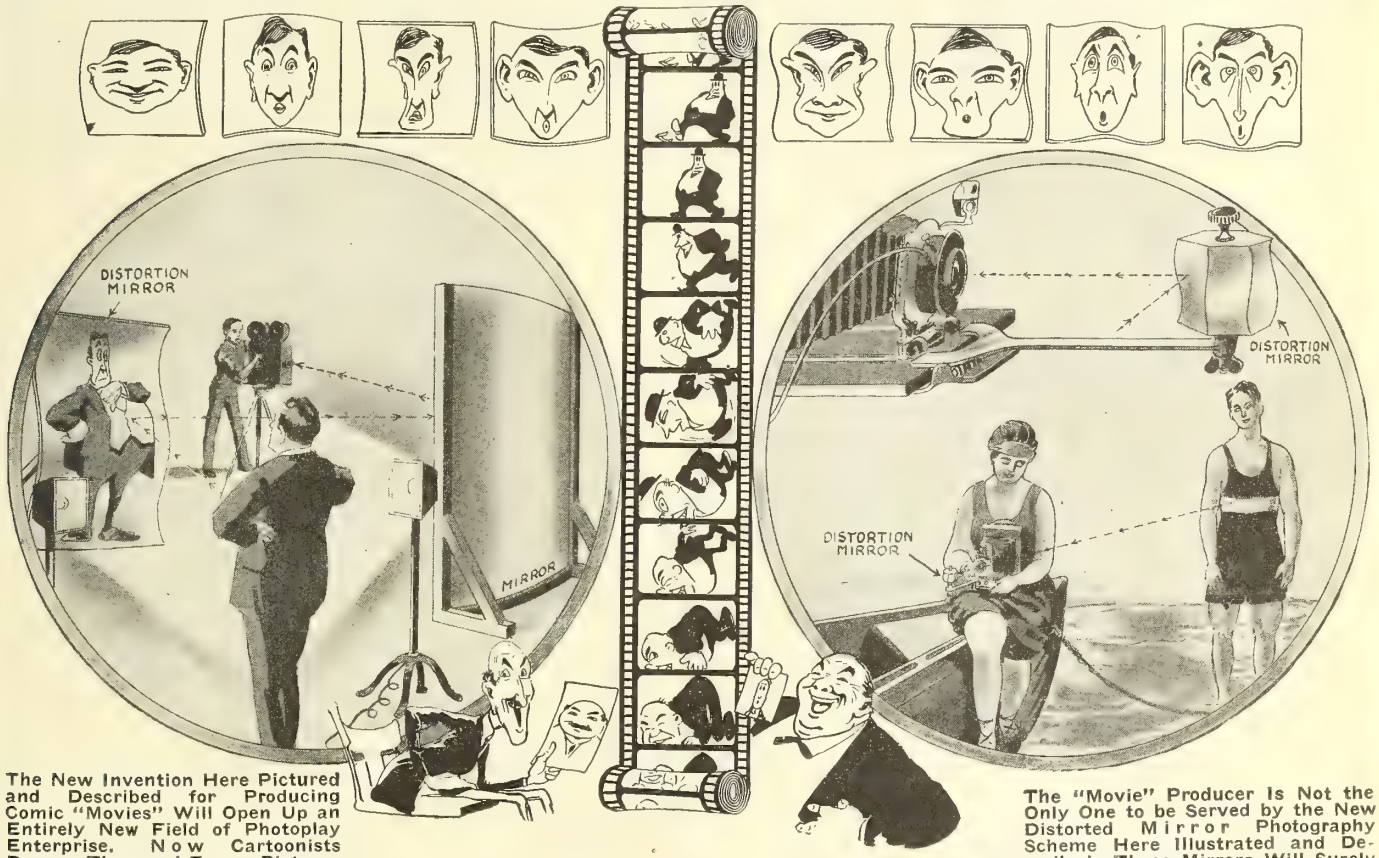
By the intelligent use of this device one star may do the work of three or four. One with a Sherlock Holmes figure may get away with a Fatty Arbuckle stunt with great *éclat*. No longer need the harassed director bemoan the lack of a fat star, when a thin one will do the work. The dwarf shall sprout into a giant, and the giant shall shrink into the minute proportions of a dwarf. Broomstick calves can gracefully be rounded like unto the well-turned spindles of a Richelieu, and graceful plumpness shall blossom where before only spareness reigned. Figures, which normally are upright, can be made to show a list to starboard or port which will defy the laws of gravitation.

This invention is of such universal application as to throw Charlie Chaplin's feet into the shade and make entirely unnecessary the wearing of rubber trousers by maids of the chorus, and which are inflated, sometimes with disastrous results. Ears may be increased to the proportions of a flivver's mudguards, eyes may be separated by the proverbial chasm which yawns between Kipling's East and West, chins may be sharpened to a razor's edge or bifurcated like twin mountain peaks. Horselike noses may be sported and all the monstrosities of the midway may be brought into the privacy of the home.

In this latter connection it may be explained that by a slight adaptation of the same principle this device may be used on any camera for the purpose of making trick pictures.

The possibilities of humor on ordinary lines appear to have been nearly reached, but the Orance invention offers a new and wide field. Its chief value lies in the fact that slap stick is unnecessary and it provides a medium whereby vulgarity may be reduced to a minimum.

A further explanation as to the principle of curved mirrors might be given in this connection. A person looking into a curved mirror will see his features distorted and the direction of the distortion depends upon the direction of curvature, and the amount of distortion varies with the degree of the curvature of the mirror. If the curvature is convex about a horizontal axis the image is shortened and broadened, and if convex about a vertical axis it is lengthened and narrowed. A concave horizontal mirror produces an elongated image constricted at the middle of its height, and a concave vertical mirror a broadened image constricted at the middle of its breadth. By combining convex and concave curvatures in various ways into the form of concave-convex combination mirrors, more or less complex distortions of the subject will result including longitudinal and lateral curvatures in addition to the contractions and elongations.



The New Invention Here Pictured and Described for Producing Comic "Movies" Will Open Up an Entirely New Field of Photoplay Enterprise. Now Cartoonists Draw a Thousand Funny Pictures for One Film Story. Thousands of Grotesque Poses Can Be Rapidly Filmed with Suitably Distorted Mirrors.

The "Movie" Producer Is Not the Only One to be Served by the New Distorted Mirror Photography Scheme Here Illustrated and Described. These Mirrors Will Surely be Sold to the Public by the Thousand, Especially Adapted for Attachment to the Ordinary Hand Camera as Here Shown.

What Caused the Great Flood?

THE Bible teaches us that some thousands of years ago there was a great inundation, the so-called Noachian Deluge. In comparatively recent times, the biblical account was not taken seriously, until in recent years science has taken hold of the problem, and has begun to make investigations.

It has been established today, without any doubt whatsoever, that such a cataclysmic deluge actually did occur since man appeared on this globe. And the flood can be proven today in many ways.

In the first place, with the exception of some African tribes, there are flood stories in every country of the world, whether they be European, American, Asiatic or Australian. All of these peoples or races have some tale which was handed down by word of mouth, that such a great deluge occurred some thousands of years ago. To be sure, the story varies considerably, as is the case of any story transmitted by mouth down thru generations, but the fact remains that the story persists. If this was the only proof, it might be questioned. But there are many geological reasons which teach us that a great flood actually did occur. The following proofs are taken from Professor G. Frederick Wright's article on the "Geological Confirmation of the Noachian Deluge." Many other geological proofs can be cited, but the following will be sufficient:



One of the Most Plausible Explanations of the Historic Flood Has Been Proposed Recently by Mr. H. Gernsback; It Is Illustrated Graphically Above. If in the Course of the Ages a Great Body as Large or Larger Than the Earth Had Chanced to Pass Within Ten or Twelve Thousand Miles from Our Earth, the Tidal Waves Created by the Gravitational Attraction Would Have Been so Tremendous as to Result in the Flood Conditions Which Science Now Knows Actually Occurred in Historical Times.

1. "The filling of the numerous ossiferous fissures in Western Europe with an indiscriminate mixture of the separate bones of widely diverse species of animals, mingled with angular fragments of rock and with earth without stratification, and containing occasional stone implements made by the hand of man. These could not have been filled gradually, because there are no entire skeletons of animals, and none of the bones are gnawed. But they were evidently filled by the indiscriminate action of a (water) wave of translation sweeping everything before it.

2. "The enormous accumulations of the bones of hippopotami in the cave of San Ciro, near Palermo, on the Island of Sicily, where whole herds of this animal, which now lives only in Southern Africa, evidently sought refuge from rising water in an extensive cave at the base of the rugged cliffs of Monte Grifone.

3. "The existence of Arctic seals in Lake Baikal (Siberia) two thousand miles from the ocean, and 1,680 feet above it.

4. "The historical Chinese tradition of the existence of such a vast body of water in the same region, known as the Han Hai."

However, Professor Wright thinks that the flood occurred due to the glacial period which accumlated a tremendous weight of ice on the northern hemisphere, particularly in America and Europe during that time. Professor Wright reasons that due to the enormous amount of water deposited on these continents about two hundred and fifty feet of water was thus subtracted from the oceans, which when released later on, due to melting, produced the flood over several of the continents.

While the explanation is a good one, it does not satisfy for the reason that the melting glaciers could only have released the waters very gradually, and that if a flood occurred in this manner, it would have taken hundreds of years to produce deluge effects. Thus the rise of the waters over the continents, if it did happen, would have been almost imperceptibly slow.

Mr. H. Gernsback recently advanced a more plausible reason how the historical flood might have occurred, and his theory is based at least on undeniable astronomical facts.

That the flood was caused by the oceans and not by rain can even be proven from the biblical account where the inundation is represented to have been occasioned, not

(*Continued on page 667*)

Your Furniture In a Trunk



This Remarkable Trunk Contains Practically Every Household Utensil and Piece of Furniture You Can Think Of, Including a Sewing Machine, a Dining Table with Dishes, Three Chairs, a Bed Large Enough for Two People, and After Numerous Other Miscellaneous Articles Have Been Counted, We Wind Up by Finding Therein, a "Wash-tub".

AT last the moving "bugaboo"—as well as a good part of the "housing problem," has been solved by a young French inventor, Monsieur Louvet. As the photographs will clearly show, he packs nearly every human want imaginable into a special "trunk," measuring but 49 inches long by 54 inches wide and but 33 inches high. This trunk, altho seemingly quite large, will pass thru any standard size doorway.

As may be surmised, the great secret of this wonderful trunk lies in the proper folding and packing of the respective chairs, tables, etc. Monsieur Louvet packs everything in his trunk,—starting with a bed for two people, not to mention three chairs, a sewing or dining table, a stove, linen closet, and sideboard with dishes complete,—and finally winds up with a wash-tub having a capacity of 130 quarts of water. With two of the chairs, a *chaise longue* is easily made. All the chairs are fitted with compartments containing all the necessaries for a bedroom. The double bed at the bottom has drawers and cupboards containing space for other personal articles and effects.

Another photo shows the remarkable table fitted with all the usual kitchen accessories, including the sewing machine which folds on top of the table, with a nest of drawers full of accessories for the home, etc. Each object has its special place in a compact form, so that nothing rattles or falls out.

The third photo shows five pieces of furniture, all of which have been resurrected from the "mystery trunk" and covering a floor space of 78 by 103 inches. In these pieces of furniture are contained all the other utensils for the tabloid household *de luxe*. These five pieces fold into a compact space, the trunk measuring but 49 inches long by 54 inches wide and 33 inches high.—*Photos (C) by Kadel & Herbert.*

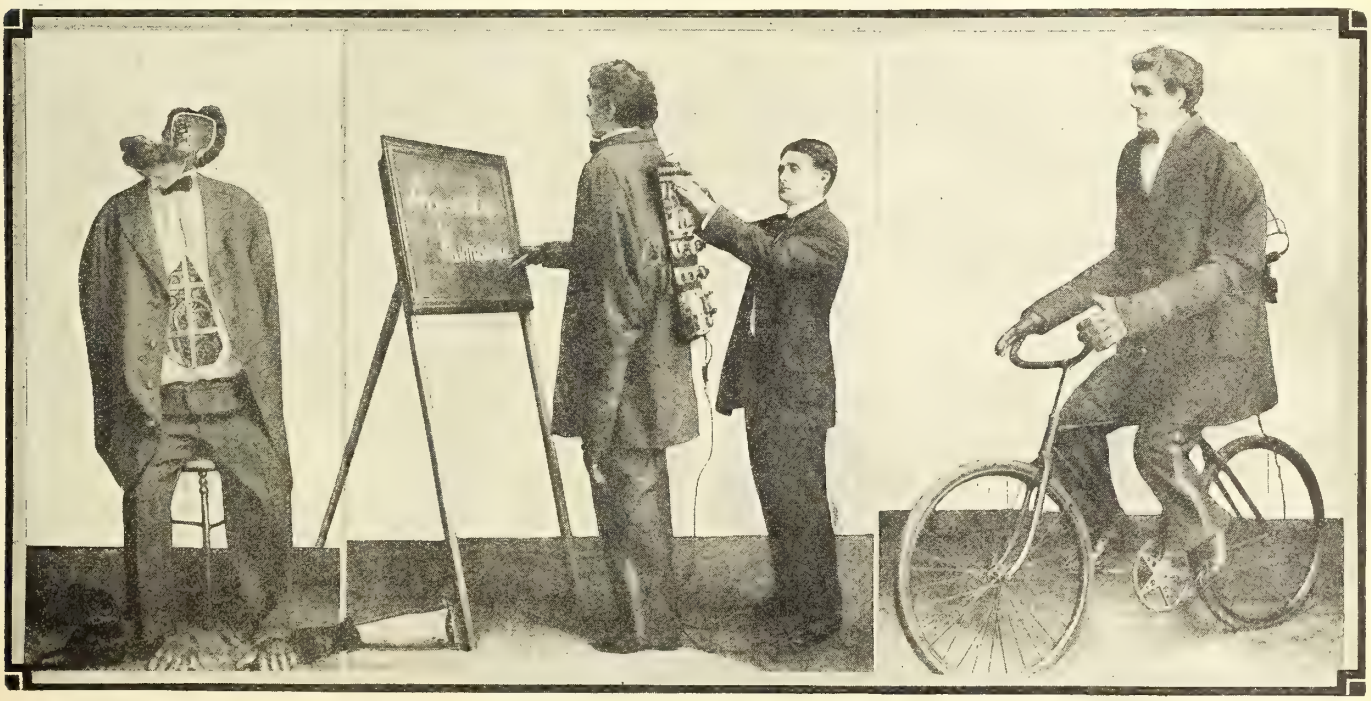
Automaton Mimics Real Man

YEARS ago there was exhibited at the Chicago Exhibition an automaton which was entirely mechanical, driven by internal motive power, and which walked and did various other human-like stunts. At this time Mr. Lu Senarens, under the pen name of "Noname," was writing a series of articles in the popular boys' magazines, describing adventures of a mechanical man created by his own brain. At first in these stories this mechanical man was steam driven and later became electrical.

A good many years have past since these fiction stories were first printed and now Fred LaReine comes forward and presents to the American theatre-goers a new mechanical "miracle man."

It may be that some of the old-time theatre-goers remember having seen a mechanical figure years ago, which did everything but talk. Writing his name on blackboards, driving horses and numerous other stunts of a similar nature were easy for him, and the mechanical device defied the best experts in the country to give an explanation of how all these things were done.

(*Continued on page* 664)



Automatic "Man" Dissected. Automaton Writing Upon Blackboard. The Electro-Mechanical Man Riding a Bicycle.

How We Balance Ourselves

BY WILLIAM M. BUTTERFIELD

WHY does a man sit or stand right-side up? On the spur of the moment, and without reflection, this seems a very easy question to answer—nine people out of ten will say, "Simply because the man *sees* he is right side up, of course." This is *not* the answer, strange as it may seem, for sight has practically nothing to do with it. If you do not believe this, place yourself in one of the six airplanes we show in the center of our drawing and, as you fly about above the clouds in this topsy-turvey maneuver, tell by observing your own plane, or any or all of the others, when you are right-side up—just merely by looking.

You cannot do it. And the makers of the planes never expected that a pilot would, for they provide a very delicate mechanical guide which, working by gravity, furnishes such information on a specially prepared dial.

Now that you have begun to consider this question, explain, if you can, why people born *totally blind* carry themselves more erect than those with perfect vision, or why the blind respond more quickly to necessary protective movements in case of a fall or accident.

Man, in common with all four-legged animals, is provided with a pair of ears whose internal parts, with the exception of size, are like the internal parts of all other ears; or every pair of ears, whether in or on the head of a man, a pigeon, a dog or an elephant, perform the functions of hearing in absolutely the same manner because the physical machinery of the ears in each head is the same. This is fortunate, for the study of these organs by anatomical investigations in vivisection on animals yields the same results as those obtained by surgical operations on the human organs. Most of man's knowledge of the performances in the human ear has been obtained by studying the action of animal ears by means of vivisection.

When, therefore, we say that "in each ear of man there lie a series of sacs and canals that keep his body right-side up," we are in possession of that proof—a rather important position to be in, when giving a definition of how the sacs and canals perform the work. Particularly so, when perhaps few persons that ever see this article will know by any direct or acute sensation just when the parts are exercising their influence.

If a person cares to receive a warning sensation, or series of sensations caused by these organs, he may let his body be carried swiftly up or down as in an elevator or seaplane, swayed violently as in a swing or boat, or spun around for a considerable time, when he will suffer nausea and dizziness.

In the ordinary movements of the head and body, there are no such sensations, yet one cannot lie, recline, stand, sit or walk in unusual attitudes *without being made aware of it,* for the organs establish a series of natural poses that fit the normal positions which the body takes at such times.

Each group of organs consists of two spherical sacs (utricle and saccule) and three semicircular canals that connect at both ends in fine openings, with the larger of the two sacs (Fig. 2). They constitute the larger and upper portion of membranous labyrinth and fill about a third of the bony cavity in which they lie (Fig. 1), held there by fibrous bands (Figs. 3 and 4). This bony cavity is filled with a fluid (perilymph) while the hollow interior of the organs is partly filled with a separate fluid (endolymph). This arrangement, it will be seen, places a sac of many parts filled with fluid within a bony cavity which corresponds identically in shape, and with all of its space not occupied with the sac—filled with another fluid. The outer fluid acting as a cushion, the inner fluid moving about in the elastic sac, thus forming a kind of pneumatic indicator that can assume any shape or take any position.

Each of the three canals is placed so that it is at right angles to the other two (Fig. 6), and is provided with a bulb that joins

(*Continued on page* 671)



In Fig. 1, We See a Section Thru the Ear, Showing the Labyrinths of the Inner Ear in Their Position as in Life; the Function of Which Is to Tell Us Whether We are "Right Side Up" or Otherwise. These Semi-Circular Canals are More Clearly Illustrated in Fig. 2. Each of These Contains in Its Center Another Canal, Held in Position by Fibrous Bands, Shown in 3 and 4. And the Three Skins of the Organs are Depicted in 5. The Peculiar Arrangement of the Canals, Each at Right Angles to the Other, Can be Seen in 6, and the Branching of the Nerve Entering These Canals in 7 and 8. A Tiny Crystal-Like Ball Is Found in These Canals 9, Which Weighs Down a Portion of the Region in Which It Lies, 10. The Shifting of These Weights Convey Thru the Nerves, to the Brain, Varieties of "Position Changes," According to a Well-Known Authority.

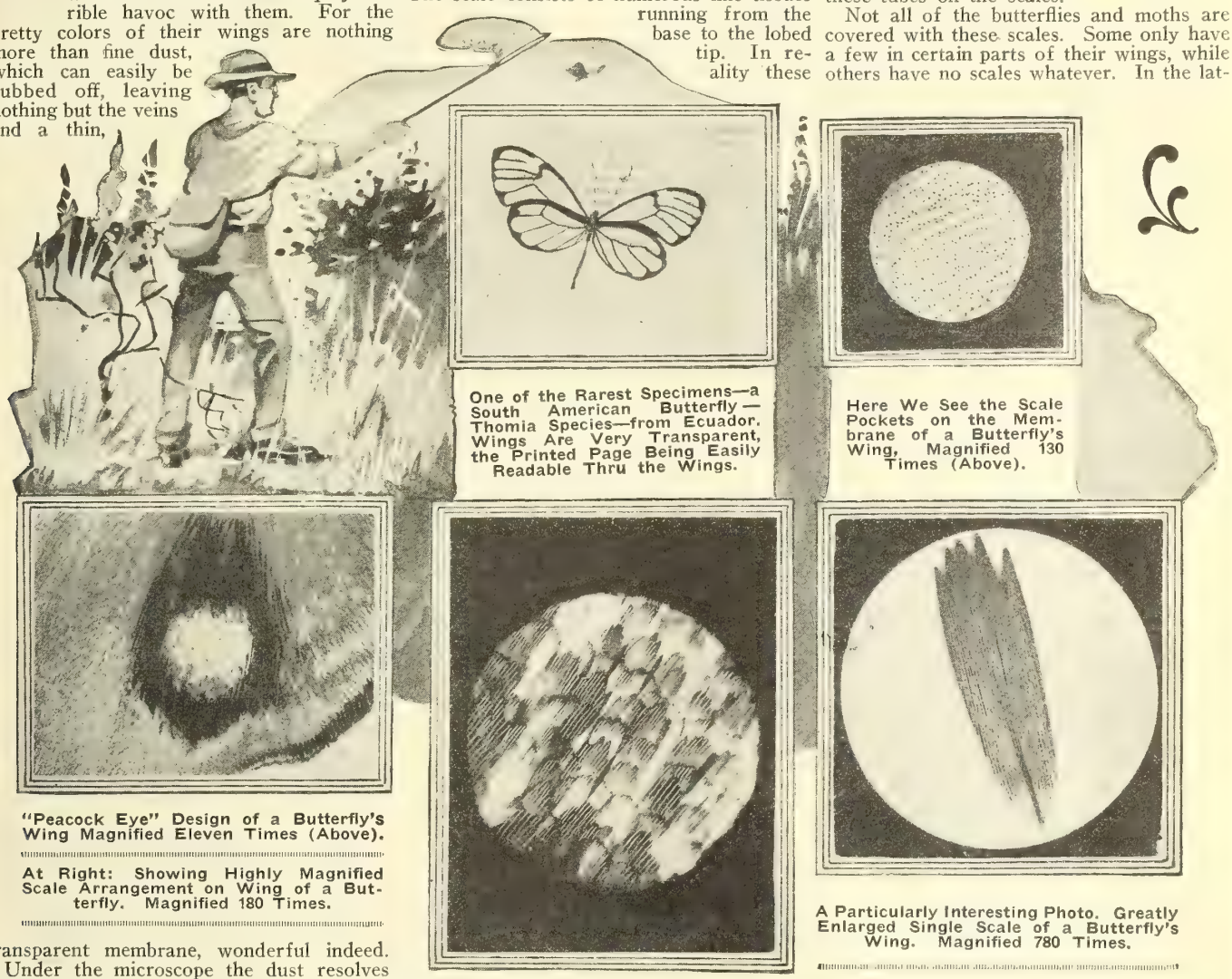
Why the Wing of the Butterfly Is Colored

By DR. E. BADE

ALTHO the wings of both butterflies and moths are very beautiful, they are indescribably delicate. Even the winds and the rains often play terrible havoc with them. For the pretty colors of their wings are nothing more than fine dust, which can easily be rubbed off, leaving nothing but the veins and a thin, transparent membrane, wonderful indeed.

Under the microscope the dust resolves itself into numerous plates, which overlap each other like the shingles on a roof. When one of these plates or scales is magnified 780 times it will be seen to consist of two parts; a base or place of attachment, and a blade or scale proper. The entire scale resembles a leaf. The base or point of attachment is like a short petiole, while the blade proper resembles the leaf. The scale consists of numerous fine tissues running from the base to the lobed tip. In reality these lines are tiny tubes used, probably, for the conduction of air. As the light strikes these tubes, it is refracted and broken up just as a prism breaks up the light into its component colors. This refraction of the light on the scales gives the wings of these insects their bright color, and the multiplicity of color is caused by the arrangement of these tubes on the scales.

Not all of the butterflies and moths are covered with these scales. Some only have a few in certain parts of their wings, while others have no scales whatever. In the latter case the wings are perfectly transparent, the veins only being readily distinguished, as shown in one of the accompanying photographs, where one can readily read the printed page thru the butterfly's wing.



"Peacock Eye" Design of a Butterfly's Wing Magnified Eleven Times (Above).

At Right: Showing Highly Magnified Scale Arrangement on Wing of a Butterfly. Magnified 180 Times.

One of the Rarest Specimens—a South American Butterfly—Thomia Species—from Ecuador. Wings Are Very Transparent, the Printed Page Being Easily Readable Thru the Wings.

Here We See the Scale Pockets on the Membrane of a Butterfly's Wing, Magnified 130 Times (Above).

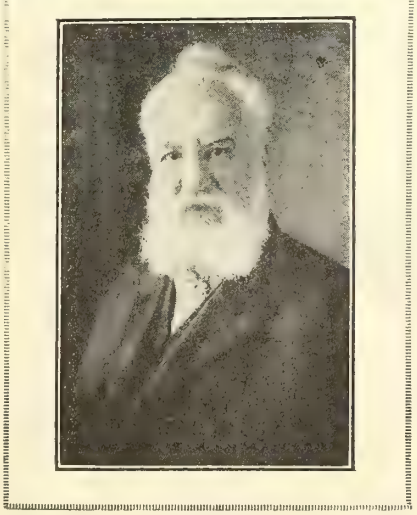
A Particularly Interesting Photo. Greatly Enlarged Single Scale of a Butterfly's Wing. Magnified 780 Times.

FROM THE INVENTOR OF THE TELEPHONE

Editor Science and Invention:

It has always seemed to me that the name ELECTRICAL EXPERIMENTER did not fully cover the scope of your interesting and useful magazine. In my opinion the title SCIENCE AND INVENTION is a great improvement and I wish you every success.

Alexander Graham Bell.
Baddeck, Nova Scotia.



FROM CLEVELAND PLAIN DEALER.

Editor Science and Invention:

While I do not know how much value you place upon a new name, I am certain that if the magazine, rechristened, delivers the goods as successfully as it has under the old name it will be a great success.

The ELECTRICAL EXPERIMENTER was one of the first in this large field and certainly has been a pioneer in giving information along the line of electrical development.

You certainly have the good wishes of the *Plain Dealer* for your success.

W. G. Vorpe,
Sunday and Feature Editor.

NO—WE WON'T!

Editor Science and Invention:

As one who has followed the rise of your publication from its first few pages in 1913 to its present size with the keenest appreciation, you may understand my interest. When I went to school I heard the ELECTRICAL EXPERIMENTER quoted as an authority, and when in turn it was my fortune to teach Science classes I recommended it to my pupils as being worthy of their study.

Here's wishes for your continued success, Mr. Gernsback. But please, Oh please don't make of your wonderful magazine a mere kid's picture-book of unusual things, which is what most of our so-called science magazines have evolved into.

Corliss L. Parry.
Jackson, Ohio.



Photo-diagram Showing How a Blood Clot May Form Under the Bony Skull Structure and Cause Pressure on the Brain.

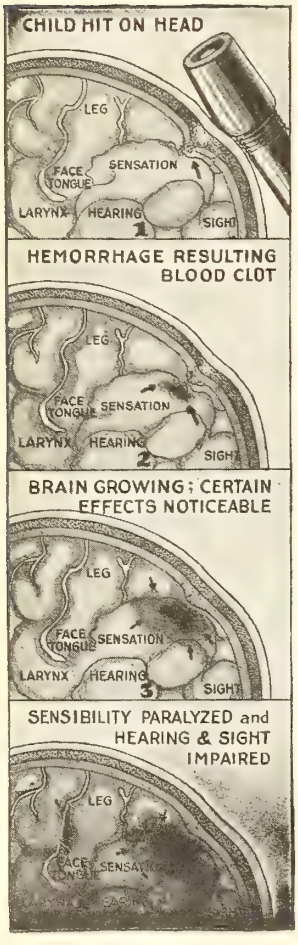
In Modern Trephining, a Silver or Other Metal Plate Is Screwed in Place Over the Opening in the Skull, in the Manner Shown.

The Series of Picture-diagrams, Numbers One to Four, Shown Below, Will Prove of Extreme Interest, Undoubtedly, to the Layman, Showing, as They Do, the Progressive Conditions Resulting from a Severe Blow on the Head of a Child or Adult. After Some Months or Years a Brain Tumor May Develop.

The Actual Trephining Saw, Driven by an Electric Motor, Is Shown in Operation Above in the Act of Cutting a Piece of Bone from a Skull.

The Progressive Illustrations Below, Figs. 5 to 8, Show the Progression of a Trephining Operation. The Motor Saw Cuts Thru the Bone, Which Is Afterward Removed, and Eventually a Metal Plate Is Screwed On Over the Opening Thru Which the Tumor Growth Has Been Removed.

Trephining the Skull



Brain Pressure Released by Surgery

TREPHINING the skull is undoubtedly one of the oldest and withal one of the most delicate operations known to medical surgery. Distinct and well marked signs of this operation can be seen in skulls coming from the Neolithic period, down thru the prehistoric iron age and the later Celtic period, and in such tribes as the Incas and the Youngans it was a very common practise.

Trephining consists of removing from the skull a considerable section of bone, and the purpose is generally to relieve intercranial pressure or for other surgical operations as indicated by proper diagnosis. Of course, there does not seem to be a plausible reason for the operation as conducted among the Incas and various savage tribes of Northern Africa.

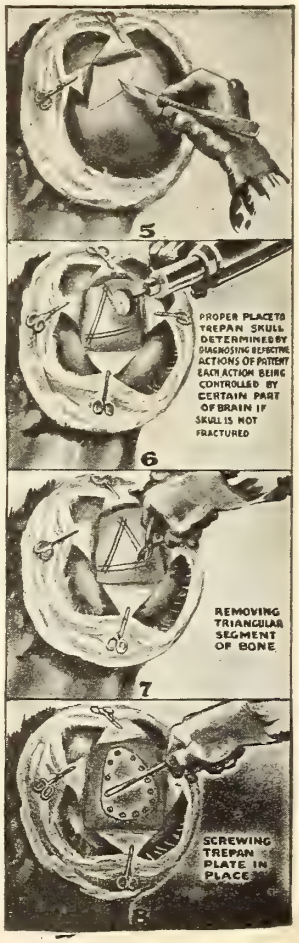
It seemed as tho this operation among those people was more a matter of form and "style" than anything else. Perhaps it also functioned greatly in helping the medicine man to keep up his prestige in the practise of medicine, and also making him appear to be a most wonderful sorcerer. The implements in use in those ages differed materially from those in present use.

Let us go back to about the seventh century B. C. Here we find the operation to be conducted as follows: The "doctor" after preparing his tools by heating them in the fire first proceeded to administer to the scalp a circular instrument which had been heated red hot. This branded a round groove into the scalp and facilitated the removal of that portion of flesh immediately within the circular burn.

At the same time it assisted in sterilizing the flesh preparatory to the operation, altho perhaps the ancients did not know that the red hot iron was of a sterilizing nature. The brand also helped to stop the blood from flowing. After the circular piece of scalp was removed, a very small drill was placed in contact with the bone and rapidly rotated between the fingers until a tiny hole penetrated the skull. Then with crude saws and other methods of chipping out the bone a hole was finally cut into the skull. This operation always took months to perform, as little was done each day.

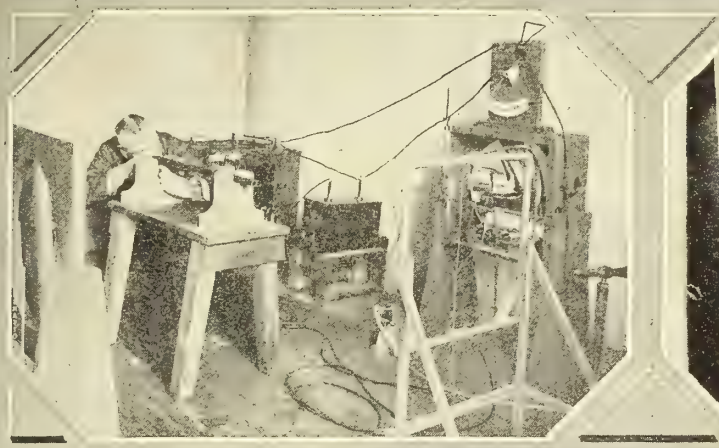
For what purpose the hole was intended has not definitely been ascertained, but the fad seemed to create a profound effect and hundreds had their heads trephined.

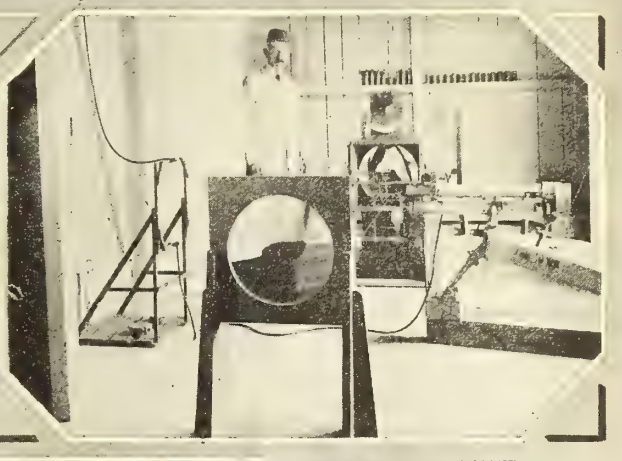
The skulls which have been unearthed indicated that the hole was cut in during life. How do we know this? Very simply. Bone which has been destroyed will finally heal the same as any cut or wound and the edges become very smooth. Should a hole be driven into the head thru some accident, it would invariably result in death and of course the edges of the hole would never smoothen up. Even as early as the seventh century B. C. attempts were made to cover (*Continued on page* 663)

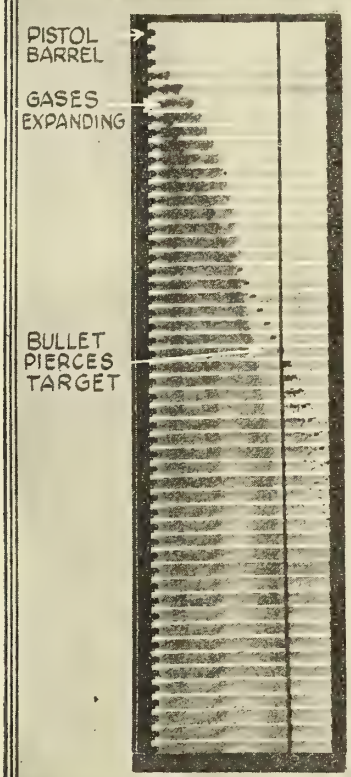


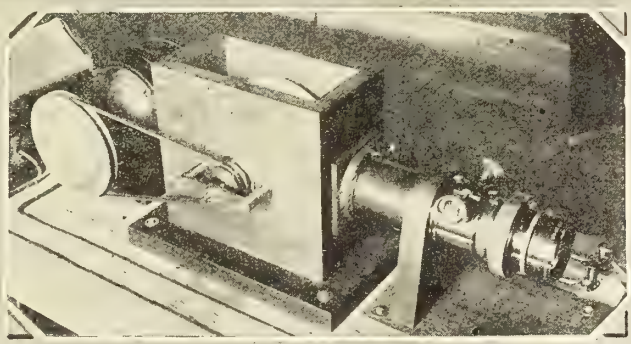
"Movies" of Flying Bullets

By PIERRE H. BOUCHERON











Top at Left—Inventor of New Apparatus for Photographing Bullets in Flight, Firing Shotgun at Wire Circuit-Breaker, Shown in Foreground.

Top at Right—Another View of the Remarkable Apparatus Devised to Photograph Bullets and Shells in Flight, Showing Focusing Lens in the Foreground.

Center Photo—Special Camera Devised for Recording the Flight of Bullets at the Rate of 20,000 Photographs Per Second. The Camera Is Electrically Driven.

"Movie" Strip at Left Shows Expansion of Gases From Muzzle of Gun, at Extreme Left, and the Bullet Finally Piercing the Target.

"Movie" Strip at Right Shows Wonderful Series of Photographs of Bullet in Flight From Muzzle of Gun, Also Unexploded Powder Grains in Wake of Bullet.

Photographing a Projectile as it Leaves the Gun, at the Rate of 20,000 Photos per Second

ORDINARILY, the popular snapshot means the reproduction upon a plate or film of the image of a scene which may last either a tenth or a hundredth of a second. It may also consist of the reproduction of a movable scene either animated or of machinery which lasts a thousandth of a second. Today a good photographer, by means of very good light and very rapid plates, accomplishes, without any great difficulty, all manner of rapid photography. However, when it is a matter of photographing revolver bullets in flight which are traveling thru space at 600 meters per second, or photographing shrapnel-shot traveling thru air at a speed of 800 to 900 meters per second, that is another story, and the problem becomes a rather complicated proposition.

There is today no mechanical device which will permit the photographing of projectiles at such high rates of speed, and it is thus that *electricity*, as usual, comes to the aid of science.

During the war Mr. Lucien Bull, subdirector of the Marey Institute, at the suggestion of the Bureau of Inventions, began work upon the problems of ballistics as applied to chrono-photographic phenomena. This method we will now briefly describe.

REMARKABLE WORK OF PHOTOGRAPHING MOVING PROJECTILES

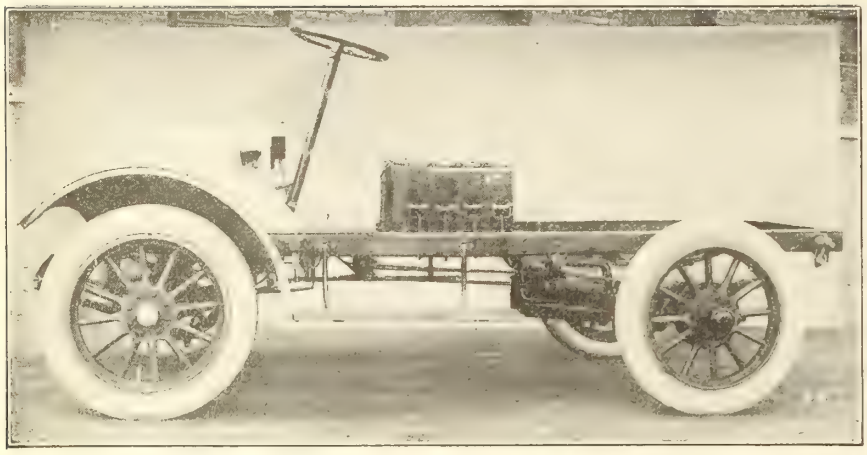
In the first place the electric spark is made to discharge in front of a concave mirror at a point situated at the principal axis, and in such a manner that the rays will converge after reflection in the objective of the photographic chamber. The entire surface of the mirror is thus illuminated at each spark discharge and since the projectile must pass thru the luminous rays, it will produce a silhouette of itself. Thus by producing a series of sparks at regular intervals and of very short durations, as well as by exposing with great rapidity the sensitive film surface upon which is projected the successive images of the projectile, it is possible to chrono-photograph the various phases of the phenomena. The photographs and diagram described in this article will enable the readers to understand the system employed by Mr. Bull and its operation.

THE ELECTRICAL APPARATUS USED

Essentially, the installation consists of a condenser C1, of large capacity shown in Fig. 1, which is in turn charged by the induction coil IC with a secondary potential of about 12,000 volts, thru the intermediary of a thermo-ionic or Villard valve, S. Connected to these instruments is another circuit having a very large resistance R, in the order of 100,000 ohms; with means of opening and closing the circuit thru the key K2 and which connects the large condenser to

(*Continued on page* 652)

Latest Electric Vehicles.



The Newest Thing in Electric Autos Is That Shown Above, the Invention of Dr. Charles P. Steinmetz, the Famous Electrical Wizard of the General Electric Company. The Field and Armature of the Motor On This Machine, Both Rotate, Thus Doubling the Power.

STEINMETZ ELECTRIC AUTO.

Dr. Charles P. Steinmetz, who has been chief consulting engineer for the General Electric Company, of Schenectady, N. Y., for the past twenty-five years, has just announced the successful development of a new type of electric delivery car upon which he has been working for the past fifteen years. The accompanying illustration shows the chassis, battery equipment and power plant of the new Steinmetz car.

Simplicity of design and light weight characterize the design of this new vehicle. Its other advantageous features are low cost of operation and maintenance, reliability and simplicity of operation, the method of motor control and the design of the motor itself. With standard battery equipment the Steinmetz car has a working radius of fifty to sixty miles at a speed of sixteen miles an hour. In package delivery, to which this car is especially adapted, it has been found that the daily working radius of electric cars is in the vicinity of thirty miles; therefore, the Steinmetz car more than fulfills the necessities of this specific use.

The motor is given compound characteristics by the use of a storage battery floating on the field circuit. As a result, the following advantages are gained: the speed is well maintained on heavy up-grades, and with heavy loads. The car has a specially quick start. On down grades the maximum speed is limited, so that a careless driver cannot race the car. Another very important advantage is that on down-grades the motor becomes a *generator*, acts as a brake, *and feeds electric current back into the storage batteries.* The brake is used only in stopping the car, as the regenerative system acts as a speed check on grades.

The field and armature of the motor *both* revolve, each driving one of the rear truck wheels. Thus the motor acts as a differential, with a decided and corresponding saving of weight. The motor is claimed to give *twice* as much power as the same motor in the customary arrangement with the field standing still.



Turn On the Current From a Storage Battery Carried Between Your Feet, On This Newest German Electric Roller-Skate, and You Can Ride Along the Street or Side-Walk At Any Desired Speed,—Simply by Adjusting the Speed Regulator!

ELECTRIC ROLLER SKATES.

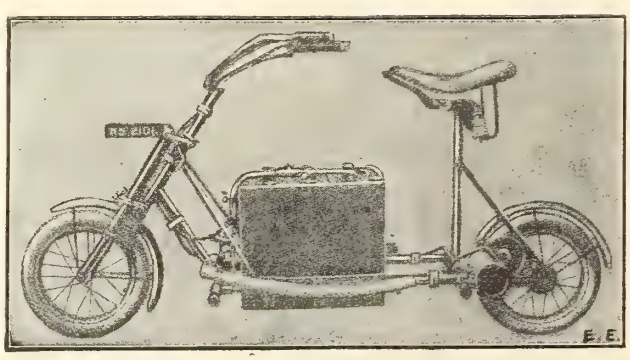
The latest electrical news from Berlin tells us of an "electric roller skate," shown in the accompanying illustration, with which German users have been having a "world of fun" and sport the past winter.

It is in reality an electric roller skate. Both skates are fastened together as shown and placed between them is a 20-volt storage battery, made up by a number of small cells. A flexible wire connected to a control switch and speed regulator or rheostat is connected up with the storage battery and the driving motor in the manner indicated in the diagram. A speed of from eight to ten miles an hour is easily obtained with these skates, and the speed is under perfect control of the *skater de Luxe* at all times.

The electric motor is of the small battery type with which all Americans are familiar and develops about 1/40 horsepower. A smaller motor can be used than at first imagined, especially when the skater gives himself a good start, as it takes a great deal less power to keep him in motion, once he has gained a reasonable momentum. The motor drives the rollers of the skates by friction in this case, but of course there are an infinite number of ways in which the driving power of the motor could be transferred to the skate rollers, such as by chain or belt drive, worm gear, etc.

AN ELECTRIC SCOOTER.

A scooter novelty is being produced by an English concern whose experimental machine has, we understand, been tried out successfully. The frame of this machine, which bears only slight resemblance to the proposed standard article, is of tubular construction and duplex so that a cradle is formed in the center position. A motorcycle saddle and footboards are provided; the wheels are intended to be 18 in. in diameter, altho those shown are only 12 in. The power plant of the machine consists of a ½-H.P. electric motor, forming one unit with its reducing gear, bolted on to and projecting from the rear portion of the frame and driving the back wheel thru a short chain. The motor will probably be later incorporated in the rear wheel. The battery, which weighs one hundred pounds and forms the bulkiest part of the equipment, is situated amidships, resting in the previously mentioned cradle. It is fitted with a quick detaching device and rollers underneath, and also a charging plug on the frame so that the battery may be either removed or charged in position. The controller is in the form of a twist-grip on the handle bar; the machine is said to attain a speed of 9 m.p.h. with a 12-mile radius on one charge of the 6-volt accumulators. No brake is fitted to the machine, but it is intended to provide a retarding effect by means of an easily-operated armature short-circuiting device, thus providing an electro-dynamic brake.



At Last We Have the Electric Storage Battery Motorcycle, or Electric "Scooter" As the English Call It. A British Concern Is Building This One-Half H.P. Electric Motor-Driven Cycle, Which Attains a Speed of 9 Miles Per Hour.

MOTOR HINTS

How I Save My Old Tires

First Prize $25.00.

I CONSIDER it quite a stunt to have run two Ford cars as taxi's for two years without having bought a single new tire. I have solved the tire problem by riveting my tires, such as double treading, etc., and obtain repair junk from the junk man for a few cents and fix up a tire good for from 2,000 to 6,000 miles; oftentimes a riveted will run longer than a new one.

I use four methods of riveting my tires as follows: retreads, reliners, rimcuts and blowouts. The accompanying pictures will show how they are prepared.

In retreading, the rim is cut off of the cover and the cover is then placed over a tire on which the tread is worn off, but has a good body and riveted on both sides with the rivets about three inches apart. If a tire has been prematurely ruined by a blowout or cut, I generally put a liner inside of the tire instead of a cover. The liner is prepared the same as a cover but the edges are beveled as shown in the picture so as to make a smooth fit inside (shown in picture) and the rivets are placed about five inches apart except near the cut or blowout, and are placed about an inch apart there. If a tire is rimcut, a rim can be taken from an otherwise worthless tire and riveted on the rimcut tire as shown by picture; also blowouts and punctures may be repaired by making a boot from an old tire and riveted in the damaged casing.



Using Old Tires to Repair Your Present Ones, Forms the Basis of Mr. Smith's Suggestions to Lengthen the Life of Your Tires.

I use No. 10 copper and copper plated rivets in this work. At first I put these rivets in with a wood block and a hammer, but now I use a little machine which cost me six dollars. It is absolutely necessary for success that the following precautions be taken—first a piece of old inner tube or a thin layer of fabric must be cemented over the rivet heads to prevent any possible injury to the inner tube. This strip can be cemented with ordinary cold patch cement. Second precaution—use plenty of cheap talcum powder to keep inner tube from sticking to tire. Third, a good inner tube must be used (an inner with a single cold patch is not good as the cold patch will invariably come off and you ruin your tire and tube). Fourth, precaution—keep the riveted tire well inflated at all times; they will stand as much pressure as a single tire of corresponding size. Contributed by C. L. SMITH.

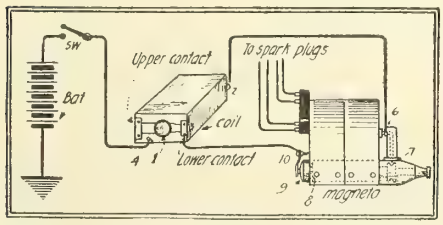
"Burnt Out" Magneto

Third Prize $10.00.

I have a car fitted with a high tension magneto, with which I have had continual trouble. I took it to a magneto service station, and there I was informed that it was "worn out" and that a new one would cost about $50.00. I didn't feel in a position to spend that amount for a new magneto, so I connected an old spark coil to it, as shown in the diagram.

First I took the vibrator points (1) off the coil and fastened the latter to the dash. Then I disconnected the wires at (8), which connects the armature with the breaker box (9) and removed the high tension brush (7). The wires must be connected as shown in the diagram, and the wire (5), which is the high tension lead must be heavily insulated.

Contributed by JOHN W. SWEIGART.



How to Hook Up a Spark Coil to the Distributor of a High Tension Magneto "Gone Dead".

$50.00 IN PRIZES

Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do, showing the essential parts, etc.

We will pay the following prizes each month:

FIRST PRIZE.....$25.00
SECOND PRIZE..... 15.00
THIRD PRIZE..... 10.00

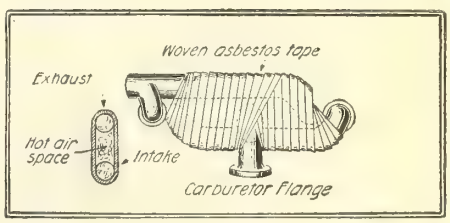
All other accepted articles, which win no prizes will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

Vaporizer for Poor "Gas"

Second Prize $15.00.

The owner of an automobile made some years back, is aware of the fact that the design of his engine is such that considerable difficulty is noted in using the present-day fuel, which contains a large percentage of kerosene. The gasoline mileage is low, the engine is sluggish, and carbon deposits are heavy, and cylinder oil must be renewed at regular intervals, owing to thinning from raw gasoline reaching the crank case.

The heat of the exhaust pipe is utilized to heat the intake gases, by wrapping several layers of asbestos tape around both, that make them practically one unit, with a hot air space between. The asbestos, being a non-conductor of heat, confines the heat to the exposed surfaces of the intake manifold, which gives an ideal heating condition that many motorists are striving for. This asbestos may be obtained at any accessory supply house or plumbing shop at slight cost. It can be wrapt about the manifolds by anyone, care being taken to have each strip of tape over-lap the other strip at least one-half inch, to guard against the possibility of cracks appearing in the walls of the tape.



Simple Yet Effective Stunt for Vaporizing Low Grade Gasoline by Using Exhaust Pipe Heat.

Contributed by R. L. PRINDLE.

CURE FOR "SMOKING" ENGINE.

A modern high speed six-cylinder auto engine had to have its cylinders ground in order to correct an annoying *piston slap*. New pistons and rings were fitted.

The entire job was done to perfection, but when the car was assembled, clouds of smoke resulted. This pumping of oil persisted even after it was reasonable to expect that the rings were worn in smooth.

When the engine was taken apart no fault was found except in large deposits of carbon.

This will be understood when one realizes that one gallon of oil was burned every hundred miles or so.

Finally the original pistons were carefully examined once more.

Under the lowest of the three rings, in the groove, were found hidden five small holes about 1/32 in. in diameter, drilled right thru into the cavity of the piston.

Similar holes were drilled in the new pistons with the immediate result that not an atom of smoke is visible operating the car, while oil consumption is lower even than before the cylinders were ground.

Contributed by C. D. MARTINETTI.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory

JUST as our planet Earth is a pigmy compared to the major planets of the solar systems, Jupiter, Saturn, Uranus and Neptune, so is the ruler of our solar system himself far inferior as a sun in size and light-giving power to such brilliant suns as Rigel, Canopus, Arcturus, and Antares. The latter are classified among the giants of the universe. Our sun must be counted among the dwarfs.

All of the intensely hot and luminous helium or Orion stars (labeled astronomically type B stars) are giants. In light-giving power the typical helium star is the equivalent *of one hundred suns.* The quantity of matter in such a star, that is, its mass, probably totals that of eight or ten such suns as ours, and it exists in these stars in such an extremely diffuse state that they usually considerably exceed our own sun in volume.

The density of a typical Orion star averages from one-hundredth to one-tenth that of the sun.

It can be shown that to act as a perfect gas a star must have a density not greater than one-tenth of that of the sun, the density of the sun being one and four-tenths that of water. Practically all of the helium stars, therefore, behave as nearly perfect gases wherein they differ greatly from our own sun with its comparatively great condensation of matter.

Tho the bluish, helium stars are massive giants and the hottest of all the stars, they are greatly surpast in size and luminosity by the giant red Cepheid variables, which are the most diffuse and voluminous of all stars.

Cepheid variables form a peculiar class of stars that have come into great prominence within the past few years thru possessing certain characteristics that have proved to be of the highest value to the astronomer in his efforts to gage the size and extent of the visible universe.

Cepheid variables received their name from Delta Cephei, the first known variable star of this class. They are without exception giant suns — red, yellow or bluish in color. They possess a peculiar form of variability of light of a periodic nature, consisting of a sudden rise to maximum brightness followed by a slower decline to minimum brightness. The cause of this periodic variability of light is still doubtful, but Shapley's interpretation of it as due to "periodic pulsations in gigantic volumes of luminous gas" is the most reasonable and satisfactory explanation that has yet been advanced. For any one star the period of variability of light is as exact and invariable as clockwork, one cycle of variability usually differing from another in length by less than a small fraction of a second.

Giants and Dwarfs Among the Stars

From star to star, however, there is great difference in the length of period. Cepheids with periods of only a few hours' duration are known to be intensely hot, bluish stars, similar to the Orion stars, with an average luminosity equal to that of one hundred suns, individual stars differing very little in luminosity from the average.

The density of these bluish colored Cepheids never exceeds one-tenth that of the sun and they are the densest and the hottest of all Cepheids. The yellow Cepheids have longer periods of light variation ranging from two or three days to fifteen days and they are cooler and less dense than the bluish variety. They are also more luminous than blue Cepheids, a typical yellow Cepheid being equal in luminosity to a thousand such suns as our own. Since they are cooler than blue Cepheids their greater luminosity is due to the fact that they radiate light from a more extended surface, that is, they are greater in volume.

Cepheids of longest period, ranging from about fifteen days to two months, are invariably red. They are the coolest of all the Cepheids, the least dense and the greatest in actual size. Exceptionally large *giant red Cepheids radiate as much light as ten thousand such suns as ours.* The average density of a red Cepheid variable is only a few millionths of that of the sun, or less than one-hundredth of the density of the earth's atmosphere at sea level. A super-giant of this class is equivalent in volume to one hundred thousand suns, and its diameter is therefore something like forty million miles as compared to a solar diameter of eight hundred and sixty-four thousand miles. If placed at the center of the solar system such a luminary would extend more than half way to the orbit of Mercury and would have in our skies an apparent diameter of nearly twenty-five degrees. In rising it would cover nearly one-third of the distance from the horizon to the zenith. To add to the weirdness of the effect this huge volume of deep red gaseous vapors would pulsate rhythmically in an invariable period of several weeks' duration, if the theory of an internal cause of the variability of the Cepheids is correct.

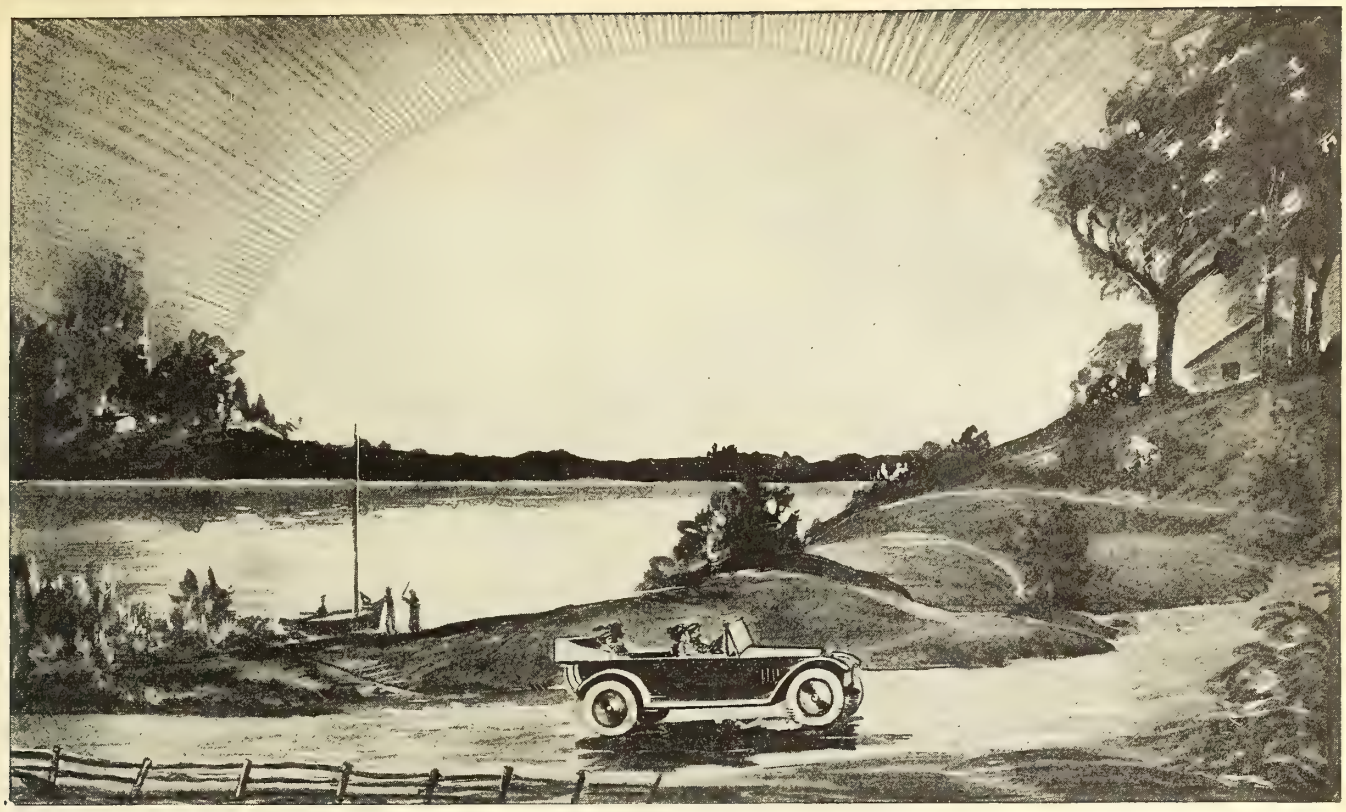
We have noted that the size luminosity, density, temperature and color of a Cepheid is a function of its period of variability.

The Cepheids of longest period are always great in volume, and low in density, and are comparatively cool, reddish bodies averaging several thousand times more luminous than the sun. Owing to the great extent of their radiating surface they are the super-giants of the universe. As the periods of the Cepheids decrease in length from a few weeks to a few days, a change takes place in the size, color, density and temperature of the stars. Cepheids with periods of only a few days' duration are yellow and denser, hotter and less voluminous than giant red Cepheids. Typical yellow Cepheids are one thousand times more luminous than the sun on the average with very little departure from this average for individual stars. When we come to Cepheids



Photograph of the Nebula in Orion, Showing Stars in Midst of the Nebulosity. The Entire Constellation Is More or Less Enmeshed in Nebulosity. Are the Stars Condensing From the Nebulae or Are the Nebulae Emanations From the Surfaces of Excessively Hot Massive Stars That Are Driven Forth by Radiation Pressure? There Is Considerable Uncertainty as to Whether the Nebulae Are the Progenitors of the Stars, or the Products of Their Dissolution. Only the Bluish White Stars Are Found Associated With Nebulae. Red Stars Are NEVER Found in the Midst of Nebulosity.

This Photograph Shows the Lower Half of the Constellation Orion. The Disk-Like Appearance of the Stars Is Due to the Cumulative Effect of Light on the Photographic Plate During the Exposure of Two and One-Half Hours. Even the Nearest Stars and the Most Brilliant Stars Appear Visually as Mere Points of Light in the Telescope. The Great Nebula in Orion Is Dimly Seen Just Below the Center of the Photograph. The Three Stars Evenly Spaced Form the Belt of Orion. Rigel Is the Brilliant Star at the Lower Right. Orion Stars Average One Hundred Times More Luminous Than the Sun.



We Are Accustomed to Think That Our Sun Is a Giant, But This Is Not the Case. There Are Dwarf Suns and Giant Suns, and Even Super-giant Suns. Our Own Sun Is An Intermediate Between Giant and Dwarf Suns. A Sun of the Size of Planet Jupiter Would Be Considered a Dwarf Sun, While the One Shown in This Illustration Is One of the Super-giants, Many of Which Exist Thruout the Universe. Such a Sun Would Give About 10 Million Times the Amount of Light and Heat of Our Own Sun. It Would Take Up Nearly Three-quarters of the Entire Sky, If That Sun Was Spaced at the Same Point in Space as Our Own Sun. The Above Illustration Shows This Graphically, and Also Shows How Such a Giant Would Appear to Our Eyes. Needless to Say, the Great Heat from Such a Sun Would Be Sufficient to Wither Everything on Earth and Dry Up Every Ocean and Lake in Short Order. The Picture Is Simply Given as a Comparison to the Size of Our Own Sun as Per Illustration Below.

with periods of variability of only a few hours' duration we find that all such stars are bluish in color, and hotter, denser bodies than Cepheids belonging to the two preceding groups of red and yellow variables. Blue Cepheids are uniformly giant suns approximately one hundred times more luminous than our sun, as is also true of the helium or Orion stars.

It is evident, then, that knowing the period of variability of a Cepheid we are able to say just how luminous a body it is intrinsically in terms of the luminosity of our own sun. That is, we know its *intrinsic brightness,* or absolute magnitude as the astronomers call it, and we have a means for finding the *distance* of such a star, which is a matter of highest importance in gaging the scale of the universe.

A street light of known candle-power will appear fainter the more distant it is from us and its apparent brightness will decrease with distance according to a definite known law, so that by measuring the light's apparent brightness and knowing its *true* brightness we can find its distance from us. The same principle holds for the stars for they are but light sources at varying distances from the earth. When we once know the absolute magnitude or *intrinsic* brightness of a star and have observed its *apparent* brightness we can obtain its distance by the simplest computation, and that is exactly what the astronomers have done in the case of the giant Cepheid variables. The period of variability of a Cepheid is observed; the intrinsic luminosity of the star, which has been found to be a function of the period then follows directly from the period. A measure of the *apparent* brightness of the star is next made and a comparison of the two shows the distance of the star.

It was by this method that Shapley found the distances of globular star clusters which contain Cepheid variables of all three types, red, yellow and blue, and which are so distant (between 30,000 and 200,000 light years from the earth) that a star of the luminosity of our own sun, if existent in even the nearest of such clusters would be hopelessly beyond the reach of the most powerful telescope in existence.

We have spoken so far of giants of the Orion or helium type, the hottest and most massive of all stars, and of the giant Cepheid variables, red, yellow and blue, the blue type resembling the Orion stars in temperature and density and the huge red giants being the most diffuse and greatest in actual size of all known stars, tho lower in temperature than the more condensed blue giants.

How is it, then, with other classes of stars, the hydrogen stars and the calcium stars, which are respectively white and yellowish-white stars, the class of yellow solar stars to which our own sun belongs (type G), and reddish stars (the K and M types of the astronomer's classification), in which the formation of metallic compounds testifies to a comparatively low temperature? Are these stars giants or dwarfs among the glowing suns of our wonderful universe?

With the exception of the hydrogen stars, which resemble the Orion stars in being intensely hot and brightly luminous stars averaging one hundred times more luminous than our own sun, but with a greater range of individual brightness, we find a most remarkable division of each type of stars into giants and dwarfs.

This separation of each class into two distinct groups is not so marked in the yellowish-white calcium class but it becomes more pronounced among the cooler types until in the class of red stars (known as type M) there is a sharp division into two groups of dwarfs and giants with a complete gulf between the two groups, wherein no stars of intermediate size and brilliancy appear. Dwarf red stars have only one ten-thousandth part of the brightness of the giants of the same class on the average. As the similarity in the color and spectrum of all red stars shows that unit for unit of surface area they radiate with equal intensity, this difference in luminosity is due to an actual difference of ten thousand fold in *surface area* or *ten million fold* in volume. Red dwarfs of class M, therefore, have only one-millionth of the volume, or one-hundredth of the diameter, of giant red stars of the same class.

So far as can be judged from data which are as yet very meagre, stars differ one from another very little in their masses or the quantity of matter they contain. The known range in masses of the stars is from one-sixth that of our sun to twenty times that figure, while in intrinsic luminosity some stars are known to differ from others *ten million fold.* This great difference in luminosity must be chiefly due, therefore, to a difference in the *density* and *volume* of the stars.

(*Continued on page* 650)



This Picture Shows Our Own Sun at Sunset Time, and Is Merely Printed as a Contrast to the Picture Above.

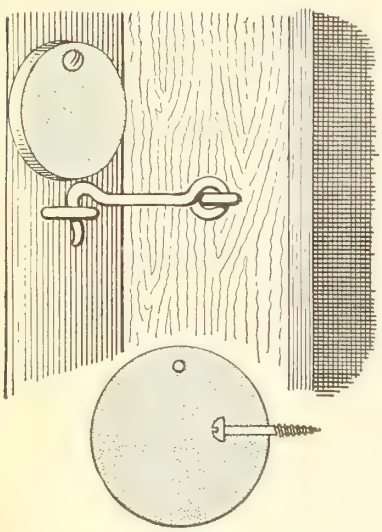
Home Mechanics

Conducted By WILLIAM M. BUTTERFIELD

AUTOMATIC HOOK LOCK.

ON screen doors generally thruout the country a common hook and screw eye is used for a lock, people often depending upon this simple device at night as a means of protection. It is the easiest thing in the world to unhook such a fastening from the outside with a bent hairpin or wire stuck thru the netting —which acts as a support for this simple house-breaking device. It is just as easy to stop the possibility of such light-fingered proceedings. The device here shown is automatic in its operation, always locking the hook by itself whether one remembers to do this or not.

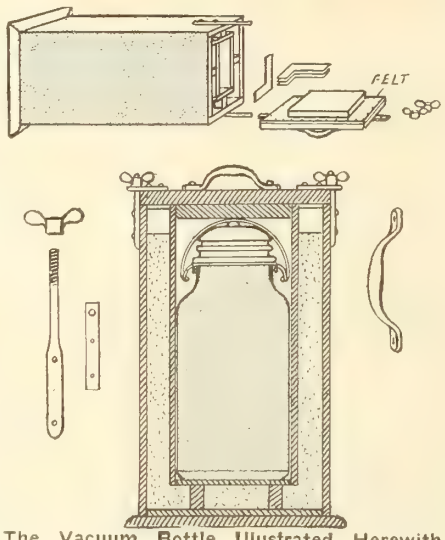
It consists of a round disk of wood or metal, 2½" in diameter and ½" thick, screwed to the door frame just over the screw eye in such a way that it swings loosely like a pendulum. It will be seen from the drawing that this disk secures the hook when placed in the screw eye and falls into position of its own weight once the hook is thus placed. It cannot be swung back from the outside.



The Ordinary Hook Lock Affords No Protection Whatsoever, So Simply Can It Be Opened From the Outside of the Door With Either a Hairpin or Bent Wire. The Device Here Shown Prevents This, Always Locking Securely By Itself.

A HOME-MADE THERMOS BOTTLE.

Our bottle consists of a glass container, such as a fruit jar, that is water-tight at the top, and a wooden sheath with an air-tight cover. The size of the container regulates the size of its sheath, of course, which consists of two oblong boxes, set one within the other as shown, and held apart by suitable cleats—the smaller one just fitting the container in a loose manner at the sides and 1⅛" longer on the inside for the cover. There should be a space of 1½" between the boxes on each side and at the bottom for the insulation of sawdust, bran or chopt hay. The cleats hold the boxes flush at the top. All nailed joints must be made air-tight, using tarred string or oakum driven into the cracks, just as tho caulking a boat. The insulation must be tampt down firmly in a compact mass and retained with the four tin squares shown in the upper illustration, using small nails driven part way into the wood around their upper surfaces. The cover is made of one-inch wood and consists of two parts, one fitting snugly into the top of the inner box, the other covering



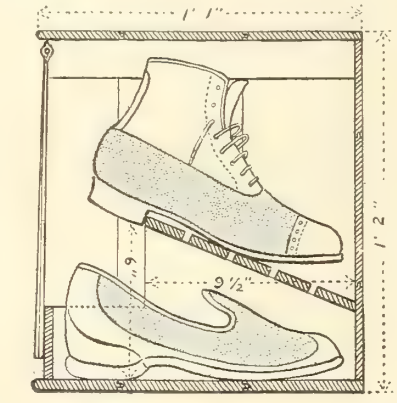
The Vacuum Bottle Illustrated Herewith, Can Be Made With Very Little Trouble and Expense.

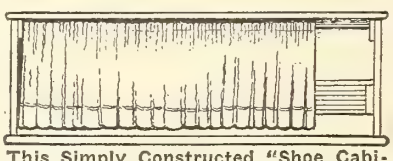
the outer box in the manner shown: both are nailed to each other and secured to the outer box with bolts and thumb-nuts. The top is provided with a handle for carrying the bottle. Along the under surface of the cover, over the boxes, a square of heavy felt makes the top airtight, like a fruit-jar. The outside of the sheath is stained or painted if desired.

HANDY SHOE AND RUBBER CABINET.

At Fig. 1 we show a home-made shoe and rubber case that has the advantage of being easily made either for the bottom of a bedroom closet, or when more pretentiously or carefully constructed, as a window seat. In either case, the foot coverings are protected from dust, allowed sufficient air to dry, and from their position in the case, kept in their original shape.

For the closet form the proportions should be about as given on the drawing, using lumber of the kind known as sheathing (¼" thick and 4" or 5" wide) with tongue and groove, the length to be governed by the requirements of the maker. The ends are



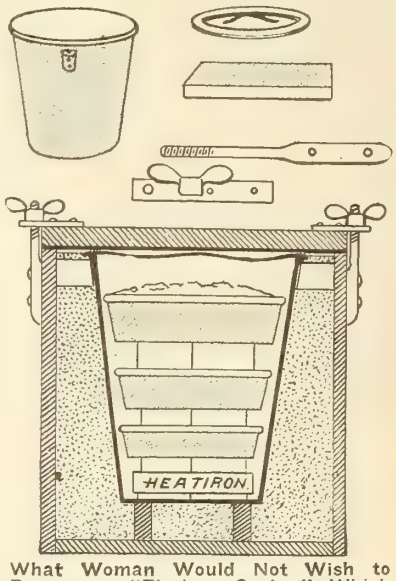


This Simply Constructed "Shoe Cabinet" Gives a Very Neat Appearance and is Indispensable for Protecting Shoes From Dust and Dirt, Besides Keeping Them Carefully Concealed From View.

made first with the board held together at the top by cleats of ½" lumber, and at the bottom by the pieces holding the shoe-rack, also ½" thick and 9" wide. Top, bottom, back, front-rail and rack are nailed to the ends as shown. An ordinary curtain-rod is used to hang the screen or curtain. If the case is designed as a window seat, the lumber should be ½" for the top and bottom and 1" for the cleats and rack holders. Such a seat, covered with creton, will make a very presentable cabinet for "milady's" thirty-dollar boots and pumps.

A FIRELESS COOKER.

The cooker consists of a galvanized pail and cover with the bail or handle removed and the handle-holders on each side bent down below its top edge; a square wooden box 2" wider at the sides than the diameter of the pail and 1¾" longer; a wood cover 1" thick, and fastenings, cleats and insulator as shown. The pail is the ordinary one commonly found at hardware and grocery stores. The box is constructed of ½" lumber made tight at the joints by caulking with



What Woman Would Not Wish to Possess a "Fireless Cooker" Which Does Its Work Well? This Fireless Cooker Can Be Constructed at Home at Small Cost.

tarred twine or oakum; the under surface of cover is lined with heavy felt and the insulating material is sawdust, bran or chopt hay.

In order that the pail can be taken from the box for cleaning, a jacket of cardboard roofing or tin is first fitted and wrapt around the pail loosely and held with a cord; between this jacket and the box the insulating material is put in round the pail and rammed into a compact mass, forming a permanent pocket to contain the pail and hold the insulating body in place. The two sustaining cleats at the bottom, and those at the four sides, are adjusted and fastened before the insulator is installed; to prevent its spilling it is covered at the top edge of the box by tin or cardboard fitted to the pail and along the edges of the box as shown, held by small nails driven part way into the wood above the upper surface. Squares of sheet iron are used between the dishes and under the *heat iron;* this iron may be one or more stove griddles piled one above the other.

To use this fireless cooker, heat the *heat iron* or stove griddles over a hot flame or fire; then place the iron and dishes in the position shown, and fasten the cover down either with bolts or weights.

The "Loaded" Line

By CHARLES S. WOLFE

I GAZED in frank curiosity at the man seated across from us. Of modest stature, plain featured, quietly drest, this man was of the type that blends into the mob. And yet, as president of the local traction company, he had dragged that concern from a very violent flirtation with the sheriff to its present impregnable position. Truly, here was a book not to be judged by its cover.

Davidson and I were sitting thru the recital in attentive silence, while Fenner probed at his pleasure with an occasional question or two.

"This matter, gentlemen," Forbes, the traction man, was saying, "may not seem to you to require the services of the police. I thought at first that a little searching on the part of the linemen would clear the thing up. But I am convinced now that this is no ordinary leak.

"Every morning at 1:45 there comes this extraordinary call for power. At this time practically every thing is off our lines but the freight cars. When we first noticed it I attributed it to *grounding*, but the regularity with which it occurs — considering, too, the unusual hour—forces one to abandon that theory.

"The linemen found several small *grounds* and removed them. This had no effect whatever on this mysterious drain. Then I gave the engineers a try at it. They have been unable to eliminate it or account for it.

"Of course, the story leaked, and it has been going the rounds at the barn. And this is really the reason that I have sought police aid. For the affair threatens to assume unsuspected proportions. You see, the men superstitiously attribute the thing to supernatural agencies and the theory that we are being warned of a catastrophe is gaining a serious following. A few men, rather than risk flying in the face of fate, have quit their jobs already, and I realize that it is only a matter of a short time when a general walk-out will ensue.

"Chief Davidson here has brought you to me as a man qualified to handle the matter by reason of your knowledge of electrical matters," I must urge you, Mr. Fenner, to bend every effort to the speedy ending of this peak, and I can assure you that the company will pay well for a successful solution.

"All our resources are at your disposal. Here are passes over our lines, and should you need aid of any kind at any time you have only to use the telephone. From this you will understand the importance we attach to the affair."

"Superstition is a force against which even the rifle is helpless," acquiesed Fenner. "I will do my best to bring to light the real cause of this power loss in time to avert trouble with your employes. Let us review the facts in the case. To begin with about a month ago the men in charge at your power house noticed a sudden and severe call for power about 1:45 each morning."

Forbes bowed in silence. Fenner proceeded.

"And how, Mr. Forbes, was their attention called to this unusual call?"

"By the peak in the power curve," responded the traction magnate.

"The peak in the power curve?" echoed Davidson, blankly. "What in thunder is that?"

Both Fenner and Forbes smiled.

"You see, Chief," Forbes explained, "we make our generators keep a record of their output. By means of a simple electrically actuated writing arm, or stylus, we cause them to trace on squared paper a record of the day's activities. This tracing—this record is—is known as the *power curve*. Clear to you?"

"Well, I get the general idea," admitted the Chief, slowly, "but I'm hardly up on the details."

"Later you'll see more of it," Fenner interposed. "Let us resume. You have had your linemen go over your circuits with a fine tooth comb, Mr. Forbes, and they have found no leak that would account for the loss. Also your engineers can find no clue to its cause."

Forbes nodded.

"Have you, personally, a theory?"

Forbes seemed uncertain. When he spoke it was hesitatingly. "Well—I hardly know. I did have a sort of a suspicion, to be frank with you, but honestly I don't think it will hold water."

"In confidence, then, Mr. Forbes," Fenner was pleasantly persuasive, "let us have your suspicion. It can do no harm to air a personal opinion."

"Well, when I realized that we were up

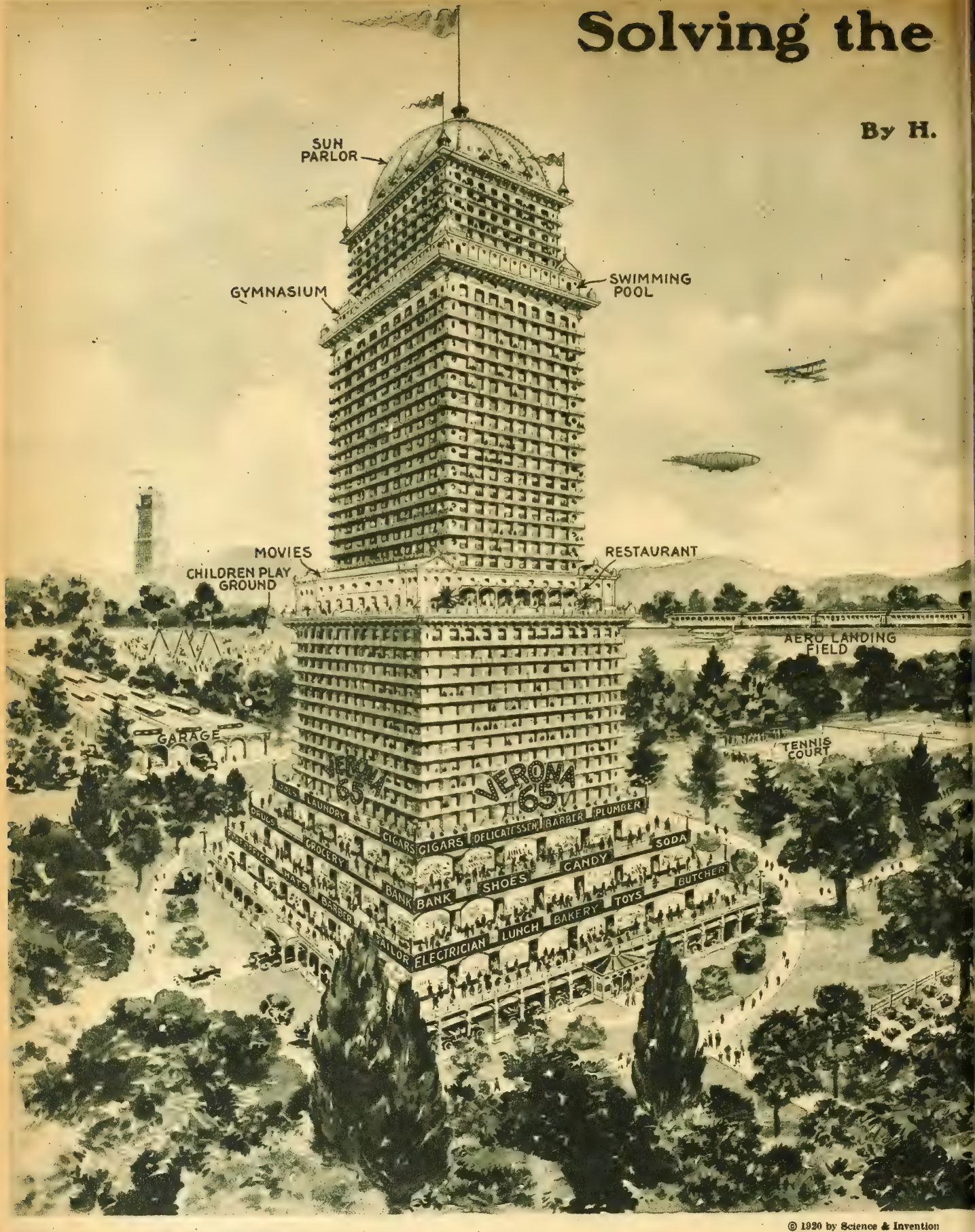
(Continued on page 672)



"... Heavy Breathing and a Blacker Bulk Moving in the Blackness Before Us. With Bated Breath I Watched Its Shadowy Movements. Fearful of Even the Sound of My Own Breathing, I Was Half Stifled From An Effort to Live On a Minimum of Air. Then the Bulk Retreated Toward the River, and Presently, Silhouetted in the Moonlight At the Clearing's Edge, We Got a Glimpse of the Man's Form."

Solving the

By H.



© 1930 by Science & Invention

WE need hardly go into a lengthy explanation about the housing problem which confronts the majority of people at this time. It is not only a condition that prevails in the United States, but is universal all over the globe. Due to the war no new construction to speak of has taken place while the population has increased anywhere from ten to twenty per cent, depending upon the various nations. A condition has been created thereby which has become well nigh intolerable. Neither houses nor apartments are to be had and those that may be had are prohibitive in price, indeed.

The average human being prefers the country to the city. He does not live in the city because he likes it, but because he has to for business and economic reasons, as well as for the sake of convenience. The man who lives in the country gets fresh

Housing Problem

GERNSBACK

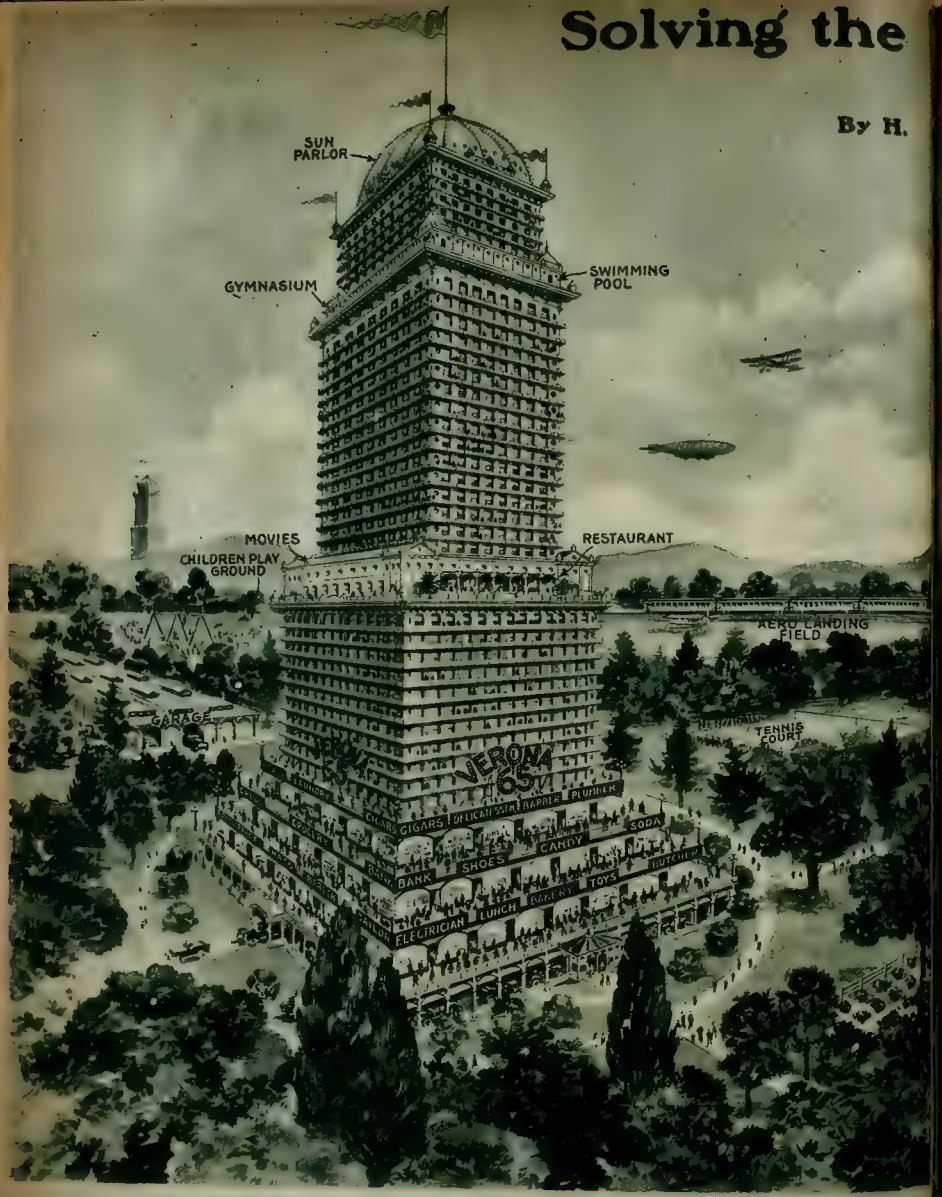


air, and fresh produce, while his children have ample room to play; moreover he has more room than his city brother. Against this it is charged that he has no convenience to speak of. He has to attend to his furnace, he has trouble in getting his coal, and he cannot buy all the things he requires in the little village or country place in which he resides. This makes for expensive transportation of small quantities of goods or other necessities. Moreover, in the average country town, there are few amusement places where a man may take his family. In the larger villages, to be sure, we have moving picture houses and the like, but in this case the village approaches again to the city size with all its congestion, high rent, etc. Moreover, many of life's necessities cannot be bought in the village, and are usually brought in from the city by the

(*Continued on page* 683)

Solving the Housing Problem

By H. GERNSBACK



© 1930 by Science & Invention



WE need hardly go into a lengthy explanation about the housing problem which confronts the majority of people at this time. It is not only a condition that prevails in the United States, but is universal all over the globe. Due to the war no new construction to speak of has taken place while the population has increased anywhere from ten to twenty per cent, depending upon the various nations. A condition has been created thereby which has become well nigh intolerable. Neither houses nor apartments are to be had, and those that may be had are prohibitive in price, indeed.

The average human being prefers the country to the city. He does not live in the city because he likes it, but because he has to for business and economic reasons, as well as for the sake of convenience. The man who lives in the country gets fresh air, and fresh produce, while his children have ample room to play; moreover he has more room than his city brother. Against this it is charged that he has no convenience to speak of. He has to attend to his furnace, he has trouble in getting his coal, and he cannot buy all the things he requires in the little village or country place in which he resides. This makes for expensive transportation of small quantities of goods or other necessities. Moreover, in the average country town, there are few amusement places where a man may take his family. In the larger villages, to be sure, we have moving picture houses and the like, but in this case the village approaches again to the city size with all its congestion, high rent, etc. Moreover, many of life's necessities cannot be bought in the village, and are usually brought in from the city by the

(*Continued on page* 683)

Science News



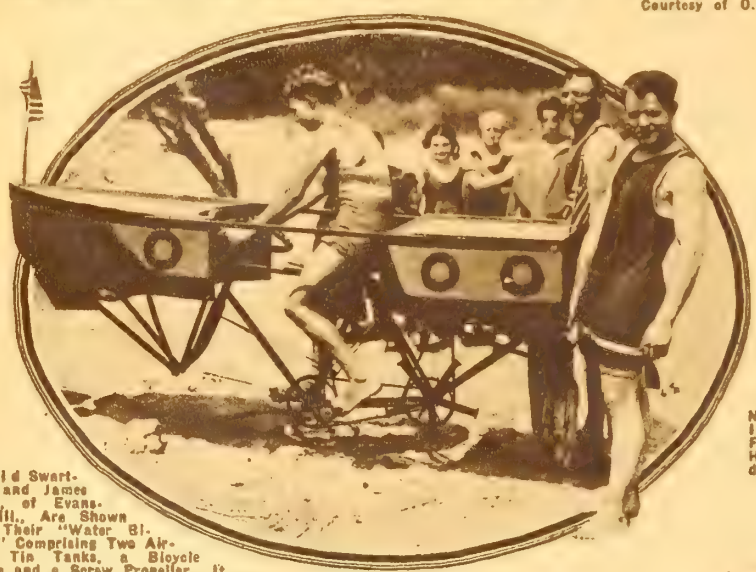
Makes Milkman Fear Water! The "Cryoscope," Which in Eight Minutes Enables One to Tell Just What Amount of Water Has Been Added to a Sample of Milk, Until the Invention of This New Testing Apparatus, Which Is Based on the Principle of the "Freezing Point" Test, No Suitable Rapid Method for Detecting Dishonest Milk Dealers Had Been Perfected.—Photo by Gilliams Service.

The Paddle Boat Affords the Aquatically Inclined Young Woman All Kinds of Sport on Pond, Lake, or Placid River. It Works on the Same Principle as the Old-Fashioned Mississippi River Steamboat, Only the Side Paddles Are Hand-Propelled. Lots of Girls Are Just Crazy About It!—Photo by Gilliams Service.





Day and Night Views of Huge Electric Typewriter Sign in New York City. The Keys of the Machine Operate in a Very Realistic Manner and the Letters Appear on the Paper as They Are Printed Until the Story Is All Told. The Typewriter Measures 28 by 35 Feet; 1,578 Ten-Watt Lamps Illuminate the Display. — Photo Courtesy of O. J. Gude Co.



David Swarthour and James Smith, of Evanston, Ill., Are Shown with Their "Water Bicycle," Comprising Two Airtight Tin Tanks, a Bicycle Frame and a Screw Propeller. It Can Make Eight Miles an Hour with One Passenger, or Six Miles with Two.—Photo © by Underwood & Underwood.

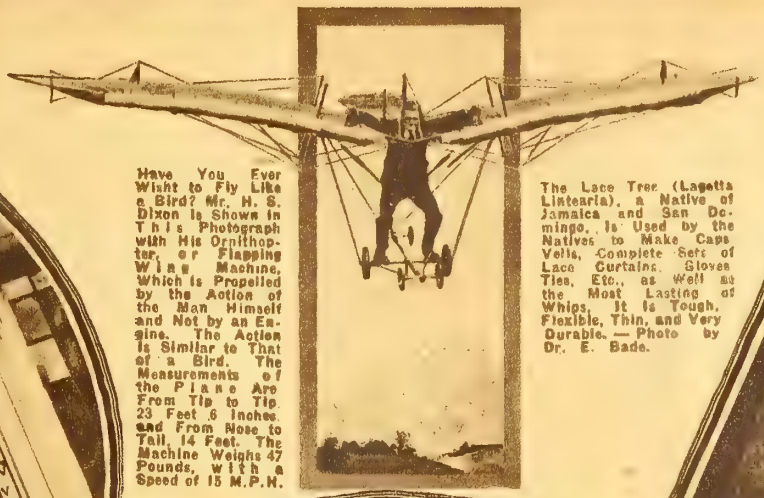
New Non-Sinkable Sea Safe? Mannotti Hanni, Chicago Inventor of a Non-Sinkable Safe, Was Locked in His Five-Ton Steel Box and Lowered to the Bottom of Boston Harbor—and Three Minutes Afterward the Giant Cylindrical Tank Shot Up to the Surface.—Photo © by Underwood & Underwood.



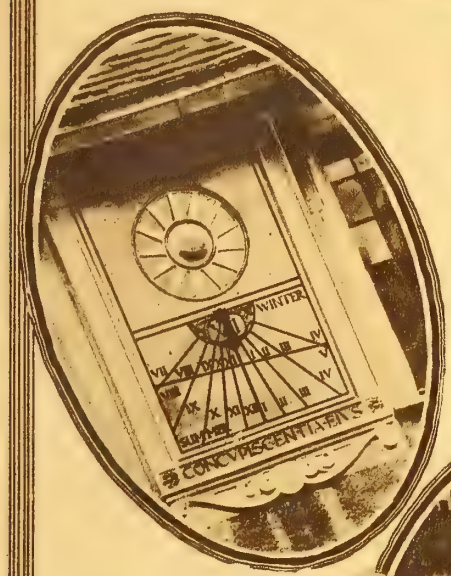
"Punching" Harding or Cox on the Voting Machine! That's What New York Women Will Do Next November—Punch the Names of Their Chosen Candidates on the Voting Machine. Under the Name of Each Candidate is a Knob, Which, When Punched Registers the Vote and Number of the Voter and Does Away with the Tedious Work of Ballot Counting.—Photo by Gilliams Service



In Pictures



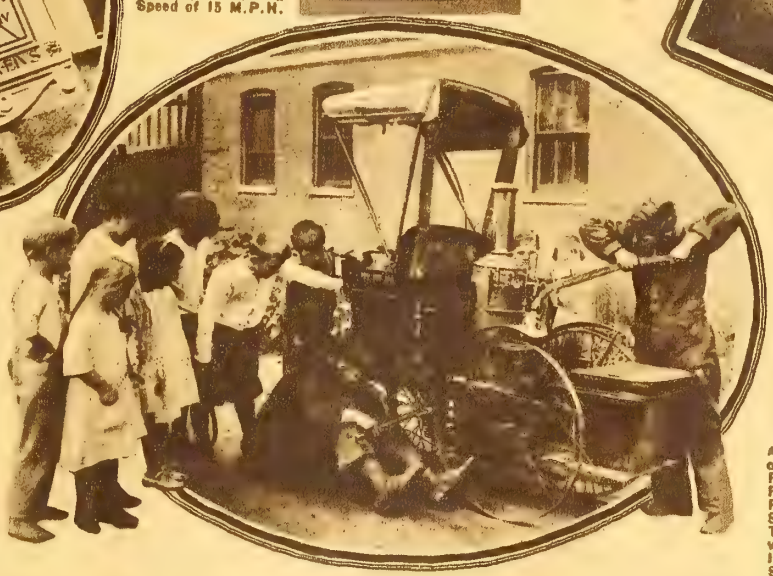
Have You Ever Wisht to Fly Like a Bird? Mr. H. S. Dixon Is Shown in This Photograph with His Ornithopter, or Flapping Wing Machine, Which Is Propelled by the Action of the Man Himself and Not by an Engine. The Action Is Similar to That of a Bird. The Measurements of the Plane Are From Tip to Tip 23 Feet 6 Inches and From Nose to Tail, 14 Feet. The Machine Weighs 47 Pounds, with a Speed of 15 M.P.H.



View of the Corpus Christi College's New Sun Dial the First in Europe to Record Summer and Winter Time. Recent Renovations at This Cambridge College Disclosed Old Fragments of a Sun Dial in the Wall in the Old Court. This New Sun Dial Is Erected In the Same Place and Is on One of the Oldest Quadrangular Buildings—1330 A. D. In This Court the Poet Marlowe Wrote His "Tamburlaine," and Here John Richardson (Organizer of the "Pilgrim Fathers' Voyage to New England") Lived.



The Lace Tree (Lagetta Lintearia), a Native of Jamaica and San Domingo, Is Used by the Natives to Make Caps Veils, Complete Sets of Lace Curtains, Gloves Ties, Etc., as Well as the Most Lasting of Whips. It Is Tough, Flexible, Thin, and Very Durable. — Photo by Dr. E. Bade.



Here Is the Original Automobile Which First Appeared on the Streets of Chicago in 1892. It Was Recently Demonstrated in Chicago Streets Again. It Employs a Steam Engine and Boiler Operated on Oil Fuel. Photo © by Underwood & Underwood.

A New Stove, the Invention of a British Army Officer Promises to Solve the Coal Problem for a Great Many People. It Consists of a Small Stove and Container. The Container Is Filled with Sawdust Which Is Ignited and Placed in the Stove. Once Lighted, It Requires No Attention for Twelve Hours.—Photo by Gilliams Service.



"Nightie Bunnie"—the Latest Addition to Children's Toys. He Has Luminous Radium Eyes 'neverythin'. There Is a Whole Family of "Nightie Bunnie's" Friends, All Blest with Radium Eyes That Shine in the Dark. A Fine Idea for Children Who Are Afraid to Go to Sleep in the Dark. Photo Courtesy Society for Electrical Development.





An American Jules Verne

ALTHO not generally known, there lived some forty years ago a personage known to thousands of readers by the *nom de plume* of "Noname." These were the days of the nickel novels when the Nick Carter series, Jesse James stories and Old King Brady were the talk of the day. For a nickel you bought a complete 32-page novel on closely printed pages in small type. These novels were always hair-raisers in more than one respect, and many of them have gone down as classics.

Lu Senarens, known to tens of thousands as "Noname," was perhaps the most prolific of these writers, and one of the most prophetic. Not only did he turn out a host of these wonderful stories, but he wrote over one thousand of them, each one of them containing from 35,000 to 50,000 words. Each of these stories were complete and had no continuations. The hero of most of the stories was Frank Reade, Jr., "the boy inventor," who supposedly invented all the many marvelous scientific wonders of that day.

Naturally, these were the days before the trolley car, the telephone, the submarine, the aeroplane, and many another modern invention. Mr. Senarens, a true genius, the same as Jules Verne, had one of the most fertile imaginations. He was not a technically-trained man nor even an engineer. His scientific knowledge was obtained solely from reading books and other scientific publications. His inventions were of course nothing but pure fiction and existed only on paper.



Lu Senarens "invented" some of the most astonishing submarines, airships, war machines and other world beaters, but the strangest part about it is that in those days no one believed that either the submarine or the aeroplane would ever be actually invented. As a matter of fact, they were considered as physically impossible, not only by Senarens himself, but by leading scientists who lived in the early 70's and 80's. It is not generally known that Senarens corresponded regularly with Jules Verne, who encouraged the American writer and read his stories as well.

The illustrations which we are publishing herewith give but a faint idea of the stories which appeared in the early 80's, almost forty years ago. We have among others the "Electric Tricycle"; then we have the "Steam Man of the Plains; or Terror of the West," a most marvelous imaginative piece of machinery which was supposed to take the place of a horse and could draw an iron-clad wagon over the prairies. The "Sea Serpent," as its name implies, was a most ambitious submarine; then we have the "Electrical Horse," an adjunct to the steam man which is propelled similarly. The "Electric Thunderer" (armored war car) is suggestive of the recent modern war machines and quite as formidable. The "Electric Submarine Boat," which may be noted, digs its path under an ice field and is worth our attention, because only three years ago Simon Lake, the inventor of the modern submarine, proposed the identical scheme to travel to the North Pole underneath the ice. The "Greyhound of the Air" approaches the modern airships, while the "Deep Sea Diving Bell" is only little different from those actually used today.

Note particularly the "Electric Air Monitor" engaged in an aerial bombardment. If you substitute the aerial monsters which were in use during the war and which bombarded the various cities, you have here a prophecy that is not far wrong. One of the most curious inventions of Mr. Senarens is undoubtedly the "Flying Submarine" as shown in one of our illustrations. This was a flying machine and submarine combined, and altho we have nothing like it in existence today, who dare say that it will not be in use at not a too distant date? Then again we had the "Electric Warrior," a war chariot used against Indians, the "Electrical Dragon," the "Terror of the Seas" and many others.

Nine-tenths of Lu Senarens' pictured predictions have actually come true. Even the helicopter arrangements in some of his air-

(*Continued on page* 665)

The Electric Shoes

By J. MAC-RICHARD

THE Brussels-Paris express was entering the Compiègne station, the last stop before reaching Paris.

It was 4 o'clock in the afternoon. Two passengers were seated in one of the first-class compartments—a gentleman of forty, who had got on at Tergnier, and your humble servant.

We had exchanged some commonplace remarks. My companion spoke with an English accent.

Scarcely had the train stopt when one of the doors was opened violently. A gust of wind blew in. My companion made a wry face. But the door remained open, held by some one on the outside.

This impolite person was a young man, with a military air. We supposed, at least, that he belonged to the army, since he had a cavalry sword strapt to his valise.

The gentleman opposite me arose and slammed the door.

The officer opened it again. Try as my companion could, he wasn't able to force it shut.

"How ill-bred!" he growled, as he returned to his seat.

We heard an oath outside. The valise was pitched into the compartment and the owner followed it.



"The Man Made a Slight Movement With His Left Foot. It Was Almost Imperceptible. But It Produced An Effect That Made An Ineffaceable Impression On Me. Nobody Could Describe Exactly the Transformation Which the Officer Underwent. But the Vigorous, Aggressive, Quarrelsome Man of the Minute Before, Became Suddenly An Automaton, Without Power of Resistance, Without Will. He Was Now Being Subjected to Some Mysterious Torment, Almost As Violent As Madness . . ."

He was just in the nick of time. The engine whistle blew. The guard locked the door and the train got under way.

There was a tense silence, presaging a violent outburst, as the newcomer lifted his bag into the rack.

I don't know what was passing in the gentleman's mind. But looking at his placid figure one would have thought that he was not in the least affected by the young officer's nervous movements and bellicose attitude.

* * *

"It seems to me," said the latter, looking at each of us in turn, "that I heard some one in here use the expression 'ill bred.'"

"That word was used," answered my companion, unhesitatingly.

"To whom was it applied, may I ask?"

"To you."

These last words had hardly been spoken when the officer's hand described a semi-circle and struck the gentleman's face. I expected to see the latter spring on the soldier.

He did nothing of the sort.

He made a slight movement with his left foot. It was almost imperceptible. But it produced an effect which made an ineffaceable impression on me. Nobody could describe exactly the transformation which the officer underwent. But the vigorous, aggressive, quarrelsome man of the minute before became suddenly an automaton, without power of resistance, without will.

He was now being subjected to some mysterious torment, affected by some brain disturbance almost as violent as madness. His limbs jerked convulsively; his eyes almost started from their sockets; his teeth chattered; inarticulate sounds escaped from his throat.

I felt sorry for him and got up to aid him. But the English gentleman motioned me away. With a smile on his lips he ordered me to take my seat.

"Don't be disturbed," he said in a friendly voice. "There isn't any danger. His sufferings will stop whenever I want them to stop."

"Mercy!" exclaimed the unfortunate young man, giving the Englishman a supplicating glance.

The latter smiled sardonically.

"Mercy!" the officer repeated. "Mercy!"

"So be it," said the Englishman, at last. "I pardon you. But don't start anything again with me."

The mysterious traveler withdrew the foot which I had seen him press against the officer's a few moments before.

The officer fell back in his seat, put his head between his hands and seemed completely prostrated.

"Was it a dream or was it real?" he murmured.

"It was real enough," said the Englishman. "You will remember Sir John Mextone, I think, as long as you live."

"I certainly shall."

"Well," continued Mextone (as he called himself), "I am going to explain my system to you. Will you come a little closer, my dear sir (addressing me)? It's well worth your while."

Mextone crossed his legs and showed us the tip of one of his shoes.

"You see those two points?" he asked.

"Yes."

"That is where my power comes from. Don't touch them."

"Ah!"

"They are the extremities of an electric current, fed by a battery concealed in the heel. The shocks which this gentlemen felt were merely discharges produced by a connecting of two poles, thru his body. It is the greatest invention of our age, worth all of Edison's. I have with me two similar pairs of shoes—in this package. One was made for the King of the Belgians and the other pair for the King of Italy."

So our companion was only a common commercial traveler!

But common isn't the right word. As we had just seen, he carried on his trade with the adroitness of an artist.

"What do you charge for those shoes?" I asked, still marveling at the demonstration he had given us.

"Two hundred francs. That's hardly anything."

"It's cheap enough," said the officer. "But why couldn't I buy a pair ahead of the King of the Belgians?"

"And why couldn't I buy a pair," I said, "ahead of the King of Italy?"

"Well, I don't see why you can't," replied Sir John Mextone, "on condition, of course, that you don't make any use of them for several days. I want to have a chance to offer these crowned heads a real novelty."

* * *

When we arrived in Paris the officer and I each possest a pair of electric shoes. We took leave of Sir John Mextone.

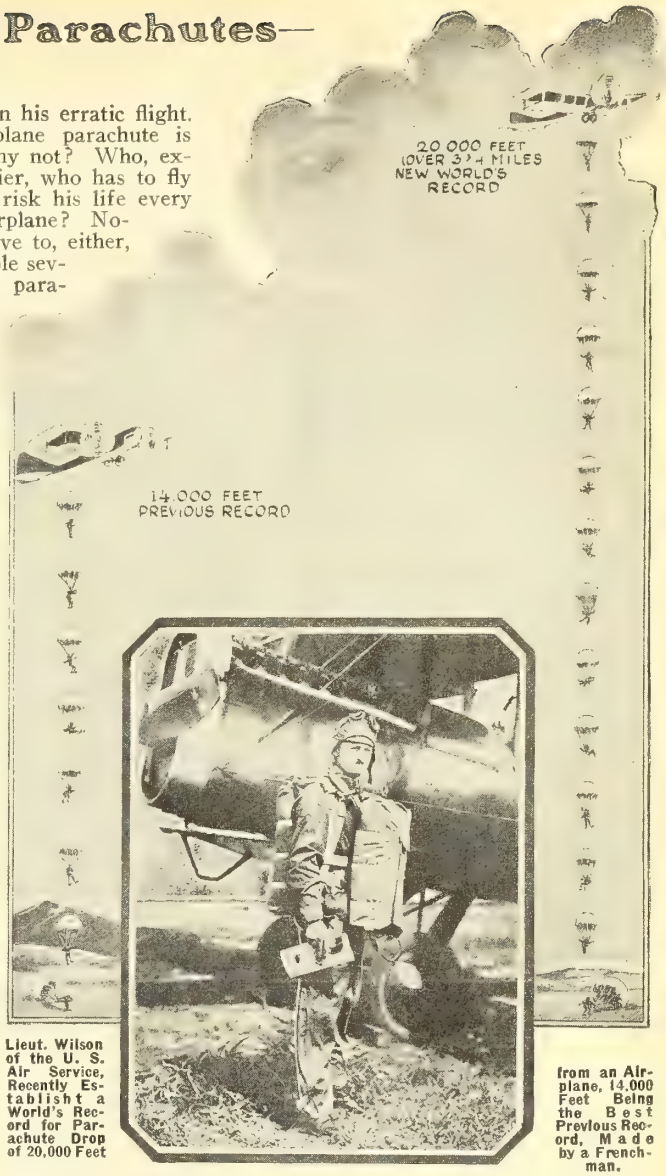
I was walking home with my precious

(Continued on page 699)

Drops 19,800 Feet With Two Parachutes—World's Record

Lieut. John H. Wilson—"Dynamite," his friends call him—photographed at Kelly Field, San Antonio, Texas, June 8th, a few moments before he "took off" on the flight which ended with his world-record-shattering parachute drop. He leaped backward from the plane when 19,800 feet in the air with a parachute in each hand. The descent occupied seventeen minutes and he drifted about 10 miles, narrowly missing a church steeple at the end. The former American record was 8,000 feet, and the world's record, made by a Frenchman, 14,000 feet. Lieut. Dunton, who piloted the plane, followed Wilson in his erratic flight.

The day of the airplane parachute is dawning rapidly—and why not? Who, except an army or navy flier, who has to fly under orders, wishes to risk his life every time he goes up in an airplane? Nobody—and they won't have to, either, for there are now available several successful airplane parachutes which are being supplied as regular equipment on many standard planes being sold on the market.



Lieut. Wilson of the U. S. Air Service, Recently Establisht a World's Record for Parachute Drop of 20,000 Feet from an Airplane, 14,000 Feet Being the Best Previous Record, Made by a Frenchman.

Why Only a Few Understand

As soon as Dr. Einstein's theory and law of relativity began to attract public notice, an eminent scientific person blandly announced that only a dozen people in the world—of whom he, of course, was one—could understand any explanation that anybody might make of these momentous achievements. That, naturally enough, inspired considerably more than a dozen people to attempt the task that had been declared hopeless, and unnumbered thousands of us did our best to help the new expositors prove that the first man was wrong, says the New York *Times* editorially.

The offered explanations were marked by a common peculiarity—they all began with illustrations and analogies that were beautifully simple and within anybody's comprehension, but the passage from them to relativity as Dr. Einstein views it always involved the leaping of a chasm wider and deeper than the Grand Cañon of the Colorado.

It helps a little toward the soothing of ruffled tempers and prides to learn just why Dr. Einstein is so hard to understand. That secret is revealed in the report of a joint meeting in London of the Royal Society and the Royal Astronomical Society, called to give the members of those famous organizations information as to the results attained by the two expeditions sent to observe the solar eclipse of last May. After that had been done there was a discussion in the course of which Sir Joseph Thomson of the Royal Society made this enlightening statement:

"The weak point in the Einstein theory is the great difficulty in expressing it. It would seem that no one can understand the new law of gravitation without a thoro knowledge of the theory of *invariants* and of the *calculus of variations*."

Now we know! Anybody without the equipment mentioned will waste his time in trying to understand the new relativity.

Artificial Sun-Baths for Curing Tuberculosis

By DR. ALFRED GRADENWITZ



Here We See Convalescent Soldiers and Others Being Treated With Artificial Electric Sun-baths, Which Have Proven Particularly Efficient It Is Claimed, in the Treatment of Severe Inflammation and in the Healing of Wounds, as Well as the Curing of Tuberculosis of the Lungs.

The light of quartz tube mercury arc lamp, contains the chemically active radiations of sun light (ultra-violet rays) to which the wonderful curative effects of sun-baths are due. Such lamps have therefore been used in German military hospitals to promote the healing of wounds, and excellent results have lately been obtained in the curing of tuberculosis of the lungs.

An artificial sun-bath hall, according to Prof. Jesionek, as represented in our picture, consists of a spacious room connected up to the central heating plant. The light is supplied by several lamps each of which mainly consists of a quartz tube 16 centimeters long, containing the mercury, and a rectangular housing with slanting reflecting magnalium walls open in front, the lamp being lighted by tilting the housing thru the agency of a handle at the lower edge.

The walls, floor and ceiling of the room are lined with some fabric reflecting ultra-violet rays, aluminium bronze and a plain bluish-white lime coating being used for the walls and ceiling, whereas a lining of coarse linen is sufficient for the floor. The patient walking to and fro in front of the lamps immediately passes from one cone of light into the other. He, of course, should protect his eyes by means of smoked auto goggles. His skin soon becomes sunburnt as under the action of actual sun-baths, this being an outward symptom of a successful cure.

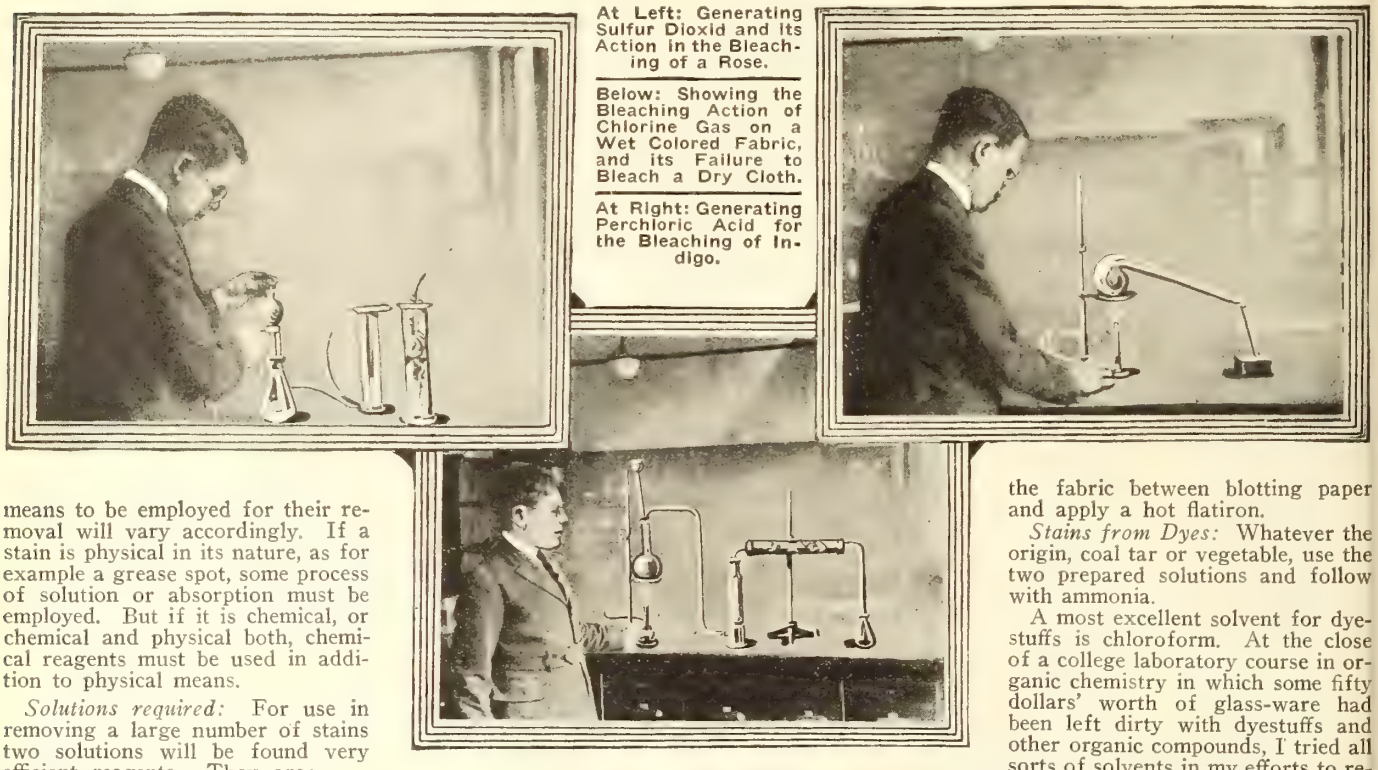
Practical Chemical Experiments

By PROF. FLOYD L. DARROW

STAINS AND BLEACHES

SOME of the most interesting and practical applications of Experimental Chemistry have to do with the removal of stains and the bleaching of fabrics. Such experiments are not quite so spectacular as fireworks and explosions, but they are usually of more practical importance. In this article I shall take up these phases of chemical work.

Nature of Stains: The subject of stains is a very deep one. Stains may be either physical or chemical, or both, and the means to be employed for their removal will vary accordingly. If a stain is physical in its nature, as for example a grease spot, some process of solution or absorption must be employed. But if it is chemical, or chemical and physical both, chemical reagents must be used in addition to physical means.



At Left: Generating Sulfur Dioxid and Its Action in the Bleaching of a Rose.

Below: Showing the Bleaching Action of Chlorine Gas on a Wet Colored Fabric, and its Failure to Bleach a Dry Cloth.

At Right: Generating Perchloric Acid for the Bleaching of Indigo.

Solutions required: For use in removing a large number of stains two solutions will be found very efficient reagents. They are:

1. Tartaric or oxalic acid—20 grams to 100 cc. of water.
2. Five grams of bleaching powder (ordinary chlorid of lime). Boil this in 100 cc. of water until a pink color appears, then filter and add 50 cc. of cold water.

Most of the common ink eradicators consist of these two solutions. In order to test their power to remove ink, coffee, tea, fruit and dye stains select some such stain and treat it first with solution No. 1 and then with solution No. 2. After wetting the spot with the first solution, absorb the excess of liquid with a blotting paper and then apply the second solution. Rinse with water and if necessary repeat the operation. Sometimes a persistent yellow spot remains after the color has been removed. This is especially true of woolen goods. In such a case rinse the goods thoroly and then apply fresh hydrogen peroxid. This will oxidize the yellow coloring matter and remove it.

Removal of Acid Stains: The removal of the common mineral acid stains is a very difficult matter. Hydrochloric acid does not usually leave a stain but in order to prevent injury to the fabric the acid should be *neutralized immediately* with ammonia water.

Sulfuric acid, if strong at all, will char cloth and very quickly make a hole. This action is due to the very great affinity of sulfuric acid for water. Most fabrics contain the elements, hydrogen and oxygen, in proportion to form water and therefore the acid extracts these elements leaving a charred spot of black carbon. There is no remedy for such a spot, unless the presence of the acid is noted as soon as it falls upon the fabric and can be neutralized by the application of ammonia water. Ammonia is pre-eminently the base to use in such cases, because it is not strong enough to injure the fabric itself, and it will neutralize even the strongest acids.

To show the *action of sulfuric acid* in such cases apply a drop of the concentrated acid to a piece of cotton goods and note the charring effect. Repeat with woolen goods.

To show this affinity of the acid for oxygen and hydrogen still more, prepare a concentrated solution of cane sugar and into 25 cc., of it in the bottom of a beaker pour a few cubic centimeters of strong acid. Immediately the contents of the beaker will begin to steam and turn brown and presently it will boil up and a black mass of carbon will overflow the sides. See Figure 1. A piece of wood thrust into a test tube of the acid will char and disintegrate thruout.

The yellow stains of *nitric acid* are very troublesome and persistent. As soon as discovered wash the spot thoroly with water and then apply solutions Nos. 1 and 2. Nitric acid is a strong oxidizing agent and the substitution of oxalic acid, a reducing agent, for tartaric in this case is advisable. But the removal of nitric acid stains is very nearly impossible.

For the removal of any *other acid stains*, such as fruit acids for example, apply cold water, also alcohol if possible and then follow with solutions Nos. 1 and 2.

Grease: Among the most common and troublesome stains are grease spots. As everyone knows, gasoline is an excellent solvent for grease. In addition the following solvents are excellent: Carbon tetrachlorid (ordinary "Pyrene" of the fire-extinguishers), chloroform, ether, carbon disulfide, ammonia water and soapsuds. When grease spots are fresh, the application of French chalk will frequently absorb them.

For *paraffin* there is no ready solvent. The best procedure in such cases is to place the fabric between blotting paper and apply a hot flatiron.

Stains from Dyes: Whatever the origin, coal tar or vegetable, use the two prepared solutions and follow with ammonia.

A most excellent solvent for dyestuffs is chloroform. At the close of a college laboratory course in organic chemistry in which some fifty dollars' worth of glass-ware had been left dirty with dyestuffs and other organic compounds, I tried all sorts of solvents in my efforts to remove them. But more efficient than the strongest acids and bases or any of the common organic solvents was chloroform. It dissolved practically every residue.

A most difficult substance to remove usually is *gum*. But either chloroform or carbon tetrachlorid will loosen it with perfect ease. Carbon tetrachlorid in composition is very similar to chloroform. Both are substitution products of the hydrocarbon methane. In the former case all four of the hydrogen atoms in methane are replaced with chlorin, while in the latter only three of them are.

Iron Rust: Iron rust is red oxid of iron and is easily soluble in a dilute acid. Prepare a moderately strong solution of oxalic acid, warm it and then apply with a soft sponge. Wash with water.

Silver Stains: Stains from silver nitrat and some indelible inks containing silver salts are exceedingly persistent. A ten per cent solution of potassium cyanid, however, will readily dissolve such stains. But, since potassium cyanid is a *deadly poison, it must be used with the greatest care!*

Iodine Stains: The yellowish brown stains of tincture of iodine are very common. To remove them use a dilute solution of washing soda (sodium carbonate) or a ten per cent solution of potassium iodid. Wood alcohol may also be employed

Paint and Varnish Stains: For these stains use turpentine, carbon tetrachlorid or gasoline. Follow with soap and water. Some varnishes are easily removed with alcohol, particularly shellac varnish.

On any of the ordinary stains not included in this list use the two solutions prepared, and follow with thoro washing.

BLEACHING.

A most important branch of the textile industry is that of *Bleaching.* This subject is also of importance in the household and therefore a knowledge of the chemistry of it is desirable. The two fundamental chemical processes employed are *oxidation* and *reduction.* The bleaching agent employed must be selected in accordance with the material to be bleached. Wools and silks will not stand the action of chlorin while cotton will.

Bleaching with Chlorin: Chlorin as is well known from previous articles in this series is a greenish gas, heavier than air, poisonous and very active. It was one of the earliest bleaching agents to be used and is still indispensable for this purpose.

To show its action arrange apparatus as shown in Figure 2. Generate the gas by action of manganese dioxid on concentrated hydrochloric acid. Pass it thru a drying tower containing lumps of calcium chlorid and then thru a three-fourths' inch tube containing a piece of wet colored cloth and a piece of dry cloth of the same material, separated from each other by calcium chlorid held in place with small quantities of glass wool. Let the excess of chlorin bubble thru a strong solution of potassium hydroxid. Cloth dyed with turkey red is excellent for this experiment.

Now start the generator and pass the gas. In a few moments the wet piece of cloth will have been entirely bleached while the dry cloth will be entirely unaffected. The chemical action is this: The chlorin unites with the hydrogen in the water on the cloth and liberates oxygen in what is called the *nascent state,* i. e., a very active state always characteristic of elements at the instant that they are formed. The oxygen unites with the color substance and changes it to a colorless compound.

In case you are unable to provide apparatus similar to that just described you may perform the experiment with cylinders of the gas. Fill two cylinders by allowing the gas to pass downward into the cylinders and displace the air. In one of the cylinders place a piece of wet colored fabric and in the other a dry piece. In a few moments the wet piece will be entirely decolorized, while the dry piece will remain unchanged.

Bleaching Inks: In one bottle of chlorin place a piece of paper having on it ordinary ink and in another a piece of printed newspaper. Both pieces should be moistened. The ordinary ink will be quickly bleached, while the printers' ink will remain unchanged. The reason is this: Printers' ink is largely carbon and it will not oxidize readily.

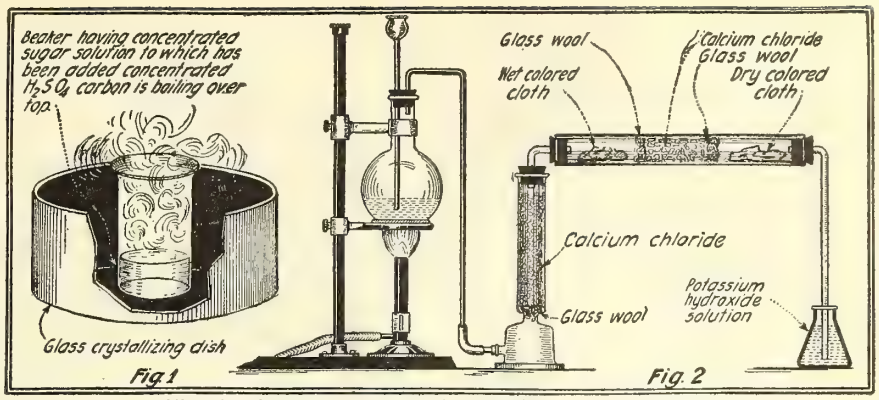


Fig. 1—Showing Affinity of Sulfuric Acid for Water.
Fig. 2—Bleaching Cotton Goods with Chlorin.

Bleaching with Hydrogen Peroxid: Hydrogen peroxid is another substance depending for its bleaching power upon the liberation of nascent oxygen, and yet there is nothing about the reagent itself that will injure the article being bleached as there is in the case of chlorin.

To show the bleaching action of the peroxid to good advantage prepare a solution of aniline red by dissolving a very little of the dye in 100 cc. of water. To this solution add a few cubic centimeters of fresh hydrogen peroxid and upon boiling the color will be discharged. Should this fail to happen it will indicate that the peroxid is acid. In that case add a little sodium hydroxid and the color will instantly disappear.

If the hydrogen peroxid is made very slightly alkaline in advance it will discharge the color even in the cold. This reaction also affords a good stage experiment. In the bottom of a tumbler place a few cubic centimeters of the alkaline solution of peroxid and pour into it from a pitcher containing a solution of aniline red.

Bleaching with Sulfur Dioxid: Sulfur dioxid is a bleaching agent very extensively used to bleach woolens, silks and straws. To show its action prepare a cylinder of the gas using apparatus as diagrammed in Figure 3. In the flask place dry sodium sulfite and in the dropping funnel concentrated hydrochloric acid. Allow the acid to drop slowly on the sulfite and large volumes of the gas will be generated.

Into a jar of the gas lower a bright red rose. The color will very rapidly disappear. The color may then be restored by placing it in a cylinder of chlorin gas or by holding it in the vapor of fuming nitric acid. With a jar of each gas prepared in advance these two experiments make an excellent stage demonstration.

The color may also be restored by immersing the rose in a 50 per cent solution of sulfuric acid.

Bleaching with Hydrosulfurous Acid: Indigo which is not bleached by sulfur dioxid is bleached by hydrosulfurous acid. To prepare this acid bubble sulfur dioxid, generated as already described, thru 100 cc. of water until a saturated solution is obtained. Then place in the solution a small quantity of zinc dust and allow the mixture to stand for a time; the zinc reduces the sulfurous acid to hydrosulfurous, which remains in solution.

Place 50 cc. of indigo solution in a beaker and add some of the hydrosulfurous acid. It will be decolorized as will also a solution of litmus.

Turning Wine into Water: A very striking color change can be had by the bleaching action of sulfur dioxid on a wine-colored solution of potassium parmanganate.

Fill a cylinder with sulfur dioxid gas and cover it with a glass plate. In another similar cylinder prepare a dilute solution of potassium permanganate. Upon pouring the permanganate solution into the apparently empty cylinder of sulfur dioxid it will be immediately decolorized and changed to "water."

Bleaching Action of Perchloric Acid: To prepare perchloric acid arrange a retort and test tube as shown in Figure 4. In the retort place 5 grams of pure potassium perchlorate and pour on to it thru a funnel introduced into the neck of the retort 12 cc. of concentrated sulfuric acid. Heat gently with a small flame and a few drops of an oily, fuming liquid will distil over and can be collected in a test tube. This is *perchloric* acid.

Allow one drop of this acid to fall into a test tube containing 3 or 4 cc. of water. When this solution is added to a solution of indigo, the latter is immediately bleached.

Bleaching Cotton Goods: A solution for bleaching cotton fabrics can be made as follows: In a gallon of water dissolve 3 pounds of sodium carbonate crystals. Place this on a stove and boil for ten minutes. Then add the contents of a can of ordinary chlorid of lime. Stir the chlorid of lime into the hot solution and strain thru fine muslin or cheese cloth in to a large bottle. Keep this bottle tightly stoppered.

Into a kettle of white cotton goods which are to be bleached pour water and a small quantity of the prepared solution. Upon boiling, chlorin will be liberated and this is the active bleaching agent. Then thoroly rinse the goods and dry.

Bleaching Wool: One method of bleaching woolens makes use of sulfur dioxid as follows: Prepare a 5 per cent solution of sodium bisulfite and a one per cent solution of sulfuric acid. First wash the fabric in the bisulfite solution and follow it with the acid bath. This liberates sulfur dioxid in the fiber of the goods and this does the bleaching.

Sometimes the wool is simply washed and suspended in the atmosphere of sulfur dioxid obtained from burning sulfur. It is then washed in water containing a little bluing.

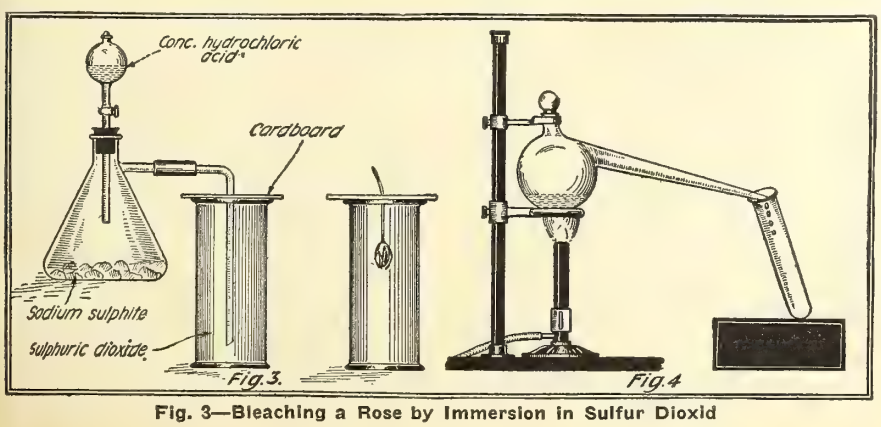


Fig. 3—Bleaching a Rose by Immersion in Sulfur Dioxid
Fig. 4—Generating Perchloric Acid for the Bleaching of Indigo.

(*The next installment will appear in the November issue.*)

How We Smell

By JOSEPH H. KRAUS



In the Upper Left Is Shown the Olfactory Bulb, a Process of the Brain Projecting Forward Which Lies Directly Above the Bony Roof of the Nose. Very Fine Nerves Passing from the Mucous Membrane in the Nose Penetrate the Bone and Enter the Bulb as Shown in the Middle Diagram and at the Bottom Is Shown the Way the Nerves Join or Anastamose with Each Other and Then Enter the Brain to the Region of Smell. At the Upper Right Is a Cross-Section Thru the Organs of Smell, Also Showing Sections of the Glands Which Secrete the Watery Content Found Therein. At the Lower Right We See the Nerve Cells with the Olfactory Hairs Upon Them as Brunn Describes Them. All These Organs Working Correctly Will Give Us a Keen Sense of Smell.

OLFACTORY or sense of smell sensations are rendered difficult of analysis because this function is so closely allied with the sense of *taste,* and because of the fact that it plays but a very small part in man's life. Before we delve into the realm of smell, let us first determine what the conditions of smell really are and just what an odor is due to.

Odors are emitted upon the vaporization of a substance which diffuses in the air, finally disseminating to the nose, where it strikes a number of cells in what the physician calls the olfactory epithelium (skin lining inside of the nose). The skin here is of a yellow color, mostly composed of cells having a peculiar column-like shape. But lying between these cells are also found a large number of spindle-shaped cells, otherwise known as *olfactory cells,* which consist of a bulb-like portion and a fine hair-like process called the *olfactory hair,* as shown in the illustration.

From the other end of the cell is seen the nerve which passes upward thru the bone into the skull and there trails into a projection of the brain called the *olfactory bulb.* The nerve in this bulb then couples with another nerve, which latter proceeds to the brain area of smell. The coupling of the nerves is clearly shown in the lower left corner of our illustration, and the olfactory bulb and how the nerves enter it is shown above this.

We have the lining of the nose or epithelium, so-called because of the nature in which the cells therein are arranged and classified. This lining is also and more aptly called a *mucous membrane,* because of the fact that it contains many glands which constantly secrete a watery-like substance and keep the lining in the nose constantly moist.

A small section from this mucous membrane cut transversely is shown in the upper right-hand corner of our illustration. The large peculiar shaped inclosures are sections of the glands and immediately above are seen the hairs and cells which associate with the nerves, thus giving us the sensation of smell.

According to Brunn, the olfactory cells are in reality *nerves* which have hair-like extremities. Up to the present time neither view has been definitely determined. So much for the anatomical part of this sense.

Let us now see how this function acts. Experimentaly we know that if a greater or smaller amount than normal of fluid should be present in the upper part of the nose, the sense of smell is very seriously affected, being impaired in both instances. Altho *the air which enters the nose rarely, if ever, passes any of the sensitive cells which lie near the top of the nasal cavity,* the readiness with which odorous substances diffuse in air enables us to determine their smell.

In other words, we can assume that the nose is similar to an hour-glass, and air constantly circulates in the lower bulb of the hour-glass. Ordinarily, no air can be forced into the upper part, but fine particles of the odorous substance will diffuse into this part and finally a *smell* is also noticed there.

Altho the following order is rather imperfect, smells seem to arrange themselves in the following manner: First—ethereal smells, these consist of fruit and other ethers, bees' wax and aldehydes. Second—aromatic smells, composed of spicy smells, camphor, anise, lavender, lemon, rose and almond smells. Third—balsamic smells, in which are included orange blossom, lily-like and vanilla smells. Fourth—the amber and musk set. Fifth—what are known as allyl cacodyl smells, in which class are found fishy smells, halogen (chlorine, bromine, etc.), and hydrogen sulfid. Sixth—burning smells, toast, tobacco, smoke and the phenols (carbolics). Seventh—caprylic ordors, in which class are cheese, sweat, etc. Eighth—repulsive smells comprised of narcotics and the odors of certain bugs, and Ninth—putrifying bodies.

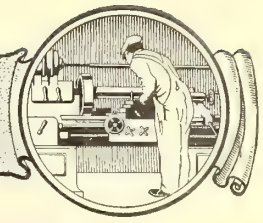
Certain individuals, however, are unable to detect any odor; many are unable to determine certain odors, chiefly vanilla and violet, and the third type have hallucinations of smell and are constantly smelling a certain type of odor. Generally this sense is very easily fatigued, but the effects of a certain odor when fatigue occurs, do not seem to affect the cells to such an extent that they will not notice other foreign odors.

Hence a person may be sitting in an inclosed room all day and never notice the foul air, but by an outsider it will instantly be perceived. An odor is also very easily disguised, and for that reason perfumes have come to have a predominant use the world over. Likewise a different odor presented to each nostril may completely disguise the effect, forming a non-odorous sensation or produce an entirely different sensation than those presented, our nose being

(*Continued on page* 690)



THE CONSTRUCTOR



How To Make a Simple Stereoscope

By DR. E. BADÉ



The Successive Stages to be Followed in Constructing the Home-Made Stereoscope Here Described by the Author, Is Clearly Shown in the Progressive Series of Photographs. The "Modus Operandi" of the Apparatus Is Shown Clearly in the Diagram at the Extreme Right. The Photograph or Picture to Be Viewed Stereoscopically Is Placed Under the Bottom of the Box Adjacent to the Opening Thru Which the Necessary Light for Illuminating the Picture Passes. The Eye Is Placed Before the Lens Opening, as Shown, and the Reflected Image of the Picture in the Mirror Mounted at an Angle in the Top of the Case Causes the Details and Objects in the Picture to Stand Out in Relief, the Same as in the Regular Double-Lens Spectroscope Requiring Special Duplex Photographs. The Present Instrument Uses Any Photographs or Pictures You May Have. Many Pleasant Hours May Be Spent with the Use of This Simple Home-Made Apparatus, Which Costs Practically Nothing to Build.

A SIMPLE one-lens stereoscope affords just as much pleasure and is just as instructive as a similar binocular instrument. The principal parts involved in its construction are a heavy cardboard box, an old or part of a broken mirror and a convex lens with a focus of about ten inches. The cardboard is cut as shown in the photo, the exact dimensions depending on the focus of the lens. The focus can be easily gotten by holding the lens against the sun, and measuring the distance between the lens and the smallest circle of light thrown upon a piece of paper.

The peephole, which is made ⅛ of an inch smaller than the lens so that a small strip of paper will glue it in place, is made at the upper part of the box and is about an inch below the focus of the lens. The mirror is attached to the slanting side and lies directly opposite the peephole. It should be attached at an angle of 45 degrees so that the line of sight is deflected to the bottom of the box. (See sectional view at right.)

After the mirror has been fastened with strips of paper, close the box and be sure to leave a large opening in the back at the bottom. When the box has been neatly finished, photos or pictures cut from magazines are placed in the opening at the bottom. If one now looks thru the lens the pictures will appear to stand out in relief. Only one picture of each subject is needed for this instrument.

Novel Electric Lamp Flasher

This flasher if constructed properly should light red, white and blue lamps consecutively, then extinguish and light all together, following which the same red, white and blue are flashed over again respectively.

This flasher is constructed as follows: Take a large cartridge fuse about two inches in diameter and two and one-half inches long between caps, as per Fig. 1. Holes are then drilled in the center of caps so that shaft can fit. Three strips of thin sheet copper or brass are needed, three-eighths of an inch wide, for each of the following lengths: 3 strips one and one-quarter inches, one two inches and one one inch. These are to be put on in the fashion illustrated in Fig. 2. The three strips one and one-quarter inches long should be fastened in line about one-half inch apart. These are laid over a strip connecting these strips to cap.

On the other side of the cylinder or fuse are fastened the other three strips. These are so fastened that when the cylinder rotates the three inch strips or red light is connected first, then the two inch, or white light, followed by the one inch or blue light, succeeding which all the lights go out at once.

These strips are also connected to cap. The fuse which is soldered to shaft by the caps, is supported on an axle or shaft with a support at each end connected with the binding post. Three more strips are used for brushes. These strips are not to be connected to each other in any manner.

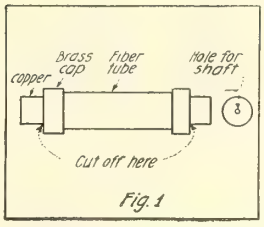


Fig. 1

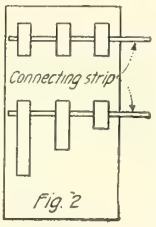


Fig. 2

A Very Effective Electric Lamp Flasher Is Shown in the Accompanying Drawing. It Is Made from a Discarded Fiber Fuse Shell.

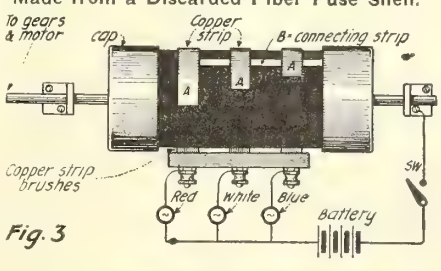


Fig. 3

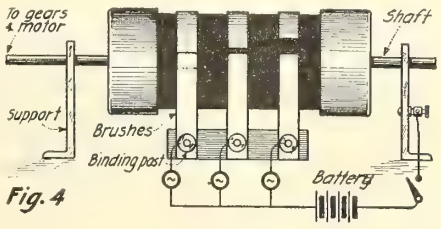


Fig. 4

They are fastened to a small fiber block by the side of the cylinder. The cylinder is rotated by means of a small electric motor operated on two batteries with a worm gear on its shaft and a small gear wheel on the shaft of the flasher.

A small rheostat is used to regulate the speed of the motor. The worm gear, shaft and gear wheel from a Mysto erector set work very well. There are three 3½-volt colored lamps used, red, white and blue respectively. The connections are shown clearly in the diagram. The flashing mechanism can be put in a small box and the lamps in a store window or on the wall. This makes an attractive little patriotic display which no doubt will win the approval of everybody.

The detail and general idea so far outlined for constructing a novel electric lamp flasher from a discarded fiber fuse tube, is just the beginning of a whole host of practical ideas which the electrical experimenter or embryo electrician will be able to readily work out. Some of the prettiest effects imaginable are readily obtainable at little expense by means of home-made switch flashers of this type. The flasher drum need not be driven by a battery motor, if you are using battery power to light the lamps, and thus exhaust the battery owing to the notoriously low efficiency of battery motors,—but instead, the switch drum may be rotated by an old alarm clock spring motor or by any other form of mechanical motor.

Contributed by HAROLD L. OSTERBY.

Building "Your Own" Phonograph

PART 2

IN the first part of this article describing how to build your own phonographs, the important details of motors and speed regulators, as well as sound chambers or horns, were described in complete detail. In the present article, we will concern ourselves with one of the most vital parts of the talking machine, namely, the tone-arm and reproducer, or, as it is sometimes called, the *sound-box*. In this category also comes the consideration of modulators or sound mufflers, for regulating the strength of the sound transmitted thru the horn or amplifying chamber to any degree desired.

Full Details Describing How to Build Tone Arm and Reproducer

THE SIMPLEST REPRODUCER.

For those interested in the experimental side of phonography, reference may be had to Fig. 1, where two of the simplest talking machine reproducers are illustrated. The one at the left comprises an ordinary wooden shingle, the harder the wood the better, and in one corner of which is pushed an ordinary steel phonograph needle. The writer has tried this with very interesting results, the entire shingle vibrating with sound and giving very articulate reproduction of the music. The shingle may be held between the fingers at the upper corner, or else suspended and balanced carefully on a thread or string, when it will be found that the groove on the record will propel it across the latter as the turn-table rotates.

One of the earliest forms of reproducers and sound amplifiers is that shown at Fig. 1, and this may still be found on some of the cheap phonographs sold on the market today. Here the horn is suspended or pivoted so as to move freely across the record when propelled by the needle in the groove, while the diafram, composed of mica or fiber, etc., is firmly clampt between two rings, or else spun into a ring, at the smaller end of the horn. A suitable stylus arm is usually fitted in the manner shown and standard needles are used.

SPEAKING OF TONE-ARMS.

Figures 2, 3, and 4 show three distinct, yet different, ideas in the construction of tone-arms. One of the most important features to be watched in any phonograph tone-arm is *the weight exerted on the stylus needle,* and in turn upon the record groove. This must not be too great, or the records will soon become "choppy," owing to the breaking up of the grooves, and also due to wear and scratching. Some tests made on a number of standard phonographs by the writer, brought out the following facts, which will be of interest to all phonograph enthusiasts, whether for operating a standard machine, of which there are 40 or 50 different makes and more on the market just now, or building one of their own.

The average pressure exerted on the stylus needle of the best commercially built phonographs today, such as the Victor and Columbia, is about 4½ ounces; as these companies have spent a "King's ransom" in perfecting the phonograph to its present stage, we can rest assured that with standard records, this is the optimum pressure and one which should not be exceeded, except by a small amount in certain cases, perhaps.

Where an extra large sound-box is used with a large diafram, say, one having a diameter of 2¾ inches, as is the case with several commercial machines, the excessive weight exerted on the stylus and on the record may be counterbalanced with a counter-weight or else by a spring fastened to the base of the tone-arm and arranged so as to counteract the pressure, which in one case measured 8 ounces, so that eventually the pressure on the stylus when measured by a postal scale placed under it, measured but 4½ ounces, the average standard pressure.

At Fig. 2 is shown the extreme simplicity of the Columbia tone-arm, which provides the usual two degrees of movement, that is, vertical and horizontal. The moving joints are made to have a very good mechanical fit, and the degree of movement is limited by a set screw threaded thru the outside collar, usually, and the tip of this screw caused to move back and forth in a slot in the smaller end of the arm in each case—all of which is clearly shown at Fig. 2. This diagram also shows the horizontal movement A-B of the tone-arm when the latter is centrally located with respect to the turn-table on the average machine. As will be seen, this movement is not so great as might be imagined, and simplifies the construction of the arm if you are building one yourself.

A standard form of tone-arm which is sold by many of the phonograph houses supplying parts for the building of home-made machines, is shown at Fig. 3. With the Victor and Columbia machines, it is not possible to reverse the sound-box or throw it over as in some of the other machines, in order to play *hill-and-dale* records such as the Pathé. However, there has recently been put on the market several attachments, selling as low as one dollar, with a saffire ball complete, by which Pathé or other *hill-and-dale* records can be played on a Victor or Columbia machine. Several of the machines on the market, including those fitted with the tone-arm of the type shown at Fig. 3, play any style of record. The two positions of the sound-box and needle holder are shown clearly in the figure. When playing hill-and-dale records, a round saffire ball point must be used, and this costs but sixty cents and fits in any standard needle holder.

A saffire ball possesses the advantage over the pointed steel needle in that it will play as many as 1000 records, without scratching or injuring the record surfaces, as a scientific test of the stylus of this machine has demonstrated. A new steel needle should be used for each record, or one needle used for playing the two sides of the record; and if you should want to be real careful about it, it is best to preserve your record by using a new steel needle for playing each side.

The construction of the tone-arm illustrated at Fig. 3, is evident from the drawings. The diameter of the throat at the base of the tone-arm where it fits over the opening in the wooden shelf, is about 1¾ inches on the average, and from this diameter it slowly tapers or decreases downward to the point where it enters the sound-box, and here it may have a diameter of about ½ inch to ⅝ inch. In the Columbia and Victor tone-arms, the arm itself is made of drawn metal, usually brass, and expands progressively from the sound-box to the base of the arm. The trouble with a great many of the cheap tone-arms is that they are made of cast metal, and also their joints are poorly fitted. The greatest criterion whereby to judge the efficiency of any tone-arm, no matter of what make, as pointed out by Prof. D. C. Miller of the Case School of Applied Science, of Cleveland, in a recent conversation with the writer, is that it shall be *thoroly air tight,* in order that the vibrations set up by the column of air within it shall undulate, swell and amplify as they progress down into the sound chamber in a faithful and natural manner. This cannot be the case when there are bad *air leaks,* due to poor joints along the length of the tone-arm at any point, and on certain notes, harmonics may make their presence severely noticeable, or, in other words, some of the notes will be harsh or perhaps "flat", depending upon the position of the leak hole and the record being played.

One of the latest developments in tone-arms are those made entirely of wood, which gives a very faithful and mellow reproduction, especially on musical selections. These are supplied on one of the best commercial machines and are also available from phonograph parts companies. Due to their weight they should be mounted in ball bearings in all cases, at their base, and if necessary be very careful and keep it balanced so as not to exert excessive pressure on the stylus or needle. If you are ingenious, you can make one yourself out of good hard wood such as mahogany or walnut. The method used in one commercial tone-arm for swinging the reproducer over and off the record by means of a tubular valve is clearly shown at Fig. 4. The position of the ball bearing ring at the base of the pivot tone-arm, when used, is also indicated.

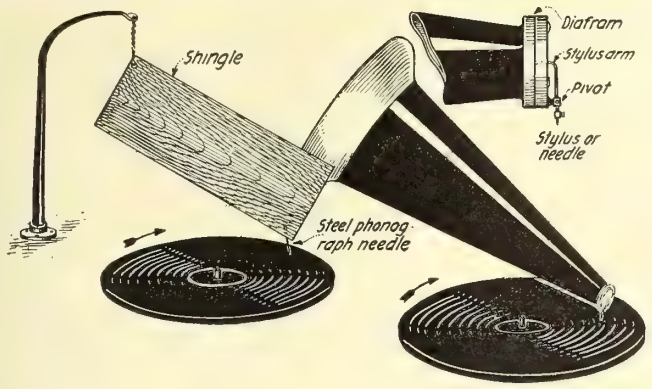
CONSTRUCTION OF SOUND MODULATORS.

Three distinct and more or less efficacious types of *sound modulators* or *mufflers* are shown at Fig. 5, A, B and C. The one shown at A is used on several machines, including the Conried phonograph. It is simply a sliding valve affair, the valve being made of a piece of wood with a circular hole cut thru it. Sliding this hole into register with the tone-arm and sound amplifier chamber gives a maximum sound, while if this valve is moved to the right, the opening becomes smaller and smaller until the sound is a minimum. Movement of the valve is transmitted thru a small metal rod with a button on it, extending thru to the outside of the cabinet.

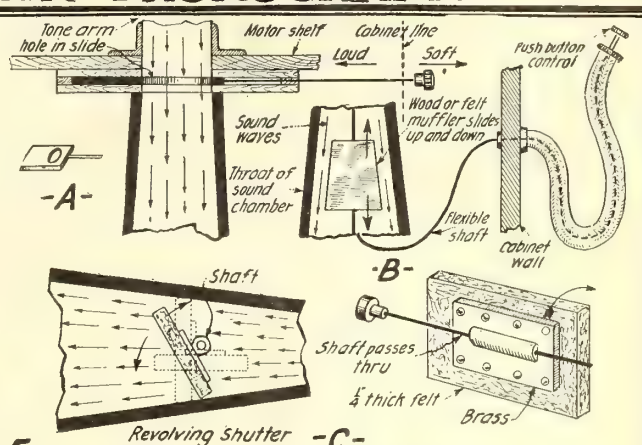
The arrangement shown at "B" is used on one of the well-known commercial machines, and those desiring to have a flexibly controlled cord, three to four feet long, extending from the side of the phonograph cabinet so that they just push the button on the end of the cable and modulate the tone, can utilize this or a similar principle. A flexible shaft explains the way this trick is worked, the inner end of the shaft moving the wooden or felt covered conical plunger or valve up and down in the throat of the amplifying chamber; when this valve is all the way up, it blocks off the chamber completely. This style of valve has the advantage that it reduces the area of the sound chamber evenly in any position and not unsymmetrically or all on one side as is the case at A.

(*Continued on page* 698)

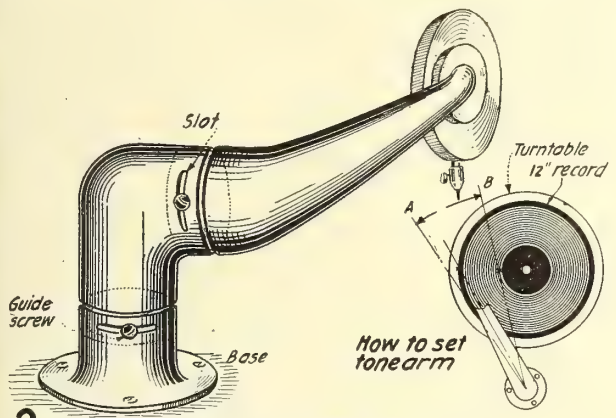
HOW TO MAKE "YOUR OWN" PHONOGRAPH



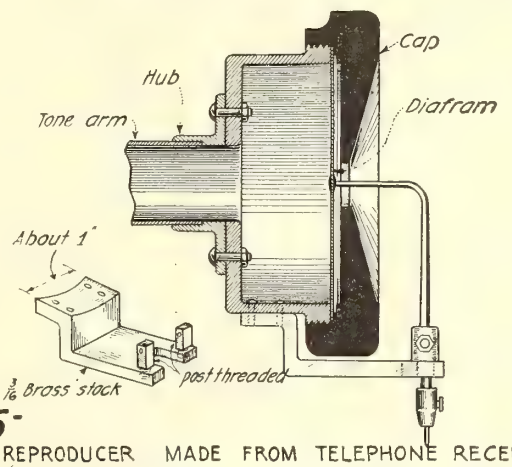
-1- SIMPLE REPRODUCERS



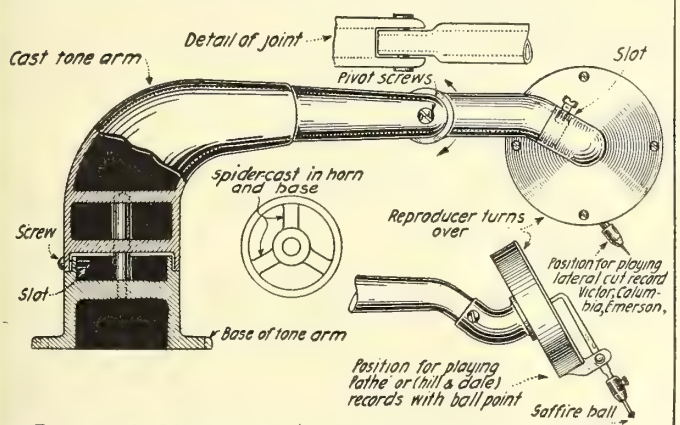
-5- THREE TYPE OF SOUND MODULATORS



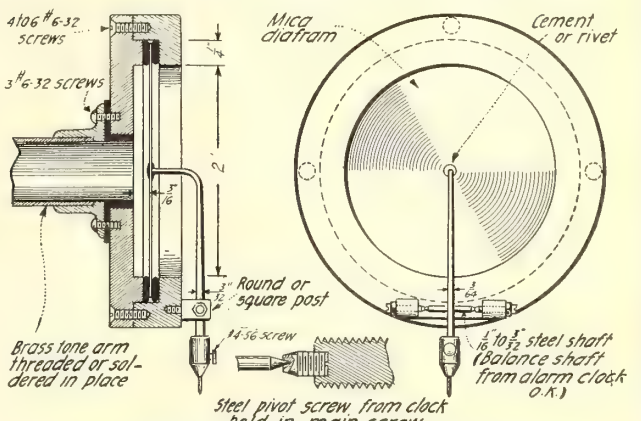
-2- HOW THE COLUMBIA TONE ARM WORKS



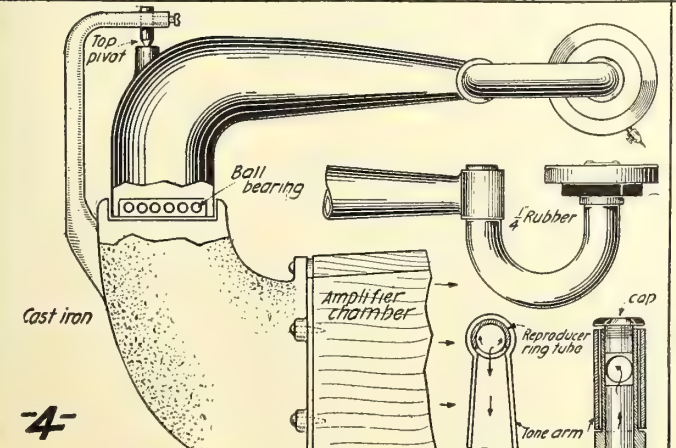
-6- REPRODUCER MADE FROM TELEPHONE RECEIVER



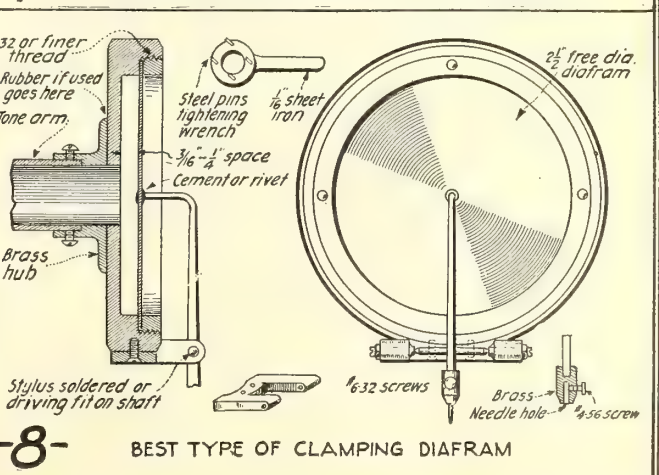
-3- STANDARD TONE ARM FOR PLAYING ALL RECORDS



-7- STANDARD METAL TYPE OF REPRODUCER



-4- BALL BEARING TONE ARM AND ARRANGEMENT OF VICTOR REPRODUCER

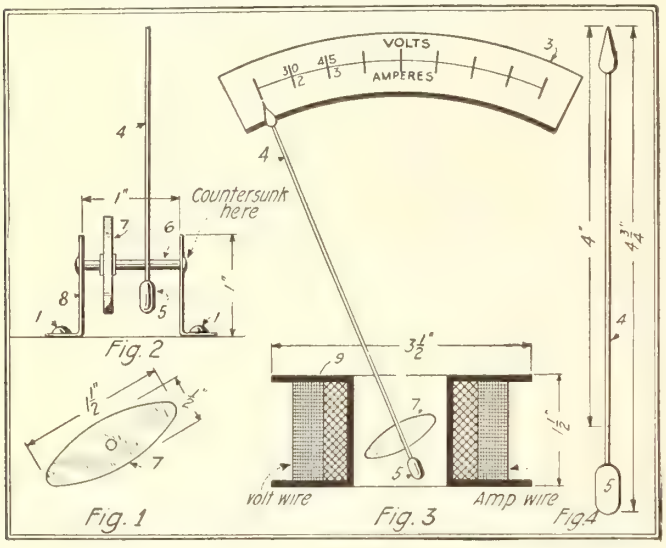


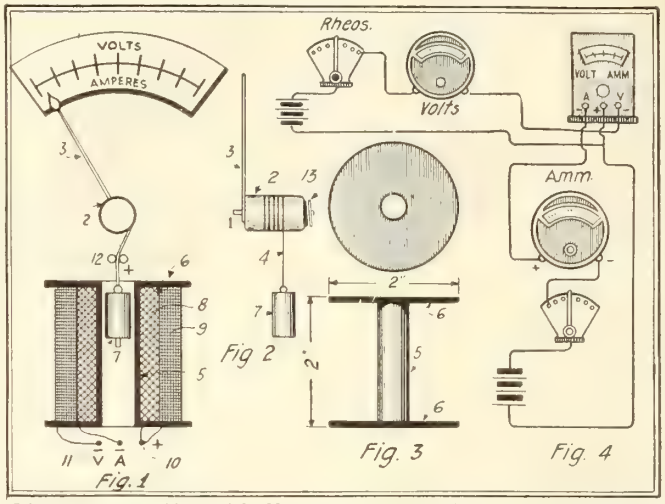
-8- BEST TYPE OF CLAMPING DIAFRAM

A Home-made Volt-Ammeter

By EVERHART TURNER

Here is a description of my home-made volt-ammeter. For the first type a brass box is made for the windings, top and bottom ends, 1½" x 3½", as shown in Fig. 3; the inside portion to fit core is 1" x 1¾" and 1" deep. When finished it is first wound with three layers of bell wire. When that winding is complete, a coat of shellac is applied and when dry five layers of No. 38 cotton-covered magnet wire is wound, leaving about five inches of wire for connection as shown in diagrams.





The Diagrams Herewith Show How to Build Two Distinct Types of Volt-Ammeters. These Instruments Possess the Distinct Feature of Simplicity and Very Good Accuracy For All Experimental Requirements, Especially if They Are Carefuliy Calibrated With a Standard Meter.

It is then tested with a compass and the negative end of the coil turned down. The hand is then made of aluminum 4¾" long with a piece of brass, No. 7, fastened at the end, ¾" up from the weight 5. An axle is soldered in place. This axle must be made of aluminum, No. 6, 1" long and 1/16" in diameter. On the axle a brass. There are two supports 1" high and 1" wide, countersunk on both sides so that the axle 6 will swing easily between them. It is then placed in the middle of the coil as shown in Fig. 3 and held in place with two brass screws, No. 1. It is put in a suitable box and three binding posts connected to it as shown in the diagram. The meter is then ready for calibration, as plainly shown in Fig. 4, for design No. 2.

VOLT-AMMETER NO. 2.

Here is the description of volt-ammeter No. 2. First we make a bobbin; Fig. 3 clearly illustrates the same. The ends are of hard rubber No. 6 and the brass tube, No. 5, is then fastened in place. It is wound with two layers of bell wire and on top of that we wind five layers of No. 38 gage insulated copper magnet wire. It is connected to the proper binding post as shown in Fig. 1. The roller is constructed of wood and placed on the axle. The hand is placed on the front of the roller. It is made of aluminum and is 4" long as shown in Fig. 2. A spring No. 13 is fastened to the roller to hold it in place and to register on zero when no current is applied to the meter. A piece of silk thread is placed on the roller No. 4 and fastened to it. On the other end a piece of steel No. 7 is fastened. It is then placed in a box and two pins are fastened in place to guide the thread and weight into the core hole. The apparatus is then ready for calibration as shown in Fig. 4. The diagram is all that is necessary for the instruction.

Making a Hand-Type Telephone

By JORDAN BAUER

I give herewith a description of a hand-type telephone, which can be made with the help of a small wood lathe, or, if a lathe is not available the shells and flanges may be made square instead of round in shape.

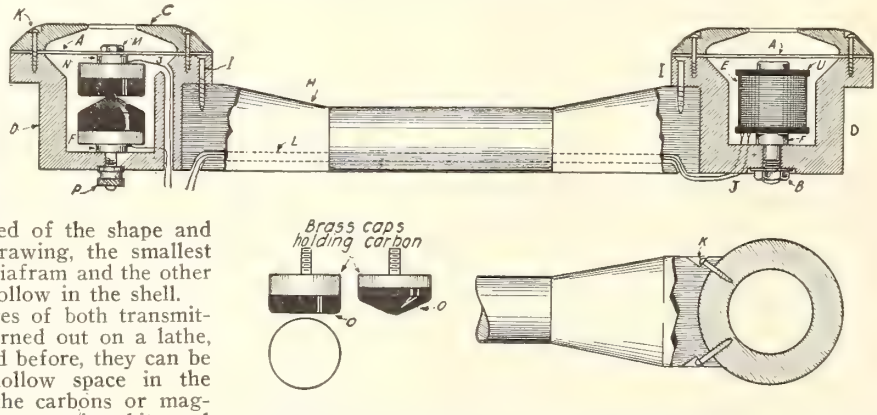
The diafram of the receiver is made of tin-type tin, while the diafram of the transmitter is made of either tin-type tin or mica.

In making the transmitter instead of using carbon granules the tops of two old battery carbons are used of the shape and size of those in the drawing, the smallest being attached to the diafram and the other to the bottom of the hollow in the shell.

The shells and flanges of both transmitter and receiver are turned out on a lathe, or, as I have mentioned before, they can be made square. The hollow space in the shell, which contains the carbons or magnet, is made with an extension bit, and should be large enough to hold the carbons or magnet without touching the sides and deep enough so carbons or magnets fit as illustrated in the drawing.

The core of the magnet is made of an annealed iron bolt with fiber washers spaced ¾ inches apart, the bolt being about 5/16 in. in diameter; a magnet of this size should be wound with 375 ft. of No. 33 B. & S. gage wire, which gives 75 ohms resistance (the right resistance for a telephone receiver). This wire should be insulated. The finished magnet is attached with a rubber washer between it and the shell as shown in the drawing.

The handle connecting the transmitter and receiver is made entirely of wood.



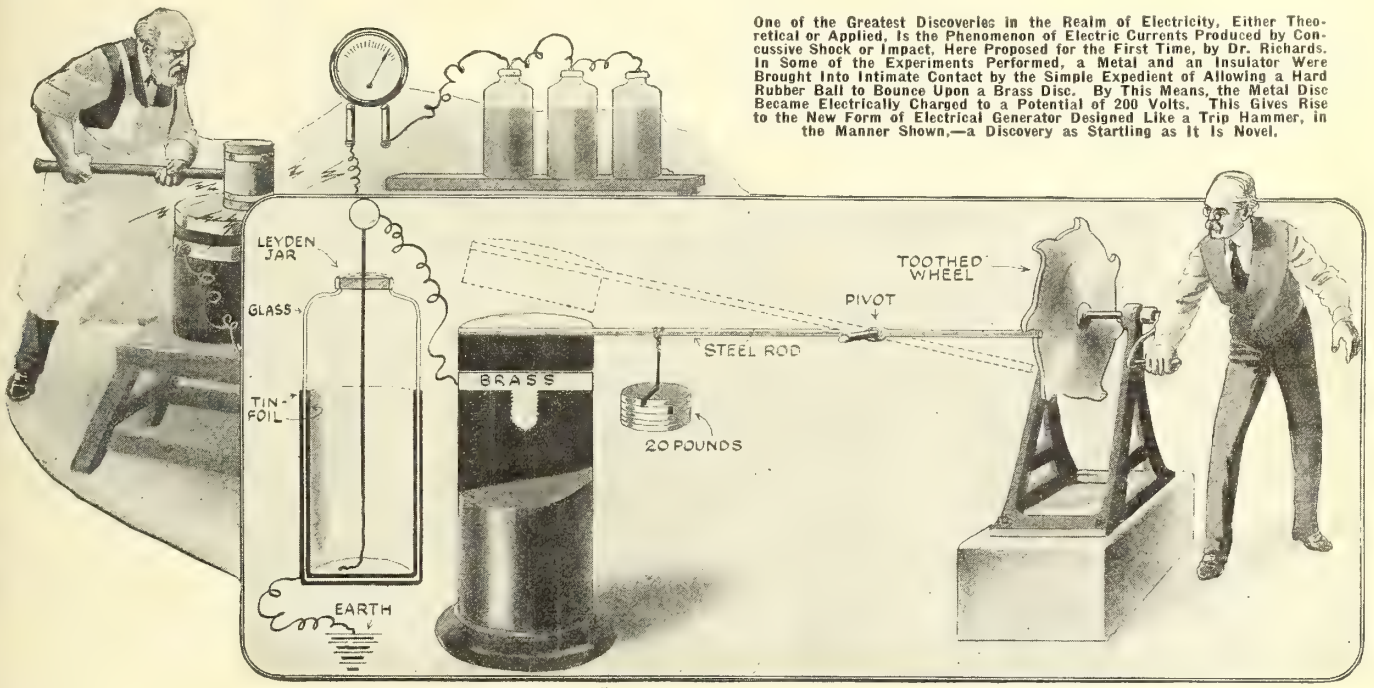
We Often See the Hand-Type Telephone Similar to That Used in European Countries, But the Experimenter Does Not Usually Care to Pay the Price Asked For This Type of Instrument. The Writer of the Present Article Shows a Clever Way to Build This Type of Telephone, Complete With Microphone and Receiver, All From Wood. Here is the Way to Build Such a 'Phone in a Very Simple Manner. The Simple Carbon Microphone Shown May Be Used, But Best Results Are Invariably Obtained by Using Standard, Polished Carbon Granules in a Carbon Cup, as Shown in All Telephone Hand-Books.

For carrying on conversation, two of these hand-type telephones of the pattern illustrated and described are used. To make a first-class job of this instrument, the microphone should be made somewhat after the fashion of the standard types with which the reader is undoubtedly familiar, or which can be found described in any telephone handbook. One of the principal things which the young telephone experimenter will find when building his own telephone apparatus is that it does not pay to monkey around with "crushed" carbon particles. Buy some polished carbon granules from telephone or electric companies.

Hammering Electrons Out of Matter

By HAROLD F. RICHARDS, Ph.D.

STRANGE it is that the oldest known electrical phenomenon is the last to be explained. The spinning wives of ancient Phoenicia knew that their amber spindles, rubbing against feminine garments, generated a strange power by virtue of which they clutched up threads and leaves as if by invisible talons. As early as 1730 the Wizard Bose set up in Germany a huge glass globe revolved rapidly against leather pads, and with the electricity thus generated knocked over at one crash twenty of Frederick's best soldiers. He invited guests to a banquet table, and filled them with amazement as they saw electric flames break forth from every dish and flower and wine glass. He had insulated the table on cakes of pitch and connected it to his enormous friction machine operating in an adjoining room. He introduced his guests to a fair forerunner of Theda Bara, whom he had insulated with rubber soles and electrified with his friction machine. When a handsome gallant essayed to kiss the lady's enticing lips, the electric shock which he received must have caused him to conclude, as Kipling did later, that "the female of the species is more deadly than the male."



One of the Greatest Discoveries in the Realm of Electricity, Either Theoretical or Applied, Is the Phenomenon of Electric Currents Produced by Concussive Shock or Impact, Here Proposed for the First Time, by Dr. Richards. In Some of the Experiments Performed, a Metal and an Insulator Were Brought Into Intimate Contact by the Simple Expedient of Allowing a Hard Rubber Ball to Bounce Upon a Brass Disc. By This Means, the Metal Disc Became Electrically Charged to a Potential of 200 Volts. This Gives Rise to the New Form of Electrical Generator Designed Like a Trip Hammer, in the Manner Shown,—a Discovery as Startling as It Is Novel.

WHY RUBBING PRODUCES ELECTRICITY.

Since the days of Bose, induction, X-rays, radioactivity, wireless and countless other electrical phenomena have been discovered and, after a fashion, explained, yet at the present time electrification by friction is little understood either by scientists or by laymen. Many people believe that friction will produce electricity upon only a few substances, such as amber, glass and hard rubber, but the fact is that *any* substance will be electrified if rubbed with any *other* material, provided only that one of them is an *insulator*. Whittling a pencil, sweeping the floor, grating chocolate, polishing furniture and bowing the strings of a violin all generate electricity. Even metal can be electrified by friction if it is held by an insulating handle and rubbed with a dry insulator, as silk, leather or rubber.

Until recently scientists themselves have been almost as much at sea as the public regarding the nature of electrification by friction. It is well known that if two *dissimilar metals* are placed in contact, and then separated, they will be found to be electrically charged, *even if they have not been rubbed together*. The difference of potential is in some instances nearly a volt. It was formerly held that this electricity was due to a chemical action occurring between the two metal surfaces and whatever gas they had absorbed from the air, just as in a primary battery, and there are many who still entertain this view. At present, however, the electrical energy of this *contact effect* is considered by most writers to come from the motions of the *free electrons*, which are in a vibratory state inside the metals. These are the same electrons whose free motion in metals, under the action of an applied voltage, constitutes the electric current, which produce X-rays by their collision with the target in a Coolidge tube, and which are known as beta rays when they are spontaneously shot forth from radium. If copper, for example, has more free electrons in a cubic inch than zinc, there will be a greater *electron pressure* in the copper than in the zinc, and, if these two metals are placed in contact, electrons will pass from the copper to the zinc, so that the copper will become positively charged and the zinc negatively. This diffusion will continue until enough negative electricity has accumulated on the zinc to repel any more electrons that may be urged towards it by the electron pressure. Since the substance which possesses the greater concentration of free electrons is the better electrical conductor, a metal always becomes positively charged when placed in contact with a metal *that is a poorer conductor than itself*.

Attempts have been made to apply this same theory to the problem of the electrification of insulators by friction, on the assumption that the rubbing merely serves to bring the molecules of the two substances *into closer contact*. The electrons in an *insulating* substance do not move freely, so that the rubbing is necessary to bring the two surfaces sufficiently close together to permit the passage of electrons from one to the other. According to this view, a metal ought always to become positively charged when rubbed with an insulator, for the metal has an enormously greater number of free electrons than the insulator, and, therefore, ought to lose electrons to the latter. But experiments have shown that this is not always the case, and the results are clouded by erratic variations, so that certain experimenters have concluded that electrification by friction is entirely different in nature from the contact electricity of metals, and the view has been advanced that in some manner part of the energy of friction is *directly transformed into electrical energy*.

It occurred to the writer that this puzzling question—why rubbing produces electricity—might be answered if *another means* could be found of obtaining on the same surfaces an electrical charge of the same magnitude as that due to friction. The problem seemed to resolve itself into the question of finding whether there is a *natural tendency* for a metal to give up electrons to an insulator. If the electron, or *contact*, theory of frictional electricity was true, it seemed evident that if we could get the two substances, say a piece of brass and a piece of hard rubber, sufficiently close together, then it ought to be possible to obtain the same electrical charges *without friction* as are obtained *with friction*. If this effect could be found, then there would no longer be any doubt that electrification by friction is of exactly the same nature as the contact electricity of metals, and the electron theory of the constitution of matter and electricity would be further strengthened.

POUNDING ELECTRICITY OUT OF MATTER.

In order to test the truth of this idea,

(*Continued on page* 656)

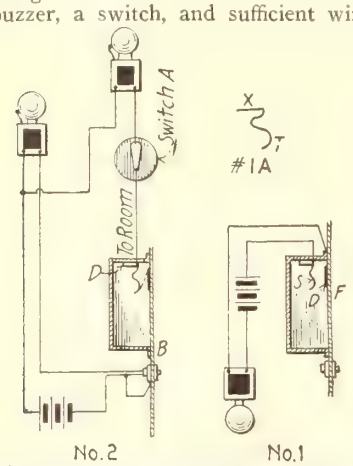
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; Second Prize, $3.00; Third Prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

AUTOMATIC "MAIL" SIGNAL.

All that is necessary is a flat brass or German-silver spring about 2 or 3 inches long and about ⅛ inch wide, a vibrating bell differing from the sound of the house bell, or buzzer, a switch, and sufficient wire to



The Accompanying Photograph Shows In Detail the Method for Constructing An Automatic Signal for Notifying One That Mail Has Been Dropt Into the Letter Box.

reach from the letter box to the room where bell is to be installed.

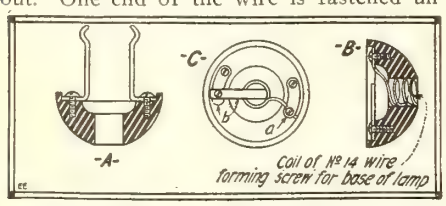
The spring is bent as in Fig. 1A with two holes as in 1B. The spring is then fastened to the top of letter box as in Fig. 1 at S, with end T (Fig. 1A) 1/16 inch from drop shutter D. When the shutter is pushed in the circuit is closed.

Fig. 2 shows how to connect alarm on house battery. The house button battery wire is grounded to letter box frame B. A wire is then run from spring D to switch A, which may be conveniently placed next to door-opener push button. Switch A is connected to one binding post of special bell. The other binding post is connected to corresponding binding post on house bell.

Contributed by LOUIS J. ALBERT.

MINIATURE LAMP SOCKET FROM SEPARABLE PLUG CAP.

Herewith is a description of a lamp socket made from a separable attachment plug cap as shown at A. One of the lugs is cut off and the other is bent down, as shown at B. A piece of No. 14 copper wire is coiled around the base of the lamp so that the lamp may be screwed in and out. One end of the wire is fastened un-



This Lamp Socket Is Made From a Separable Attachment Plug Cap, Full Description of Which is Given in the Above Article.

der a screw head as in B. C shows the bottom view of the completed socket. Connecting wires are fastened under screw heads A and B.

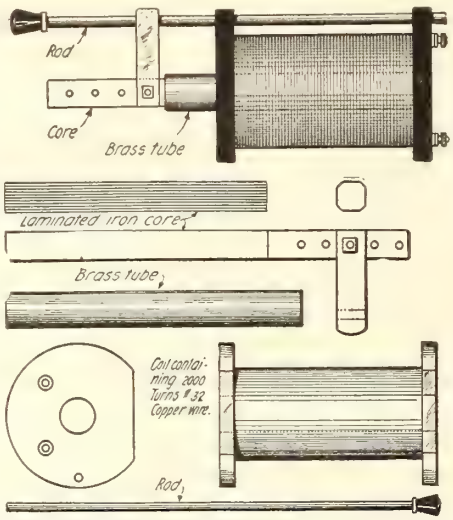
Contributed by HORACE R. BROKAW.

SECOND PRIZE, $3.00

YALE LOCK DOOR OPENER.

The accompanying drawings show a very simple and accurate method of constructing a magnetic door opener for door equipt with a Yale lock. Procure a piece of brass tubing 6 inches long by 15/15 inches. Two pieces of wood cut as per drawing one—the straight side to fasten on door and to be screwed on. Let brass tube extend 2 inches outside of spool on one end. Make iron core from old bail band iron or stove pipe, using fifteen pieces and extend same out 1½ inches with holes.

Rivet all together and file to fit tube, putting long strip with holes in center or core. Make rod out of old No. 4 wire. Use a rod between the core and iron. An old dry cell nut may be employed. Make hole in wood block large enough to slide freely on iron rod. Use No. 32 cotton covered wire; put on 2,000 turns. First wind on 1,000, then give a coat of shellac. Let dry for ten hours, then shellac again. Finally cover with black paper.



By the Use of the Magnetic Door Opener Here Shown, It Becomes a Simple Task to Open Any Door Fitted With a Yale Lock.

Bore 3/6-inch hole in finger bolt of lock at bottom and ½ inch to right of center. Put in wire hook. Tie strong string to holes in core. For binding post use old dry cell binding post. Wind all wire in the same direction. Then hook on 110-volt line. Wire to door bell.

Owing to the simple construction and low operating cost of this magnetic Yale lock opener, it ought soon to win popularity. Those desiring to use this magnetic door opener on battery current, can wind it with considerably heavier wire in order to adapt it to the lower voltage. If the spool is wound full with about No. 22 B. & S. gage cotton covered or enameled magnet wire, it will give a good strong pull on 8 to 10 volts battery current. The pushbutton for controlling the solenoid can be located wherever desired.

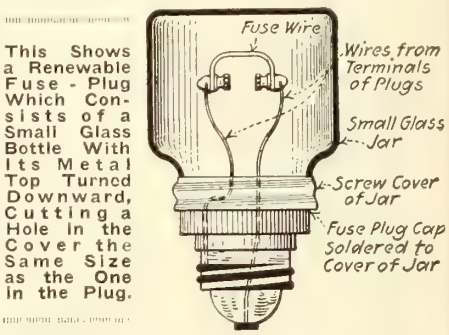
I have used one like this for two years and have found it very satisfactory.

Contributed by BERNARD McGEE, E.E.

THIRD PRIZE, $2.00

A "RENEWABLE" FUSE PLUG.

Take a fuse plug that has been burned out and carefully remove the brass cap, mica and pieces of wire. Now get a small glass jar with a screw top. One that has contained vaseline will do very well. Cut a hole in the cover the same as the one in the cap of the plug. Solder the cover



to the cap as in the drawing. Solder two pieces of well insulated wire to the terminals of the plug as shown and slip the brass cap and cover over them and fasten as originally. Now solder two of the zinc binding posts of a dry cell to the free ends of the wires and connect them with a piece of fuse wire of the desired size. Screw in the glass jar which acts as a cover and use as an ordinary fuse plug. When burnt out, put in a new piece of fuse wire. 'At's all!

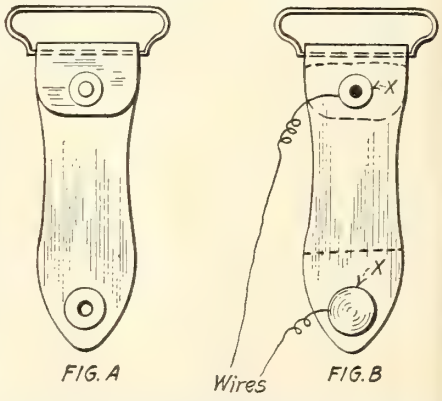
Contributed by O. P. MEAKER.

"SNAP" SWITCH FROM OLD SUSPENDERS.

The accompanying drawing shows a simple snap switch, with the accent on the simple, made from parts of an old pair of suspenders, and which I have found very handy in connecting wire to various instruments, etc.

Fig. A shows part as taken from suspender. In figure B leather part is cut out along dotted lines, and wires are soldered to metal parts at points X. To connect circuit, snap one to the other. It's a snap!

Contributed by JOHN J. SPAULDING.



This "Snap Switch" Consists of a Wire Connected to Each Suspender Button, the Dotted Lines Indicating the Points Where the Leather Is Cut Out.

$10.00 Prize—"Perpetual Motion" Again

By A. d'ABRO

IN your February issue you publisht different answers to your "Perpetual Motion Prize Contest."

The first prize is allotted to Mr. Burgin, who claims that your first perpetual motion device will not work because of the buoyancy of the rubber chambers being the same on either side.

According to Boyle's law, this would mean that the pressure of the imprisoned air is the same whether the weight be crushing the rubber cylinder down or whether it be stretching it lengthwise.

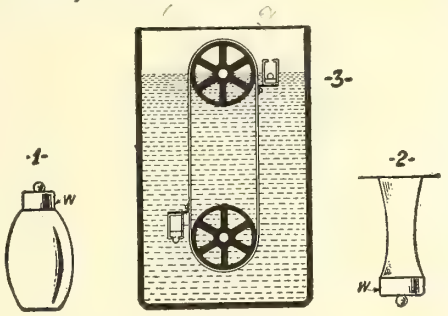
Surely this is incorrect. Assuming that the cylinders contain air at atmospheric pressure and are immersed in the atmosphere, when the weight presses down the top of the cylinder the walls bulge out and the cylinder assumes the form of a barrel—when a state of equilibrium is reached. (See Fig. 1.)

The pressure of the imprisoned air on the top surface of the cylinder is sufficient to counteract the push of the atmosphere, plus the push of the weight—thus the pressure of the imprisoned air is increased.

On the other hand, when the weight is suspended at the base of the cylinder the tendency is to lengthen the cylinder; thus increase the volume of the imprisoned air and decrease its pressure. (See Fig. 2.)

The outside atmosphere will push in the walls of the cylinder and create a waist. Finally, when a state of equilibrium is reached, the interior push on the bottom of the cylinder will be equal to the atmospheric push on the bottom, minus the weight, thus the interior pressure is reduced.

I am assuming for simplicity's sake that the bottom and top of the cylinder are rigid and only the walls elastic.



Three Phases of the Recent Perpetual Motion "Water-Bucket Machine" Which Formed One of the Problems of the Prize Contest Some Months Ago. Mr. d'Abro Offers a Ten Dollar Prize ($10) to Anyone Who Can Give a Successful Explanation to the Questions He Here Propounds. All Answers Must Be in the Editor's Office by October 15, 1920.

In short, according to Boyle's law the buoyancy cannot be the same on both sides and the device must rotate—and yet, of course, it will not!

May I suggest a slight modification of your highly ingenious device? Instead of rubber pockets let us consider metallic cylinders in which pistons can run without friction, and let us fix the weights to these pistons and place rings at the extremities of the cylinders to prevent the pistons from slipping out. Let us suppose that the cylinders contain no air, and let us place the device in water.

When the weights press down the pistons toward the bases of the cylinder, the pistons will come in contact with the bases of the cylinders, since no air is interposed—when the weights pull the pistons down away from the bases of the cylinders the pistons will glide down to the other extremities of the cylinders until arrested by the rings. (See Fig. 3.) To obtain this result it will be necessary for the weights to be of sufficient magnitude to overcome the cumulative effect of the atmospheric pressure, plus the hydrostatic pressure—theoretically, at least, this is possible.

In this modified form the increase in volume and thus of buoyancy of the cylinders is manifest, and the device should undoubtedly rotate. If not, why not?

Could any of your readers explain the reason? I hereby offer a ten dollar prize for the best answer.

(ED. NOTE.—*Mr. d'Abro has deposited the* $10.00 *prize money with us. Send all letters of explanation to Perpetual Motion Editor,* SCIENCE & INVENTION, *233 Fulton St., New York City.*)

Cutting Clock Gears

Being a "Bug" from way back, I am very much interested in the "How to Make It" department of your paper. Making an Electric Clock interested me considerably, since I made a Grandfather's clock some years ago. Even the wheels I cut, and the method I used is very simple, and if any of the other "Bugs" will follow my way of making them they will be pleased with the result, I am sure. I will say, to start with, that I have a lathe, one made by "yours truly," every bit of it, slide rest and all. It is not a beauty, I admit that, but it is rigid and the live center is true and in the right place, the most important thing.

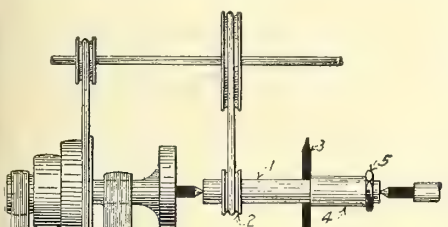


Fig. 2.

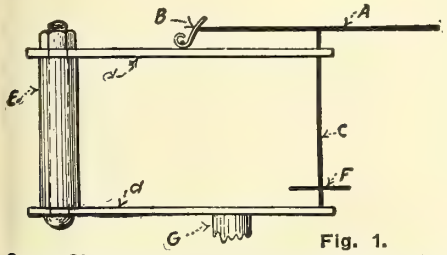


Fig. 1.

Some Clever Ideas Are Presented in the Accompanying Article by Mr. Richards, Describing How to Cut Home-Made Clock Gears. A Small Lathe Is All That Is Required in Order to Perform This Work in a Creditable Manner.

From the family gas stove I took a round sheet-iron plate, seven inches in diameter, secured it to the face-plate and turned it true and drilled a ⅜-inch hole in its center. I drew a line across the plate thru the center, dividing it into two halves; on one of the halves I placed a protractor, carefully clamping it in place, and cut 180 notches in the rim, repeating the same operation with the other half. Now I had a guide plate with 360 marks; this plate will guide the cutting of any wheel from a grandfather's clock down to a one-flea-power wrist-watch.

Fig. 1-A represents the guide plate. B is a spring resting in a notch in the edge holding it rigid. C is an arbor moving freely in supporting arms. At d, d, are two short pieces of flat iron connected rigidly at E, by a bolt run thru a gas pipe five inches long. F is the block screwed securely to C, this whole guide frame to be fastened to tool post at G.

Fig. 2. This shows the cutting device. 1 is a piece of round iron 5 by 1 inches centered and turned true; a small wooden pulley is fastened at 2. The cutting tool, 3, is a piece of 3/16 round tool steel, 2½ inches long, filed flat at one end and then very carefully filed to the shape of a tail, hardened and tempered to a pale straw color. A 3/16-inch hole is drilled thru arbor with a loose sleeve, 4, forced against the tool by a nut, 5.

With a countershaft and two pulleys as shown a speed of several thousand revolutions per minute is easily obtained; the faster it runs the better it cuts. Feed slowly.

I bought sheet brass ⅛ inch thick for the big power wheel and a little less for the others. I cut a square with a hack saw, fastened the corners to the face plate and turned the blanks round.

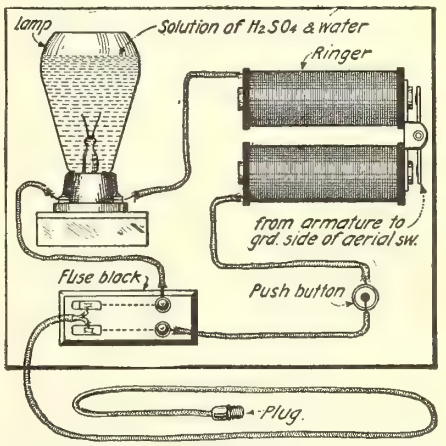
The escape wheel is three inches diameter, thirty teeth, controlled by a seconds pendulum. The hour, minute and second hands are all moved from the center; the second hand, being the largest, making big strides for each swing of the pendulum.

Contributed by G. RICHARDS.

High Frequency Buzzer

A base board is first prepared, about 6 in. x 6 in., upon which the instruments are to be mounted. An ordinary polarized bell ringer from a telephone set is strapt to the board and is to be connected to a fuse block, push button and current reducer.

The current reducer may be made by cutting the large end off of a burned out electric light bulb, and filling the remaining part with a weak solution of sulfuric acid and water. The lamp is then screwed into a porcelain socket and secured to the base.

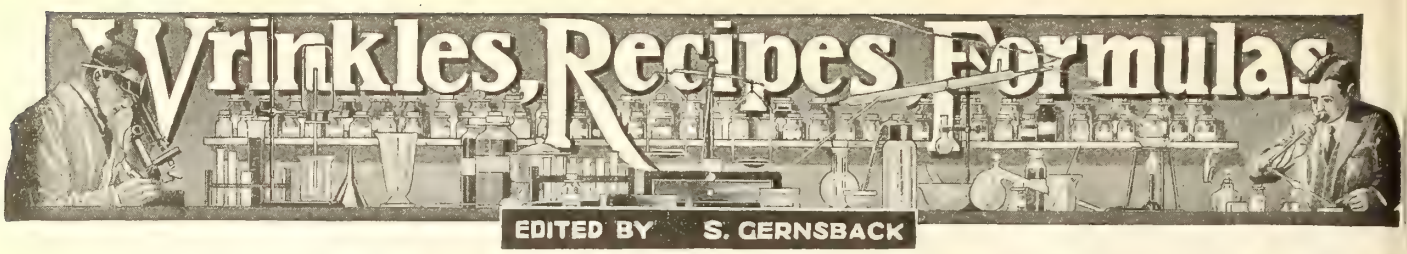


The Drawing Above Shows a Novel Form of High-Frequency Buzzer Constructed From a Polarized Ringer Movement, Together with a Lamp Resistance Filled with a Dilute Solution of Sulfuric Acid and Water and Operated on A. C.

This buzzer may be operated on 110 volts alternating current and will give a high-pitched note in the receiver when used as a tester. It does *not* work on D.C. current.

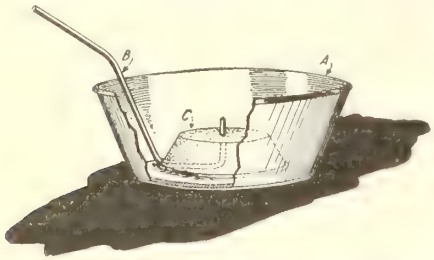
If it is desired, the clapper may be filed off close to the armature. Connections to the receiving set are made from the armature to the ground side of the aerial switch.

Contributed by W. F. CURRENT.



A PNEUMATIC TROUGH.

Take a flower pot saucer and drill a hole in the center of it, if there is not one there already. A slot must be cut in the side of the saucer wide enough for a glass tube to pass thru. The saucer is then placed in a pan and connected up as shown in the illustration. (A) is a pan



How to Make a Pneumatic Trough for Chemical and Other Experiments Is Here Shown in a Simple Manner.

which is to be filled with water, (B) is the delivery tube and (C) is the flower pot saucer.

Contributed by
FREDERICK REYNOLDS.

INK FORMULAS.

Inks that appear thru heat:

1. A solution of caustic potash.
2. A solution of hydrochlorate of ammonia, in proportion of 15 to 100.
3. A weak solution of copper nitrate becomes red when heated.
4. The juice of lemon, orange, onion or artichoke may be used.
5. Cobalt chloride solution can be used on rose colored paper.
6. Sulfuric acid, diluted, may be used. If too strong it will destroy the paper.
7. A slightly alcoholic solution of bromide of copper appears when heated and disappears when cold.
8. A very dilute solution of perchloride of copper becomes yellow when heated.
9. Digest 1 oz. of oxide of cobalt, at a gentle heat with 4 oz. nitromuriatic acid until no more will be dissolved; then add 1 oz. salt (Na Cl) and 16 oz. water. This becomes green when heated.
10. Put in a vial ½ oz. distilled water, 1 dr. potassium bromide and 1 dr. pure copper. This becomes brown when heated.
11. When a solution of acetate of protoxide of cobalt contains nickel or iron it is green when heated; when pure it is yellow.
12. Milk or buttermilk may be used as inks.
13. Boil oxide of cobalt in acetic acid. If salt is added the writing will be green when heated; if nitre it will be pale rose.
14. A weak solution of nitrate of mercury becomes black when heated.

Inks that appear thru light:

1. Chloride of gold forms characters which appear when exposed to daylight for one hour.
2. Write with a solution of 1 part silver nitrate and 1,000 distilled water. It becomes slate color when exposed to daylight.

Inks appearing thru Reagents:

1. Use a solution of acetate of lead and distilled water; the letters appear black when dipt in an alkaline sulphide solution.
2. Chloride of gold, as ink, becomes brown upon passing a solution of perchloride of tin over it.
3. An ink of gallic acid becomes black thru a solution of sulfate of iron, and brown thru some other bases.
4. When starch is used as ink and iodine vapor is passed over it the writing becomes blue. It disappears under the action of hyposulfite of soda in proportions of 1 to 1000. Iodine in solution may be used.
5. Characters written with a 10 per cent solution of nitrate of protoxide of mercury becomes black when moistened with liquid ammonia.
6. Characters written with a weak solution of soluble chloride of platinum or iridium becomes black when the paper is submitted to mercurial vapor.
7. Potassium iodide 1 part, water 8 parts; to develop apply a solution of mercuric chloride; the writing will appear red.
8. Boil starch and a small amount of potassium iodide. Chlorine vapor or ozone (O_3) will develop it.
9. Write with a solution of ferrocyanide of potassium; develop by placing a blotter moistened with a solution of copper nitrate upon it.
10. Write with a dilute solution of tincture of iron; develop with tea on a blotter.
11. Mix one part linseed oil, twenty parts of water of ammonia, one hundred parts water. This will appear when immersed in water and disappear when dry.
12. Characters in sulfate of copper can be developt by ammonia. They appear blue.

Contributed by LE ROY ASHLEY.

TO COAT CHARCOAL WITH GOLD.

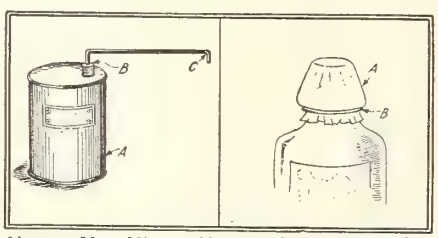
Pour half an ounce of diluted muriate of gold into a drinking glass and immerse in it a piece of very smooth charcoal. Expose the glass to the rays of the sun in a warm place, and the charcoal will soon be covered over with a golden coat. Take out with forceps and enclose it in a glass for show when dry.

Contributed by W. W. HOLLISTER.

HOME-MADE RETORT.

"A" is a can with a stopper B that screws on. A brass or iron tube C is soldered around a hole punched in the stopper B. The retort can be easily cleaned and also the tube by unscrewing B.

Keeping Dust from Bottles—To keep the dust from accumulating around the necks and between the necks and stoppers of bottles in the laboratory I put a paper A with a rubber band B as in the diagram.



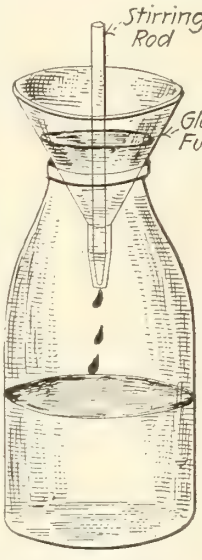
Above, Mr. Klaus Shows How to Build a Home-Made Retort at the Left; and, at the Right, a Good Method of Keeping Dust From Chemical Bottle-Tops.

When the bottles are wrapt with tissue paper I cut it off at the top of the neck and put this on, making it neater.

Contributed by HENRY KLAUS.

AUTOMATIC MIXER FOR SULFURIC ACID.

Quite recently I had occasion to mix sulfuric acid and water together, and found that it was a very slow and messy job, so I devised an apparatus to do the mixing. In the neck of a milk bottle I placed a glass funnel and then inserted a stirring rod into the funnel. When the acid was poured into the funnel it fell into the bottle a drop at a time. Hope that some other experimenter will find this "dropper" useful.



If You Have Occasion to Mix Sulfuric Acid and Water Together, Which Is Always a Slow Job, You Will Find This Automatic Mixer a Great Time-Saver.

Contributed by
H. W. WILSON.

AN AID TO THE STUDENT OF CRYSTALLOGRAPHY.

Many experimenters refrain from the study of crystallography because of the lack of a microscope with which to enlarge these minute bodies to a size clearly visible to the human eye. This difficulty may be partially overcome by the use of a Mirroscope, a Balloptican, or any one of the other patent post card projectors, and plates of glass upon which substances are crystallized being inserted in the place of the postcards. Pieces of different colored papers placed behind the plates will bring out various details of the crystal.

A most beautiful color spectacle can be arranged by mounting various different colored crystals on one plate, projecting them on a white screen.

One of these projectors may be procured for about two dollars at any second-hand store, if not already in the possession of the experimenter. This is somewhat cheaper than the cheapest microscope, which costs about ten dollars, besides making the object visible to both yourself and visitors at the same time.

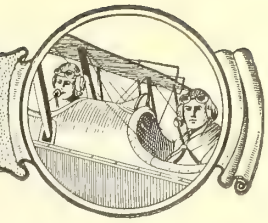
A Noisy Fulminating Powder.—A noisy fulminating powder is made by mixing in a mortar three parts potassium nitrate (powdered) with two parts potassium carbonate and one part of sulfur. The whole being thoroly mixed by grinding, forms the powder in question. Grind each separately and mix carefully with spatula.

When a small quantity of this mixture is placed on a shovel and heated gradually, until the sulfur begins to inflame, it explodes, giving a loud report, and leaving the ears hardly in a state to hear anything more for several hours, or if a very large quantity was ignited, for a whole day. Not more than *fifteen or twenty grains should be set off* at one time, as there is some danger of bursting the eardrums.

Contributed by O. R. COBLENZ.



RADIO DEPARTMENT



Radio Power Transmission

By SAMUEL COHEN

IT is rather surprising to learn just how little has been done in the direction of *radio transmission of energy* ever since the art was begun by our real father of radio, Dr. Nikola Tesla. If our average individual or even our engineers should stop for a moment to think of the nature of this problem he would soon realize the complexity of it. It is by no means unsolvable, yet to some it would seem that the carrying out of such an undertaking to a successful finish would be beyond the realms of human endeavor.

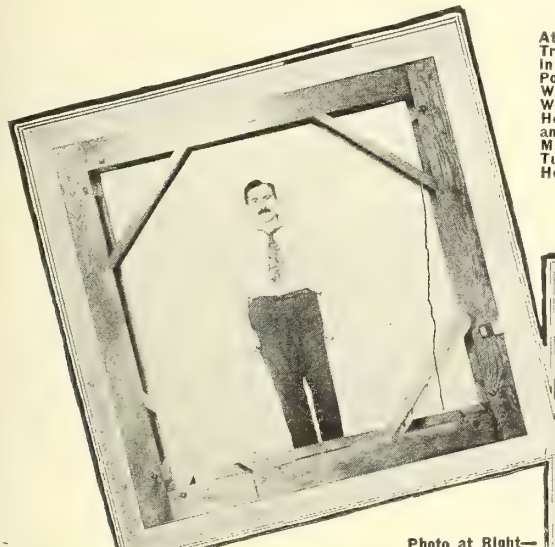
WHY RADIO POWER TRANSMISSION DEVELOPS SLOWLY.

The reason for the slow progress in this field is mainly due to the lack of interest on the part of financiers in giving their aid to the scientists who are in a position to develop this most important enterprise. Insofar as records go, it is certain that Dr. Nikola Tesla has done more in this direction than any one person or group of individuals in this country or abroad. His master pioneer work in the field of energy transmission has been fully recognized. His most important work has been conducted in Colorado and in his plant at Shoreham, Long Island. The cost of the erection of this latter plant ran into the hundreds of thousands of dollars. This will give the reader at least some idea of the progress made by him in the direction of completing his world-wide radio transmission system. The writer feels quite certain that the final steps in the development of the equipment for the radio transmission of energy will at least depend upon the fundamental principles laid down by Dr. Tesla.

The question whether transmission of energy thru the *ether,* without the use of a metallic conducting medium, is more economical than the present method of electrical energy transmission, is a point to be considered. Will a system of this nature be more flexible and will the initial cost of the equipment warrant the use of the same? These are only a few of the numerous questions that the financier will ask before he can or will attempt to promote an enterprise of this sort.

From an engineering point of view, the final system must be so designed so as not to discard the present equipment used in factories, etc. It is quite certain that the final accomplishment of the system for the radio transmission of energy will require the use of high frequency currents and that at the receiving side it will be necessary to utilize some form of efficient frequency converters for the transformation of the high frequency currents into currents of

(*Continued on page* 687)



At Left: View of the Huge Transmitting Helix Employed in the Radio Transmission of Power by the Author. This Wooden Helix Frame Is Wound with Many Turns of Heavy Insulated Copper Wire, and Produces a Powerful Magnetic Field, Which in Turn Reacts on the Secondary Helix or Coil at a Distance.



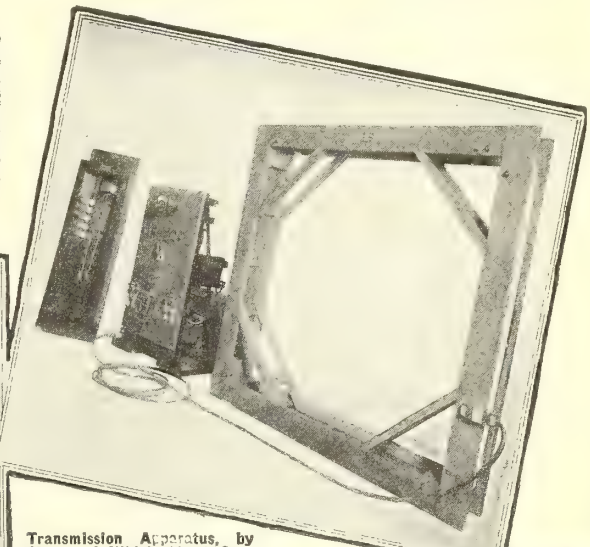
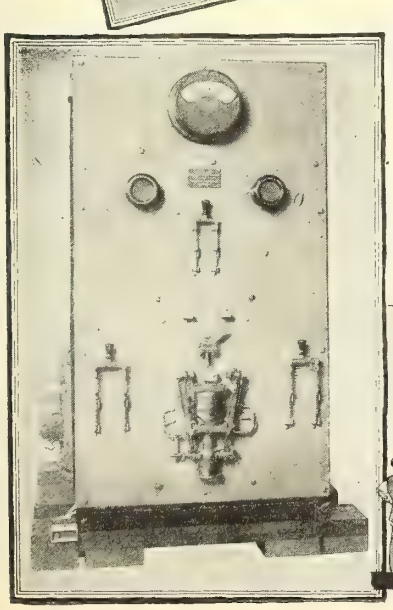


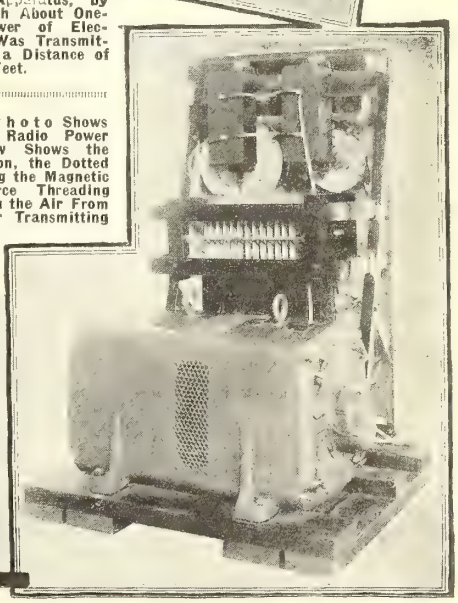
Photo at Right—Shows Front View of Receiving Helix with Lamp and Motor, Which Were Operated by Power Received Wirelessly.

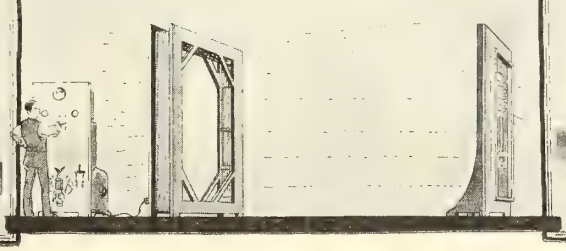
Photo in Lower Right-hand Corner—Shows the Rear of Transmitting Panel with Motor-Generator Set.



Transmission Apparatus, by Means of Which About One-fifth Horse-power of Electrical Energy Was Transmitted Thru Air, a Distance of 20 Feet.

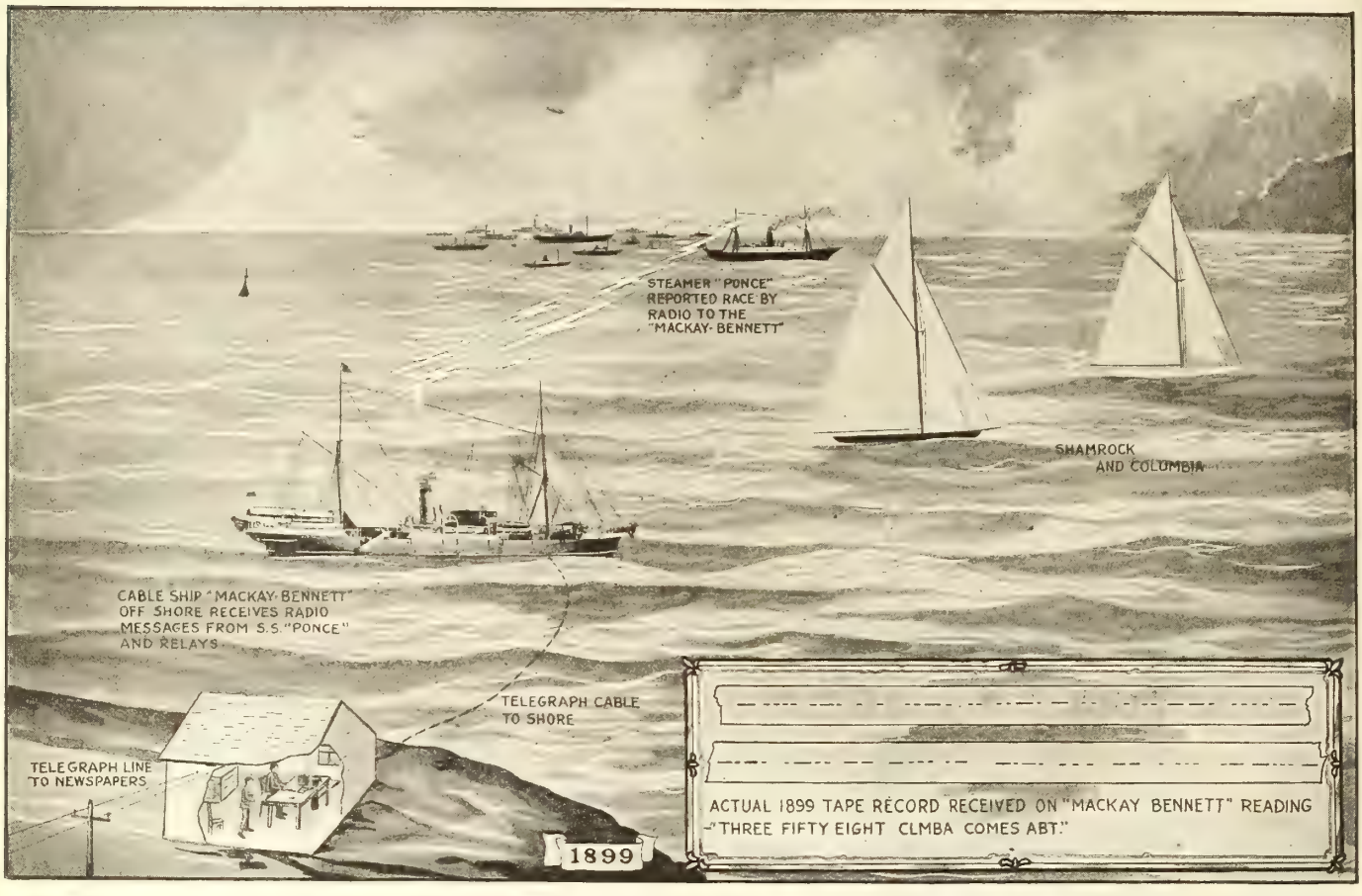
Above: This Photo Shows the Complete Radio Power Diagram Below Shows the Set in Operation, the Dotted Lines Indicating the Magnetic Lines of Force Threading Their Way Thru the Air From the Primary or Transmitting Helix to the Receiving Coil or Helix.





Reporting Yacht Races via Radio

By DONALD McNICOL



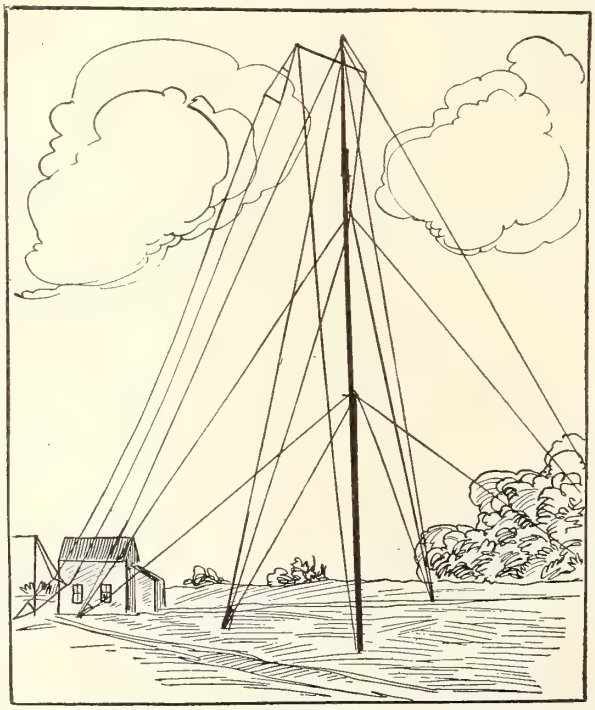
The First Yacht Races Reported by Radio to Newspapers Were Those of 1899, and the Method of Furnishing the Radio Signals from the S. S. "Ponce," Out at Sea, to the Cable Ship, "Mackay-Bennett," Is Clearly Shown. The Received Radio Signals Indicating the Progress of the Yachts "Shamrock" and "Columbia" Were Relayed by a Cable Running From the "Mackay-Bennett" to a Telegraph Station on Shore, and Thence by Telegraph to the New York City Newspapers. The Insert Shows an Exact Copy of the Radio Tape Record Received From the "Ponce."

When the old coherer sputters and the de-
coherer kicks,
And the tape begins to show the signs of
talk;
You can bet—no chance of failing—
That it reads "Columbia's trailing
In the wake of Good Sir Thomas'
Shamrock."

THIS is what one of the British wireless men thought the day before the International Yacht Race began in the year 1899, while he was engaged fixing up wireless apparatus off Sandy Hook to receive reports of the progress of the races as sailed. But the radio man was a better poet than prophet, for on the following days Sir Thomas Lipton's first attempt to capture the much prized cup with the original Shamrock proved a failure as did the later attempts of 1901 and 1903.

It was during the yacht races of 1899 that wireless telegraphy was first used to supply instantaneous reports of the progress of the contending racers. In telegraph and newspaper circles the undertaking was regarded as a revolutionary innovation in methods of news transmission.

Since the year 1870, when the first International Yacht race was sailed off New York Harbor, there had been a demand for quicker reports of the progress of the yachts from the time the starting gun was fired. Carrier pigeons, long range telescopes, swift motorboats, wig-wag signals and all other methods of communication employed on these occasions failed to give results which satisfied the demand of the press and the public for "up to the minute" news.



One of the Earliest Commercial Stations in Radio History Was That at Jamaica, L. I., and Used in Reporting the Yacht Races of 1903.

In the year 1895, when Valkyrie III sailed against the Defender, the first attempt was made to establish telegraphic communication between a shore station and a station at sea from which the race might be observed over the entire course. On this occasion the Commercial Cable Company either laid a temporary cable, or "tapt" an existing cable, establishing an office at sea on board the cableship *Mackay-Bennett*. Observers and representatives of the press stationed on the cableship were enabled to transmit a continuous series of bulletins direct to newspaper offices in New York over the submarine cable circuit. The cable scheme, while a decided improvement over previous methods of reporting the yacht races, was rather expensive, and there was always the possibility that rough weather might blow the cableship around so that the cable end would have to be thrown overboard and communication abandoned.

In the British Isles in the year 1898 the Dublin *Daily Express* had used Marconi's wireless apparatus on the steamer *Flying Huntress* to report the events of the Kingstown regatta. In the following year, therefore, when the International races were to be held off New York Harbor, Dr. Marconi was commissioned by the New York *Herald* to come to America, prepared to set up wireless ap-

paratus by means of which the great race might be reported in a new way.

Those were the days of the "sputtering" coherer and the "kicking" decoherer, celebrated in the jingle at the head of this article. Operators who were experienced could read the incoming signals by the sounds made by the decoherer, but in order to have an unmistakable record of the message a recorder was connected in the relay circuit so that the signals would appear in the form of short and long marks representing the dots and dashes of the Morse code. The maximum range of the radio apparatus employed was about thirty miles and modern radio enthusiasts can easily picture the various and sundry marks which appeared on the strip of paper tape in addition to the markings of the transmitted signals—the former being due to interpolations of static.

On October 7, 1899, the steamer *Ponce* had been fitted up with a transmitting outfit consisting of a ten-inch induction coil, condensers, sending key, aerial, etc., and on board the Commercial Cable Company's cableship *Mackay-Bennett,* Mr. Marconi had installed an aerial and a set of receiving instruments consisting of coherer, decoherer, relay and tape recorder. The cableship was anchored offshore far enough to be in deep water and had a short length of shore cable connected between the ship and a land line telegraph office on shore. Fig. 1 shows a reproduction of a section of the tape as recorded on board the *Mackay-Bennett* during this pioneer demonstration of radio signaling. Those who understand the Continental code may recognize the signals as reading: "Three fifty-eight Clmba comes abt," the abbreviations being those used by the British telegraphers who were in charge.

The section of tape selected for reproduction is free from static markings.

In the year 1903 when the *Shamrock III* was pitted against the New York Yacht Club's *Reliance,* wireless telegraphy had made progress, and in the United States the De Forest Wireless Telegraph Company was making a bid for commercial work. There was at that time intense rivalry between the Marconi and De Forest interests. To cover the races this year the Associated Press arranged with the Marconi Company to set up apparatus on the speedy steam yacht *Chetolah,* so that communication might be kept up between the yacht and the Marconi shore station at Jamaica, L. I.

Radio men who were in the game at that time remember the excitement and the difficulties of the occasion. With two wireless companies attempting to operate in the same limited area, without prearranged agreement in regard to allotment of sending time, and without dependable tuning systems, there was no little confusion of signals. Indeed, there were open charges of malicious interference. One concern claimed that a rival company had chartered a brick schooner, equipt it with a transmitting outfit and anchored the schooner in proximity to the other company's sending station at sea, with instruments to send out a continuous series of unintelligible radio signals so that the opposition receiving operators would be unable to read intended signals.

The De Forest Company set up a station near the Navasink Highlands which was connected by land wire with New York City. At that time the De Forest Company's operators used the American Morse alphabet, while the Marconi operators used the Continental alphabet.

In the 1903 operations the Marconi Company still had in service the coherer and the tape recorder, while the De Forest Company employed a receiving device known as a "responder." The device consisted of a small tube containing an electrolytic compound sensitive to electromagnetic radiations. The responder was connected in circuit with a local battery and a pair of head telephones, the radio signals being read by ear instead of by sight, as when marked tape was used.

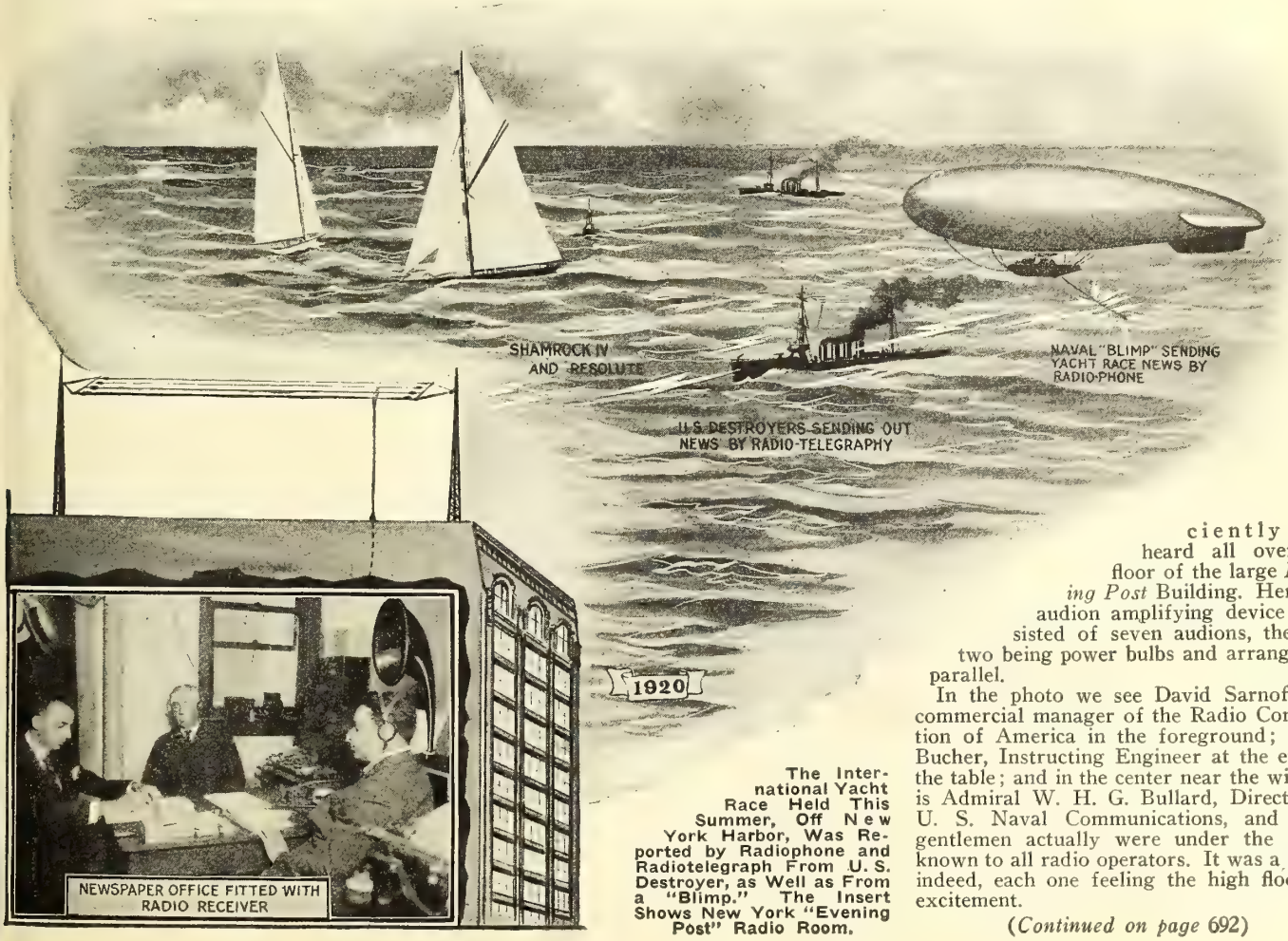
The foregoing history of the use of radio telegraphy in reporting the events of the International Yacht Races, in fact, constitutes a brief history of the introduction of radio signaling in the United States and present day radio enthusiasts are in a position to realize the vast strides that have been made in developing and perfecting the apparatus of radio, with the *coherers* and *responders* of the year 1903 as a beginning.

YACHT RACE REPORTING TO-DAY.

And now we have the modern method of reporting the yacht races *via radio,* as received in the pressroom of the up-to-date paper. Two stations installed at the New York *Evening Post* represented one of the most elaborate installations made for receiving these radio messages; one set for receiving from the destroyer U. S. S *Goldsborough,* and another apparatus not shown in the photo, for receiving the radio-phone messages from the naval blimp or airship.

This dirigible was transmitting at the time of the third race, on a wavelength of exactly 350 meters, with a General Electric set of five watts capacity, and the sending range was approximately ten miles.

With a bank of six audions, signals were sufficiently clear to allow the Blimp to be heard if other noises in the room were eliminated, but the most reliable sources of information were the radio telegraph methods of transmiting those signals. Both the Blimp and the U. S. S. *Goldsborough* were heard clearly in the receivers and with the loud-talker, the signals bellowed forth sufficiently to be heard all over the floor of the large *Evening Post* Building. Here the audion amplifying device consisted of seven audions, the last two being power bulbs and arranged in parallel.



The International Yacht Race Held This Summer, Off New York Harbor, Was Reported by Radiophone and Radiotelegraph From U. S. Destroyer, as Well as From a "Blimp." The Insert Shows New York "Evening Post" Radio Room.

In the photo we see David Sarnoff, the commercial manager of the Radio Corporation of America in the foreground; E. E. Bucher, Instructing Engineer at the end of the table; and in the center near the window is Admiral W. H. G. Bullard, Director of U. S. Naval Communications, and these gentlemen actually were under the stress known to all radio operators. It was a strain indeed, each one feeling the high flood of excitement.

(*Continued on page* 692)

Ship's Radiophone Heard 500 Miles

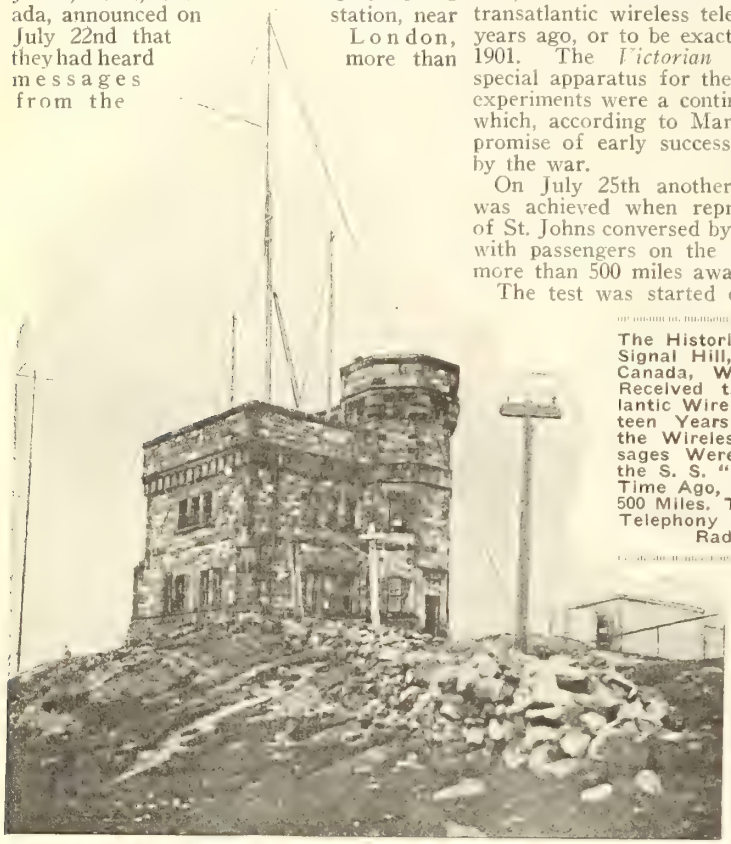
EXPERTS from the Marconi Wireless Company, conducting experiments in long-distance wireless telephonic communication during July, at Signal Hill, St. Johns, N. F., Canada, announced on July 22nd that they had heard messages from the Chelmsford station, near London, more than 2,000 miles distant. They said that they recognized the voice of Capt. Round, the expert in charge.

The officials in charge also said they heard faintly messages from the steamer *Imperator* at their station when 500 miles west of Bishop's Rock.

The station was located on historic Signal Hill, where Dr. Marconi received the first transatlantic wireless telegraph message 19 years ago, or to be exact, on December 12, 1901. The *Victorian* was equipt with special apparatus for the experiment. The experiments were a continuation of a series which, according to Marconi officials, bore promise of early success when interrupted by the war.

On July 25th another scientific marvel was achieved when representative citizens of St. Johns conversed by wireless telephone with passengers on the steamer *Victorian*, more than 500 miles away.

The test was started on board the *Victorian* with a phonograph selection. Then the chief electrician called Lord Burnham, who spoke to the Hon. R. A. Squires, Prime Minister of New Foundland. The postmaster general (on behalf of the government and people of New Foundland) then welcomed the press conference aboard the ship to the Western Hemisphere.



The Historic Radio Station on Signal Hill, St. Johns, N. F., Canada, Where Dr. Marconi Received the First Transatlantic Wireless Message Nineteen Years Ago, and Where the Wireless Telephone Messages Were Picked Up from the S. S. "Victorian" a Short Time Ago, Over a Distance of 500 Miles. Transatlantic Radio Telephony Is the Goal of the Radio Experts.

Everybody in the radio room used the receivers during the test. Some of the messages were repeated owing to disturbances. The phonograph selection was distinctly audible not only to those with the receivers but also to those standing near the instruments.

The wide attention given the wireless conversations which the steamer *Victorian* has been holding from mid-Atlantic with both England and Canada is an indication of the slowness with which the new means of communication has been developed. In 1912 wireless telephony was successfully carried on in Italy over a range of 250 miles and inventors declared that it would soon be in general use. In 1915 the voice was carried by wireless from Arlington, Va., to Honolulu, 4,900 miles distant, and a little later from Arlington to Paris. In 1916, anticipating recent achievements in Europe, De Forest transmitted musical selections by wireless for distances of a score of miles or more. Two years later considerable telephone conversations were held between Canada and Ireland and Washington and Paris. Wireless telephony shared in the development that so many recent inventions received during the war and was extensively employed over short distances by sea, land and air forces. Nevertheless, its progress since 1912 has not been what sanguine people hoped. If it had been, the press would not be giving headlines to an account of how imperial press delegates on an English steamer talked over several hundred miles of waves with ease.

Wireless telephony will have come into its own when it is used on a large scale for commercial purposes and supplements wireless telegraphy as effectively as the latter now supplements the electric cable. That hour seems near. Marconi made his first fully successful experiments with wireless telegraphy in 1895, but it was not until 1907 that a public commercial service was establisht across the Atlantic. A little more time and conversations like the *Victorian's* will be too commonplace for notice.

Advice to Amateurs by One of Them

IF one will go to any of the numerous wireless stations in this (New York) city any night between the hours of 7:00 and 11:30 and put on a pair of head 'phones he will be greatly surprised, unless he is one of New York's amateur operators himself.

New York is the largest city in the United States. There are probably more amateur wireless stations in New York than any other city. As in every vocation and avocation, there will be found those who are taking it seriously, those who are just doing it to pass time, and sad but true, some who try to make the lives of the serious minded ones miserable.

Jamming, both intentional and thru carelessness or ignorance of the adjustment of the transmitting set, is the greatest evil among the large body of amateur wireless operators. I can think of nothing more exasperating than to be in the middle of copying a message and to have another station, in the neighborhood, or quite a distance away, with a decrement and wave far in excess of the stipulated allowance for amateurs, break in and ask some other fellow about his spark tone, wave, strength of signals, etc. I do not have to tell you, you have all had the same experience.

Again, so often you will call a station and before he has answered you another station will call you and start right in to tell you something. In the meantime the other station will have answered you and you will, in the majority of cases, lose what he says. Why do people do this?!! If I went out with a bunch of fellows and one of them asked another a question and, before he could answer, I butted in and said something else, a few things might be said in my absence about manners and proper bringing up. It is the same thing in wireless. Just because the persons engaged in conversing can not be seen is no reason for taking advantage of the fact that if you want to you can *break up* the converation. It is purely and simply a matter of *manners!*

Then there are, of course, our well-known friends, *the little boys,* with the spark coils whose pitch varies from zero to 1.000 cycles, and who can understand nothing that is said to them, even if you "QRX" and "QRT" them a thousand times. Some do understand, but out of pure deviltry refuse to stop. Of course, we were all "Hams" once. I dare say, however, that we all would appreciate the suppression of some of the stations that maliciously interfere as they do nightly. The fact of the matter is that the Navy Department, having had so many complaints made to it lately, is, figuratively speaking, putting on the thumb-screws, and getting after the offenders. However, more for long wave length and for jamming other amateurs. What I would like to see done is the serious-minded amateurs of New York City form a committee representing the amateur body of New York City, and visit personally the houses of the offenders and have a little talk with them. I would be glad to hear from any who would like to co-operate in this plan and try and help out conditions in and around New York City.

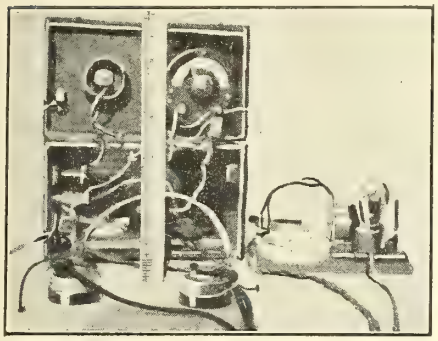
If the few offenders who are nightly causing constant interference with the nearby commercial stations are not brought to an understanding quickly, the whole amateur wireless body thruout the United States will become jeopardized, as the Navy Department is becoming impatient with the number of complaints sent in. Why not start now and help bring matters to a state in which there need to be no fear of endangering the status of the amateur? I am sure that such a society as the Radio League of America would be only too glad to co-operate with us. Remember that a hint well taken will save a lot of trouble. The amateurs who have expended a lot of money on their apparatus and who are interested in the furtherance of the art, would surely feel pretty much hurt if they were forced to cease operations by the Government. Yet that is what we are surely coming to unless something is done quickly, and now is the time. What do you say?

Simplest Long Wave Receiver

By ELLIOTT A. WHITE

FORMERLY INSTRUCTOR IN RADIO, AIR SERVICE SCHOOL FOR RADIO MECHANICS, CARNEGIE INSTITUTE OF TECHNOLOGY, PITTSBURGH

Complete Details of a Set of Remarkable Compactness and Simplicity



View of Long-Wave Radio-Receiving Set Lying on Its Side with Cover Opened, in Comparison with a One-Foot Rule.

PERHAPS radio amateurs find pleasure in the dozen or more adjustments which have to be made in tuning the long wave receiving sets of pre-war vintage, with either two or three tuned circuits (antenna, grid and plate), with a multiplicity of inductance coils and condensers, the former usually of the long single-layer type, and the latter usually variable. But aside from the pleasure of constructing and playing with a lot of unnecessary apparatus there is now no excuse for such sets as these. The tendency in modern radio is towards *compactness* and *simplicity!*

In the first place, there is practically no interference among long wave stations. This eliminates the loose coupler except during heavy summer static. Moreover, if sharp tuning is necessary, a series condenser in the antenna circuit acts the same as loose coupling, if it is small enough.

In the second pace, with an *ultraudion* hook-up or a *tickler feedback,* no plate circuit tuning is required. This eliminates all but a *single tuned circuit,* common to antenna and grid.

In the third place, fixt condensers and resistances are easily made to take the place of expensive and superfluous variable condensers and rheostats, with the added advantage of fewer adjustments.

In the fourth place, modern bank-wound, pancake-wound and honeycomb-wound inductance coils make the old-fashioned single-layer coils several feet in length look "foolish." Their advantage is compactness, cheapness and absence of the capacity effect which made the old type so delicate in adjustment and so annoying when they "broke" at the approach of the hand.

2,500 TO 20,000 METERS RANGE.

The set here described, which tunes from 2,500 to 20,000 meters, was constructed with these four considerations in mind and gives excellent results in flexibility of use, loudness of signal, extreme compactness, cheapness and great simplicity of tuning. It has only three, practically *one,* adjustment. Furthermore, either an open antenna or the loop antenna which is coming into favor, may be used. Figure 1 shows the connection for an open antenna, and Fig. 2 shows the connection for a loop antenna, the loop being inserted at A, in series with the inductance coil L, with the tuning condenser C1 across both coil and antenna. No other change in the set is necessary, so that the change can easily be made by throwing a *single* switch if so desired.

The apparatus (Fig. 1) consists of one inductance coil L with from three to five taps; one variable condenser C1, the ordinary 43 plate with .001 mfd., capacity; one tickler coil T of fixt inductance but variable coupling with L; two fixt condensers—a grid condenser C2 of .00015 mfd., and a bridging condenser C3, of about .004 mfd.,

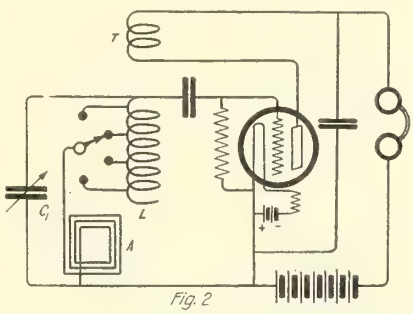


Fig. 2

Hook-Up of Long Wave Receiver Here Described in Connection with a Loop Antenna "A," Together with the Single Audion Used.

and one fixt resistance R, of a value depending on the kind of tube and the voltage of the filament battery; besides the ordinary vacuum tube outfit of filament and plate batteries, tube and phones, with a small switch for the inductance. Altho definite values are given above, it should be remembered that the builder can use whatever apparatus he has on hand, making due allowance for difference in inductance and capacity, and that the fixt condensers and resistance can vary considerably from the above values without interfering with the efficient operation of the set. For instance, if the builder has only one variable condenser, it does not have to be exactly .001 mfd., maximum capacity, but may be anything from half that, up. Again, instead of using the inductance coil here described he can use one of his own manufacture, provided that it is large enough, even one of the old single-layer type, altho at a great sacrifice of compactness. And in building the fixt condensers, only approximate accuracy is necessary.

THE TUNING INDUCTANCE.

The inductance coil L should be bank-wound, pancake-wound, or honeycomb-wound, the last being much the best. By using fixt loading condensers in parallel with the tuning condenser C1 it is possible to use a ridiculously small inductance coil—merely enough to permit coupling with the tickler. If they are used, each loading condenser should be of the same capacity as C1 or slightly smaller, and two or three of them may be used, up to a total capacity of say .005 mfd., which would allow an inductance to be used only a fifth as large as the one here described. Another way is to use loading condensers of .001, .002 and .003, which in various combinations, in conjunction with the variable of .001 mfd., will give any capacity up to .007 mfd. A set of these condensers which has been so used was made up in units of 4 and 5, 5 and 6, and 7 and 8 plates respectively (see paragraph below on C2 and C3), tho, of course, as will be noted later, the number of plates depends on their size and especially on the thickness of the mica, paper or other dielectric used.

If bank- or pancake-wound coils are to be used, dimensions may be found in various radio magazines, and text-books. The author used a six-layer bank (of No. 24 wire), 3 inches long on a tube 7 inches in diameter, with the condenser and other parts mounted inside, until he discovered the improvement detailed later. Another experimenter used a 4-layer bank, 6 inches long, of small "Litz" cable wound on a 5-inch tube with the *tickler* rotating inside. For the average small sized antenna any coil is suitable so long as it has an inductance of 125-175 millihenrys, with a .001 condenser, and no loading condensers. Of course the greater the capacity of the antenna the longer the wave length on smaller settings of the condenser C1; and with a loop antenna, the larger the loop and the greater the number of turns the longer the wave length; or the smaller L and C1 need to be for the same wave length.

(*Continued on page* 694)

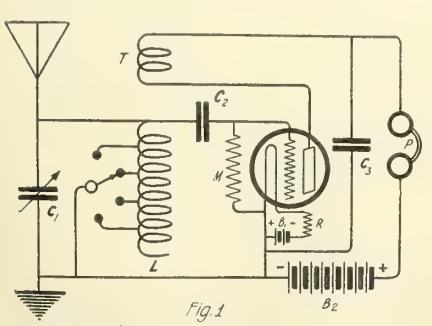
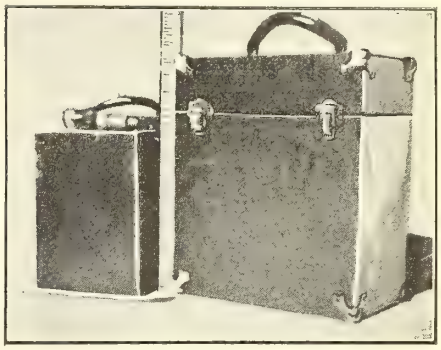


Fig. 1

Hook-Up of Long-Wave Radio Receptor, Including Single Tuning Inductance, Together with Tickler Coupling Coil "T," and Single Audion Employed.



View of the Long-Wave Receiving Set with Carrying Cabinet Closed, Compared with Rule. The Cabinet Measures About 14 Inches High and Is Fitted with Leather Handle and Snap Locks, Which Can Be Purchased From Any Trunk or Leather Goods Supply House.

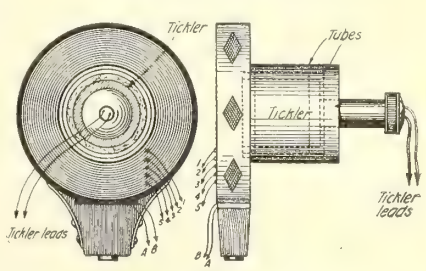


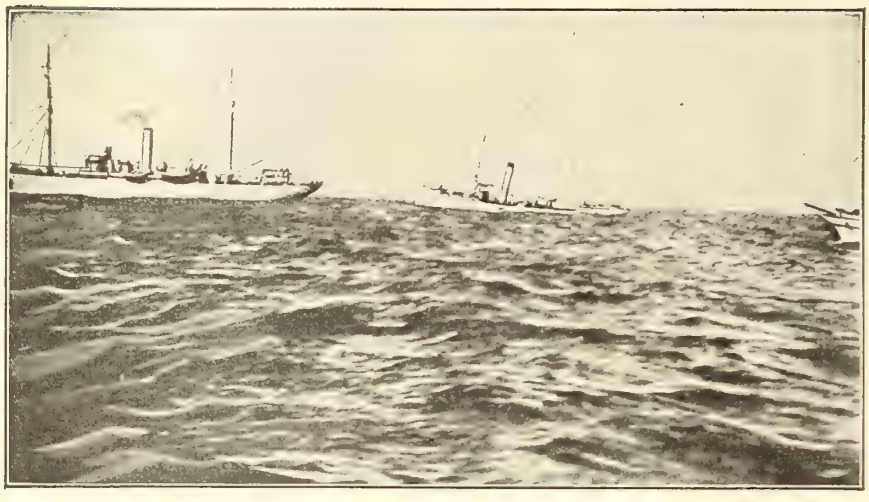
Fig. 3

Detail of Tickler Coil, Which Is Arranged to Slide in a Fiber Tube, Mounted in the Opening of a Honeycomb Inductance. The Latter Coil Is Supplied with Tap Leads, as Shown, For the Purpose of Close Tuning.

How to Become a Professional Radio Man

Part II

By PIERRE H. BOUCHERON



Actual Photo of Ship Sinking at Sea—Center of Photo. Help Had Been Summoned by Flashing the "S O S" Call—and Two Vessels Are Seen Standing By.

YOUR DAILY DUTIES

A GREEN operator setting out for the first time to battle with the *etheric waves,* often has visions of *heavy traffic,* meaning the sending and receiving of hordes of messages between land and ship each day. This is quite natural for he is cursed with an over-active fist, and his palm literally itches for key manipulation. Alas, a very small number of ships ever have occasion to send more than twenty-five messages each day, a greater number will not handle that many messages during a whole voyage, while a still larger number will handle exactly *two* messages between ports, one on leaving and one on arriving. The "speed king" operator, therefore, will spend the intervening intervals at the pleasing pastime of twiddling his thumbs, unless he finds himself "something to do" which will prove of more benefit to him. Of this we will speak later.

There are, of course, other things that enter into the operator's daily routine besides the actual *sending* and *receiving of messages.* Most Captains realize the value of radio in navigation and insist upon checking their chronometers by means of the radio time signals sent out by American and foreign government stations at noon and evening each day as well as securing radio compass positions whenever possible. While the first is comparatively an easy task, it does necessarily require *quickness of action* and *accuracy* in order that these time signals be of value to the skipper. Personally it took me several days before I had acquired the knack of conveying the final time tick to the captain's quarters, so that there was practically no lag between the radio signal and the blowing of a whistle or pressing of a key leading to the captain's quarters. I soon learned that the captain was not satisfied with a *half-second's* loss of time.

Then there are the weather reports which are also sent out by the various governmental and other coast stations. Masters of vessels invariably look for these with considerable interest and depend upon the radio operator's vigilance in keeping them advised of impending storms. Keeping the "gang" on board supplied with as many press news items as you are able to pick up is, of course, very essential in keeping every one on board in touch with the outside world.

On the whole, however, these duties are not what might be called over-strenuous and will hardly tax the endurance of the average operator.

Articles to Appear In October Issue of "Radio News"

A 15 k.w. Radiophone Set
The Crewless Battleship Controlled by Radio
Reporting News by Radiophone
Improved Circuits for Short Wave Communication By A. S. Blatterman
The Audion—Its Action and Some Recent Applications
By Lee DeForest
Code of the Wireless Man
By Erald A. Schivo
Portable Combination Receiver
By Russell H. Robinson



Asleep on the Job, But Don't Get Caught Doing It—It Is Bad Business. In this Instance the Ship Is Lying at a South American Port Where Not Much Radio Work Is Possible and the Operator Evidently Has Succumbed to the Tropical Heat of the Noon Day Hour.

STATUS OF THE OPERATOR ON BOARD SHIP.

Under this heading I can start off in no better way, perhaps, than by quoting to you a section of the *United States Shipping Board Emergency Fleet Corporation* Contract with the radio companies, which has the following to say:

> "Radio operators shall be treated as officers, but without executive authority, and shall be provided accommodations suitable for an officer."

This is indeed a pleasant little paragraph. It infers untold possibilities to the embryo Paul Jones. Think of it, you are drest up in a snappy blue uniform with brass buttons, and with a rakish cap having the seal of the United States Navy embroidered in a suitable manner directly above the visor. The senior operator rates two gold stripes on his sleeve, while the junior operator rates one. Lieutenants and Ensigns in the making!

Referring to the above quotation this means that the radio operator is accorded all rights and privileges of a merchant vessel officer, with the exception that he has not the authority to give executive orders to any member of the crew unless, of course, he has been specifically instructed to do so by the captain or other accredited officer of the ship. This is quite proper since the operator is really in a class by himself and is not supposed to be versed in the ship's executive routine.

The present increased wages of the operator, as well as the improved conditions of the profession, are destined to considerably improve the prestige and status of the operator. In the past there have been altogether too many boys in their 'teens who have entered the work during summer vacations, and in order to avoid paying the high prices of the Cook's tours.

That is where the European operator has the advantage. He is usually a well-seasoned, serious individual who remains on the same ship year after year and is comparatively much better paid than the American operator. Not only that, but he is actually accepted as one of the ship's high officers commanding the respect of those from the captain, down to the lowest member of the crew. Unfortunately, this cannot always be said of some of our American operators who have sown a path of bad reputations behind them.

THE "PICKINGS."

The old days of the underpaid radio operator have past for good. Today he is a well paid member of the crew, and judging from present indications, bids fair to receive still better pay as we will shortly see. Personally I went to sea for $30.00 a month and by dint of hard application eventually reached the dizzy height of $50.00 per month.

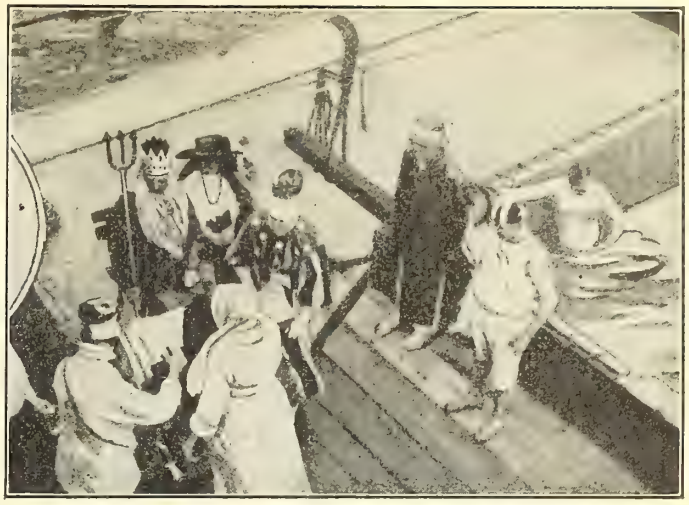
At the present writing a senior operator of any seagoing vessel is paid $125.00 per month, and the junior operator $100.00 per month. In addition to this is included his board and lodging which, with the present H. C. of L., easily amounts to an additional $50.00 a month or more.

There is also the possibility of securing a berth aboard a cargo vessel and acting as super-cargo in addition to radio duties. There are several steamship companies who offer these combination posts at $140.00 a month or slightly more. On other vessels there is also the opportunity of checking and guarding cargo when the ship is loading or unloading freight at foreign ports, particularly in ports where native talent is unavailable. This extra work easily falls to the lot of "Sparks," due to the fact that he has nothing else to do while the ship is at anchor. The remuneration for this sort of pastime is 30c per hour and upward.

In the past many radio men have considerably boosted their incomes by means of various legitimate commercial ways, such as the representing of American business houses in foreign countries. This naturally brings into play salesmanship, which all of us practise, more or less, as well as the possible knowledge of a foreign language, such as Spanish for the Latin-American nations, or French and Italian for the European ports.

Considering the matter of wages again, at a recent meeting of Radio Association men in connection with the American Steamship Owners' Association, there was considered an increase in pay of $200.00 per month for the senior operator and $150.00 for the junior operator. It is expected that the demands of the operators will be approved without serious opposition.

It is also understood that when the ship is at the home port where meals are seldom served, an additional allowance of $3.00 a day for subsistence is allowed.



An Interesting Ceremony Which Takes Place on Many Vessels When They Pass the Equator. Father Neptune, Ruler of the Deep Seas, Comes Aboard and Assisted by His Able Staff Past the Zone at a Preally Initiates All Who Have Never Before Past His Domain. In This Case the Ruler's Privy Counsellor Is Examining the Credentials of a Lady Claiming to Have Passt the Zone at a Previous Time. In the Main Part the Initiation Consists of a Sound Dousing in a Tank Filled with Sea Water Purposely Erected for the Occasion. Afterward a Certificate Is Issued as Proof of Initiation so That Should the Person Chance to Pass the Equator Again, There Will Be No Need of an Additional Dousing.



L+H

PROCLAMATION

Know ye all men by these presents that We,

Neptune, the Great God of all the High Seas,

have this day appointed to Learn Greenhorn worthy subjects

Pierre Chastenet

who has been duly initiated into the mysteries of Our Realm, thereby constituting him a free and lawful citizen of Our Imperial Dominions, and entitling him as such to pass and to pass in peace at all times. Brothers and Sisters of the Order are hereby commanded to assist him in all his wanderings.

Given under Our Seal this 30th day of June 1920

Attested
W. E. Norman
Commander R.N. Ret.

Neptune Rex
Lord of all the High Seas

Certificate Issued to the Author Showing That He Has Past the Equator.

These desirable conditions which considerably improve the standing of the radio operator are the result of the fact that radio operators on board ship have become almost as indispensable as the navigators and engineers and, therefore, should be paid accordingly. Organization, however, has probably been the greater factor in this change of affairs. The United Radio Telegraphers' Association is doing a great deal toward the improvement of the operator's lot. For that reason it is not a bad idea to join it at the very start.

There is, of course, a great divergence as to the quality and variety of the food and accommodations given operators by various steamship companies. On some vessels the operator is housed in a large roomy cabin close to his operating room, and usually on the top deck—a desirable position for a quick exit! On some of the older vessels the sleeping quarters of the operators are below decks. Invariably, however, the operating and sleeping rooms are combined in the same superstructure on the top side, as it is recognized that the radio apparatus should be the last part of a ship to slip beneath the waves after an accident.

The greater part of the steamship companies supply the best quality of food and quarters for the crews of their vessels and do their utmost to make the men contented, so that they will remain on the same ship trip after trip. On the large passenger ships, the radio men eat their meals in the saloon with the passengers, in some cases presiding at the head of their own particular tables, as do the Captains, Chief Engineers, Pursers and Doctors.

There are, however, one or two lines which are notoriously bad providers in the matter of food. Then again it is sometimes a hit-or-miss affair, depending upon the ability of the Chief Steward and his knowledge in purchasing the necessary quality and quantity of food supplies.

I shall never forget a seventeen day voyage on a diminutive tramp steamer. The



This Is the Way Things Look Inside a Ship's Radio Cabin. In This Case, You See a Pioneer Operator, Mr. E. D. Prey, Waiting for an "SOS" on Board the Palatial S.S. "Abangarez." By Way of Instruments, the Famous "Double Decker" or "I.P.76" Receiving Tuner May Be Seen to the Extreme Left. No, Young Man, the Desk Telephone on Top of the Tuner Does Not Connect to Shore Stations but Is for Direct and Instant Communication to the Vessel's Navigating Bridge.

phone transmitter which I
and upon which I am now
Albrechten, 500 17th St., N.

WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

This Month's $5.00 Prize Winner—Clarence Glasman



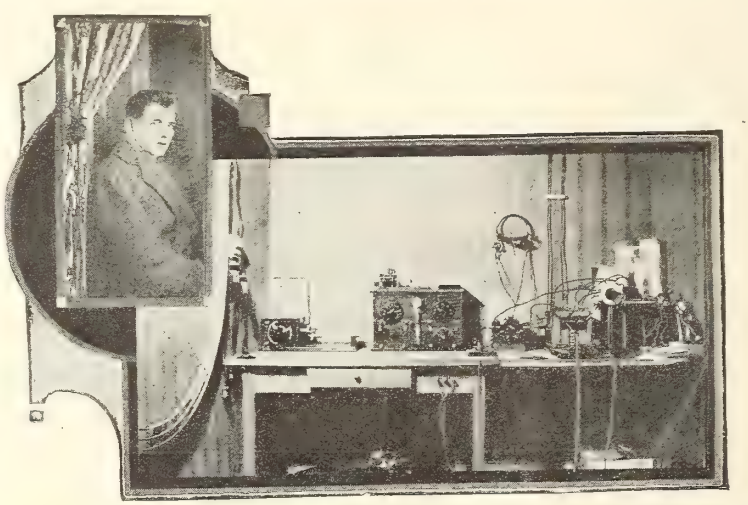
WHO said that a fellow living in the wilds of Canada couldn't keep up with the World of Science? Here is proof that we have all the latest gogs for making gasoline and sugar.

I indulge in all branches of science and have considerable apparata, mostly constructed by myself from articles and plans found in SCIENCE & INVENTION magazine and RADIO NEWS.

The photos are: my mechanical and electrical department; a view of an oscillation transformer made of copper tubing and porcelain knobs; a receiving apparatus showing a two-step amplifier and crystal detectors; a discharge from a 10-inch induction coil showing my hand in the spark (double exposure); and the "wheel of mystery" is a musical apparatus which displays colored pictures when in motion. It consists of a Bakelite disc ¼ inch thick and 18 inches in diameter and the music is produced by sparks jumping thru different series of perforations on the disc. The picture is seen from the sparks in a parabolic reflector behind the disc, and for each different tone made, a light of a different angle strikes the reflector, and as the tones are consecutive, a very weird effect is produced. I rigged up a number of army mess kits "strung up" like violins, and each instrument giving a different note. The tones are produced by little magnetic hammers on the finger-boards, and all instruments are controlled by one keyboard having 21 keys; these keys also operate the high tension switches which send the sparks thru the Bakelite disc. Both instruments cannot be played simultaneously, because the motor driving the disc is run by direct current from a Delco farm lighting system, and the speed is not constant, therefore changes in pitch and accompanying discords occur, but they produce good "jazz" music when played together, neither instrument being practical because their tones are not very loud or distinct.—Clarence Glasman, Russell, Manitoba, Canada.

Honorable Mention—A. E. C. Albrechtsen, $2.00 Prize

AS I am an Amateur, my radio set is naturally the work of an amateur. It consists of a home-made cabinet with two variable condensers, one comprising 43 plates and the other 17. It is also equipt with a set of Holtzer-Cabot phones, one Marconi V.T., and an Audiotron bulb. I can use either one by throwing the four switches that can be seen on the cabinet, also one rheostat and one receiving transformer with a wave length of 3,600 meters.

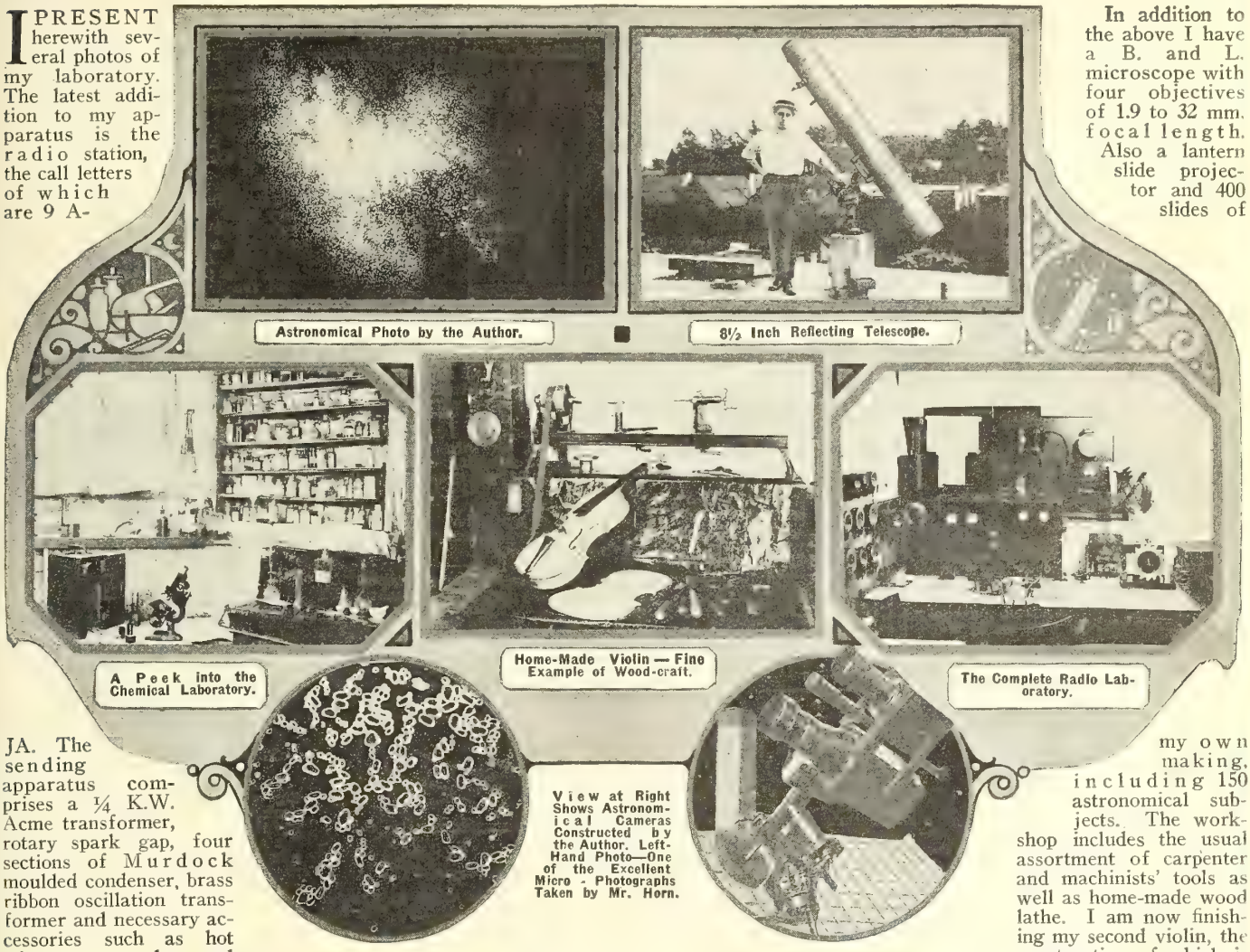


My transmitting set consists of a ½ K.W. Blitzen transformer, one Sayville rotary gap, 7,500 R.P.M., one oscillating transformer, one ding condensers and a also includes one tele- intend to use shortly, working.—A. E. C. etroit, Mich.

antenna switch, four sen line protector

Astronomy, Radio and Chemical "Lab" of Elden F. Horn

Special Laboratory Prize $10.00



Astronomical Photo by the Author.

8½ Inch Reflecting Telescope.

A Peek into the Chemical Laboratory.

Home-Made Violin — Fine Example of Wood-craft.

The Complete Radio Laboratory.

View at Right Shows Astronomical Cameras Constructed by the Author. Left-Hand Photo—One of the Excellent Micro - Photographs Taken by Mr. Horn.

I PRESENT herewith several photos of my laboratory. The latest addition to my apparatus is the radio station, the call letters of which are 9 AJA. The sending apparatus comprises a ¼ K.W. Acme transformer, rotary spark gap, four sections of Murdock moulded condenser, brass ribbon oscillation transformer and necessary accessories such as hot wire ammeter, key and switches. With full power and loose coupling this will put two amperes in the aerial, which is a small four-wire inverted "L" affair.

For receiving I use honeycomb coils, a three-step audio frequency amplifier and Baldwin or Brandes 'phones. "B" battery is of the regular lead plate storage type with pasted plates. I use a Tungar rectifier for charging and find it will charge satisfactorily against 20 volts of the "B" battery. My first radio station was put up in 1911, but was dismantled several years ago; however, as has been remarked before "they always come back." Much of the above apparatus is home-made, my method being to first figure out all sizes and then make a half size drawing with all details shown, then following this drawing exactly in the shop.

THE CHEMICAL "LAB"

The chemical department is furnished with all essential apparatus and chemicals for carrying on experiments in both inorganic and carbon compound chemistry. During the war, when the supply was cut off, I made my own developer, starting with phenol and finishing with amidol. All of my analysis is made by volumetric methods as I have no balance. A good assortment of standard flasks, pipettes and burettes are all that I use outside of the reagents. The reagents were standardized at Lane High School of which I am a graduate, class of 1916.

In inorganic chemistry I have prepared BeO from the mineral beryl, $Zr(SO_4)_2$ from the mineral baddelayite, etc. For the qualitative determination of minerals I use a blowpipe almost exclusively.

DABBLES IN "ASTRONOMY," TOO

For the study of *Astronomy* I have an 8½-inch reflector equatorially mounted. The mounting is fastened to a concrete pier which rests on the top of the brick wall of the house, a hole having been cut in the roof to allow it to pass thru. There are two slow motions and circles by means of which an object is easily found if you have its correct position. An old phonograph motor is used to drive the telescope in right ascension, the only drawback being that it requires rewinding every twenty minutes. For photographing I have two large portrait lenses which are used on wood box cameras. I have ground several telescope mirrors by hand including a 10½-inch of 54-inch focal length, but cannot get them perfect; hence the above mirror was purchased. At present I am carrying on the Saturday night program of the Dearborn Observatory, which includes measuring double stars and taking parallax plates. Their telescope is an 18½-inch refractor of high quality.

In addition to the above I have a B. and L. microscope with four objectives of 1.9 to 32 mm. focal length. Also a lantern slide projector and 400 slides of my own making, including 150 astronomical subjects. The workshop includes the usual assortment of carpenter and machinists' tools as well as home-made wood lathe. I am now finishing my second violin, the construction of which is a task I recommend to anyone caring to do neat and accurate work.

COLOR PHOTOGRAPHY

My photographic equipment includes a 3¼ x 4¼ Graflex with a B. and L. Tessar of F-4½ opening, also a large view camera mostly used for enlarging. I have taken several dozen autochromes, which is one of the best color processes now on the market. The present plates are better than those produced before the war.

ELDEN F. HORN.

ARE SOUND WAVES VISIBLE?

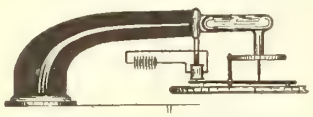
Considerable interest has been shown of late with respect to the possible visibility of sound waves. A French scientific journal relates some curious incidents which seem to indicate that such waves are sometimes perceptible to the eye. A well-known authority on volcanoes, Mr. Perret, relates that after an eruption of Vesuvius he has hundreds of times observed the appearance of luminous and shadowy arcs above the crater subsequent to explosions, these arcs being visible before the arrival of the sound and disappearing rapidly. "The only explanation," says Mr. Perret, "which accords with the characteristics of such a phenomenon is the theory that we are here concerned with visible waves of sound, whose speed of propagation corresponds to that of sonorous waves."

LATEST PATENTS

Phonograph Attachment.

(1,344,186, issued to Ralph W. Morrison.)

This device provides for a means of causing a constant pressure of a phonograph stylus against the disc so that the stylus will be maintained in the groove of the record, regardless of the inclination of that record. An electro-magnet is supported from the tone-arm or any other suitable

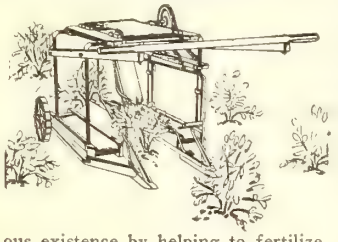


way and acts upon a cross-arm of the stylus, causing a pressure which can be regulated by a rheostat. In this way the device will be seen to be a particular advantage in instances where the grooves of a record are shallow or where the stylus is in the habit of jumping from one groove to another.

Potato Bug Trapping Machine.

(1,344,119, issued to James Monro Drake.)

Altho this device is almost human, it is indeed very simple. A small wagon-like device is run over the potato vines whereupon two sliding mechanisms lift the foliage up and shake the plant, dislodging the bugs. These bugs can neither fly away, because they would be trapt in the top portion of the machine, nor can they escape and the bugs finally find themselves sliding on to an endless band, and as the cart moves along the bugs are crushed between the two rollers, thus ending their tuber-

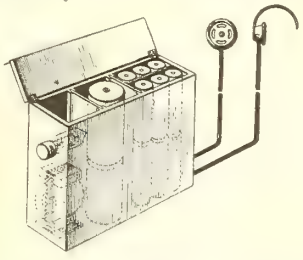


ous existence by helping to fertilize the ground when they are thrown from the machine dead. A flapper-like arrangement does the shaking of the plants.

Electric Deaf-Phone.

(1,343,717, issued to Earl C. Hanson.)

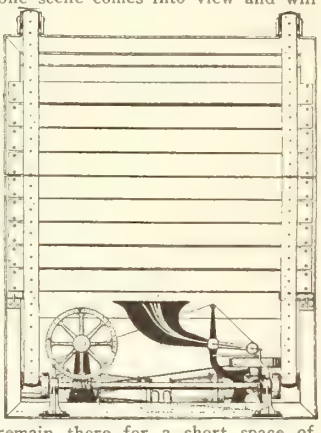
The inventor of this telephone apparatus for the deaf has realized another of the features to which audions can be put. In addition to using the regular apparatus for deaf people which ordinarily consists of a carbon ball transmitter and telephone receiver, together with the necessary batteries, he has incorporated a small induction coil, the secondary of which goes to the grid of a vacuum valve. The plate potential then passes thru an amplifying transformer, thru a second valve and thence thru head phones, thus amplifying incoming voice waves considerably.



Combination Talking and Moving Picture Machine.

(1,345,128, issued to Pierre T. L. Champeix.)

This apparatus is for the purpose of presenting animated pictures formed by sections of an illustrated band and a means of synchronizing the presentation of the pictures with a phonograph thru mechanical means. It consists of a frame-work having a number of horizontal or vertical transparent bands separated from each other by two thicknesses of "picture" bands and illuminated from behind. This picture band is movably mounted and its movement is accomplisht by means of perforations along the edges, much like moving picture film. A phonograph placed in the base of the instrument can be regulated by a differential mechanism and a device for locking the movable picture in place is also added. In this way one scene comes into view and will

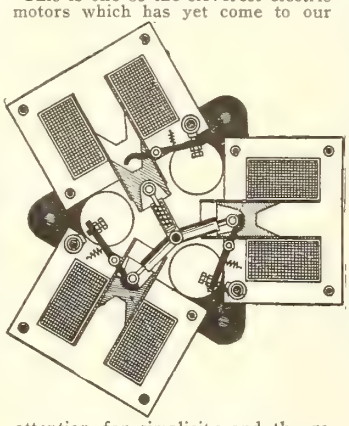


remain there for a short space of time until released, when the entire band moves the distance of the horizontal or vertical slats, and a new scene comes into view. The device is similar to the "moving pictures" printed on strips of paper which are sometimes to be won in prize bags and certain brands of popcorn, except that it is built on a much larger scale.

Electric Impulse-Motor.

(1,347,002, issued to Marie Emile Alfred Baule.)

This is one of the cleverest electric motors which has yet come to our

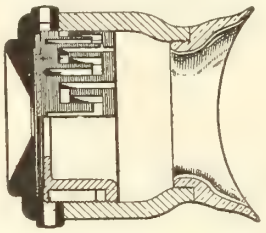


attention for simplicity and the remarkable number of unique features. It consists of three electro-magnets arranged 120 degrees apart, the cores of which communicate with a crank-pin on the driving shaft. The movable cores of these electro-magnets are composed of plates insulated from each other and arranged so that when the core is out the current will flow thru the solenoid itself, but the moment that the core is fairly well attracted by the electro-magnet, a resistance is automatically inserted which diminishes the amount of current in the solenoid, and therefore gives an equal pull instead of the much stronger pull generally found when an armature closely approaches the iron core of a solenoid. A commutator excites the various core magnets in order.

Telephonic Apparatus.

(1,345,049), issued to Maximilian Weil.)

The following invention is for the purpose of eliminating telephone

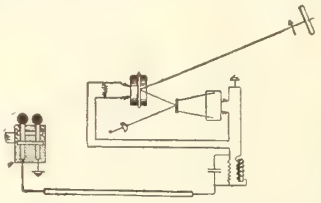


booths, etc., so that conversation can be carried on in private without the inconveniences of a booth. It consists of a special transmitter adapted to fit the user's mouth while telephoning, and the voice then passes thru a series of labyrinths, which eliminates air pressure and also minimizes reflecting echo and other sound waves, whereupon it impinges on a diafram. From this diafram the sound is focust upon the transmitter of a regular telephone, from which it is held away several inches when in use.

Telegraphy Improvement.

(1,339,550, issued to Thomas Bullit Dixon.)

As is generally known, in cables, particularly submarine cables, great difficulty is experienced by operators in overcoming the low time period surges due to earth currents

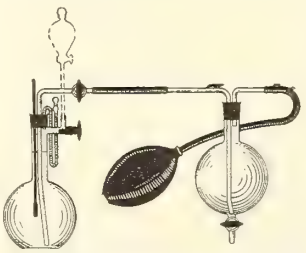


which sometimes upset telegraphic communication completely. The fact that these changes are of low time period in comparison with the regular signal changes has induced the inventor to place two coils in the apparatus, so that one will counteract the effect of the other and yet they will in no way interfere with regular reception of signals, either those recorded by the galvanometers or siphon pens, or those received thru relays.

Apparatus for Conducting Experiments.

(1,338,967, issued to Reuel W. Bennett and Elmer M. Jones.)

This apparatus is designed for performing a large variety of experiments for use in class rooms, etc., and can be used with little or no modification by the experimenter to perform various experiments, quickly. It consists of a flask with a side tube thereon, having a stop-cock, and is

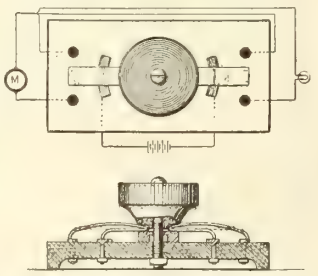


provided with a compressible bulb, a manometer and thermometer, and also if desired, a drying tube and a separatory funnel, any or all of which can be used at the same time. The inventor then shows the additional apparatus used in determining the hydrogen equivalent of metals; the percentage of oxygen in air; the weight of gases; the amount of carbon dioxid in baking powder; and the absorption of ammonia by water, etc.

Electric Switch.

(1,336,455, issued to Clifford L. White.)

We have in this patent a very clever switch which promises to take the place of the ordinary double-pole, double-throw type and is particularly adapted to control branch circuits. A novel feature of it is that it is simplicity in the extreme, and the fact that it operates by a very easily controlled ⅛ turn of the knob moving, in this way, the blades. The radial arms or switch blades are

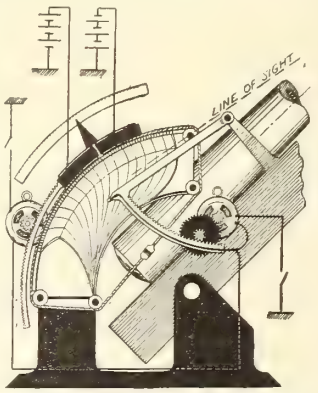


made out of one piece of brass or other material bent upon itself, so that its major portions lie in contact with each other. The shorter blade makes contact with a bar and the longer blade with the switch points.

Electric Sight-Controlling Mechanism.

(1,343,003, issued to Robert V. Morse.)

This mechanism is for the sighting of anti-aircraft guns and particularly for continuously readjusting the sight range of elevation, as the angle of position of the enemy aircraft changes as it flies. It consists of a sight mechanism which is automatically controlled by a motor, after the initial altitude has been



transmitted to the gun by the officer in charge. A gage is then set. From the bottom part of this gage are two long brushes which automatically connect a series of curved, angular copper segments to a battery making one side above the pointer of the gage positive, and the other side a negative potential. A brush upon the sight telescope then allows the motors to be kept in constant operation. Contact on one side would cause the motors to turn to the right, and contact on the other, because of difference in polarity, causing the motors to turn to the left, thus either elevating or lowering the gun and sight mechanisms and making the device entirely automatic. In this way, when once the altitude of the enemy aircraft is obtained, the gunners are not confused by the rapidly changing range.

Scientific Humor

And the Kids Wanted To See the "Fireworks".—While riding on a train one day I saw a man wearing handcuffs. Beside him sat his wife.

Soon she said to him, "John, shall I bring the children down to see you electrocuted?"

The man looked astonisht and said, "You ought to be ashamed of yourself suggesting such a thing."

"That's just like you," she remonstrated; "you never did want the children to enjoy themselves."—*Max L. Goldstein.*

What's the Citrate of Magnesia?—VIOLET: I see where nitrates have gone up in price.

RAY: What do I care? We never telegraph anywhere.—*Theo. R. Williams.*



He Ought to Move Into the 4th Dimension—Chug-Chug! Br-r! Br-r-r-r-! Honk! Honk!

The pedestrian paused at the intersection of two busy cross-streets.

He looked about. A motor-car was rushing at him from one direction, a motorcycle from another, a steam truck was coming from behind and a taxicab was speedily approaching. He looked up and saw directly above him an airship in rapid descent.

There was but one chance. He was standing upon a manhole cover. Quickly seizing it, he lifted the lid and jumped into the hole—just in time to be run over by a subway train.—*John C. Batchelor.*

The Worst Yet!—To prove: That a piece of writing paper equals a lazy dog.

PROOF: A piece of paper = an ink-lined plane.

An inclined plane = a slope up.

A slow pup = lazy dog.—*Ralph E. Carson.*

But Did He Count Them?—TEACHER: What is a kilometer?

PUPIL: A hundred feet.

TEACHER: Oh, no, that would be a *centipede*!—*Ralph E. Carson.*



Probably "Matched" Each Other.—"What caused the fire in the match factory?"

"There was some friction, I believe, between the heads of the departments."—*J. W. Case.*

He was En-light-ened.—During a flood a few years ago the river reached the power plant about 3 a. m., cutting off the power.

The operators in the telephone exchange called the wire chief, who started to the office in his flivver, and found his lights out. Before reaching the office he was stopt by a police officer, who askt him why he had no lights. Doing a little quick thinking, he told the officer:

"Of course, my lights are out, the juice is out all over town."

The officer studied a minute and said: "By golly that's so, go ahead."—*H. M. Palmer.*

FIRST PRIZE $3.00

We'll All Want One—



— "I've an invention at last that will mean a fortune!"

+ "What is it this time?"

— "Why, it's an extra key for a typewriter. When you don't know how to spell a word, you hit this key, and it makes a blur that might be an e, an a, or almost anything else!"—*Joseph F. X. Prestia.*

And Both Are Very Fragile.—Love is like a photographic plate—it takes a dark room to develop it.—*A. G. Kalmbach.*

Why Didn't the Car Burr Ate 'Er?—"I had the devil of a time with my Ford last night. I got awfully 'cranky' with it and when I gave it the gas it thought it was laughing gas, I guess, for it just spluttered. The engine kicked because the timer didn't have time to help the spark plug, which was 'broke,' and wouldn't give a scent if the exhaust was exhausted waiting for the radiator to get 'rady.' Anyway, the bearings couldn't bear it because the axles held up 'the chassis'; and the transmission forgot its mission, when the gears got 'shiftless' after finding out that the wheels were tired. And so I decided to retire, too!"—*Carleton Farmer.*

ALL jokes accepted and publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

Easy Marks Must Be Fingerprints.—"A man's boot marks on the roadway are called footprints, aren't they?

"Yes."

"Well, what would you call the marks of a motor car?"

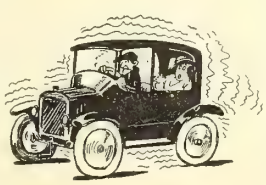
"Oh, *autographs,* of course."—*C. Spurrow.*

And Chemistry Won't Be Repaid.—"We owe a great deal to chemistry."

"Yes, indeed. For instance, to chemistry we owe a great many of our blondes."—*G. H. Roskein.*

Sure! The Equator Is in Africa.—TEACHER—"What is the equator, Johnny?"

JOHNNY—"The equator is *a menagerie lion* running around the center of the earth."—*N. Back.*



And at 25 Miles He Gets Rattled.—"I don't need any speedometer on my Ford. I can easily tell my speed."

"How do you do it?"

"Well, when I go 10 miles an hour my lamps rattle, when I go 15 miles an hour my fenders rattle and at 20 miles an hour my bones rattle.—*Dale Hackley.*

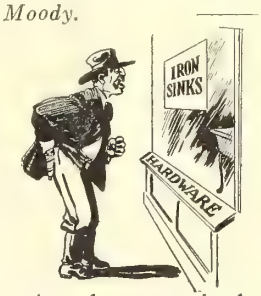
We Simply Can't Down These "Currant" Jokes!—ANODE—"What is the difference between a Direct Current Dynamo and a currant bush?"

CATHODE—"Search me."

ANODE—"The dynamo produces direct current, and the currant bush produces currants direct."—*Benneville Bertolet.*

And It Makes a Bad Scent.—IKEY (looking up from his book)—"Fader, what is der meaning of 'Vortex'?"

FATHER—"Vy, Ikey, don't you know? Dat's der extra cent vat dey charge on movies und ice cream 'Cohns'."—*Harry L. Moody.*



And Dew Drops.—Struck by the notice *"Iron Sinks"* in a hardware shop window, a wag went inside and said that he was perfectly aware of the fact that "iron sank."

Alive to the occasion, the smart shopkeeper retaliated:

"Yes, and time flies, but wine vaults, sulfur springs, jam rolls, grass slopes, music stands, Niagara Falls, moonlight walks and holiday trips, scandal spreads, standard weighs, India Rubber Tires, the organ stops, trade returns, and—"

But the visitor had bolted. After collecting his thoughts he returned, and showing his head at the doorway, shouted:

"Yes, I know, and marble busts!"—*John Bigenwald.*

The Dy(e)ing Lover.

I love thee, blue-eyed sweetheart. Be mine!
Dibromocresosulphonaphthalein!
Thine eyes, blue as the sky, tint divine,
Tetrabromphenosulphonaphthalein!
I'll dye a Parisian blue if you decline,
Oh, dibromthymoesulphonaphthalein!
—*Harry L. Moody.*

One on the Prof.—PROFESSOR, explaining the movements of heavenly bodies—"Perhaps it will be clearer if I let my hat represent the moon. First is there a question?"

PUPIL: "Is the moon inhabited?"—*Kenneth Purdy.*



He Ought to Evaporator.—"This," said he, "is the engine boiler."

"But why boil the engines?" said the sweet young thing.

"To make the engine tender," he answered gently

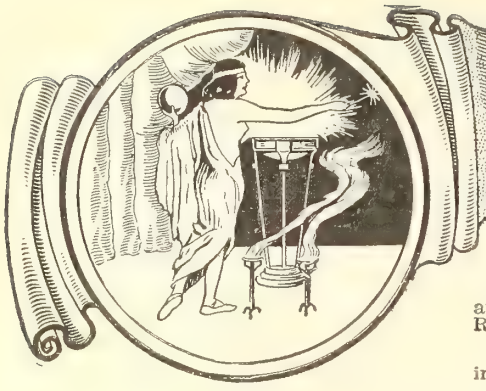
—*A. Tzatzhen.*

He Was Tickled to Death.—FIRST BOY: "My father occupied the seat of applied Physics at Harvard."

SECOND BOY: "Dat's nothin', my fader occupied the chair of applied electricity at Sing Sing."—*B. Rosenblatt, Jr.*

He'll Get It Coming and Going.—A certain town in Nova Scotia receives its electricity by high voltage transmission from a coal mine. Each pole within the town limits bears the following notice:

Danger—66,000 *Volts.*
Contact with any one of these wires will prove fatal.
Any person tampering with these wires will be prosecuted.—*W. E. Davidson.*



THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

RECTIFYING COMMUTATOR.

(1061) W. H. Rogers, Turtle Creek, Pa., asks:

Q. 1. Several questions as to the salability of a motor-driven rectifying communicator.

A. 1. We would advise you as follows concerning the rotary converter which you propose:

There does not seem to be anything radically new in the scheme you outline for rectifying A. C. to D. C. and comprising a multiple segment commutator driven by a synchronous A. C. motor operated from the incoming A. C. mains, as several of these machines have been placed on the market in the past few years.

They are used for operating motion picture projectors, etc., where a high amperage of from 50 to 100 amperes is required. These machines have been advertised in various electrical journals.

This type of rectifier possesses, as you mention, the merit that only a small motor is required to drive the commutator, no matter how much current is taken from the latter device.

EDISON PRIMARY CELL.

(1062) E. I. Abrams, Chicago, Ill., asks *The Oracle:*

Q. 1. As to the merits of the Edison primary battery for lighting lamps.

A. 1. The Edison Primary Battery is excellent for lighting six volt automobile lamps, but about 5 to 6 cells connected in series will have to be used. This cell can readily be refilled by renewing the electrodes and the electrolyte.

It can be used steadily and does not deteriorate to any appreciable extent when not in use. The voltage of these cells is very low (about .9 volt usually), altho the output runs up to 200 or 300 ampere-hours for each cell.

PECULIAR TRANSFORMER AND SPARK COIL EFFECT.

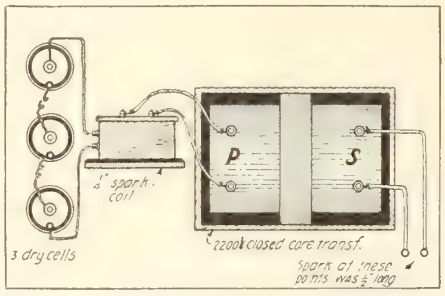
(1063) Thomas S. Parker, Palestine, Texas, writes this department:

Q. 1. I have just obtained a 2200-volt, 60-cycle, closed-core alternating current transformer from the local electric light company. It steps up the potential from 110 volts to 2,200 volts. It is a transformer which has both primary and secondary enclosed in the core.

With it connected up as shown in the diagram I was able to obtain a ½-inch spark. As you see, the spark coil only gives ¼-inch spark, and I want to know if there is any advantage obtained in this way for use on a wireless transmitter, or will the transformer cut down the voltage of the spark coil to where it will be only 2,200 volts?

Could this transformer be used for wireless if it was connected with a 110-volt line, 60 cycles, alternating current?

I connected a bell in series with six dry cells and connected the wires to the transformer, and obtained a good loud spark at the secondary terminals; a fact which I thought impossible with an alternating current transformer.



Peculiar Arrangement of Spark Coil and Step-Up Transformer, Which Yielded a Larger Spark Than the Usual One Produced by the Spark Coil Alone. A Freak Condition It Is Thought by the Editor.

The bell was acting as an interrupter and I obtained a good loud spark with the direct current, which same is considered impossible with an alternating current transformer; nevertheless it worked, and would even charge a Leyden jar to the extent that it could be heard all over the house and out in the yard. The jar was a little larger than one pint. How do you account for these facts?

A. 1. In regard to the operation of a spark coil in conjunction with a step-up transformer of a closed-core type, our opinion is as follows: What you have done is apparently this: You have taken several thousand volts secondary output from your spark coil and passed this thru the primary of a transformer. The transformer thus should raise this current of several thousand volts to twenty times its value, if the transformer was wound to stand this voltage.

Frankly speaking, our idea of this whole matter is that the secondary current from the spark coil at several thousand volts potential has simply "walked" thru the transformer, or at least jumped thru it by some peculiar freak, managed to induce a somewhat higher potential in a part of the secondary winding, perhaps, and produced in consequence the one-half-inch spark which you describe.

Of course, the whole matter sums up as follows: Whether or not such an arrangement was practicable, electrically speaking, you could not gain any power in this way, as every time the current passes thru another piece of apparatus there is a loss of efficiency of transformation. That is to say, while the voltage might be higher, as manifested by the spark after the current has past thru the transformer, the strength of the current or amperage would be less, and the wattage less than that resulting or available from the secondary output of the spark coil originally.

The transformer you have rated at 2,200 volts at the secondary is too low for any ordinary type of wireless transmitter as about 8,000 to 10,000 volts at least is invariably used to charge a glass plate or other form of condenser for wireless transmission. The experiment you made by using a vibrating bell in series with six dry cells to the primary of the transformer and obtaining thereby a good-sized spark at the secondary, is nothing so unusual.

There are a number of different radio sets as well as ozone transformer outfits in which a vibrating interrupter is used in the primary circuit for locations where direct current is available. But for radio work the spark gap must be synchronously attuned with the primary interrupter and moreover, the interrupter should be made in the form of a commutator with two or more segments, as described recently in *Radio News* and also several months ago in the Radio Department of SCIENCE AND INVENTION.

AUDION AS AN AID TO HEARING.

(1064) Miss Belle Henry, St. Paul, Minn., writes:

Q. 1. I have been much interested in "The Versatile Audion" in your February issue.

Not being a scientist the information on the audion was new to me and seems very wonderful.

But the use which immediately occurred to me, to which it might possibly be put, is not mentioned. That is, in connection with the electrical instruments for the deaf. These instruments now are only partially successful but would be wonderful if they could be perfected to take the place of normal ears.

A. 1. There is one application of the audion as an aid to hearing for the deaf which comes to mind at the present time, which uses its amplifying properties when used in conjunction with a microphone or sound-detecting instrument, together with the telephonic receiver or reproducer. When a two-stage audion amplifier comprising two vacuum bulbs is suitably connected, the sound picked up by the microphone will be of course wonderfully intensified when reproduced in the receiver attached to the ear.

A very interesting article entitled "The Physiophone" appears in the April issue, and this covers a new scheme for putting music into undulating electric currents which are taken thru metal handles into the body, and it is pointed out in the article in question that even deaf mutes, who have never and can never hear orally thru the ear, may indeed be able to "feel" or "hear" indirectly, as we might say, the rhythm and beauty of music, and also for that matter the spoken word or speech.



FREE



Draftsman's Complete Outfit

Everything used by expert draftsmen given you absolutely free. Outfit includes "professional" complete set of drawing instruments with double set of compasses and dividers all in velvet lined case. Drawing board, T square, two triangles, protractor, universal curve, triangular standard scale, water-proof ink, pens, pencils and all accessories—furnished you free in this expert's complete outfit.

Bennett Wellington Cooke
President of the Coyne Trade & Engineering Schools. Leading Educator and Trainer of High Paid Men.

Easy to Learn at Home
from Largest School of Its Kind in the World

The Coyne Home Study course is directed personally by President Bennett Wellington Cooke. He guarantees to train you. Remember, the Coyne Trade and Engineering Schools is the largest institution of its kind in the world. Students come from all over the world to get Coyne training. Why, because of the Coyne Schools' long established, tremendous reputation for successful teaching by its great staff of experts. Coyne is not a "one man" school but a great educational institution, 21 years old, an acknowledged leader and originator. This school, under the direction of President Cooke, originated the "Learn by Doing" method now endorsed by educators everywhere. Coyne has graduated thousands of successful, prosperous men all over the world. You can't make a mistake if you write for the Coyne free book. Coyne students say every minute of the course was enjoyable. Some students took **good positions 3 months before their course was finished.**

Send for FREE Book

Mail this coupon for our interesting book, "Drafting the Foundation of Industry," sent you free. It explains all about the Coyne home study method and shows you how to become a draftsman in the quickest and easiest way. You want to know all about this great institution. Don't put it off. Send for this book now. It's absolutely free, no obligation. It contains the most valuable information you will ever get in your life. Send the coupon now.

COYNE
HOME STUDY DEPT.
TRADE & ENGINEERING SCHOOLS
Largest Institution of Its Kind in the World
39-51 East Illinois St., Dept. 1257, Chicago, Ill.

Draftsmen Make $225.00 to $500.00 a Month

There is a tremendous demand now for trained draftsmen. Employers are competing for men to fill positions. There will be no let up in this demand for many years to come. Now is the time to get started. Draftsmen get good pay from the very start and can work up to $500 a month *and more.* Draftsmen are needed everywhere. Once you are trained you can choose your own business and work in any part of the country you please. Don't be afraid you can't do it. Coyne training makes everything easy for you.

Coyne student L. T. Dubendorf writes: "Immediately after completing Coyne course I went to work for Armour & Company. Work was easy for me. Five months later I accepted a position in NewYork at a large increase in salary."

You Can Do As Well. Start Now
Write Today for Coyne Free Book

Coyne Trade and Engineering Schools
Department 1257, 39-51 East Illinois Street, Chicago, Illinois

Dear Sirs:—Please send me, absolutely free, without obligation, your book, "Drafting the Foundation of Industry," also full information about the Coyne Home Study Course in Drafting.

Name.....

Address.....

State.....



Who Wants These Boxing Lessons?

How would you like to give that chap who thinks he's a scrapper the surprise of his life? Wouldn't it be great if you could say to him, "Come on, I'll put on the gloves with you"—and then show him some really scientific boxing!

Or suppose you are attacked, without any weapon of defense except those two fists of yours; wouldn't you give anything to know how to disable your opponent with a powerful blow or jiu-jitsu hold?

You can learn boxing and self defense in your own home. Marshall Stillman is the first man to successfully teach boxing by mail. Many pupils have written saying that, after the first few lessons, they've outboxed bigger and heavier opponents. The proof of the pudding is that the big new course (6 books) is sent on free 10 day approval. If you keep it you pay $5 in complete payment; otherwise you return the course, and that settles the matter. But you'll keep it all right, when you see how good it is.

The lessons are practiced before your mirror. You start with simple movements such as holding out your hand for a coin, the breast stroke in swimming, etc., and, before you know it, you are striking heavy blows, guarding, ducking, feinting, side-stepping, just as if you had a real opponent before you. Every move is illustrated with pictures, and the type is large so that you can practice while you read.

After you've thoroughly mastered the fundamentals you take up shadow boxing. Here you go through 3 lively rounds combining such scientific blows as the Bennie Leonard Triple Blow, the Jack Dempsey Triple Blow, etc.

Then follows the volume on "Boxing Blows and Guards." Every worth-while blow used in the ring is fully described and posed for by two experts. Following each blow is the guard for that blow. When you face your first opponent, you'll know what blows to use, when to use them, and how to guard against the blows your opponent uses.

Then there's a complete set of daily muscle-building exercises; also the "Colon Exercise," one of the best remedies for constipation, and "Synthetic Breathing," a lung developer and aid against nervousness. 23 illustrations.

To complete your training in self defense you're taught 15 jiu-jitsu holds and 8 holds in standing wrestling for use against violent attack—how to disarm an opponent with pistol, dagger or club, how to release a strangle-hold, etc. This book alone contains 54 illustrations.

There's an illustrated article on Mass Boxing, showing how to teach boxing to large masses of men—an article on training—an article on mental, moral and physical development, with a short criticism of sports such as baseball, football, swimming, tennis, etc.—a copy of the International Sporting Club Boxing Rules—and a history of 69 great boxers with their pictures. The fact that there are 246 illustrations in the course will give you an idea how complete it is.

SEND NO MONEY

Remember, send no money—we'll send the books on free approval. So simply fill out the coupon and mail it to the Marshall Stillman Association, Suite E-110, 461 Fourth Avenue, New York City.

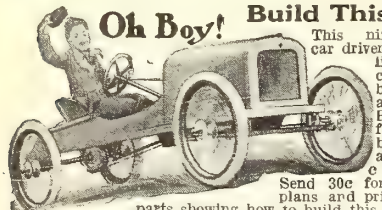
— — — — FREE TRIAL COUPON — — — —

MARSHALL STILLMAN ASSOCIATION
Suite E-110, 461 Fourth Avenue, New York

You may send me on approval your complete course in Boxing and Self Defense as described above. I have always been faithful in paying my obligations, and I give you my pledge that you may feel safe in trusting me as agreed and that I will either return the course or remit $5 (Canada $6, foreign countries $7) in 10 days.

Name .....

Address .....



Oh Boy! Build This Car.

This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 30c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO., 156 Sypher Bldg., Toledo, Ohio

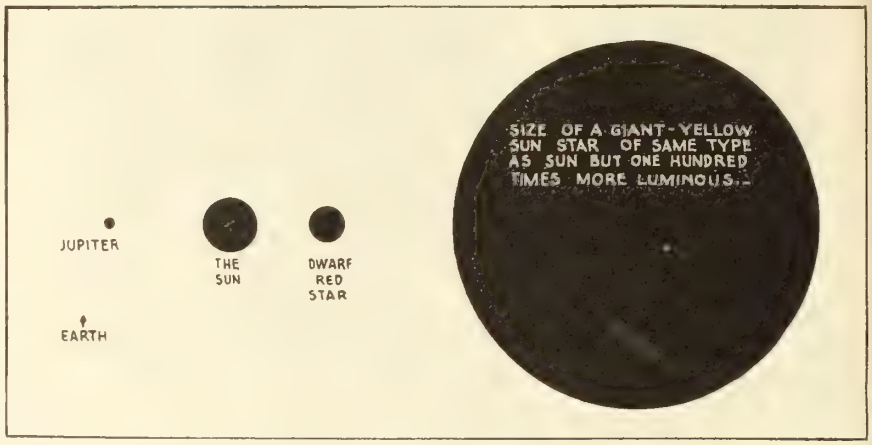


Send for a Complete Catalog of
MASONIC BOOKS
Jewelry and Goods
REDDING & CO.
Publishers and Manufacturers
Dept. 5 200 Fifth Avenue, N. Y.

Popular Astronomy

By Isabel M. Lewis

(*Continued from page* 615)



A Giant Red Star If Drawn to Scale Would Be Represented by a Circle with a Diameter About Four and a Half Times That of the Giant Yellow Star.

The red giants of class M probably have densities that average only a *few millionths* of the density of the sun while their diameters may occasionally be as great as forty million miles. On the other hand, the density of the red dwarf stars cannot be much greater than that of our own sun for it is very doubtful whether a body much more condensed than our sun would be in a gaseous condition. Moreover, if a dwarf star were as dense as the sun and contained only a tenth of its mass or quantity of matter it would be a very faint object and therefore invisible to us even if comparatively near. A dwarf star of the size of Jupiter or Saturn and of the density of the sun would have such a small mass that it would probably be practically non-luminous. Many such dark suns may exist in the universe. Jupiter has a density almost exactly equal to that of the sun and the density of Saturn is less than one-half that of the sun and both are non-luminous bodies resembling extinct suns rather than planets.

It was believed, before the discovery of radio-activity, that the radiation of the stars was supplied solely by the gravitational contraction of gaseous bodies. Assume that a giant red Cepheid variable of enormous volume and very low density begins to contract under the gravitational attraction of its parts. According to the law of gases as it contracts it grows hotter and its radiations become more intense. It becomes yellowish in color as its temperature rises and density increases and at the same time its size decreases. As it becomes still hotter and more condensed its color changes gradually from yellow to white and then to bluish white and its density increases still further. When its density approaches one-tenth of the density of the sun, however, the star no longer behaves as a perfect gas and its loss of heat by radiation begins to surpass its gain of heat by gravitational contraction and it gradually cools off, and grows dwarfish in size and high in density, going thru the color changes in the reverse order from bluish white to white, then to yellow, orange and red. On this hypothesis the existence of the two groups of dwarfs and giants in each spectral class can be accounted for and the order of stellar evolution as outlined by Russell is from diffuse giant red stars thru orange, yellow, yellow-white, and white giant stars successively to the hottest type of stars, the blue helium stars, which stage can be reached only by the most massive of all stars. Stars of moderate mass would not attain to this height of development, but would begin to decrease in size and density and return thru the dwarfish groups of the same types to dwarf red stars without at-

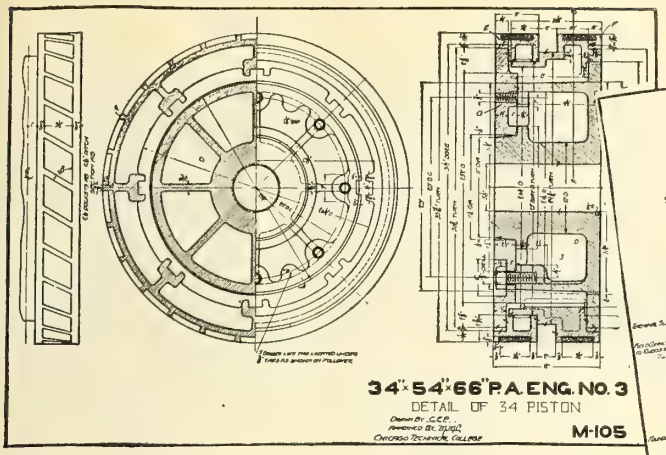


Outline of the Constellation Orion—With the Exception of Betelgeuse, Which Is a Giant Red Star, All the Stars Shown in This Group Are Giant Stars of the Helium Type, Often Called the Orion Type Stars Because They Occur in Such Profusion in This Particular Constellation; Rigel Is One of the Super-giants of the Universe, Being at Least One Thousand Times More Luminous than the Average Star of the Helium Type or One Hundred Thousand Times More Luminous Than Our Own Sun.



Diagram Showing Relative Sizes of the Sun, a Super-giant Red Star, and the Orbits of the Planets Mercury, Venus and Mars.

(*Continued on page* 662)



Draftsmanship

Become an Expert by Home Study

The illustrations show the work of some of the students of Chicago Technical College.

These drawings were picked at random from hundreds equally good made by men who, before taking the courses, had had no training as draftsmen.

Naturally the large reduction made necessary to reproduce the drawings in the space of this page gives only a partial idea of the high excellence of the work—some of the lines losing the strength they show in the originals. But even so, it will be seen that these drawings are equal in merit to the work of men of long experience.

Make Yourself Worth $60 to $150 a Week

You, too, can master draftsmanship as easily as these men did under the Chicago "Tech" method of training. You can soon become proficient simply by giving some of your spare time to home study under the direction of our experts. Then you will be ready to step into a paying job and be in line for promotion to important managing positions.

Draftsmanship today offers opportunities which no ambitious man should overlook. American industries are constantly looking for experts—and none are more eagerly sought than the draftsman.

No need for you to settle down in any humdrum occupation or to accept an outlook without promise of large success when great manufacturing organizations, railroads, architects—all classes of concerns engaged in technical work—are searching everywhere for trained men. At least look into this profession today.

Train Under Practical Men

From the day you enroll with Chicago "Tech" you are under the direction of practical engineers who teach you thoroughly the methods which they use in their own work and which you will use when you practice the profession yourself. Lessons, exercises and special texts deal with conditions as they exist, so when you graduate you are perfectly familiar with the actual work of the drafting room.

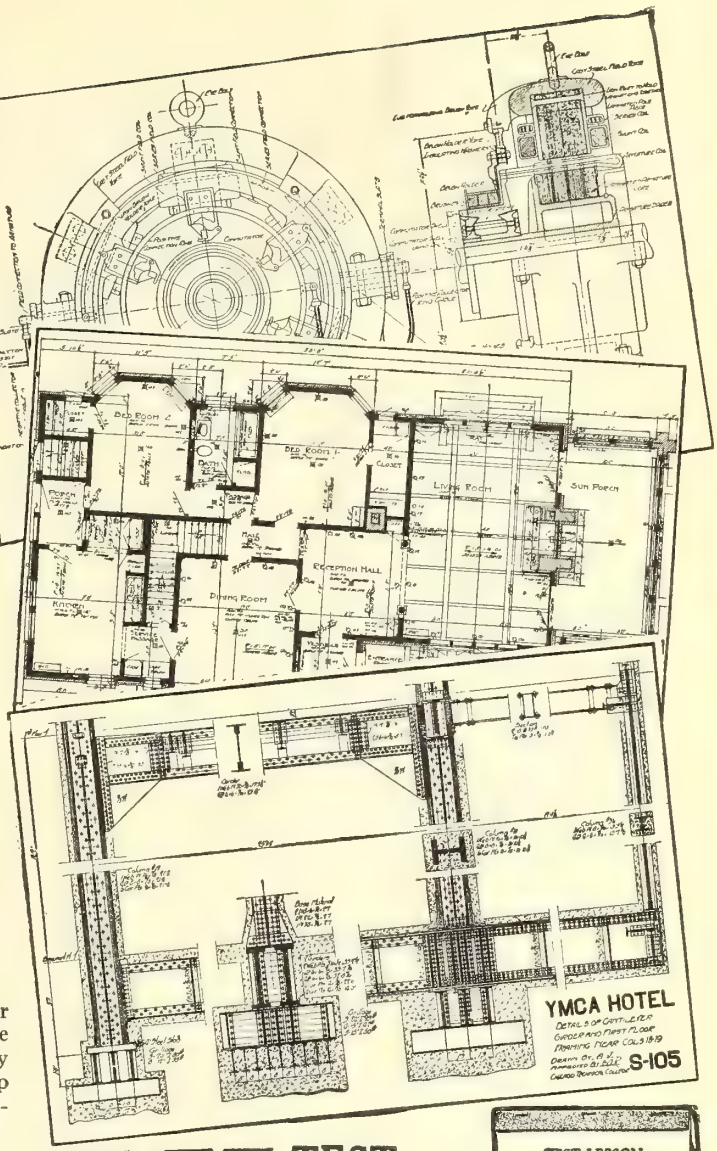
You are carefully instructed on every point, taken upward step by step, everything being made so clear that your advancement is sure and constant. No time is put in on unnecessary studies—you concentrate on the work that will make your services in demand.

You get the same instruction by mail that you would get if you came to Chicago to attend the College. Therefore if now employed you can hold your present position until you are ready to enter the field of expert Draftsmanship.

Moderate Fees, Easy Terms

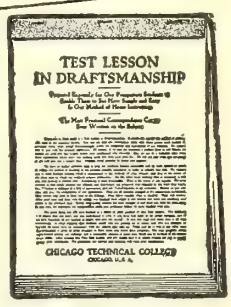
Chicago "Tech" offers this practical instruction at a price and on terms which place any of the courses within the reach even of the man of moderate means. And payment can be made on easy monthly terms. No man who wants such training can give himself an excuse for not grasping the opportunity now.

CHICAGO TECHNICAL COLLEGE
1045 Chicago "Tech" Bldg. CHICAGO, ILL.



FREE TEST LESSON

This free test lesson will show you how well qualified you are for Draftsmanship and how practical the Chicago "Tech" courses are. While other schools ask you to enroll and send money first, we send the free lesson first. The only offer of its kind. Read the lesson, practice the exercises and then decide for yourself whether to take the course or not. No obligation on you for asking for this.



Drawing Outfit—No Extra Charge

FREE outfit is included with our Home Study Course or credit given if you already have an outfit. These are high grade instruments, drawing board, T square, etc.—same as used by leading draftsmen.

Other Chicago "Tech" Courses

Chicago "Tech" opens the field of specialized training not only in Draftsmanship but in other paying lines also. If you want information on any of these, mark the coupon with X to show which subject interests you and full information will come by return mail.

SEND THE COUPON

No obligation upon you is implied when you ask for the facts about Chicago "Tech" Instruction. We gladly send catalogs and information telling you about the opportunities offered in any line of work we teach. Then you can decide what the field offers for you. Big jobs are waiting now for men like you—WITH TRAINING. Send the coupon—today.

CHICAGO TECHNICAL COLLEGE 1045 Chicago "Tech" Bldg., Chicago, Ill

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below:

[ ] Architectural Drafting	[ ] Auto. Engineering
[ ] Machine Drafting	[ ] Aero. Engineering
[ ] Electrical Drafting	[ ] Gas Engines
[ ] Structural Drafting	[ ] Plan Reading—Buildings
[ ] Sheet Metal Drafting	[ ] Estimating—Buildings
[ ] Topographic Drafting	[ ] Plan Reading—Machinery
[ ] Surveying	[ ] Plumbing—Estimating
[ ] Designing	[ ] Heating and Ventilating
[ ] Contracting—Buildings	[ ] Steam Engineering

Name.....

Address.....

Post Office.....State.....

Free Trial Lesson included when inquiry is for Draftsmanship or Plan Reading.

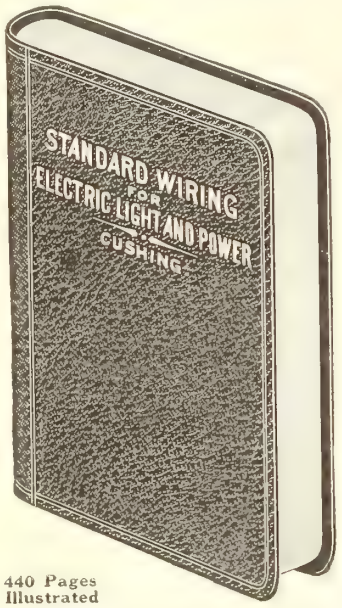
College or Home Study, state which.....

LEARN WIRING

AND EARN

$75 a Week

This year's Edition will make you an Expert



440 Pages
Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. 250 Electrical Units and their Definitions and Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve your wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges. Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.

8 West 40th Street New York

"Movies" of Flying Bullets

By PIERRE H. BOUCHERON

(*Continued from page* 611)

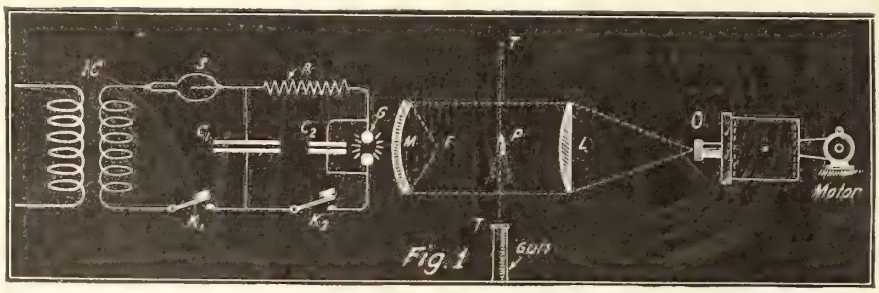


Diagram Showing Arrangement of Camera, Spark Gap, Etc., for Photographing Bullets in Flight.

the spark gap G, across which has been shunted a condenser C2, of very small capacity.

When the large condenser is fully charged and the circuit is closed, the electrical current will continue thru the circuit and charge the small condenser. When the potential of this smaller condenser has obtained a sufficient value to jump across the space of the spark gap, a spark takes place. Thus this cycle of events reproduces itself constantly and as the charge of the large condenser diminishes, the sparks occur less frequently. Furthermore, by directing a comprest air-jet upon the spark to prevent the formation of an arc, and while maintaining the voltage and capacity at a constant factor, as well as the length of the spark gap, it is possible to regulate the frequency of the sparks with exact precision.

The electrodes of the spark gap are placed facing the approximate center F of the parabolic mirror M, which has a diameter of 40 centimeters. This mirror projects the emitted light of the spark in a stream of parallel rays upon a convex glass L of equal diameter placed 3 meters distant, and which causes the rays to be ultimately focust upon the objective O of the photographing apparatus.

In order not to damage the instruments during fire and so that nothing is lost of the action, the firepiece is installed in such a manner that the trajectory T-T of the projectile P will pass at an equal distance

(*Continued on page* 654)

Solving the Housing Problem

By H. GERNSBACK

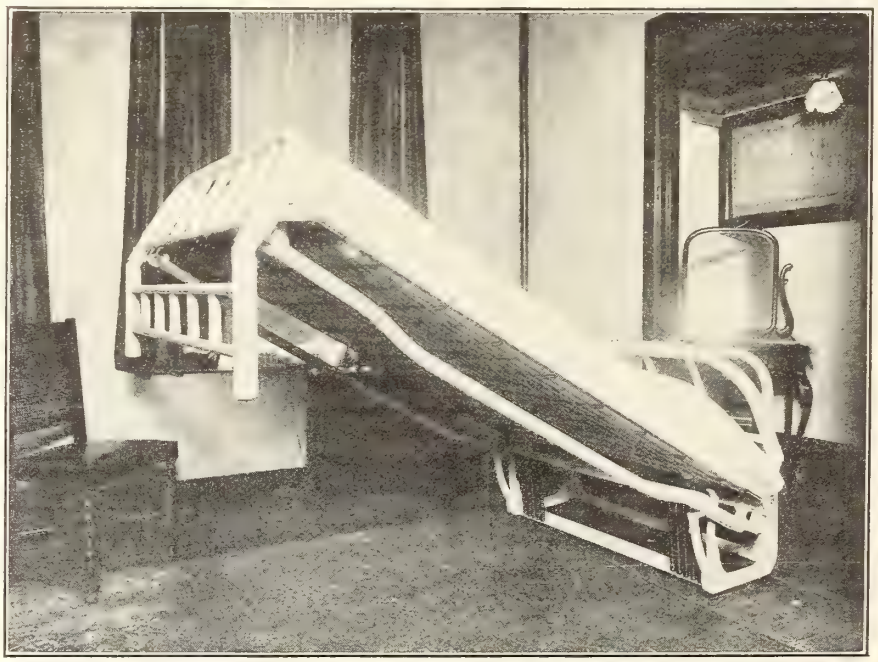
(*Continued from page* 619)

commuter. Just watch any outgoing commuters' train where every other man is loaded down heavily with bundles and packages.

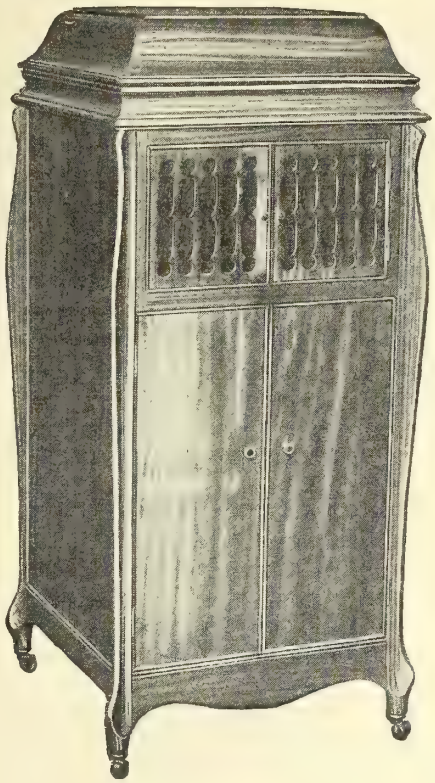
MR. EDISON'S PREDICTION.

What then is the solution of the problem? Some months ago when the writer interviewed Mr. Edison, the latter predicted that within twenty years Manhattan Island (New York City proper) would not contain a single residence. It would then only contain business houses, factories, etc. Everybody would come to work by suburban rapid transit trains and return home in the evening. Mr. Edison's prediction is, of course, correct. For, if you look about us, you find that the City of New York is becoming more and more a business center, driving out apartments every year. Last year, for instance, has witnest the erection of hundreds of business institutions, theaters, etc., while this year there is only contemplated the erection of *a single apartment house,* where several thousand of them

(*Continued on page* 683)



Here Is the Latest in "Space Savers"—a Full-Size Folding Bed That Folds Up Into an Alcove in the Daytime. Thus You Have No "Bedroom" Waste Space During the Day.



You Can Build this Phonograph EASILY

Tremendous Saving in Cost

A FEW hours pleasant work—some simple tools found in any man's home—and

Our Simplified Plans

IT'S an easy and interesting job to build this fine, sweet-toned cabinet instrument by our system. We furnish blueprints, diagrams, motors, tone arms and all other metal parts together with knockdown cabinet and ready built horn all complete. You do the assembling and finishing at a saving of more than one-half the retail cost. You can't go wrong if you follow our instructions. There's a model and price for every taste and purse. Your choice of four beautiful models.

Everybody who has built a Makafone has found it much easier than he first thought. You will find it so too

Read What Satisfied Builders Say

"I have built my phonograph that I purchased from you and it is a dandy. I am well pleased. I had neighbor in to look at it and he thinks it is nice. I think that he will buy one."—Crawford, East Peoria, Ill.
"I received everything O.K. and I have already built and enjoyed it for two weeks and I am very much pleased with it."—Bieschke, Chicago, Ill.
"I have the model No. 1 set up and in fine running condition and would not sell it unless I could get another one like it. It is equal to any I ever saw. I have finished it in natural wood and all that have seen it say that there is not a finer machine in any store in town."—Corbin, Vancouver, Wash.
"Have just finished the cabinet and believe me she sure does look swell. I can guarantee you several more orders very soon."—Armhein, Milwaukee, Wis.
"I am well pleased with the MAKAFONE I ordered from you some time ago and am now placing another order for a No. 4 machine."—Hysong, Covington, Ky.
"I received my MAKAFONE and have built it and find it a dandy. I will send an order for a No. 3 machine in the very near future."—Bank, Sanatobia, Miss.

Get Into the Phonograph Business for Yourself

No experience is necessary under our plan. Hundreds have gone into the business of building Makafones which they sell to their neighbors and friends at a clear profit of not less than $50.00.

"I received the outfit in good shape. Am perfectly satisfied that the machine plays well and it was sold right away. Please send more price lists and order blanks, as I want to order a No. 5 outfit right away."—Schettling, Kansas City, Mo.

Gentlemen:
I have the phonograph finished, ordered from you some time ago. The music reproduced on this instrument is better than any I have ever heard. This machine is now sold and I soon will be able to take advantage of your discount for ordering six outfits at a time. J. A. Devenny.

Many of these people have come from clerical or other non-mechanical vocations. *And they are all making good.* Why not you? We shall be glad to give you full particulars so send in this coupon today.

Modern Phonograph Supply Co.
342 Springer Bldg., 313 So. Clinton St., Chicago, Ill.

Fill Out This Coupon And Mail Today

MODERN PHONOGRAPH SUPPLY CO.
342 Springer Bldg., 313 S. Clinton St., Chicago, Ill.

Gentlemen:—Please send me full particulars of your "Build Your Own Phonograph" proposition, without obligation to me.

Name .....

Street Address.....

City or Town.....State.....

Play the Hawaiian Guitar

Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs, and other effects that make this instrument so delightful.



The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Your tuition fee includes a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 complete lessons and pieces of music.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK

I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc., etc.

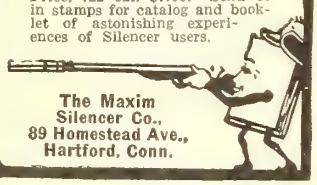
NAME .....
ADDRESS .....
TOWN .....
STATE .....E.E.
Please write name and address Clearly.

Shoot Without Noise

Avoid disturbance, also flinching. Enjoy quiet shooting, anywhere, anytime. Use a

MAXIM SILENCER

Price, .22 cal. $7.00. Send 6c in stamps for catalog and booklet of astonishing experiences of Silencer users.



The Maxim Silencer Co.,
89 Homestead Ave.,
Hartford, Conn.

"EARN WHILE YOU LEARN"



If you are earning less than **$100.00 PER WEEK** and like to draw—you should study

Commercial Art

Leading Art Managers—the men who know — recommend us and employ our students. We will guarantee to make you successful—Learn at home in your spare time—or in our resident school—Day or evening. Many of our students earn money by the sale of their drawings while learning. Write for FREE illustrated catalogue.

COMMERCIAL ART SCHOOL
708, 116 So. Michigan Avenue, Chicago, Ill.

LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries. Thousands needed today. We give you personal and thorough training—practical, technical courses three months to two years, under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. **Not a trade school.** Enroll anytime. Do not judge us by size of ad but write for free illustrated catalogue.

FINLAY ENGINEERING COLLEGE
Greatest of its kind
1001 Indiana Avenue Kansas City, Mo.

STAMMER NO MORE

Kill the *fear* of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Order a copy today. THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago, Illinois

"Movies" of Flying Bullets

(*Continued from page* 652)

between the mirror M and the lens L. As for the chrono-photographic apparatus itself, this is built up of a hermetically sealed wooden case and which brings the objective within its interior.

In the inside of this box is placed a very light cylinder made of *duraluminum* which is rotated at the rate of 12,000 revolutions per minute by means of an electric motor. The next, and one of the most important parts of the arrangement, is the moving picture film which is wound upon the drum or cylinder. Since it is mounted upon a horizontal axis every spot of its circumference is placed within the focus of the lens. The film attains a speed of 100 meters per second which speed permits the taking of 10,000 images, each 1 centimeter in length, or 20,000 images of five millimeters. By means of an electrical arrangement, the shutter of the camera may be opened at the beginning of the experiment and closed at the conclusion.

Now that we have an idea of the various parts which enter into the chrono-photographic apparatus, that is, the electrical as well as the optical ones, let us see just exactly how film pictures are taken at the rate of from 5,000 to 20,000 images per second, and which feat must be accomplisht within the very short space of time taken by a projectile to pass the photographic field.

Whether the experiment is for the purpose of studying the characteristics of a 37 millimeter cannon, or that of a hunting rifle, gun or revolver, the arrangement does not differ in principle. The discharge circuit of the Ruhmkorff coil is quite short in order that the sparks may be extremely brief in duration. These sparks are very photogenic, that is to say, they serve to illuminate the movable projectiles, and since the duration of the sparks are of the magnitude of one millionth of a second, the photographs are practically instantaneous. The spark gap or discharger is formed between aluminum electrodes which are thoroly polisht with fine emery cloth before each operation. The gap distance is about one millimeter.

THREE GRAPHIC EXAMPLES.

Thanks to this ingenious method Mr. Bull was able to secure very remarkable photographs of the projectiles. Possibly a few remarks concerning their characteristics are not untimely. Upon the films reproducing the movement of a projectile issuing from a 37 millimeter cannon, and which are of the order of 5,000 images per second, are distinctly seen the various phases of the phenomena and which may be studied by referring to the illustrations of the film. First is noted the preliminary puff of gas which is due to the rapid expulsion of air caused by the explosion and which takes place at about 70 centimeters' distance from the muzzle. The size of this preliminary gas increases gradually and travels at a speed of 60 meters per second. Following this are seen the gases caused by combustion surrounding the projectile and this is followed immediately by the large mass of gases. Finally the film shows a series of small sparks which are probably due to flaming powder grains surrounding the projectile.

The films taken at the discharge of a regular rifle show, among other interesting particulars, the grouping of the lead shot after leaving the barrel.

In the films of revolver explosions obtained by Mr. Bull, the frequency of the images reaches from 15,000 to 20,000 images

(*Continued on page* 656)

Super-Sensitive Microphone ONLY $8.00



This instrument is offered at an extremely low price. It is excellent for building your own amplifier. Can also be used in many experiments where a sensitive microphone is required.

Detectagraph, $18.00

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

Send for One To-day and Convince Yourself



Detectagraph $18.0



THE $18.00 MICROPHO DEAF-PHONE

is a super-sensitive instrument which has been developed to meet the demands for a practical and efficient hearing device at an extremely low price. It is equal to any $35 instrument made and superior to most of them. The outfit consists of One Super-Sensitive Transmitter with cord connector; One Super-Sensitive Ear Piece with small black cord; One Black Single Headband; Black Case and Two Batteries.

Adjusted Model "B" Horn, with No. 20 High Grade Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete.

Write To-day for Free Booklet



G. BOISSONNAULT CO.
26 Cortlandt St. New York
Makers of Super-Sensitive Microphone Apparatus

$15.00 SUIT MADE TO ORDER SAVE



To prove our unbeatable values and get your steady trade, will make suit to your measure for **only** $15.00. Style shown in the picture or any one of 185 style combinations to select from. One year's satisfaction guaranteed or every penny back—quick.

NO EXTRA CHARGES

You pay just once, we say, not one penny of extras for anything. We even pay all postage and express. You save one-half—like before the war.

EARN $60.00 CASH WEEKLY

You can take orders easy for these clothes in spare time and make $3000 a year and up at home. Friends and neighbors buy on sight. Young Fred Green made $174.50 in seventeen days. **SEND NO CASH**

FREE—BIG SAMPLES

New samples show latest styles and 80 real cloth samples. Buy at inside Wholesale prices. Write now for Big Free Outfit.

SPENCER MEAD COMPANY
Wholesale Tailors Dept 927 Chicago

WIND YOUR OWN HIGH-OHMAGE RECEIVERS



No. 44 B. & S. Enameled Wire

This wire, which is so fine that over 45,000 feet go in one pound, is used for all high grade **Wireless Receivers.** We have only the following few spools left over. Order at once. First come, first served.

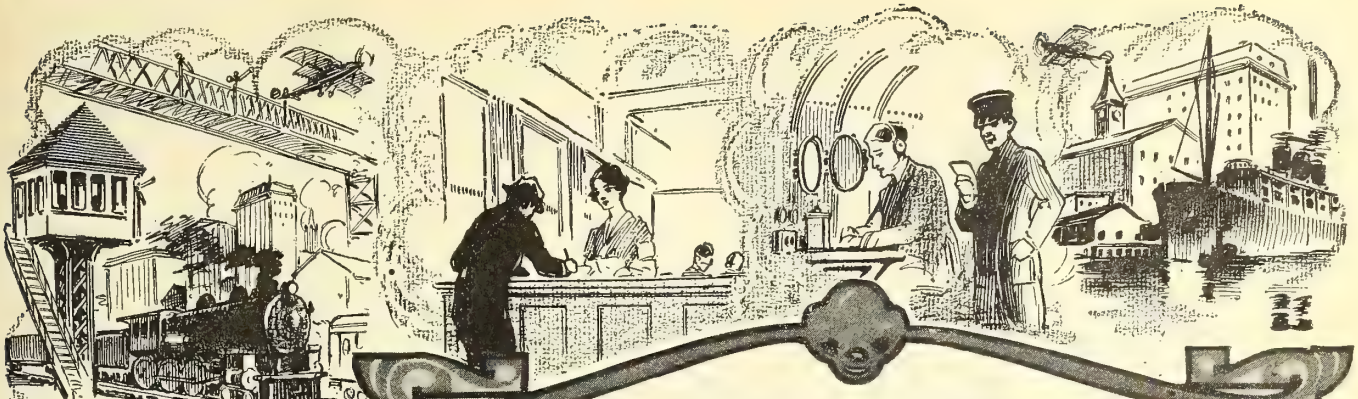
	Weight—Hundredths of lbs.													
	40	36	14	39	38	28	49	34	29	30	36	16	46	22	43
Amt.	$9.20	$8.28	$3.22	$8.97	$8.74	$6.44	$11.27	$7.82	$6.67	$6.90	$8.88	$3.68	$10.58	$5.06	$9.89

Don't send any Money! Simply select the spool wanted and we will send it, or the next in size, C. O. D.

ELECTRO IMPORTING COMPANY
231A FULTON STREET, NEW YORK, N. Y.

YOU NEED LOCOMA

—an interesting, inspiring, instructive MAGAZINE, dealing with the serious side of *Personal Subjects* — LOVE, MARRIAGE, DIVORCE, BIRTH CONTROL, EUGENICS, SEX HYGIENE, etc. 15c. a copy, $1.50 a year, 8 months trial 50c.
100 E. E. & M. Bldg., Farmington, Michigan.



LEARN WIRELESS

At Home Quickly and Easily

WIRELESS is the hinge upon which swing the doors to success. It is the very foundation of the road which leads to many professions, vast in scope, big in responsibility, satisfying in progress and salary.

A trained Wireless Operator with initiative and ambition can easily fulfill his ideals for a successful future; one including a position filled with vital enterprise, adventure, and financial success.

Attractive Work—Alluring Salaries

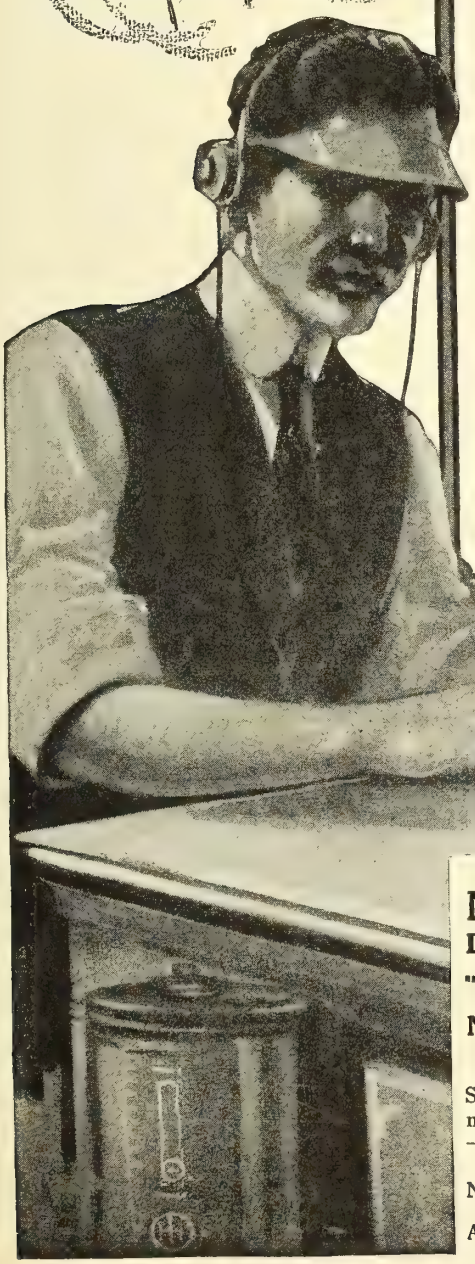
Radio offers interesting work in pleasant environment, besides substantial salaries. Radio Operators' salaries start at $125 a month with all living expenses—board, lodging, laundry, etc. —paid. When totalled and added to salary, it means $200 or more a month, at the very start. Advancement to higher positions with bigger pay is readily accomplished.

Travel Without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs, wireless offers unequalled opportunities. On shipboard you are rated as an officer, living and eating with the officers, and mingling with the passengers. All without one cent's expense to you! Land Wireless positions are just as attractive if you prefer them.

Instrument Furnished Every Student

We furnish all necessary books and equipment *with our course.* Our famous Natrometer—automatic transmitting and receiving set—is among this outfit. This instrument sends you messages at varying speeds just as you would receive them from distant wireless stations—and is operated entirely without the use of "aerials".



BOOKLET FREE—It explains how we helped hundreds of ambitious men and women, and how we can give you a thorough Wireless training in your spare time, at home, by mail, and help you secure a worth-while position.

NATIONAL RADIO INSTITUTE
Dept. 339, 14th & U Sts., N. W., WASHINGTON, D. C.

SEND THIS COUPON TODAY

NATIONAL RADIO INSTITUTE
Dept. 339, 14th & U Sts., N. W., WASHINGTON, D. C.

Send me your FREE book "Wireless The Opportunity of Today". Tell me about your Home Study Course in Wireless Telegraphy and Telephony —the free post-graduate course—and your Special Instrument Offer.

Name .....

Age ..... Address .....

City ..... State .....

What Would You Give To Be A Man Like This?

What would you give to have the appetite of a wolf, the digestion of an ostrich—to have every muscle in your body hard as nails and your system running as smoothly as a dynamo?



OWEN CARR—One of Our Boys

If you were a runt or a weakling, what would you give to become a real two-fisted chunk of nerve and brawn? A thousand dollars? You bet you would. Well, there's many an under-developed chap who has bought perfect health and physical perfection for a few cents and fifteen minutes work a day for four or five months. And, by George, we can give you their names and their actual "before and after" measurements, if you want 'em.

Are you looking for a better, bigger body and a clearer head? You can have them. That's not a promise. We GUARANTEE it.

Give us an hour and a half per week (by correspondence) play fair with us; and in four or five months if you haven't made good with a capital "G", WE will. The exercises we will give you won't be hard and they won't strain you. They're things a kid could do. But they're scientifically correct, and they'll take it off your bread basket and put in on your shoulders and chest.

We'll bet you our free folder, describing our course, against the post card it takes to get it, that you will like our course, and six months from now will be twice the husky you are now. Come on. Put up your post card.

THE MILO BAR BELL CO., Dept. 9

Physical Culture Specialists and World's Largest Manufacturers of Bar Bells, Dumb Bells and Kettle Bells. Publishers of "STRENGTH."

Diamond & 3rd Sts., Philadelphia

YOU HAVE A BEAUTIFUL FACE

BUT YOUR NOSE?



BEFORE AFTER

IN THIS DAY AND AGE attention to your appearance is an absolute necessity if you expect to make the most out of life. Not only should you wish to appear as attractive as possible, for your own self-satisfaction, which is alone well worth your efforts, but you will find the world in general judging you greatly, if not wholly, by your *"looks,"* therefore it pays to "look your best" at all times. **Permit no one to see you looking otherwise;** it will injure your welfare! Upon the impression you constantly make rests the failure or success of your life. Which is to be your ultimate destiny? My new *Nose-Shaper*, "TRADOS" (Model 24) corrects now ill-shaped noses without operation, quickly, safely and permanently. Is pleasant and does not interfere with one's daily occupation, being worn at night.

Write today for free booklet, which tells you how to correct ill-shaped noses without cost if not satisfactory

M. TRILETY, Face Specialist 1401 Ackerman Bldg., Binghamton, N. Y.

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.

Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. **Guaranteed by the maker.** Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.

EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.

"Movies" of Flying Bullets

(*Continued from page* 654)

per second. First is seen the barrel extremity of the revolver, then come the fusing gases surrounding the ball and altho the initial speed is very great, it is observed to rapidly diminish. Just as soon as the projectile has completely left the revolver, the gases escape from the muzzle in small circles of but an instant in duration, after which they assume a conical shape. Then as these gases gradually lose speed the bullet overtakes them and the latter becomes visible once more at a distance of about 15 centimeters from the muzzle of the revolver. A short distance further, the projectile is made to penetrate a narrow pine strip, the splinters of which are readily discernable in precise order to the right and to the left of the bullet. In connection with this a curious observation is that several of these splinters of wood attain speeds much greater than that of the projectile.

In summing up the explanation of these interesting experiments, thanks to the employment of continuous spark discharges broken up by blowing, electricity once more is made to play an important rôle in the production of moving pictures at a rate of speed exceeding 20,000 photographs per second. Here is an excellent and golden opportunity for our American film producers to utilize this method for the filming of some unique and refreshing "movies."

Hammering Electrons Out of Matter

By HAROLD F. RICHARDS, Ph.D.

(*Continued from page* 633)

some experiments were performed in which the metal and insulator were brought into intimate contact by the simple expedient of allowing a hard-rubber ball to bounce upon a brass disc. *By this means the metal disc has been electrically charged to a potential of nearly 200 volts.* A *single* collision of the ball with the disc has produced as much electricity as would have been obtained by a considerable amount of rubbing, altho the ball and the disc were in contact for only a *minute fraction of a second.* In the course of the experiments, balls of hard rubber (ebonite), glass and ivory have been allowed to strike upon discs of brass or zinc, and in *every instance* the metal received a positive charge of electricity. All the results showed that there is a natural tendency for the free electrons in the metal to diffuse into the insulator, which possesses fewer free electrons. Thus it is evident that rubbing is not necessary to produce the electricity. Many delicate experiments were performed to find how the electrical charge depended upon the velocity of impact, the weight of the colliding bodies and the electrical capacity of the metallic system upon which the charge was produced, and all the results showed conclusively that the electrical energy does not depend directly upon the mechanical energy lost in collision. It is, therefore, apparent that electrification by friction and by impact are contact effects of the *same nature as the contact effect between metals,* and that there is no direct transformation of the mechanical energy of rubbing into electrical energy. When electricity is produced by friction, the electrical charge does not come from the mechanical work done, but from the vibratory energy of the electrons. These results seem to settle conclusively the much-discussed

(*Continued on page* 661)



Go as High as You Like

No Limit to Salaries in Aviation

No other industry offers the wonderful chances for big money-making that the Airplane Industry offers to ambitious men today. Trained men are needed immediately to fill big paying jobs. The airplane has come to stay—it will soon be a part of our everyday life. The men who get in now are the ones that will cash in big. Look at the "big fellows" in the automobile game today. They represent power and wealth because they got in early—you can do the same in aviation and you have an advantage because you can be trained before you start.



Delivering Newspaper "Extras" by Airplane



A New Seven-Passenger Airplane



A New Job—The Aerial Postman



View in an Airplane Factory

Thousands of Airplane Mechanics Needed

Airplane factories are being built by the dozens. Transportation, passenger carrying, and mail carrying lines are being opened up everywhere. This means men, men, men. Trained men only are wanted—men who know what's what. Ten times the number of men now engaged in this work are needed. Jobs with big pay are waiting for men to fill them just as soon as they are trained. Why don't you prepare for one of these big jobs now?

Here Are a Few Jobs That Will Pay $50.00 to $250.00 a Week:

Aeronautical Instructor · Aeronautical Engineer · Aeronautical Contractor · Airplane Repairman
Airplane Mechanician · Airplane Inspector · Airplane Salesman · Airplane Assembler · Airplane Builder

Learn at Home In Your Spare Time

Keep right on with the work you are doing now. A little of your spare time is all you need. Our Special Course is simplified for home instruction and is endorsed by airplane manufacturers, aeronautical experts, aviators and the leading aero clubs. Any man that can read English can understand it. The Lessons are self-explanatory and are made plain as day with Blueprints, Diagrams, etc. Our Advisory Council and Instructors are behind you all the time giving you everything you must know. The entire field of Practical Aeronautics and Science of Aviation is laid right before your eyes. You are bound to succeed with this training. This means for you a man's size job with a man's size pay.



Big Book of Opportunities FREE!

Send for our big free book showing just what is going on in the Airplane Industry. It also shows what other men have done in this fascinating field and what you can do, too. It gives a list of some large manufacturers and dealers in airplanes and some of the jobs that are open to trained men. With the book we will send you a special offer that you will be glad to know about. This special offer may be withdrawn at any time without notice. *Send the coupon now and take advantage of this offer.*

American School of Aviation
Dept. 7447 - 431 S. Dearborn St., Chicago

Mail This Coupon For FREE BOOK

AMERICAN SCHOOL OF AVIATION
Dept. 7447
431 S. Dearborn St.
Chicago

Without obligation on my part you may send me your book entitled "Opportunities in the Airplane Industry" and your SPECIAL Limited offer.

Name .....

Address .....

City .....*State*.....

A Thousand Things About

How to repair and take care of Dynamos and Motors

How to write and read installation specifications

How to estimate the cost of wiring a building

How to plan and install individual motor power units

All about modern lighting fixtures

How to know electrical material and select the best

EVERY day in your work and experiments you get up against new problems—sometimes it is only some old 'sticker' coming in a new way. Just the same though it takes a lot of time to figure them out. **Don't do it.** Here's everything worked out for you. Every problem big or little that you will meet. Hundreds of new ideas and better ways of doing things. Hundreds of ways the other fellows are making money. Hundreds of ways **you** can make more out of the same work you are doing now.

The Cyclopedia of Applied ELECTRICITY

The greatest electrical books ever published. Eight fine, big, thick volumes, bound in genuine American Morocco and trimmed in gold. 3,800 pages and more than 3,000 pictures, plates, diagrams, tables, plans and blue prints of electric wiring. It took twenty electrical engineers, experts and practical electricians three years to prepare these books. Over 25,000 sets of the old edition have been sold. This is a brand new edition. Everything in every volume is right up-to-date. Every experimenter, every man in the shop, or on the job should have a set.



You Ought to Know Electricity

The old days of hit-or-miss experience are passed. You have got to **know** if you want to keep in the running now. A little of your spare time and the Cyclopedia of Applied Electricity will put you 'way ahead of the rest. See our FREE trial offer and easy **payment plan below.**

Consult Our Experts

With every set of these books we give free a one year consulting membership in our society. This entitles you to consult our engineers and experts on any electrical proposition, any time for one year. Write often—ask as many questions as you like.

FREE EXAMINATION

11 Months to Pay

Send the coupon for these great Electrical books TODAY. You can't afford to be without them and you don't take any risk at all. The coupon brings the whole set by express collect for a week's free examination. Use the books a week and notify us to get them back if they don't please you. If you like them send us only $2.80 and $3.00 each month until $34.80 is paid. If you prefer to pay cash with order send only $31.30. The return privilege holds good just the same. Send the coupon NOW and get the consulting membership free. This part of the offer will be withdrawn when the membership is filled. Remember—sending for the books does not obligate you to buy.

AMERICAN TECHNICAL SOCIETY, Dept. E-257, Chicago.

Please send me the 8 volume Cyclopedia of Applied Electricity, shipping charges collect. I will send you $2.80 in seven days and $3.00 each month until $34.80 is paid or notify you to send for the books at your expense. If I buy the books I get a membership in your society free.

Name .....

Address .....

City .....State.....

Reference .....

Please fill out all of these lines.

New and up-to-date appliances and how to use them

All about alternating current machinery

What you should know about the new telephony equipment

Armature winding and construction of Dynamos and Motors

The National electrical code and Underwriters requirements

Planning and installing lighting systems in Factories Houses Stores etc.

Wiring old buildings—problems and solutions

How to succeed in business for yourself

A Thousand Things About

How to repair and take care of Dynamos and Motors

How to write and read installation specifications

How to estimate the cost of wiring a building

How to plan and install individual motor power units

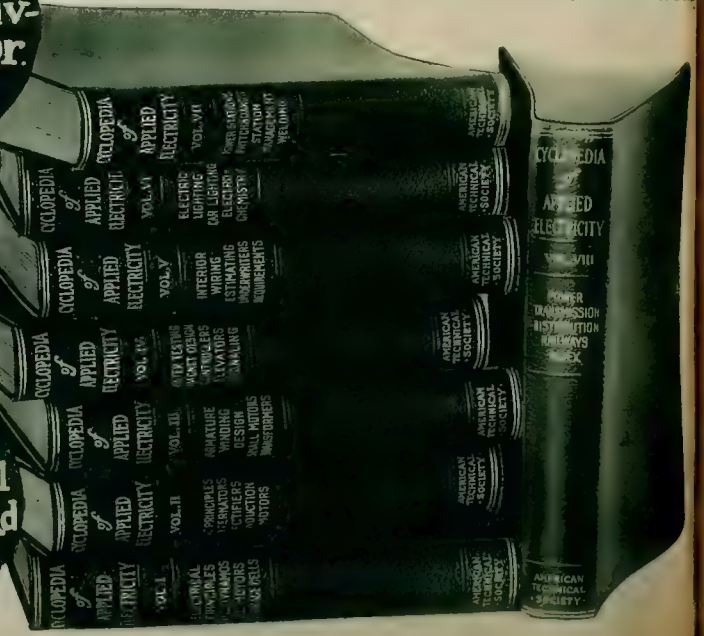
All about modern lighting fixtures

How to know electrical material and select the best

EVERY day in your work and experiments you get up against new problems—sometimes it is only some old 'sticker' coming in a new way. Just the same though it takes a lot of time to figure them out. Don't do it. Here's everything worked out for you. Every problem big or little that you will meet. Hundreds of new ideas and better ways of doing things. Hundreds of ways the other fellows are making money. Hundreds of ways you can make more out of the same work you are doing now.

The Cyclopedia of Applied ELECTRICITY

The greatest electrical books ever published. Eight fine, big, thick volumes, bound in genuine American Morocco and trimmed in gold. 3,800 pages and more than 3,000 pictures, plates, diagrams, tables, plans and blue prints of electric wiring. It took twenty electrical engineers, experts and practical electricians three years to prepare these books. Over 25,000 sets of the old edition have been sold. This is a brand new edition. Everything in every volume is right up-to-date. Every experimenter, every man in the shop, or on the job should have a set.



You Ought to Know Electricity

New and up-to-date appliances and how to use them

All about alternating current machinery

What you should know about the new telephony equipment

Armature winding and construction of Dynamos and Motors

The National electrical code and Underwriters requirements

Planning and installing lighting systems in Factories Houses Stores etc.

Wiring old buildings—problems and solutions

How to succeed in business for yourself

The old days of hit-or-miss experience are passed. You have got to **know** if you want to keep in the running now. A little of your spare time and the Cyclopedia of Applied Electricity will put you 'way ahead of the rest. See our FREE trial offer and easy **payment plan below.**

Consult Our Experts With every set of these books we give free a one year consulting membership in our society. This entitles you to consult our engineers and experts on any electrical proposition, any time for one year. Write often—ask as many questions as you like.

FREE EXAMINATION

11 Months to Pay

Send the coupon for these great Electrical books TODAY. You can't afford to be without them and you don't take any risk at all. The coupon brings the whole set by express collect for a week's free examination. Use the books a week and notify us to get them back if they don't please you. If you like them send us only $2.80 and $3.00 each month until $34.80 is paid. If you prefer to pay cash with order send only $31.30. The return privilege holds good just the same. Send the coupon NOW and get the consulting membership free. This part of the offer will be withdrawn when the membership is filled. Remember—sending for the books does not obligate you to buy.

AMERICAN TECHNICAL SOCIETY, Dept. E-257, Chicago.

Please send me the 8 volume Cyclopedia of Applied Electricity, shipping charges collect. I will send you $2.80 in seven days and $3.00 each month until $34.80 is paid or notify you to send for the books at your expense. If I buy the books I get a membership in your society free.

Name .....

Address .....

City ..... State .....

Reference .....

Please fill out all of these lines.

Use Nature's Greatest Aid

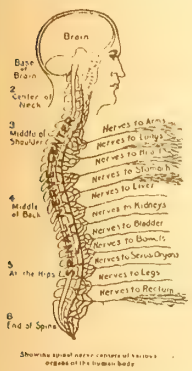
Renulife VIOLET RAY

To Health and Beauty



Treat yourself at home with *Renulife Violet Ray*—affording the marvelous curative forces of electricity in their most pleasant and effective form. This *High Frequency* electric current is shockless and painless—can do no injury—yet is most powerful in helping Nature to restore normal conditions. You should know just what it will do for you. Send for full information, mailed free. Write at once.

Treatment at Nerve Centers



Showing spinal nerve centers of various organs of the human body

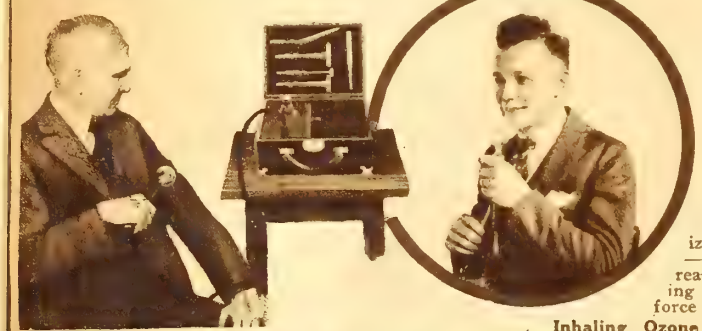
For Chronic Functional Disorders And for Nerves, Blood and Circulation

You treat locally as well as the great nerve centers. You saturate the system with revitalizing, health-bringing forces. Circulation is brought to parts treated—the glow and warmth of a fresh blood supply brings relief and permanent benefit. Aches, pains, sluggish organic functioning of liver, bowels, etc., respond remarkably to this powerful, purifying administration. you feel a sense of relief as you gently and surely aid Nature to put back in order her vital machinery. Assimilation and elimination are improved.

Send for Book Telling All

Don't delay getting our book telling all about the Violet Ray—its many uses, its wonderful accomplishments and how you, yourself can employ this 20th Century, scientific mode of treatment

Mail the Coupon





Every Woman and Man should have a *Renulife* at hand to keep *100% Fit*



Every beauty parlor uses a Violet Ray for hair, scalp and skin treatments. The secret of its success is that it brings about a healthy, natural circulation stimulating natural processes — and thus hair growth is promoted or the complexion given the attractive charm of rosy health; wrinkles and blemishes disappear. Health is the foundation of beauty as it is also the source of strength and success. Nothing has ever been discovered that would act both as a stimulant or as a sedative—as does the Violet Ray—with no harmful after effects — only permanent beneficial results. Find out just how these results are accomplished.

Thousands in Use

Many thousand people in all parts of the United States and the World are using *Renulife Generators*—and some of the most astonishing results—approaching the miraculous—have been reported to us. Thousands testify to their satisfactory use. We are confident that you or anyone seeking improved health or relief from ailments that have not yielded to other methods—will find it well worth while to investigate. We ship on a MOST LIBERAL TRIAL PLAN—giving you ample opportunity to determine what you could expect in your own case. Send for particulars.

Health *via* Violet Ray

That's the title of the Book—telling how the Violet Ray is really atomized electricity—sprayed into the body—penetrating every tissue and cells—carrying an invigorating and refreshing stimulation. Nothing else reaches in the same way the hidden cause, or removes the painful or annoying symptoms. Learn how you may now use this irresistible, revitalizing force for any ailment listed on coupon. Send for Book.

Inhaling Ozone

The Violet Ray produces Ozone, the greatest purifying element. Tissues absorb it from external application. An attachment is also provided for inhalation. Breathing Ozone is unequalled for Catarrh, Hay Fever, etc., and for Anemia.

RENULIFE ELECTRIC CO.

1210 Marquette Bldg. Detroit, Mich.		
New York City	Chicago	Toronto
27 Warren St.	123 West Madison St.	384 Yonge St.

Sales Distributors

If you are in position to handle a territory in a big way as a local agency, write for proposition.





Made in Several Models—Most Effective, Least Expensive—Violet Outfits

COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO.,
1210 Marquette Bldg., Detroit, Mich.

Please send without obligation your book "Health" explaining Violet Ray treatments with Renulife Generators, also give full particulars as to its application for ailments checked below.

TREATS SUCCESSFULLY

..Abscesses	..Facial Neuralgia	..Obesity
..Anemia	..Failing Hair	..Pain in Abdomen and chest
..Asthma	..Female Complaints	..Paralysis
..Arteriosclerosis	..Goitre	..Piles
..Baldness	..Gout	..Pimples
..Blackheads	..Haemorrhoids	..Tyorrhea
..Brain Fag	..Hay Fever	..Rheumatism
..Bronchitis	..Infantile Paralysis	..Scars
..Bunions	..Insomnia	..Sciatica
..Bruises	..Lameness	..Skin Diseases
..Catarrh	..Locomotor Ataxia	..Sore Throat and Throat Diseases
..Colds	..Lumbago	..Sprains
..Chilblains	..Nervous Affections	..Toothache
..Dandruff	..Neuralgia	..Weak Eyes
..Deafness and Ear Diseases	..Neuritis	..Wrinkles
..Eczema		..Warts and Moles
..Enlarged Prostate		

Name .....

Address .....

.....

Hammering Electrons Out of Matter

(*Continued from page* 656)

problem of why friction produces electricity. All that the rubbing does is to bring the molecules of the two surfaces sufficiently close together to permit them to exchange electrons in accordance with their *natural* tendency.

A NEW ELECTRICAL GENERATOR.

In accordance with the results of these experiments, an electrical generator can be constructed which will operate upon an entirely new principle. The diagram shows how to make it. The machine is nothing more nor less than a little trip-hammer, with electrical connections to take off the charge generated. The wheel is turned by hand and carries teeth, so that it alternately raises and releases the hard-rubber (ebonite) disc attached to the end of the lever. Thus the disc strikes repeatedly upon the metal anvil, which may be of iron, brass or any convenient metal, and the electricity generated upon the anvil can be drawn off thru the wires shown. In order to obtain a continuous production of electricity it is necessary to discharge the surface of the ebonite disc occasionally by passing a flame rapidly over it, for negative electricity is produced on the ebonite at the same time that positive charge is formed on the metal anvil, and after a sufficient amount of electricity has accumulated upon the ebonite the further production of electricity will stop. With an apparatus similar to this, the writer has charged a metal anvil *of small capacity* to a potential of 386 *volts.* The ebonite disc had to strike the brass anvil thirty-three times in order to produce this voltage, and it was found necessary to discharge the disc three times during the course of that experiment. This generator will not produce electricity fast enough to be of practical use, but it is intensely interesting because it operates *by virtue of an entirely new principle!* If an ordinary Leyden jar is connected to the metal anvil, *a few minutes of turning the crank of the machine will generate enough electricity to kill a rabbit or give a strong shock to a human being.*

WHEN BABE RUTH KNOCKS A HOMER.

It is interesting to think of the electricity which we are constantly generating. When the typist pounds the keys, when the pianist dashes thru the Twelfth Hungarian Rhapsodie, when Jack Dempsey lands his right, electricity is produced. Even in walking, the repeated collisions of the leather soles with the pavement cause a continual generation of electricity. A pile-driver produces electricity every time it strikes. Babe Ruth, the home-run king, is a notable generator of electricity, for every time his mighty bat collides with the leather-covered sphere this strange thing called electricity is produced. The experiments that have been performed indicate that if we should collect in a Leyden jar the electricity generated every time he makes a hit, forty hits would suffice to electrocute a mouse. From this it appears that Ruth's efficiency as an electrical generator is not very high, when we consider how many mice he could kill if he used his bat directly on their heads. The efficiency of producing electricity by hammering the electrons out of matter is so small that this new method of generation will never be used practically, but the discovery of the effect and the laws governing it have shed much light upon many puzzling electrical phenomena.

You Can Qualify in a Short Time to Fill a BIG JOB



Don't be satisfied to take what comes. Go get the job you want. It is not hard to do when you are fitted to fill it.

The demand for good men in every walk of life is simply immense. There are far more jobs than there are competent men to fill them. Every day you put off preparing yourself for a better paying, more pleasant position is just so much time and money lost.

RIGHT NOW IS the Time to Start

Take the hours you idle away each week. Turn them into money-making, job-improving hours of study. All you need is ability to read and write and the determination to win. You can't make a mistake. Our system of instruction won't let you.

It is Easy to Master Any Subject Taught By Our Methods

Every student's work gets individual attention from men who know exactly what is right and what is wrong.

Our faculty is composed of men who have made real successes in their chosen fields. You learn in months what took them years to find out. And the beauty of it is

Everything Made Simple As the Alphabet

Where technical terms are used they are explained and illustrated. Only simple English that anyone can understand is used. Hundreds of illustrations, diagrams and charts—make the study of our text books easy.

Write TODAY for Latest Bulletin—FREE

Get complete details about the course you favor. Also learn how others have succeeded through our help.

American School of Correspondence
Dept. G-726,
Drexel Ave. and 58th St., Chicago, U. S. A.

Pick Out the Job You Want

Office Men
Auditors, Accountants, Office Managers, Credit Men, Cashiers, Bookkeepers and Cost Clerks—$2,500 to $7,500 a year.

Factory Men
Electrical and Mechanical Engineers, Factory Managers, Superintendents, Foremen, Designers and Draftsmen—$2,500 to $12,000 a year.

Construction Men
Civil and Structural Engineers, Transit Men, Construction Superintendents and Foremen, Estimators, Designers and Draftsmen—$2,500 to $10,000 a year.

Trades
Machinists and Tool Makers, Auto Repairers, Electricians, Stationary Engineers, Firemen, Plumbers, Carpenters, Pattern Makers and Telephone Men—$2,500 to $3,000 a year.

Read This Letter From One Young Man Who Grasped His Opportunity

North Chatham, Mass.

Dear Sirs:
I am enclosing a circular of the Brown Tire Pump, and thought that it might interest you, as it is one of my devices and is manufactured by the Brown Co. on royalty.

Your school is the best of the Correspondence schools that I know of, and am glad to recommend it to any one in need of a course, as I feel that it helped me greatly in my work.

Very truly yours,
(Mechanical Eng. Dept.) C. GOULD WELD.

Here is the First Step To a Real FUTURE

Mail Coupon NOW

AMERICAN SCHOOL OF CORRESPONDENCE
Dept. G-726, Drexel Ave. and 58th Street, Chicago, U. S. A.

Explain how I can qualify for position checked:

.....Mechanical Engineer	.....Accountant and Auditor	.....Employment Manager
.....Architect	.....Bookkeeper	.....Steam Engineer
.....Building Contractor	.....Draftsman and Designer	.....Foreman's Train'g C'rse
.....Automobile Engineer	.....Electrical Engineer	.....Machine Shop Practice
.....Auto Repairman	.....Electric Light and Power	.....Photoplay Writer
.....Aeroplane Mechanic	.....Fire Insurance Expert	.....Sanitary Engineer
.....Civil Engineer	.....High School Graduate	.....Plumbing and Heating
.... Structural Engineer	.....General Education	.....Telephone Engineer
.....Surveying & Mapping	.....Common School Branches	.....Telegraph Engineer
.....Business Manager	.....Lawyer	.....Wireless Operator
.....Cer. Public Accountant	.....Shop Superintendent	

Name.....

Address.....



Earn Big Money

Pack your grip today and come to the Sweeney School of Auto-Tractor & Aviation Mechanics. Strike out for the big money and a world wide opportunity.

Expert Mechanics Wanted The machine expert is the boss of creation today, whether on the farm or in the city. If you are mechanically inclined learn to make and repair autos, tractors, trucks, gas engines, auto tires, etc., **in Eight Weeks by**

PICK YOUR JOB

Farm Mechs.	$125
Tire Men	150
Drivers	150
Repair Men	200
Taxi Drivers	175
Tractor Men	200
Garage Owner	400

The Sweeney System OF PRACTICAL EXPERIENCE

Learn as 35,000 other men have learned—**by tools, not books.** Learn power farming on my big Tractor farm—18 tractors. Learn to make a $30 tire from 45c worth of junk. Learn to fix any piece of machinery. You can't get this System anywhere else. Thousands of opportunities for experts trained in this **Million Dollar School—the greatest in the world.**



FREE Send today for my 72-page catalog, or simply say when you're coming and I will have classes arranged and your rooms ready. I guarantee railroad fare round trip if you find a single misrepresentation.

EMORY J. SWEENEY,
President



LEARN A TRADE—Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
844 SWEENEY BLDG. KANSAS CITY, MO



NEW MOTORS

FACTORY GUARANTEED ALL SIZES PROMPT DELIVERY

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

6 v. 10 amp.	$19.50
15 v., 10 amp.	$26.50
40 v. 6 amp.	$31.50
110 v, 2½ amp.	$31.50
110 v, 5 amp.	$52.50
40 v, 12 amp.	$52.50
110 v, 9½ amp.	$67.50
40 v, 25 amp.	$67.50
110 v, 18 amp.	$116.50
40 v., 50 amp.	$116.50
110 v, 26 amp.	$156.50
110 v, 50 amp.	$238.50
Moving Picture Arc Generator 60 v., 35 a.	$116.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60c., 1750 R. P. M., Complete with base and pulley.

½ H. P.	$46.50
1 H. P.	$66.50
2 H. P.	$86.50
3 H. P.	$98.50
5 H. P.	$116.50
1 H. P. Special Grinding and Buffing Motor	$106.50

Direct Current Motors
110 or 220 volts, D. C., shunt wound, 1750 R. P. M. With base pulley and starting box.

¼ H. P. Washing Machine Motor	$28.50
¼ H. P., 32 v. Washing Machine Motor	$28.50
½ H. P.	$58.50
1 H. P.	$82.50
2 H. P.	$124.50
3 H. P.	$142.50
5 H. P.	$218.50

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

¼ H. P., 220 v. Induction Washing Machine Motor	$28.50
¼ H. P., 110 v. grinding buffing motor	$28.50
½ H. P. induction, full load start	$46.50
½ H. P. repulsion induction For compressor service	$54.50
1 H. P. repulsion induction, Special Garage Motor	$74.50
2 H. P. repulsion induction with sliding base	$126.50
3 H. P. repulsion induction with sliding base	$146.50
5 H. P. repulsion induction with sliding base	$188.50

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

1/4 H.P. SPECIAL 110 volts A.C., 60 c. S. P., 1750 R.P.M., Complete, cord, plug and pulley

WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. **$26.50 Each** Reg. Val. $34.50



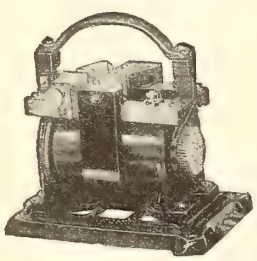
MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 12, West End, Pittsburgh, Pa.

BATTERY CHARGING PAYS BIG



F-F BATTERY BOOSTER

or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current

Bantam type 6-6 amp. 6 v. battery.	$15	**Bantam** type 12-5 amp. 12 v. battery.	$20
Type 16-8 amp. 6 v. battery....	24	Type 112-6 amp. 12 v. battery...	24
Type 166-12 amp. 6 v. battery....	32	Type 1612-7 amp. 12 v. battery...	32

Type 1626-12 or 7 amperes in combination for both 6 and 12 volt batteries.. 48

Shipping weight complete with **Ammeter** and **Battery Clips.** 11 to 15 pounds.

All outfits do the same work except as to time to complete a charge.

Include postage and insurance with remittance for parcel post shipment.

Bulletin **No. 12** describes these and other F-F charging apparatus that operate on Farm Lighting Plants and Direct Current.

F-F ROTARY RECTIFIER

BATTERY STATIONS—Write for Bulletin on the F-F Big Boy—Full Wave—Automatic Rotary Rectifier of 14 battery capacity and larger.

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

SUCCESS OPPORTUNITY **UTTMARK'S NAUTICAL ACADEMY RADIO SCHOOL**

8 State St., New York, N.Y.
Phone Bowling Green 8079

Complete instruction in radio operating in all branches for Merchant Marine, Ocean Steamships, Telegram Service. Special course in Vacuum Tubes and Radio Telegraphy. Preparing for Government Examinations.

Elementary and Advanced Classes
Day and Evening Classes

Write for Circular.

Popular Astronomy

(*Continued from page* 650)

taining to the splendor of a giant helium star. This theory accounts very reasonably for the division of each cooler stellar type into groups consisting of dwarfs and giants. Among the helium and hydrogen stars, however, there would be, evidently, no division into dwarfs and giants since all stars attaining to this height of development would necessarily be exceptionally massive giant stars. This scheme of evolution of the stars does not recognize nebulae as the progenitors of the stars. Tho helium stars are often found associated with nebulae, no giant red star has ever been found associated with a nebulae. It has always been the orthodox belief that the nebulae condensed into "young" or "early type" helium stars, which in turn condensed further in cooling into white, yellow, orange and reddish stars, consecutively.

This theory of evolution has no place for the diffuse giant stars of the same series and the discovery of their existence has proved somewhat disconcerting to the supporters of the older, more firmly establisht theory of the origin of stars from the great diffuse gaseous nebulae. It has been suggested that the nebulae may rather result from the disintegration of unusually massive helium stars that have become so abnormally hot in contracting from a diffuse state that radiation pressure has prevailed over gravitational attraction with a resulting dissipation of the "star stuff" into space.

The origin of the diffuse giant red stars is indeed a puzzle. It is plainly evident that they do not arise directly from condensation of the luminous nebulae since the two are never found associated in space. It has been suggested tentatively that diffuse red giant stars may owe their origin to *interatomic action* in the vast non-luminous tracts of matter known to exist universally in space. Tho the density of these red giants is less on the whole than the earth's rarer atmosphere, there is every reason to believe that they are strongly condensed toward the center, instead of being uniformly dense thruout.

Since it has been definitely proven that contraction alone is insufficient to keep up the supply of radiant energy of the stars too great stress cannot be laid upon any one theory of stellar evolution. Many puzzling astrophysical problems would be solved if the source of the radiant energy of the stars were known.

There are known to be stars differing little in size, mass and density that differ tremendously in light-giving power. Thus the companion of Sirius, tho half as massive as the brighter star and of the same type of spectrum, gives only one five-thousandth as much light as Sirius.

There was discovered but a year or so ago a most remarkable calcium-type star near us in space that possesses only one five-thousandth part of the intrinsic luminosity of the sun, altho per unit of surface area normal stars of this type radiate much more intensely than the sun. Either this star is not much larger than our planet Earth in size or else it radiates far more feebly per unit of surface than a normal star of its class. A true solution of the puzzle depends upon a knowledge of the source of the radiant energy of the stars. Certainly no known source of radiant energy, including radio-activity, could keep in a state of sun-like incandescence thru the ages a minute sun no larger than our own little planet.

On the other hand, there are known to exist among all types of stars, super-giants such as Rigel and Canopus that radiate fully five thousand times as much light and heat as a normal star of the same type.

How to Become a Professional Radio Man

By PIERRE H. BOUCHERON

(*Continued from page* 643)

first day out of New York the food was passable and there was plenty of it. After this, however, we had prunes and canned "Willie' for breakfast, canned "Willie" and prunes for lunch and "Willie" canned and prunes for supper. I do not mention tea or coffee because, altho the mess cook called it by these names, they were *not;* in fact there was no palatable difference between the two.

For that reason, I say to you, *take along the books,* also the notebook and the camera. Take out a correspondence course even if it be only one in correct English. Several prominent radio men have reached their present positions today, solely by the amount of technical book-learning they were able to secure while seagoing operators. The majority of radio men are young; that is, all ages ranging from 18 to 30, at which time the mind is more pliable and receptive than in later years, making comparatively easy the mastery of various technical subjects allied with the radio art.

The camera and the notebook are most valuable. The camera for its all-seeing eye and the notebook (call it a diary if you wish) for its graphic record of your experiences while in "foreign lands." Preserve these records as you would your life insurance or your bankbook. They will prove invaluable to you in later years.

Trephining the Skull

(*Continued from page* 610)

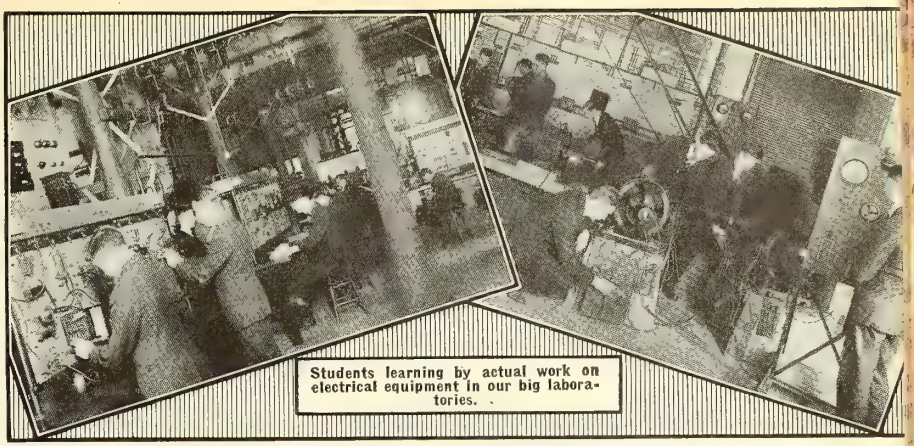
up the area of the opening with cocoanut shells. Compare with the modern idea of covering up a hole with a silver plate screwed in place.

The instruments have been improved upon and the operation instead of taking months requires only 12 to 15 minutes. Altho sometimes the old form of trephin is still used, electricity has rapidly taken its place in the form of a new circular bone saw. The old style trephin was auger-like in nature and drilled a starting point for the saw. The cylindrical saw then cut a perfectly round pellet out of the skull, which was removed with the saw. This then gave access to the covering of the brain which had to be incised in many cases.

The purpose of the operation is many fold. The skull, as we now know, is made up of three distinctly different sections of bone. An outer table which is firm and hard, a middle or diploëic table which acts as the nourishing layer, and the third or inner table of hard boney matter. The middle one is quite porous.

Thus a blow on the head will sometimes not show any perceptible injury on the outside and yet a fracture of the inner table might have occurred, driving fragments of the bone into the brain tissue. Here, due to the wonderful blood circulatory system of the brain quite a bit of blood is forced out, which will later clot, the same as blood does in any other portion of the body.

A blood clot may now undergo a series of degenerative changes or may disappear entirely thru being absorbed by the tissues. In the latter case there is nothing to fear, but in the former it causes degeneration of the tissues, and rapidly spreads over quite a large area. The pressure inside the cranial vault or skull becomes very great, and the action of the brain is markedly impaired.



Students learning by actual work on electrical equipment in our big laboratories.

Become an Electrical Expert in One Year

Or Learn an Electrical Trade in Six Months

QUALIFY for *your* future success in the great field of Electricity here in the big laboratories of America's Greatest Institution of Electrical Education. Through our intensive, specialized training and practical method of instruction you can become an Electrical Expert in one year or learn an Electrical Trade in six months.

For over 15 years School of Engineering of Milwaukee has been training men for brilliant successes in all branches of Electricity. Today it offers you greater advantages in *your* Electrical training than you can find anywhere else.

Earn While You Learn

Our method of co-operative assistance to the Student of moderate means brings an Electrical career within the reach of every ambitious man. The majority of our students are earning their own way by our "Earn-While-You-Learn" system. By this arrangement you may spend half time working for a Milwaukee industrial concern and the other half in the class-room and laboratory.

Our free Employment Department, which is in close touch with Milwaukee industries secures positions for those students who wish to earn part or all of their expenses. In addition to this, the department will help you get a good position in the Electrical industry when you have completed your training.

Electricity Offers You Big Success

Now as never before wonderful opportunities are open to you to win splendid success, high position and handsome earnings in this fascinating, uncrowded field. There are not enough Electrically trained men to supply the demands of this vast, rapidly developing industry. More trained men are needed at once to fill big, high-salaried, Electrical positions. It is *your* great opportunity.

Greatest Electrical School Shops in America

Learn Electricity by actual practice on complete working equipment in our big Electrical laboratories. Thousands of dollars' worth of motors, machines, dynamos, switchboards, ignition and lighting systems, etc., for your use. Over 90 Electrical Experts to give you personal instruction.

What You Learn Here

School of Engineering first grounds the student in the *general theory and practice* of Electricity, then trains him for whatever branch he desires to specialize in. He becomes both a good Electrician and a *trained specialist qualified and ready to step into a highly-paid position.*

Electrotechnics

Practical Electrical training of 2 to 3 years which leads to positions such as Superintendent of Maintenance, Director of Construction, Automotive Electrotechnician, Radio Engineer, Superintendent of Testing and Installing and Electrical Equipment Salesman. All of these positions pay extremely well and the work itself is intensely fascinating.

Practical Electricity

Course requires one year for completion and gives Student both principles and practice in the application of Electricity. The course includes wiring, armature winding, motors, generators, transformers, efficiency tests, installation and care of commercial electrical equipment and machinery.

Drafting

Urgent demand for and scarcity of Draftsmen offers unusual opportunities with high salaries and brilliant futures. To prepare men for this field, we offer a six months' to one-year course in Electrical and Mechanical Drafting which prepares Students for immediate acceptance of responsible positions in commercial Drafting rooms. Part-time employment while taking the one-year course.

Armature Winding

A six-months' course—brief but intensely practical and leading to well paying positions. Instruction under recognized experts who have made life studies of most practical and expedient methods in this field. A very popular course among men who desire a short period of training.

Automotive Electrotechnics

An intensive practical 3 or 6 months' course. Teaches every phase of electric starting, lighting, ignition and storage battery work for automobiles, trucks, tractors, motorcycles, aircraft, etc. Opens up the way to big pay positions in the Automotive industry.

Write for Free Catalog

Mail the coupon today for our big new illustrated Catalog. Tell us what course interests you most and we will send you special information. Find out about *your* great opportunity in Electricity today. See how easily you can become qualified for splendid success, high position and handsome earnings in the wonderful field of Electricity. Don't waste any time! Mail the coupon now. No cost or obligation.

SCHOOL of ENGINEERING of Milwaukee

Dept. 1-BK, 373 Broadway, Milwaukee, Wis.

SCHOOL OF ENGINEERING OF MILWAUKEE
1-BK, 373 Broadway, Milwaukee, Wisconsin

Please send me without cost or obligation, your free illustrated book and details of course which I have indicated below. Also tell me about your "Earn-While-You-Learn" system.

Course .....
(Write plainly name of course in which interested.)

Name .....

Address .....

City ..... State .....

Age ..... Education .....

DRAFTING



Learn at Home!

Employers everywhere are looking for skilled draftsmen. They are offering splendid salaries, and good positions are always open.

No line offers greater opportunity for advancement. Drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture.

There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving men and women just the training they need for success in Drafting and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6163-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

- ☐ MECHANICAL DRAFTING
- ☐ STRUCTURAL DRAFTING
- ☐ SHIP DRAFTING
- ☐ ELECTRICAL DRAFTING
- ☐ ARCHITECTURAL DRAFTING
- ☐ SHEET METAL DRAFTING
- ☐ BOILERMAKER DRAFTING
- ☐ BRIDGE DRAFTING
- ☐ MACHINE DESIGN
- ☐ ELECTRICAL ENGINEER
- ☐ Electric Lighting and Railways
- ☐ Electric Wiring
- ☐ Telegraph Engineer
- ☐ Telephone Work
- ☐ MECHANICAL ENGINEER
- ☐ Machine Shop Practice
- ☐ Gas Engine Operating
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ STATIONARY ENGINEER
- ☐ Marine Engineer
- ☐ ARCHITECT
- ☐ Contractor and Builder
- ☐ Concrete Builder
- ☐ Structural Engineer
- ☐ CHEMIST
- ☐ SALESMANSHIP
- ☐ ADVERTISING
- ☐ Show Card Writer
- ☐ Sign Painter
- ☐ ILLUSTRATING
- ☐ Cartooning
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Public Accountant
- ☐ TRAFFIC MANAGER
- ☐ Railway Accountant
- ☐ GOOD ENGLISH
- ☐ Teacher
- ☐ Common School Subjects
- ☐ Mathematics
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ AUTOMOBILE OPERAT'G
- ☐ Auto Repairing
- ☐ PLUMBING AND HEATING
- ☐ Textile Overseer or Supt.
- ☐ Navigation ☐ Spanish
- ☐ AGRICULTURE ☐ French
- ☐ Poultry Raising ☐ Italian

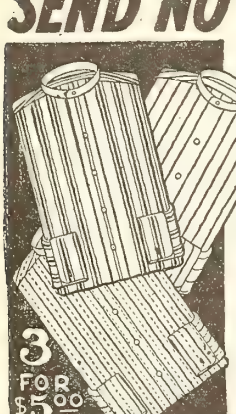
Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____

SEND NO MONEY



Write quick for this amazing shirt bargain. Only limited lot. Wonderful quality fine count percale. Record breaking cut price. Guarantee $8.00 value for only $5.00 C. O. D.

Send No Money just your name and neckband size on postal or letter for these **three wonderfulpercaleshirts.** Cut extra large, roomy armholes. This season's latest black, blue or lavender stripe effects on white background. Guaranteed fast color. Best quality pearl buttons, soft French turn back cuffs, finest workmanship.

We guarantee to refund your money if you can match these 3 shirts for less than $8.00. **Save money**—write today before this astounding offer is withdrawn. We pay delivery charges. You pay only $5.00. Just send your name, address and neckband size.

BERNARD, HEWITT & COMPANY
Desk R3910, 900 West Van Buren Street Chicago, Illinois

The degeneration changes may gradually spread so that finally they become distinctly localized and begin to show defects in bodily movements or sensations. If the leg area is reached, the leg will become paralyzed on the opposite side of the injury, i. e., if the right hemisphere of the brain has been injured, the left leg will be paralyzed and with the leg of course the arm on that side.

The injury or abscess then would penetrate the brain tissue still further and may result in blindness in one-half of the visual field of both eyes. Difficulties of speech would present themselves and word blindness occur, dependent on the direction in which the abscess grows. In addition, intense throbbing in the head and perhaps deafness on the same side as the injury would be indicated. Of course, none of these signs would show invariably that the brain has been injured or that there is any intercranial pressure.

The attending surgeon always attempts to ascertain by interrogation whether or not there had been any previous injury, and if the answer is in the affirmative, regardless of whether the injury was on the surface or not he advises immediate operation when the other signs just mentioned are present.

If the operation is not refused by the patient, it means but a matter of a few moments to carry it to a successful completion. The surgeon after setting the depth gage for the saw and adjusting the width of the saw-cut, places his patient under anesthesia, and then as near as possible he attempts to locate the position of the injury. A flap of scalp is then removed, the head having been shaved at the spot determined upon, the current turned on and the saw cuts its way thru the skull, without necessitating any pressure upon the handle of saw.

This causes two parallel incisions to be made, even into the proximity of a splintered skull, and there is no danger of forcing fragments of bone into the brain as was generally the case with the old style trephines. Reversing the saw and cutting two more parallel lines at right angles to the first cut, the surgeon is able to remove a square portion of bone or a triangular portion if the same should prove advisable, in which case the saws are close together.

A cut thru the dura mater or covering of the brain exposes the brain, and instantly if there has been any cranial pressure quite a large quantity of pus will escape. Sometimes the opening thus formed, if it is of large size, is covered by a silver plate screwed into place right into the bone, the dura mater of course having been sewed up prior to this step.

Automaton Mimics Real Man

(*Continued from page* 607)

Mr. LaReine, after having obtained a mechanical man, discovered the fraud in the method of actuating its mechanisms which, as the readers undoubtedly know, was controlled by a real live midget, and after years of research has produced a rival to the old type. This new marvel, in addition to writing his name on blackboards and riding a bicycle, can actually talk; the voice emanating from him being very distinct and clear.

The arms of the man in writing are actuated by a series of cams, which enable the operator to direct any desired movement to these arms. A selective device allows any of the various functions to be actuated separately, much the same as these selective controllers employed in wireless controlled vessels. A gyroscope in the bottom enables the mechanical man to ride a bicycle across the stage in startling fashion.

This All Wool Suit Made to Your Measure Only $25.00



Here is the most remarkable value we have ever offered. Equal to suits others sell at $35.00 to $40.00. Guaranteed all wool. Made to individual measure. Perfect fit guaranteed. DELIVERY CHARGES PREPAID.

FREE Latest Style Book with 66 Beautiful Cloth Samples

Send postal today for our big Fall and Winter Style Book with 54 cloth samples of very finest, high grade fabrics. Pictures latest up-to-date styles and gives complete instructions for taking measures—so simple a child can follow them. You can save at least 25%. We guarantee absolute satisfaction or there is no charge. Don't pay fancy prices. Write us today.

THE BELL TAILORS (Largest in the World)
Adams at Green St. Dept. 1068 Chicago, Ill.

WIRELESS

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 22 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 80 Big Pages, 300 illustrations, 200 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 22 measures 6" x 9". Weight ½ lb. Beautiful stiff covers.

Send 6 cents in stamps or coin for which we will send our latest Cyclopedia Catalog No. 22 as described.

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

WHY DONT YOU WRITE
THE WORDS FOR A SONG
WE'LL HELP YOU ALONG

By composing the music Free and publishing same. Send poems to-day.
D. N. LENOX CO., 271 W. 125th St., N. Y.

WHISPER IN YOUR TELEPHONE
with a **"THERAPHONE"**



mouthpiece. It saves your time, temper and money. No more shouting to make yourself heard; slightest whispers clearly audible. A boon to busy, nervous, highly strung people. Necessary to all phone users. Affixed in a minute. Satisfaction Guaranteed. Price $1.10.

The EVOLUTION PHONE CO., Inc.
Dept. 11, 48 Greenwich Avenue
New York City

MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE
Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.

Model Electric Motor Boat



30 inches long. High power.
Built like a real boat—$15.00

Send stamp for illustrated lists of working model boats, engines, etc.

BATHE MANUFACTURING COMPANY
Desk 2, 5214 Woodland Avenue, Philadelphia, Pa.

CLEAN SMOKING

One twist of mouth piece cleans this pipe of smooth-smoking Italian briar. Aluminum draining canal does the trick. $1 postpaid; cash or money order. THE S. & H. COMPANY, P. O. Box 254, Wilkes-Barre, Pa.



POPULARITY FOLLOWS THE
UKULELE



If you play quaint, dreamy Hawaiian music or latest songs on the Ukulele you will be wanted everywhere. We teach by mail 20 simple lessons; give you free with every course a genuine Hawaiian Ukulele, music, everything—no extras. Ask us to send the story of Hawaiian music. You will love it. No obligation—absolutely free.



The Hawaiian Institute of Music
1400 Broadway *Dept. 5-L* New York

An American Jules Verne

(*Continued from page* 623)

ships—to lift them up vertically—are becoming a realization at the present time. Witness the various helicopter machines that actually have flown in the past few months and which were pictured in this magazine recently.

Nor did Mr. Senarens write vaguely about his wonder machines. Quite the contrary, he described them minutely. While of course no such technical data, as for instance that used by Jules Verne, appears in Senarens' descriptions, still the boy who read the stories had a pretty good understanding of the workings of the mechanism, and his imagination always helped him along so that the machine was pictured by him down to the last nut and to the last binding post. Most interesting is it that Mr. Senarens used electricity as the motive power of most of his devices. At that time, altho there were as yet no electric lights, electricity had just come into use. Electricity in those days could do anything, and the people believed that the marvelous new force was capable of doing the impossible, as indeed it has approximated to since. Not the most interesting part about Senarens' writings were his scientific creations, but the stories themselves were little classics in construction. Mr. Senarens had written since he was a boy fourteen years old, and was a very accomplisht writer with a fervid imagination, not only in things scientific. He was a master of romance, fiction, adventures, plots and everything.

Mr. Senarens is still at it, and altho he is not writing any more scientific stories just now, he is in the ring and doing work as an editor for a New York publishing house at the present time. Mr. Senarens is fifty-eight years old and is a very active and energetic man who does not show his age. Perhaps at some not too future date Mr. Senarens will give us some more imaginative stories, picturing the world as it will look fifty years hence.

And the other day when we made him dig out a few hundred of his time-worn yellowed paper-covered novels, each adorned with an old-fashioned wood cut on its front cover, Mr. Senarens smiled wistfully. He had long since forgotten those "wild impossible dreams" of his younger writing days. Altho he does not like to admit it now, he was actually ashamed to write such "nonsensical wild pipe dreams" those days. In fact, there were many people who thought that his stuff was too fantastic and would actually hurt the young boys. And here nearly everyone of his "pipe dreams" has come true!

"Yes," Mr. Senarens sighed deeply, when we called his attention to it, "truth is indeed stronger than fiction. I believe anything is possible now."

How Were the Pyramids Built?

(*Continued from page* 599)

the other hand, tools of that period brought to light by excavation are of the most primitive kind.

"How, then, were the pyramids constructed? How were enormous blocks of stone, each weighing many tons, hauled into position up to nearly five hundred feet above ground level? This is the problem which has puzzled engineers. While several theories have been advanced, none has been propounded which has met with anything like general acceptance. The most popular (if it can be so called) is the earth (or rather sand) ramp theory, which propounds that as one row of blocks of stone was laid, from the foundation upward, an inclined plane of sand was constructed around all four sides

LEARN DRAFTING

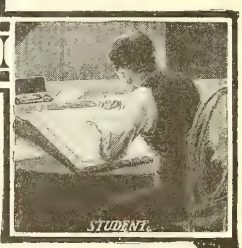
At Home—In Spare Time
as you would in actual practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed, by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher, especially qualifies him to give you the training you need to become a successful Draftsman.









Become a Specialist

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.

Draftsmen are needed in greater numbers, and receive better salaries than ever before.

Draftsmen Get $35 to $100 a Week

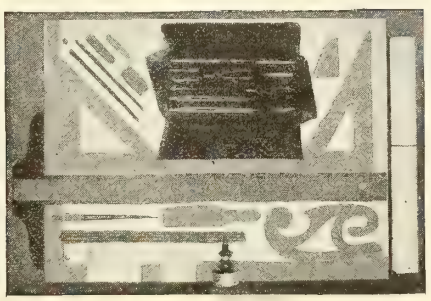
Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field paying as high as $50,000 a year.

How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions now open. Here is what "Columbia" training is doing for some of our graduates: Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.

This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



Big Concerns Employ "Columbia" Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them.

Send This Coupon Today

Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write today to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1180, 14th & T Sts., N. W., Washington, D. C.

COLUMBIA SCHOOL OF DRAFTING,
Roy C. Claflin, President
Dept. 1180, 14th & T Sts., N. W.
Washington, D. C.

I am interested in your practical training in Mechanical Drafting. Please send me Free, your illustrated book of particulars, testimonials, terms, etc. I am also interested in the special post-graduate course checked below:
(Mechanical Drafting, or Machine Drafting is the foundation course and is complete in itself.)

Architectural Drafting...	Ship Drafting .....
Automobile Drafting.....	Statistical Drafting .....
Electrical Drafting	Radio Drafting .....
Aeroplane Drafting	Automotive Drafting .....
Special Machinery Drafting	Hydrographic Drafting...
Sheet Metal Drafting....	Machine Design .....
Structural Drafting	Tool Design .....
Highway Drafting	Shop Mathematics .....
Patent Drafting	Builders' Course .....
Topographical Drafting..	

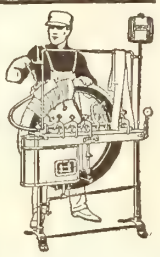
Name.....
Age..... Address.....
City..... .....State.....

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2209 Fourth St. Waupun, Wisconsin

A NECESSITY

For the Home, Shop, Garage, Automobile, Moving-Picture and Wireless Operators

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR



95c PER TUBE

TORCH $1.25

A PASTE THAT TURNS INTO METAL WHEN HEATED

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. E9
129 Sussex Ave., Newark, N. J.

COMBINATION SET Tube and Torch Complete $1.50

Dealers Send for Quantity Prices.

The Seneca MOTOR CAR — Built for the Owner — $1185



Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. Comfortable E-Z riding

4 cyl. - 27 H. P. 108 in. wheel base

Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. Write or Wire NOW.

THE SENECA MOTORCAR CO., 50 Seneca Factory, FOSTORIA, OHIO

You Can Save $50.00



$8.46 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. Guarantee Bond for 8000 Miles. (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.
901 Oak St. Kansas City Mo.,

Learn Autos and Tractors



Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

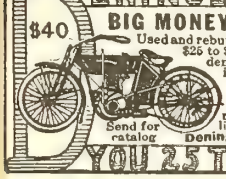
5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O.

ENINGER WILL SAVE

$40

BIG MONEY SAVINGS FOR YOU



Used and rebuilt motorcycles, single and twins. $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog

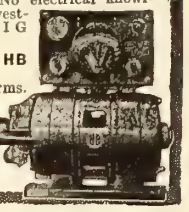
Doninger Cycle Co., Rochester, N.Y.

YOU 2.5 TO 50 DOLLARS

Big Profits Every Month in Battery Charging

You Can Make $100 to $200 Clear Extra Profit Each Month

This HB Outfit recharges 1 to 10 6-volt batteries at once for 10c to 15c each. Owner pays 75c to $2. **Figure those profits!** You can build a big, profitable business in battery charging. No electrical knowledge required. Small cash investment — long, easy terms — BIG PROFITS.

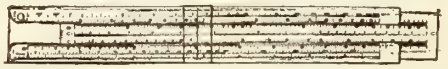


Small Cash Payment Puts This HB Outfit in Your Garage

Balance on easy monthly terms. Profits easily carry payments. No expensive renewals — steady, dependable service, with BIG PROFITS. Absolute money-back guarantee. Tear out this ad and mail today for information.

Hobart Bros. Co., Box 102E, Troy, O.
Successful Manufacturers Since 1893

RICHARDSON'S POLYPHASE SLIDE RULE



has the regular A, B, C, and D Scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case with 100 page Instruction Book $2.00.

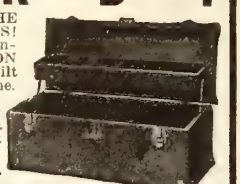
An ideal Slide Rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10. each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO. NILES, MICH.

H A R D Y

YOU CAN'T BEAT THE UNION FOR HARDINESS! This beautiful finished, conveniently arranged UNION UTILITY CHEST is built with a solid oak frame. Joints are not dovetailed, but are **lock cornered** for extra strength. Use a Union Chest to protect your tools from rust, knocks, bangs.



UNION UTILITY CHEST

For auto-mechanics, electricians, plumbers, linemen, etc. Tray lifts with cover, yet fits snugly when closed.

STRONG AND STURDY

Heavy hinges, full-nickeled hardware, strong lock and handle, make this an ideal house for your fine tools. **Write for Catalog,** prices and name of dealer. Satisfaction or Money Back.

UNION TOOL CHEST CO., Inc.
88 Mill Street Rochester, N. Y.

UNION TOOL CHESTS



"Lighting Fixtures"

Ready to Hang

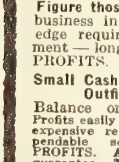
(Direct from Manufacturers)

Completely wired, including glassware. New designs.

Send for catalogue No. 18

ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

Book on Law Free



Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.

Write Today—now while we are making a special reduced price offer.

American Correspondence School of Law
7447 Manhattan Bldg. Chicago, Illinois

Every Bicycle A Motor Cycle

by using a STEFFEY ATTACHMENT.

Thoroughly PRACTICAL and SUCCESSFUL. In use over 20 years. Fits double-bar, Arch or diamond frame.

Send stamp for circulars.

STEFFEY MFG. COMPANY
Dept. E 5025 Brown St. Phila., Pa.

Learn the Sign-Show Card Business



Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.

EARN $25. TO $75. WEEKLY

You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.

DETROIT SCHOOL OF LETTERING, 490 D.S.L. Bldg. Detroit, Mich

until it was level with the top of the row. Up this inclined plane the blocks of stone for the next row were hauled, and when positioned the sand-ramp was lengthened and heightened to the top of them, blocks for another row hauled up, and so on and so on. In other words, the theory involves a belief that the Egyptians constructed one huge earth mountain to enable them to construct a smaller stone mountain, it being apparent that to get an angle for haulage over soft sand, the approach rise of the ramp would have to commence from nearly a mile away.

"To the writer this idea appears crude in the extreme. Also it gives very little credit to the master-builders of a very extraordinary age.

"The writer's theory is that the smooth cement covering (this smooth outer covering which can be seen on the pyramids even today, altho badly disintegrated in most cases, is and has been popularly supposed to have been put in place after the stone work was all finished) was put on from the bottom upward as the work proceeded. That is to say, when the first row of stones above the foundations, *i. e.*, above ground, had been positioned, their outer sides were given the cement plastering. Assuming this to be so, the edifice had a smooth *glissade* of an ever-rising height as each layer of masonry was added. The object of such a method of construction will at once become apparent if we imagine a roller to have been placed at the angle of the flat top and a number of ropes laid over it down the sides. (See illustration herewith for probable arrangement of the rollers and ropes.) When the word 'ropes' is mentioned we must calculate upon long lengths, spliced into cables. The fabrication of, say, five such fibrous cables, about three-quarters of a mile in length, replaced as worn out, would have been a small undertaking compared with the fabrication of a colossal and totally unnecessary *ramp*, or huge mountain of sand, the erection and removal of which would have been a titanic operation alone. On one end of those cables would have been hitched a block, already faced and angled, with its smooth side against the cement incline. On the other end, a number of men would have been ranged in lines for hauling.

"The number would have been a great one, but history relates that nearly *one hundred thousand men* were employed in the construction of the pyramids! With regard to the hauling of the blocks into position, therefore, the only limits would have been the length of the cable and of the ridge. In such conditions, 10,000 men divided into five rows of 2,000 each, hauling on a twenty-ton mass over rollers, against a smooth *glissade*, would have had an easy job. Once up, the blocks would be hauled to the near side of the haulers (pushed along on rollers, presumably), and the process of erection would go on away from them, until the *glissade* was reached, when the latter would be built up to the new level, and work would begin again, positioning another row of blocks.

"The theory advanced is supported by several considerations. The modern block-and-tackle system is unquestionably only an evolution of the very plan of handling heavy weights just described. Both the older and the modern methods required a number of parallel ropes or cables to take off and divide the tension of a very heavy weight, without which division the strain on a single strand would be too much. In each method also there is the division of the pulling force between several strands. The principles involved are the same, only the modern power- or hand-driven block and tackle is more scientific and less cumbersome than the ancient cables working over rollers. But —and here is the point—how much less cumbersome is this method than the idea of mountainous sand-ramps, first thrown up and then thrown away?"

A Universe in Miniature

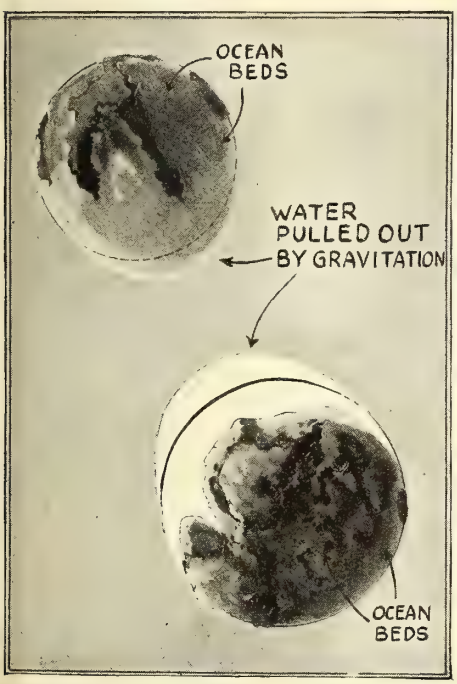
(*Continued from page* 603)

their own, and they are so transparent that one may see the farthest stars through their substance. Finally, there is the turning of the rings, and they turn according to the law of gravitation. This is a fact which all theory accepts and of which the hypothesis of Dr. Birkeland does not seem to take account. The wisest plan, therefore, until the new order comes, is to hold to the old theory of Cassini and to follow with interest the ingenious experiments of Dr. Birkeland."

What Caused the Great Flood?

(*Continued from page* 606)

so much by the rain which fell as by the breaking up of *"all the fountains of the great deep."* In plain English, this can have but one meaning, viz., the waters of the ocean.

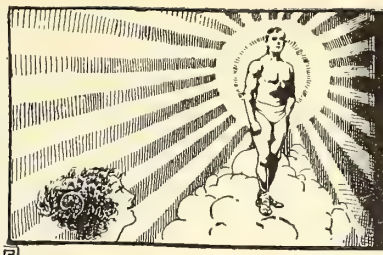


This Shows Graphically What Happens When the Earth and Another Heavenly Body Approach Within a Short Distance. The Water on Both Bodies Will be Drawn Out as Shown.

That these waters were actually ocean waters can best be proven by the fact that fossil sea shells have been found upon the summits of our highest mountains in all parts of the world with the exception of some African mountains.

Mr. Gernsback's explanation of the flood is very simple, and might readily have occurred as follows:

If some celestial body in its wanderings thru the heavens past sufficiently close to the earth, that is within ten or twelve thousand miles, there is no question of a doubt that such an encounter would have caused havoc on earth. We are not concerned here what this body was. It might have been our own moon, or it might have been any of the other planets, or even an extraordinary large cometary body of a bulk as large as the earth, or even as small or smaller than the moon, passing sufficiently close to the earth,—say two thousand miles. The mutual gravitational influences would then raise tremendous tidal



ARE YOU GOING TO MEASURE UP TO HER VISION OF MANHOOD

Are You Physically Fit?

DO you look forward serenely, confidently, towards the day when you will wed the girl you cherish? Do you see in your day dreams a loving, admiring wife and prattling children of your own flesh and blood and a dear little, happy home?

This is the picture every young man ought to be able some day to realize. But you may be one of the thousands, who, for one reason or another—known only to yourself perhaps—have stumbled into youthful errors which have discouraged and weakened you and made you almost hopeless of ever being happily married. You fear the consequences of deception. You hesitate to make love, lest you make a miserable mess of some sweet girl's life. Life looks mighty gloomy to you.

But don't be disheartened. There is hope for even the frailest of humanity, young or middle-aged.

My Hand Is Held Out To You In Friendship—I Want To Help You

Strongfortism has lifted thousands of weak, ailing, impotent, discouraged men out of the bog of hopeless and despair and placed them on the broad, straight road to health, happiness and prosperity. **Strongfortism** has restored the manhood they had destroyed and thought they had lost forever and given them renewed vitality, ambition and the power to **DO THINGS** in the world. **Strongfortism** has enabled them to beget children who will make Americans of whom both they and their country will be proud.

And you do want children, don't you? Of course you do—and you shall be a proud father, with prattling kiddies at your feet, if you listen to my advice and take my hand and let me help you to be a real man.

STRONGFORTISM Is a Science In Itself

Strongfortism is a long stride ahead of any so-called physical culture course or system that you know of. It embraces all the essentials of such systems, but is not limited to them—it goes far beyond, reaching out to a variety of Nature's aids, employing them to an advantage that brings surprising results to every Strongfort follower.



LIONEL STRONGFORT

Dr. Sargent, of Harvard, declared that "Strongfort is unquestionably the finest specimen of physical development ever seen."

That is why I have been able to banish all drugs and medicines and clumsy devices of all sorts intended to cure disease. I get results that are most astounding because my plan is so simple—my instructions so easily followed. My search after the basic truths of Nature and the facts about the diseases afflicting humanity has led me to discoveries that are proving of inestimable benefit to all to whom I have imparted them.

My FREE Book Tells All About It

Send today for your copy of **"PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY."** It's free, but the information it contains will be of inestimable value to you. It will tell you how you can, without medicines or drugs, and without the use of expensive apparatus, build yourself up to perfect health—how you may become a strong, healthy man. In short, it will tell you how to REALLY LIVE, by devoting a few minutes every day, in the privacy of your own room if you wish, to follow my easy, simple instructions. **Fill out the coupon below and mail with three 2c stamps** to cover packing and postage and you will receive your copy by return mail, with a personal letter from me concerning the subject or subjects in which you are most interested. Take the first step toward their attainment by mailing that coupon NOW.

LIONEL STRONGFORT

Physical and Health Specialist

52 STRONGFORT INSTITUTE, NEWARK, N. J.

FREE CONSULTATION COUPON
Absolutely Confidential

Mr. Lionel Strongfort—Dept. 52—Newark, N. J., Personal—Please send me your book **"PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY,"** for postage of which I enclose three 2-cent stamps. I have marked (X) before the subject in which I am interested.

..Colds	..Short Wind	..Skin Disorders
..Catarrh	..Flat Feet	..Impotency
..Hay Fever	..Stomach Disorders	..Falling Hair
..Asthma	..Constipation	..Weak Eyes
..Obesity	..Biliousness	..Pimples
..Headache	..Torpid Liver	..Blackheads
..Thinness	..Indigestion	..Despondency
..Rupture	..Nervousness	..Round Shoulder
..Lumbago	..Poor Memory	..Lung Troubles
..Neuritis	..Rheumatism	..Weight Lifting
..Neuralgia	..Gastritis	..Muscular Development
..Flat Chest	..Heart Weakness	..Great Strength
..Deformity (Describe)	..Poor Circulation	..Advanced Course
..Insomnia	..Increased Height	..Many Weight Barbell
..Youthful Errors	..Professional Training	

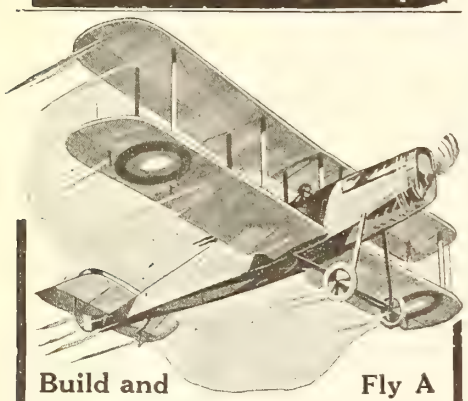
Name.....

Age.....Occupation.....

Street.....

City.....State.....





Build and Fly A

Model Aeroplane

Build a real, flying model of any of the famous Aeroplanes listed below. IDEAL Scale Drawings and Building and Flying Instructions show how you can build and fly 3-ft. models of real 'planes.
Send now for drawings and instructions for the one you want to build.

Curtiss JN4D-2 Trainer 'Plane (Just Out)
NC-4 Naval Seaplane
DeHaviland Battle 'plane
Curtiss Military Tractor
Bleriot Monoplane
Nieuport Monoplane
Taube Monoplane

35c EACH POSTPAID

SEND FOR AEROPLANE BOOK

Tells all about these and many other Aeroplanes, and how to build and fly them. Also describes IDEAL Model Aeroplane Construction Outfits, which contain everything needed for building the above Aeroplanes, and tells where to get them.
Send 5c today for your book

Ideal Airplane & Supply Company
Making Model Aeroplanes since 1911
159-161 Wooster St., Cor. West Houston St., N. Y. C.

REBUILT ELECTRIC MOTORS



General Electric
Westinghouse
Crocker-Wheeler
Emerson
Century
Wagner
etc.

All Motors Guaranteed For One Year

Motors bought, exchanged and repaired
ELECTRICAL SUPPLIES
Wholesale Prices
Sockets, wire, tape, loom, fuses, switches, cut outs, etc.
New illustrated catalogue free Satisfaction guaranteed or money refunded.
HYRE ELECTRIC CO.
631 S. Dearborn St. Chicago, Ill.

TELEGRAPHY

(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.
DODGE'S INSTITUTE A Street, Valparaiso, Ind.

waves, not only upon the earth, but upon the other heavenly body as well, providing there was water on it.

Now if Noah had been, as he presumably was, a wise man, he no doubt would have been able to foresee what was coming, just as any astronomer can foretell the return of a comet years in advance. The flood is commonly supposed to have occurred in the year 2348 B. C. If we credit a man with ingenuity enough to build the Ark, in other words a vessel 500 feet long and 50 feet deep, as mentioned in the bible, a vessel comparing very favorably with a modern ocean passenger steamer, that man must have had a rather remarkable intelligence. He probably was astronomically inclined, and he could probably foretell the time when the encounter of the two bodies, viz., the earth and the strange wanderer, would occur. This of course, would give him time enough to build his Ark, and therefore escape the ensuing cataclysm.

Our cover illustration gives a good idea of what would happen if the earth and the other celestial body would be at their nearest approach, say 10,000 miles. It should be remembered that such an encounter as this is not of long duration. The earth moves very rapidly in its orbit, namely at the rate of 1,600,000 miles per day. The other body would move at an approximately similar speed. The havoc caused by the mutual gravitational attraction would be colossal as well as swift.

As the two bodies approach, the ocean waters of the earth, being the most plastic substance of the almost rigid earth, would be drawn sky high, all depending upon the distance which separated the two heavenly bodies. That the ocean waters would be lifted up in gigantic tidal waves of anywhere from ten to twenty-five miles high is only a very reasonable surmise. The lifting up of these waters would of course be swift, and would not necessarily cause immediate havoc then, but the minute the two bodies separate, the waters naturally would recede with a rush, and would inundate the continents considerably over the highest mountain tops.

Consider that the waters of the earth cover five-eighths of the entire surface. If therefore, this theory is correct, the receding waters would rush over almost every continent of the entire globe. Nor will this titanic disturbance be momentary. The gigantic waves created will not come to rest immediately, and the momentum will probably be sufficient to cause the waters to race around the earth for many days to come. It might even take months for some continents to become depleted of the waters; undoubtedly new oceans would be created and old ones turned permanently into land. Witness, Dr. Wright's remarks as to the historical Chinese ocean known as Han Hai.

How long such a disturbance might last until the oceans finally came to rest again, is impossible to know now, but it cannot be doubted that the time element would be rather long. It is well-known that a cloud burst sometimes deluges a section of the country for some days before the waters finally have entirely dispersed, thru filtration into the ground, or by being carried away by rivers. Such a local inundation probably never exceeds an average of ten to fifteen feet deep. If then it takes days for the waters to recede from such a purely microscopic local affair, how long would it take the waters to finally disappear if an ocean wave anywhere from ten to twenty-five miles in depth swept over the lands?

No serious objection has been raised by astronomers to Mr. Gernsback's theory, and this explanation is probably as good or perhaps better than many other theories that tried to explain the reasons for the flood unsuccessfully in the past.



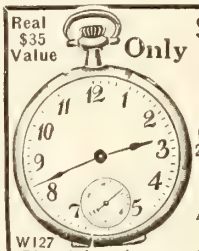
The Electric Safety Razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."
A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."
No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.
Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

VIBRATING ELECTRIC RAZOR CO.
Dept. 122, Council Bluffs, Iowa

Real $35 Value



Only **$12**

23 Jewels Full 12 Size 20 Year Gold Filled.

Ask for W127

$100 Value



Brilliant ¼ carat blue-white diamond. Cut with wide spread to look larger. 14K Solid Gold Ring. Ask for

R127 $49

W127
Biggest bargain ever offered. Timed, adjusted, regulated ready for your pocket. Perfect timekeeper. Sold on 30 days' trial.

Send for New Bargain Catalog
Full of surprises in diamonds, watches and jewelry. This 132 page bargain book will save you up to 100 per cent. Thousands of selections shown.

B. GUTTER & SONS Wholesale Jewelers, 172 Nassau St., Div. 127, New York, N. Y.

Electrical men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical

Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete

In One Year



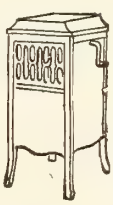
Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 28th year opens Sept. 29, 1920
BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

ENCYCLOPEDIA of Physical Culture **25c**



"Be Strong and Stay Strong"
By HENRY VICTOR
The most complete work, in concise form, ever published on physical culture. It explains all the phases of physical training. Here are some of its topics:
Diet — Constipation — Drinks — Out-Door Life—Bathing—Clothing—Air Baths—Sleep—Breathing—In Case of Sickness—Normal Weight—Truth About Fat—How Not To Be Thin—Exercise.
The regular price of my book is $1.00 but for a limited time I offer it for 25c. Send stamps or coin.
HENRY VICTOR
14-16 4th Ave. Dept. B New York

Cleartone Phonographs
$4.00 to $200.00 Retail



Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.
LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B East 12th Street, N. Y.

SAVE 25% to 60%
on slightly used
GRAFLEX-KODAKS



Cameras and Lenses of every description. Equal to new. Save money. Write now for
Free Bargain Book and Catalog
listing hundreds of money-saving bargains in slightly used and new cameras and supplies. **All goods sold on 10 days' Free Trial.** Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.
CENTRAL CAMERA CO., Dept. 1110 124 S. Wabash, Chicago

COMMENT ON THE ABOVE.

By Isabel M. Lewis, M.A.
of U. S. Naval Observatory.

If, in the course of ages, a dark body, comparable in size to our own planet, chanced in its wanderings thru space to pass so dangerously close to our solar system as to come under the overpowering attraction of the sun and were drawn thereby into his domain, and happened, as it advanced toward the sun in hyperbolic orbit, to pass within a few thousand miles of our own planet world, the effects would not be so transient as are the effects of cometary encounters.

Were our planet in a semi-gaseous state it would eject a stream of matter in the direction of the intruder as a result of the state of tidal stress and strain set up by the close approach of the two bodies. Since, however, our planet is an elastic body and as rigid as steel, it would yield but temporarily to the deforming force (unless this was so great as to completely disrupture our world), and immense tidal waves would sweep over the earth's surface for many days, increasing in force as the two bodies approached and gradually decreasing as they drew apart. Great floods sweeping over the surface of the earth would not be the only effects of such an encounter.

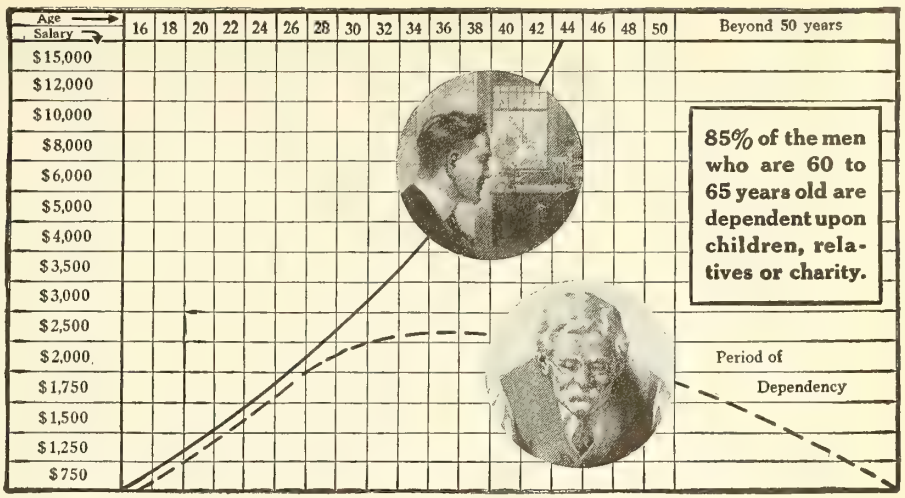
There would be great and persisting climatic changes as well. The visiting body being comparable in size and mass to the earth and exerting a great gravitational pull upon it, would produce a change in the form and size of the earth's orbit that would continue after the body itself had past on, just as a comet that has past close to a planet has the form of its orbit permanently changed by the encounter. The distance of the earth from the sun and its period of revolution, or year, depend upon the form and size of its orbit, so as a result of the encounter our year and our distance from the sun would be different and accordingly the amount of light and heat received from the sun would change and therefore our climate as well. Moreover, a change in the form of the earth's orbit would bring changes in the nature of the seasons which would be still further affected by a change in the direction of the earth's axis which would undoubtedly be brought about by the action of the disturbing body.

Great tidal waves of a transient nature, produced by the gravitational attraction of two massive bodies passing close to each other with high velocities, and lasting climatic changes produced by the change in the earth's orbit and in the inclination of its axis would result from the visit of this stranger from space.

In historical times no great changes have taken place in the earth's climate, but as we delve backward into the earth's history thru great geological eras that stretch into the dim and distant past we find quite a different state of affairs. At periods in the earth's history great climatic changes were brought about, glacial or ice ages when polar caps extended far into the temperate zones were followed by periods when luxuriant tropical vegetation flourished as far north as Greenland.

What was the cause of these tremendous variations in climatic conditions over the earth's surface during different epochs? No completely satisfactory answer has yet been given.

Periodic changes in the form of the earth's orbit, changes in the inclination of the earth's axis, or cyclical changes in the intensity of the solar radiation are some of the factors that might produce those alternating climatic periods; or again, variations in the heat of the earth itself or changes in the composition of its atmosphere might account for them more satisfactorily.



Which is Your Curve?

The broken curve represents the progress of a man who quits school early in life, takes the first job offered, and makes no effort to improve his education and training along special lines. Youth and physical energy bring fair progress until he is 25 or 26 years of age—then he hits an almost straight line that shows no increase in salary for 15 or 20 years. At 40 or 42 he starts to go down—finally he slides off into the area of dependency.

Now—contrast the record of the broken curve man with that of the heavy curve man—who has realized the value of education and training. At 30 the heavy curve man has reached a salary of $3,000 a year. By the time he is 38, he has climbed up into the $5,000 a year class—and is still going up. Note how rapidly the distance increases between the two men after they are 30. The distance doubles, trebles, and still increases until, at 40, the broken curve man has many salary squares to climb. He has been hopelessly outdistanced by the heavy curve man.

Take the chart above—go back to the time when you quit school and took your first job—trace in your line on the chart up to the present time. Are you a broken curve man or a heavy curve man? Have you been in a rut or has your advancement been gradual and steady? Be honest with yourself! Are you headed upward toward the executive class—or—are you headed downward on the broken curve toward dependency?

You can be a heavy curve man if you will but take advantage of specialized training such as you can now obtain without interference with your present position. LaSalle Extension University offers you a choice of thirteen courses of home-study in specialized business subjects. If you want to increase your salary by making your services of greater value—you can do so by spending your spare time in training at home,

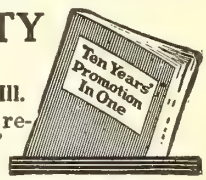
During this training under the LaSalle extension method, you will have the advantage of the LaSalle "Problem Method" by which you will solve actual problems taken from modern business and you will be guided by a staff of over 450 business experts, law specialists, expert accountants, trained correspondents, experienced bankers, traffic experts, executives, and educators.

More than 225,000 ambitious men have already been helped to promotion, increased salaries and business success by LaSalle training. More than 50,000 men are now being **trained** annually by LaSalle.

Check in the coupon the course which especially appeals to you and get full information—also our helpful book, "Ten Years' Promotion in One"—which tells how men with the aid of LaSalle training have gained in one year promotion which men without this training have not realized in ten. Make your start today. Send the coupon now!

LaSALLE EXTENSION UNIVERSITY

The Largest Business Training Institution in the World



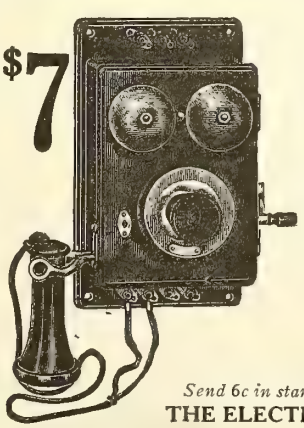
Dept. 10371-R 4046-58 S. Michigan Ave. Chicago, Ill.

Gentlemen: Please send without obligation to me information regarding course indicated below Also copy of "Ten Years' Promotion in One."

- ☐ **Higher Accountancy**
- ☐ **Business Administration**
- ☐ **Traffic Management (Foreign and Domestic)**
- ☐ **Law (Training for Bar. LL. B. Degree)**
- ☐ **Commercial Law**
- ☐ **Production Efficiency**
- ☐ **Business Letter-Writing**
- ☐ **Banking and Finance**
- ☐ **Business English**
- ☐ **Commercial Spanish**
- ☐ **Expert Bookkeeping**
- ☐ **Effective Public Speaking**
- ☐ **C. P. A. Coaching (For Advanced Accountants)**

Name..... Present Position .....

Address.....



$7

For Homes, Offices, Factories, Farms

Complete Wall Set Magneto Telephone

Western Electric Type

This is a complete commercial telephone station. They were bought from telephone exchanges who put in Central battery types. Slightly used but guaranteed to be in A1 working order.

Will work perfectly at all distances up to 20 miles.

Long Distance Telephone Set—
One station **$7.00**
Shipping weight, 15 lbs.

Two stations
Shipping weight, 25 lbs..... **$13.00**

Send 6c in stamps for our big 160 page Wireless and Electrical Catalog No. 22.

THE ELECTRO IMPORTING CO., 231 Fulton Street, New York

Be a Movie King

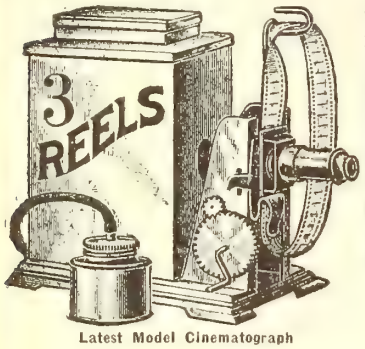


OH BOY. SOME SPORT

Surprise the Bunch—Have a Barrel O' Fun!

OWN A GENUINE MOVING PICTURE MACHINE

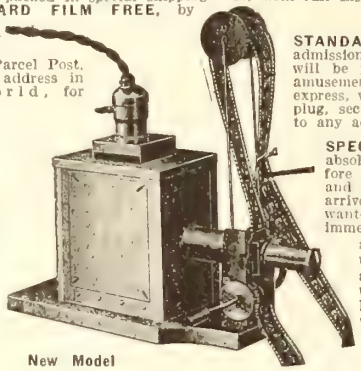
Here's what you've always wanted—a Genuine Moving Picture Machine—a machine that uses **STANDARD FILM**—like the **BIG** theatres show—at a price you can easily afford to pay. This is the **BIG** opportunity—don't **MISS** it. Read every word—then act quick. Several swell models to select from. Each the best of its kind. **ALL REAL** moving picture machines—not toys or magic lanterns—but **REAL MOVIE** Machines, that throw a big, broad, brilliant circle of light on the screen many feet away, and show a picture three to seven feet in width. One or more reels of **REAL FILM** come with each machine **FREE**, and the minute you get your machine you can start right in and give a "bully" exhibition. The "fellers" and girls and the grown ups, too, will sit spellbound, or roar with laughter, at the wonderful, lifelike, real movies you can show them.



Latest Model Cinematograph

Show Real Moving Pictures Like the Big Theatres
The New Model

This is a beautiful, high-class Moving Picture Machine. Made of sheet iron with wood base. Finished in black or battleship grey with handsome red stripe trimmings. Solid and substantial construction. Size, 12x7½x5½. Uses **STANDARD FILM** same as the big machines, and throws a **BIG** picture many feet in diameter. **TWO TYPES**—Electric and Gas. The electric machine is equipped with plug and cord, complete. Gas machine has its own generator and makes its own light. The gas machines can be used anywhere and will be sent unless Electric type machine is specially ordered. Remember this and be sure to specify "electric" if you desire this type. Sent securely packed in special shipping case, with full instructions and one **STANDARD FILM FREE**, by express, for $7.50; or by Parcel Post, to any address in the world, for $8.00.



New Model

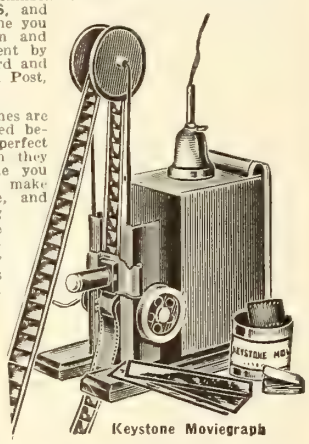
STANDARD SIZED FILMS, 3 FINE SLIDES, and admission tickets—all **FREE.** Here is a machine you will be proud of. You can have endless fun and amusement, and **MAKE MONEY** with it. Sent by express, with full instructions and extra long cord and plug, securely packed, for $12.00; or by Parcel Post, to any address in the world, for 75c extra.

SPECIAL. Order from this Ad. Our machines are absolutely as described and thoroly inspected before they are shipped. We guarantee them perfect and complete and all ready to use when they arrive. Make sure of getting the machine you want—order now—from this Ad. We can make immediate delivery now—so order at once, and avoid disappointment. Prices are going up all the time and you may never have a chance like this again to buy a Genuine Moving Picture Machine at the very low prices quoted here. You've always wanted a real Moving Picture Machine. Make sure to get it **NOW.**

Charlie Chaplin Films—25c each

Keystone Moviegraph

This is our largest and finest machine. A regular beauty and all complete, ready for you to use the minute it arrives. Hang up a sheet, put on a reel, turn the crank, and you're off—that's all there is to it. Nothing to get out of order. Made of metal throughout with heavy base casting. Finely adjusted mechanism, easily operated. Equipped to show slides as well as Real Moving Pictures—just like the big machines. 12x9½x6. Made to operate with electric light **ONLY.** Simply screw in the plug and you are all ready for an exhibit. Comes with **3 EXTRA LONG**



Keystone Moviegraph

BIG BARGAIN OFFER
3 Reels Free

Here is an astonishing bargain. Our latest Model Cinematograph is a whirlwind value. At the price it has everything beat you ever heard of. Here is a genuine Moving Picture Machine—made of metal—solidly constructed—and put together by expert workmen—that you can buy at a price that will simply astound you—knock you plumb off your feet. This machine throws a brilliant beam many feet. Comes equipped with a **SAFETY** Carbide Gas Generator, and can be used to show moving pictures anywhere. The mechanism is scientific and simple and can be operated by anyone. This is the greatest value in a Genuine moving picture machine ever offered at the price. Think of it! a genuine moving picture machine—that uses **STANDARD FILM**—by express, charges collect—with **3 REELS FREE**—for only $3.00; or by Parcel Post to any address in the world for only $3.25!

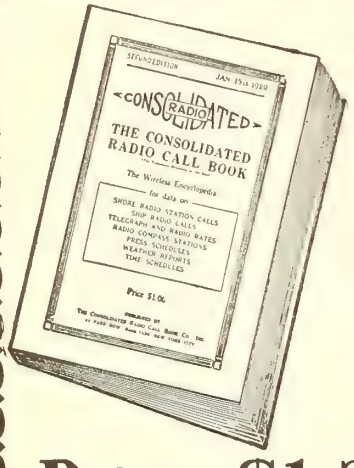
FILMS All the films you want. Splendid subjects—15c each; Doz., $1.50 (postpaid). Extra long films, 3 for $1.00; Charlie Chaplin films—slide-sollitters—famous favorites, 25c each. Lantern Slides (least sold)—6 for 75c.

JOHNSON SMITH & CO. Dept., P.M. 27, 3220-3224 N. Halsted St. CHICAGO, ILL.

The Second Edition of the

Consolidated Radio Call Book

NOW OUT—ONLY A FEW COPIES LEFT



The only book in print officially listing all the radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.

SPECIAL

Given Free With Each Copy

A Wireless Map of the World **in colors** is given absolutely free with each copy. This map shows the locations of all the high powered RADIO stations in the world, including the time signal stations. In addition it tells at a glance how far away any of these stations are. Of greater interest are the time zones, which enable the amateur to compute instantly the correct time for the zone in which he is located from any time signal station.

ALL AMATEUR CALLS ALSO LISTED

Price $1.25 Prepaid

Either Direct from us or for sale by the following responsible dealers:

American Electro Technical Appliance Co., 235 Fulton St., New York, N. Y.
Atlantic Radio Co., 34 Batterymarch St., Boston, Mass.
L. Bamberger & Co., Newark, N. J.
J. H. Bunnell & Co., 32 Park Place, New York City
California Electrical Supply Co., 643 Mission St., San Francisco, Cal.
L. W. Cleveland Co., 441 Congress St., Portland, Me.
Cutting & Washington Co., 6 West 48th St., New York City
De Forest Telephone & Tel. Co., 1391 Sedgwick Ave., New York City
Dewey Sporting Goods Co., 268 West Water St., Milwaukee, Wis.
Doubleday Hill Electric Co., 719 Liberty Ave., Pittsburgh, Pa.
A. T. Hovey, 61 Belvidere St., Boston, Mass.
Lester I. Jenkins, 923 Purchase St., New Bedford, Mass.
Klaus Radio Apparatus Eureka, Ill.
Arno A. Kluge, 638 So. Figueroa St., Los Angeles, Cal.
Manhattan Electrical Supply Co., 17 Park Place, New York City; 114 S. Wells St., Chicago, Ill.; 1106 Pine St., St. Louis, Mo.; 604 Mission St., San Francisco, Cal.
McCarthy Bros. & Ford. 75 W. Mohawk St., Buffalo, N. Y.
A. C. McClurg & Co., 218 So. Wabash Ave., Chicago, Ill.
Mohawk Electrical Supply Co., 325 So. Warren St., Syracuse, N. Y.
Newman-Stern Co., 1874 E. Sixth St., Cleveland, Ohio
Nola Radio Co., 134 Chartres St., New Orleans, La.
E. P. Noll & Co., 21 No. 7th St., Philadelphia, Pa.
Pioneer Electric Co., 137 East 5th St., St. Paul, Minn.
F. D. Pitts Co., 12 Park Square, Boston, Mass.
Precision Equipment Co., 2437 Gilbert Ave., Cincinnati, Ohio
Radio Corporation of America (Marconi Co.), Gay and Pratt Sts., Baltimore, Md.
Radio Distributing Co., 4 West Park St., Newark, N. J.
Radio Engineering Co., 827 Madison Ave., Baltimore, Md.
Radio Equipment Co., 630 Washington St., Boston, Mass.
Reuter Electric Co., 34 East 6th St., Cincinnati, Ohio
Rudolph Schmidt & Co., Inc., 51 Main St., E., Rochester, N. Y.
Shaffer's, 107 Granby St., Norfolk, Va.
Shotton Radio Mfg. Co., Scranton, Pa.
Smith Novotoy Electric, Inc., 20 West 5th Street, Charlotte, N. C.
Southern Electrical Co., Third and E Sts., San Diego, Cal.
H. E. Williamson Electric Co., 316 Union St., Seattle, Wash.
Young Men's Christian Association, 715 South Hope Street, Los Angeles, Cal.
Jos. M. Zamoiski Co., Baltimore, Md.
Young & McCombs, Rock Island, Ill.
Geo. S. Saunders, 168 Washington St., Boston, Mass.
Wireless Shop, 511 W. Washington St., Los Angeles, Cal.
Post Office News, 33 W. Monroe St., Chicago, Ill.
Meter Electrical Construction Co., 11 Otter St., Oshkosh, Wis.
United Radio Telegraphers' Association, 505 E. Baltimore St., Baltimore, Md.
American Hardware Stores, Bridgeport, Conn.

Published by

Consolidated Radio Call Book Co., Inc. 41 PARK ROW, NEW YORK CITY

How We Balance Ourselves

By WILLIAM M. BUTTERFIELD

(*Continued from page* 608)

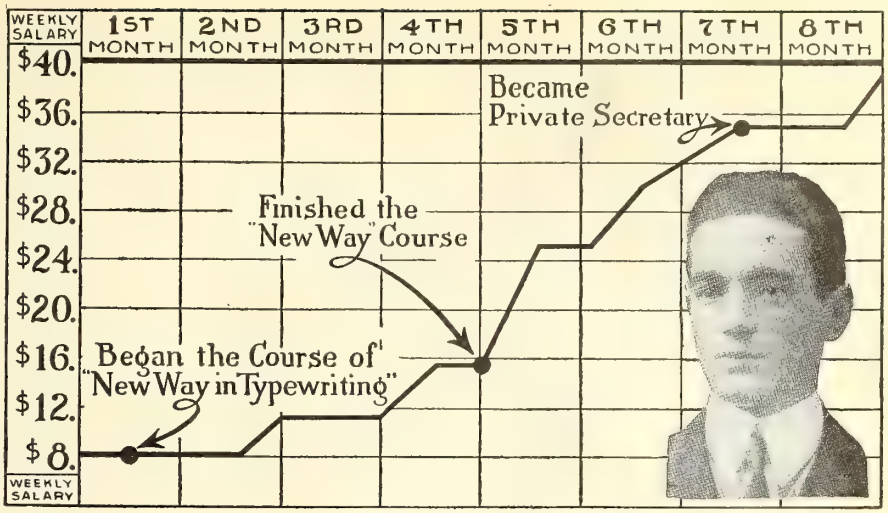
fiddle-fashion with the sac. The sacs and the bulbs appear to perform the same work, and the hollow interiors of all are filled with *long, tapering hairs* radiating toward the center from all sides (Figs. 7 and 10). The sacs and two of the bulbs are pierced by branches of the vestibular nerve (Figs. 2 and 7), and the nerve filaments, on entering the cavities, split up into twig-like formations that spread out in all directions, twisting their unprotected fibrils in among, and also around the hairs (Figs. 8 and 10). In this manner a nerve connection is made with the brain, thus informing that organ of the slightest movement of the hairs.

The envelope of the organs is composed of three separate skins (Fig. 5). Embedded in the inside skin, among the hair-cells and lying opposite the nerve entrances in the sacs, sometimes in one place and then another in the bulbs, there are always found groups of crystals that form in balls (otoliths), held together by meshes of delicate fibrous tissue (Fig. 9). The areas where the crystals lie are thus weighted and develop movements of the skin, which fall inward, obeying the action of gravity (Fig. 10), or again outward, moved by the pressure of the enclosed fluid; in this peculiar way forming an automatic gravity operating vibration.

This, in brief, is a description of the organs as now well known and understood. To illustrate what takes place when the organs perform their work, let us take a small bottle of water as representing the fluid confined in the inner cavity of each organ. It takes but a very little experimentation to show us that there is not a movement of any kind that can be made with the bottle that does not cause the water to change or move in some contrary way. If the inside of the bottle was lined with long flexible hairs, this contrary motion would be transmitted to them; hence if the bottle was revolved or dropt or tilted, the various motions would show by a series of definite motions of the hairs. For the purpose of controlling an intricate animal machine, the organs, with their hairlined parts, are most queerly shaped and situated, but the fluid in them moves the hairs in just the same way. These variations, caused very properly by the shape and disposition of the various parts, constitute the varieties of impressions conveyed by the nerves to the brain.

The weighted areas would seem to have a separate function, that of recording unusual movements, such as we have described, and as a means of notifying the individual that the body is in an unusual position. As a final illustration of the efficiency of these organs, we will give the result of some experiments made on the fowl and pigeon. When all of the semicircular canals are cut in a live bird, it for the time loses all conceptions of equilibrium, flying upside down, walking sidewise, lying on its back and kicking its feet, thus showing that it has no control of its movements. These experiments can be repeated with other birds, always with similar results. When the canals are cut on one side of the head the bird flies or walks in a circle, and so the experiments are carried on with various canals. When the wounds have healed and the canals filled with fluid, the birds are once again apparently normal.

A community carpet sweeper is to be one of the first investments of a certain little Italian town where the American Red Cross introduced vacuum cleaners in the hospital it maintained for the heroes of the Piave. As soon as a fixed quota of carpet owners pool their interests the investment will be made.



STENOGRAPHER TO PRIVATE SECRETARY

From $8.00 a week to $40.00

The Chart of a New Way Typist's Success

Most stenographers get only $15.00 to $25.00 a week simply because they lack speed and accuracy on the typewriter. No matter how good you are at shorthand, you can never expect the really big salaries unless you have speed—real speed—and accuracy on the typewriter.

EARN $35 TO $60 A WEEK! Are your eyes chained to the keys? Is your speed low? Is typewriting hard for you? Is your work disfigured by erasures and errors If so, is it any wonder that you are not earning more? All this can be quickly and easily changed by a wonderful new method of gaining finger speed and control—the New Way in Typewriting. 80 to 100 words per minute is being attained right along by New Way operators —salaries raised from $15 a week to $25, $45 and $50.

READ THIS TESTIMONIAL.

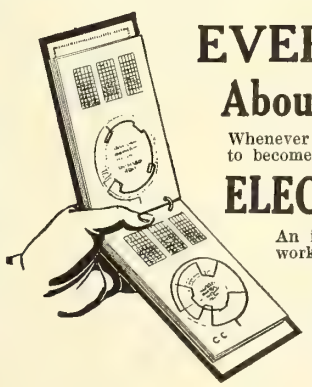
"I attribute this to the benefits that I received from the Tulloss New Way System, which enabled me to write speedily and accurately both transcription tests and the typewriting. I received appointment in July, with an increase of $200 over my old salary, and my hours are from 9 to 5. I have been **repaid many** times over in both money and time for all the course cost me." JAMES B. KERRIGAN.

LEARN BY MAIL—ONLY TEN EASY LESSONS Like every great idea, the secret of the New Way in Typewriting is so simple that you wonder why it was never thought of before. Yet the results of the new method are amazing. No matter how low your present speed, no matter how weak or inaccurate your fingers now seem to be, this new method based on special **Gymnastic Finger Training** will quickly bring you expert accuracy and speed. It's all in the fingers—nothing more. Every hand has the same muscles and nerves and can be trained to the same dexterity. All that is necessary is to find the right way of training—and that the New Way offers you. There are only 10 lessons—each one easy and fascinating. No interference with regular work. A large part of the work is done by exercising the fingers **away from the machine.** Every student receives absolute quarantee of money refunded in full if Course does not bring promised results.

NEW WAY BOOK—FREE If you are ambitious to get ahead—if you want to make your work easier—if you want more money in your pay envelope—don't wait a moment before sending for our booklet, telling all about this wonderful method. Write for it **at once.**

The Tulloss School
3580 College Hill,
Springfield, Ohio

THE TULLOSS SCHOOL
3580 College Hill, SPRINGFIELD, OHIO
Please send FREE Typewriting Book.
Name.....
Address.....



EVERYTHING You want to know About A. C. Motors and Repairing

Whenever any question arises regarding motors, or if you are anxious to become a specialist on electrical motor work, you need the

ELECTRICAL WORKERS FRIEND

An invaluable collection of diagrams and instructions for electrical workers, students, amateurs, etc.

This book contains 66 motor diagrams with complete instructions for rewinding and reconnecting A. C. Motors. Shows how to put each coil in the slots, giving all internal and external connections. For reconnecting they cover all practical changes showing which diagram to use for the change wanted. Bound in loose leaf form for handy reference. The only complete book of its kind on the market. So simple anyone can understand. It is helping thousands of other workers—it will help you too, as hundreds of testimonials prove.

SPECIAL PRICE, COMPLETE $4.00. Order today. If desired we will ship C.O.D. by Parcel Post.

YOU CAN EARN YOUR COPY FREE

We offer all owners of the Electrical Workers Friend a commission of 50c on every book they help us sell. All you have to do is show your book and recommend it. You can earn the full price of one of these books in a few days. Write immediately for full particulars—this offer is limited.

SMITH & SMITH PUB. CO. 1524 Lowrie St., N. S. Dept. B, Pittsburgh, Pa.



Be An Expert On Armature Winding

$1.25 to $1.50 an hour

HERE is *your* opportunity to earn good money right from the start! Experts are wanted all over the country who understand Armature Winding, Motor and Generator Repair and Maintenance. Training in this interesting work will qualify you to earn $1.25 to $1.50 an hour and more. Specialize in this growing field and insure yourself a permanent, well-paying position with big opportunities for advancement.

YOU CAN LEARN IN 3 MONTHS

Our intensive, practical method of training fits you for a position in three months. Come to the great School of Engineering of Milwaukee and learn by actual practice on complete working equipment in our big laboratories. Expert instructors give you personal help every step of the way.

EARN WHILE YOU LEARN

Our wonderful co-operative plan enables you to devote part time to earning money in order to defray part or all of your expenses. Our FREE Employment Department places you. **This Department will also help you secure a position when your training is completed.**

WRITE FOR FREE BOOK

Mail the coupon today or write for full particulars of our 3 months' course in Armature Winding. Read also about our special low tuition fee, dormitory and other extra privileges and our Earn-While-You-Learn plan. No other school can offer you such advantages. Send for this information today and see how easy it is for you to become an Expert in Armature Winding and earn big money. No cost or obligation in writing.

SCHOOL of ENGINEERING of Milwaukee

Dept. 1-AK, 373 Broadway, Milwaukee, Wisconsin

School of Engineering of Milwaukee
Dept. 1-AK, 373 Broadway, Milwaukee, Wisconsin

Please send me full information about your 3 months' course in Armature Winding.

Name .....

Address .....

City ..... State .....

Age ..... Education .....

The "Loaded Line"

By CHARLES S. WOLFE.

(*Continued from page 617*)

against no ordinary leak, the idea took root in my mind that we were having a taste of what the circus men call—er—dirty opposition."

Noting Fenner's arched brows and the evident bewilderment of the Chief and myself, he hastened to explain.

"There is no other traction company operating in our territory, of course, but you will recall that since I took charge our company has branched out into the business of selling *power*. Here we meet the City Gas and Power concern, and quite a lively competition has ensued. I am forced to say that we have been getting the better of the bargain, and while I dislike to entertain the thought, it occurred to me that possibly the other side was striking at us in this fashion."

"Don't agree with you, Mr. Forbes," blurted Davidson. "Theory don't gee, my way of thinking. I'm no electrician, but I can realize—and so would any member of the City Gas crowd—that this little leak would scarcely be felt by you—financially."

Fenner smiled. "You brush Mr. Forbes' theory aside rather thoughtlessly, Chief," he remarked. "Suppose that some one connected with City Gas were well enough versed in Professor James' stuff to realize the probable effect of this mysterious and unexplainable peak on the working force of the traction company, particularly on the car crews? It wouldn't be such a trivial thing then, would it?"

Forbes beamed. "Exactly, Mr. Fenner," he cried. "You have grasped my idea in its entirety. Unpleasant as the thought is, the only really plausible explanation that has occurred to me is that some one who desires to cripple us is attempting to terrorize our men."

Davidson yielded gracefully. "Put it that way, it sounds better," he admitted. "If Fenner can find the spot where the leak is being pulled over, I'll answer for the rest."

"Whoa!" laughed Fenner. "You'll have stripes on the president of that corporation within the next thirty seconds if you don't pull up. That's a possibility, not a probability."

Once Davidson became possest of an idea it took terrific and overwhelming proof to the contrary to dislodge it. "Sounds good to me," he rumbled; "I'll have a couple of gum shoes sitting on that crowd's coat-tails on my own hook."

"One thing more, Mr. Forbes," Fenner remarked, "I would like to see the charts that have those power curves on them."

From his coat pocket Forbes promptly produced a bulky envelope. "Here they are," he said, and we crowded around the table to stare at them.

They were the conventional charts, ruled off into squares, with a heavy black line meandering over the face of each. That line told the story of power consumption for every minute of the twenty-four hours that constituted the traction company's working day. Any unusual call for power was instantly discernible by the sharply rising line, the duration of the load being indicated by the length of the line on its highest level. For instance, during the rush hours the advent of the trippers and the calls made by numberless startings of frequently stopt cars stood out clearly.

And, on the other hand, the gradual lessening of the load as cars finished their runs and were turned into the barn was equally noticeable, the low dropping line telling the story vividly.

It was only necessary to glance at the time marked off on the bottom edge of the sheet to tell at what minute any particular incident had occurred.



Voice Thrower 10c

Learn to throw your voice into a TRUNK, under the bed, out in the hall or anywhere. Lots of FUN fooling the Teacher, Janitor, Policeman, Parents, Neighbors, or Friends.

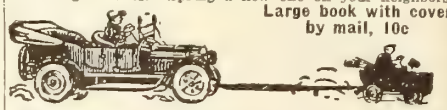
THE VENTRILO

is a little instrument that fits into the mouth out of sight. **BOYS** or **GIRLS** can use it in conjunction with the above for imitating birds and animals. Never fails. A 32-page book on Ventriloquism sent with the Ventrilo for 10 cents.

NEW FORD JOKE BOOK 1920

All the latest jokes on the Ford auto. Hundreds of them, and all good ones. Spring a new one on your neighbors.

Large book with cover by mail, 10c



ROGEN X-RAY



Price 12 cents

HERE, BOYS, is just what you want. With this instrument you can apparently see the bones in your fingers. Think of the fun you can have with it. Sample by mail, **TWELVE CENTS.**

SKULL RING



Here is a handsome, up-to-date Ring, representing a Skull and Cross-bones. Has stones in the eyes and looks something frightful. Women won't like it, but for men or boys it is a great novelty. **Sample, by mail, 15c.**

Gee! What a Wad!

This is STAGE MONEY



Looks like the GENUINE STUFF. Some Green backs and some Yellow backs. Create a BIG sensation among your friends. The girls will all be after you when they see the wad. BIG roll of 15 pieces by mail. **10 cents.**

ENCHANTED BARREL

The Most Wonderful Pocket Trick Made

CHANGE A CENT INTO A DIME



Ask your friend to drop a dime in the barrel. When he takes it out, Behold! It is a CENT. You make 9 cents every time you fool them. **Never fails.** They cannot get on to it. Sample barrel, with directions, only.... **12c**

Hindoo Flower Pot Trick



You have all heard of the great Hindoo trick (making a plant grow out of a flower pot right in front of an audience). This trick has puzzled the whole world for years until an old Hindoo fakir gave it away. We send the whole outfit by mail with full instructions for **15 cents.**

BIG VALUE for 10 Cts.



6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Baseball Book, giving rules for games; 1 Toy Maker Book; Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 5 Puzzles; 12 Games; 30 Verses for Autograph Albums. **All the above by mail for 10c.**

Trumpet in Handkerchief



The Trumpet in the Handkerchief has come to torment us. It is a startler. A small metal trumpet is ingeniously concealed in a handkerchief. On meeting your friends, after chatting awhile, you take out this handkerchief and blow your nose. It's like a sudden clap of thunder! The ladies scream, and your male friends will think they heard the whistle of a steam engine. You can blame the hideous noise to your having a very bad cold, and keep the fun up as long as you like. **Price 10c, 3 for 25 cents, by mail.**

ALLEN OUTLAWS



A new illustrated book in 42 chapters. Tells the provocation that led up to the most daring gun fight on record, where they shoot the Judge sheriff, States attorney, 3 Jurors, and 8 others in the Hillsville Court Room. All crimes have a woman back of it, and BOYS, this one is worth reading. Large bound book in plain wrapper for **TEN Cents.**

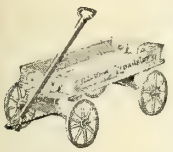
Any of the above Mailed with Catalog

ROYAL NOVELTY COMPANY

418 East Ave. South Norwalk, Conn.



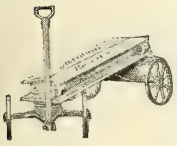
What the Spin Means



It means that the wheels on your **Auto-Wheel** will run faster and smoother. It means a sturdy coaster that will stand hard knocks. Roller-Bearings overcome friction. Get an **Auto-Wheel** and you'll always have a good wagon.

TWO MODELS

The **Auto-Wheel Convertible Roadster** and the **Auto-Wheel Coaster.** The roadster is a combination wagon. Turn the sides out to change it from a roadster to a coaster. The **Auto-Wheel** is the old standard coaster wagon.



PRIZE CONTESTS

A series of interesting prize contests for coaster "fans." "*The Auto-Wheel Spokesman*" tells about these contests and the Auto-Wheel Club. Send for a FREE six months' subscription, also a neat Auto-Wheel Coaster Dime Bank. Send us names of three coaster dealers, telling which ones sell the coaster wagon with the name **"Auto-Wheel"** on the sides.



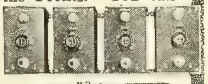
The Auto-Wheel Coaster Co., Inc.
Formerly
The Buffalo Sled Company
163 Schenck Street,
N. TONAWANDA, N.Y.
In Canada: Preston, Ont.
Export Office: 365 W. 23rd Street, New York City.

Auto-Wheel

Big Profits in Battery Charging with the HB 32 Battery Charger

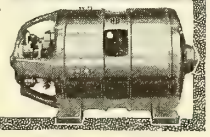
Make $150 to $350 Every Month

Start your own battery business NOW. Make $150 to $350 Clear Profit every month with this HB Charger. Recharges 32 6-volt batteries, or equivalent, at one time. Costs 10c to 15c each. Owner pays 75c to $2.00. Figure the Profits. You can make BIG PROFITS and build a permanent business. Others are doing it—YOU can too.



Small Cash Payment Brings You This Money-Maker

Balance on easy monthly terms. Profits easily pay for outfit. Absolute Money-Back Guarantee. No expensive repairs or replacements. Runs 24 hours a day. Big, steady, profitable income. Write TODAY for full information.



Hobart Brothers Company
Box 104-E, Troy, Ohio
Successful Man'f's Since 1893

Banner Storage Batteries

Mean less initial expense and real guaranteed service. It is essentially important to dealers as well as automobile owners to select a dependable battery. Our batteries are positively new and guaranteed in writing for 18 months, which means that you get that much service or we will repair same free of charge. We offer you economy and service. Compare our prices with others and be convinced of a saving of 50%.

6 volt, 9 plate 60 amps.	$18.00
6 volt, 11 plate 80 amps.	$22.00
6 volt, 13 plate 100 amps.	$26.00
12 volt, 7 plate	$30.00
12 volt, 9 plate	$35.00

Shipments made within three hours of the receipt of order. Deposit required to defray shipping expenses. 2% discount if remittance in full accompanies order.

Battery Supplies and Equipment. Write for Catalog. Discount to Dealers.

BANNER BATTERY CO., INC., 1219 So. Wabash Ave. CHICAGO, ILLINOIS

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address **HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.**

And on each sheet, at one forty-five in the morning, when the dropping line told of only a few straggling freight cars on the rails, a sharply rising peak in the power curve betrayed an enormous call for current.

Of all times, when such a call should have been lacking, that was the hour of low ebb. Therefore, this mysterious peak was a phenomenon calculated to draw the scrutiny of those who had on their hands the handling of the big generators.

As Forbes had said, that peak indicated a mighty unusual condition, and the regularity with which it occurred made the matter doubly suspicious.

Davidson gazed down on the tell-tale sheets with what very closely resembled awe.

"Clever, that power curve stunt," he rumbled his admiration; "I get that peak trick now."

"I may have these?" Fenner queried, "I'll return them at the termination of this business, of course."

Forbes nodded. "And is there anything further to be brought up? If not, I'll wish you good evening. I am relying on you in this matter."

Fenner and I arose as Forbes and the chief made their adieus. When the door had closed after them, he turned whimsically to me. "Great old world," he laughed; "now what do you think of that?"

"Looks mighty serious for somebody riding high in City Gas," I replied, soberly; "somebody is stooping to dabble in pitch, and is due to be nastily defiled."

"You and Davidson make quite a team," laughed Fenner, in mock admiration; "because Forbes suggests a possibility, you are both busily engaged picking a jury and speculating on the extent of the sentence."

"Dead open and shut," I retorted, for to me it was obvious that the only persons who could benefit by this in reality trifling steal were the heads of the suspected corporation. "Bet you a quarter we're knocking on their door before tomorrow night."

Fenner wheeled, power charts in hand, "Bet you the niftiest amplifier we can get the De Forest people to turn out, that the only reason you'll have to knock on City Gas' door will be to apologize," he said.

"You think that someone else, and not they, are doing this thing?" I cried, amazed.

"Don't think it, I know it," he retorted, "I mentioned that James' dope merely to show Davidson something of Forbes mental processes, not because I favored the theory."

"And why not?" I demanded.

"For the same reason that I would not suspicion them of doctoring their gas meters to give a dishonest reading. Too many people involved, and too much chance for leak. The president of that corporation—or any other executive officer—is too darned busy to do more than conceive a plan of that kind. He hasn't the time—and ten to one, not the ability—to execute it. And he would not dare entrust such a mission to easily bought subordinates."

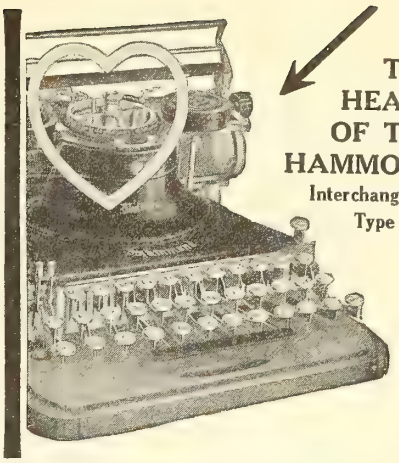
"Surely you don't regard this thing as an accidental *ground* that forms by coincidence at just that hour each morning?" I flung at him.

"It would be possible, yes," he came back, coolly. "But I am willing to take the linemen's word for it that they have scrutinized every point where grounds would be likely to occur. Which leaves us just one other hypothesis."

"Which is?" I demanded.

"Theft by an individual, or individuals, of power for some purpose."

"Yes," I jeered, "A purpose that must be served at one forty-five each morning, and which is apparently satisfied in under two minutes. Some nut, I presume, who goes forth in the wee small hours to test a freak motor."



THE HEART OF THE HAMMOND
Interchangeable Type

One of the Greatest Achievements of Science and Invention.

Hammond
MULTIPLEX

"Many Typewriters In One"

For the Mathematician, Engineer, Chemist, Astronomer, Surveyor, Navigator—there is no typewriter like the Multiplex Hammond! The Multiplex does many things that *no other typewriter* can do!

The Mathematical Multiplex contains the characters and signs used for writing in higher and lower mathematics, and for engineering, mechanics, etc., as well as for all the ordinary work that can be done on any typewriter. Just note these fine styles of Multiplex type—

TWO STYLES OF TYPE, or *two to five different languages,* carried on the machine AT ONCE. "JUST TURN THE KNOB" and change *instantly* from Roman Type, to *Italics,* or Miniature Roman, or our Beautiful Script Type, or from English to Greek, Russian, German, French, etc. *Any other type or language can be substituted in a few seconds.*

The above gives a slight idea of the versatility of the Multiplex which has literally revolutionized typewriting—has changed it from monotonous commercial work to the beauty of fine printing and engraving.

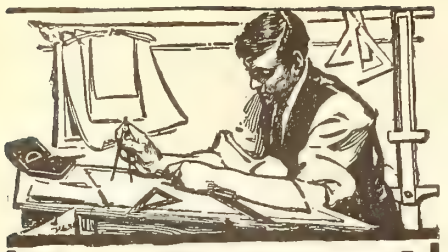
SEND FOR FREE BOOKLET showing the many languages and type sets of the Multiplex—Chinese Phonetic and Japanese Kata Kana—the latest in languages to be added to the many already available on the Multiplex.

Fill out the Coupon and mail to us *now*—before you turn this page and possibly forget. You incur no obligation.



Also—an Aluminum PORTABLE Model
For Traveling—for home. Weighs about 11 lbs. Full capacity. Ask for special folder.

THE HAMMOND TYPEWRITER CO.
589 East 69th Street New York City
Name .....
Address .....
.....
Please write your occupation below.



Be a Draftsman!

Make $40 to $100 a WEEK

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $40 to $100 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 6½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

75c a Week Only $3 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada. **Free Membership in This Society.**—A Consulting Membership **given free** with each set—worth $12.00.



AMERICAN TECHNICAL SOCIETY
Dept. D-257, Chicago, U. S. A.

AMERICAN TECHNICAL SOCIETY
Dept. D-257
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $3.00 a month until $19.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....



AGENTS GET THIS BIG BOOK—the only one of its kind in America—showing a complete line of Men's Wear—everything from Made-to-Measure Clothes to Shoes, Hats, Collars, Ties, Shirts, Sox, etc. Greatest Line you ever saw. Nothing else like it. No investment necessary. We supply everything. You make from 25% to 33% on every order you take. Send for Outfit TODAY. Address Dep't. A-65

WRIGHT & COMPANY
Congress, Throop & Harrison—CHICAGO

Agents: 90c an Hour



Introduce "Sodereze." A new wonder. A pure solder in paste form. Works like magic. Stops all leaks. For mending water buckets, cooking utensils, milk pails, water tanks, tin roofs—everything including granite ware, agate ware, tin, iron, copper, zinc, etc.

Quick Sales—Nice Profit

Everybody buys. Housewive, mechanics, electricians, jewelers, plumbers, tourists, automobilists, etc. No leak too bad to repair. Just apply a little "Sodereze," light a match and that's all. Put up in handy metal tubes. Carry quantity right with you. Write for sample and special proposition to agents.

AMERICAN PRODUCTS CO., 2712 American Bldg., Cincinnati, Ohio

Fenner's face clouded. "That's just what gets me," he said, thoughtfully, "The duration of the peak. I can't possibly think of anything that would require such an awful bundle of juice for such a short time. There's something I want to think of—something that seems to escape me. There is one thing that I can mention that would require such a load, and only one thing that I could suggest off hand."

"Which is?"

"I'm not going to mention what it is just now," came the disappointing rejoinder, "It happens to be weaker than the City Gas theory. And as I don't think much of it myself, I'm not going to get you confused by adding it to your already acrobatic mind."

Knowing him as well as I did, I did not urge. The hour was late, and we parted for the night.

We sallied forth next morning with no very definite end in view. About the only definite objective was a trip over the lines to see what we might be able to stumble over.

Passing thru a quiet block on our way to the nearest car line, we beheld a huckster actively engaged in disposing of his stock in trade, which seemed to consist entirely of fish. He was selling from a discrepit looking push cart, and as we past he quoted a price to the housewife he was bargaining with.

Fenner grasped me by the arm. "Gee, that was cheap," he said.

Amused, I bantered. "Didn't know you were up on the value of fish," I laughed, "Versatile, aren't you?"

"I know that was cheap," he retorted, "And I'm going to send that fellow around to the house. Come on."

We went back to the push cart and its odorous load. Finisht with the woman at the door, the fish merchant came over to us.

He was not a very prepossessing individual. He was a young man, but dissipation had written with a heavy hand, and the bloated countenance told loudly of an altogether too intimate acquaintance with the "cup that cheers."

Having heard his prices, Fenner gave him his address with instructions to mention the meeting. Then as an after thought, he added, "Have you a telephone? I might need fish for a special occasion in the near future, and if I could get you in a hurry you might land a sizeable order."

"I ain't got a telephone, mister," the chap replied, "But I live at number nine Juniper Street. Send me a post-card, and I'll be right on the job."

Fenner carefully noted down the address, and as we rode along on the car I remarked. "Now what? Going to treat a bunch of radio fiends to a fish lunch? You wrote that address down as if you treasured it."

"In these days of high prices I cherish anything that is cheap—even fish," came the unperturbed reply.

"And where are we off to now?" I demanded, anxious to get to the business in hand.

The reply was startling.

"To the zoo," replied the amazing Fenner.

"The zoo," I echoed, blankly, "What in Hades do you expect to find in the zoo?"

"Animals," he said, demurely, "We will feast our eyes and minds on nature's wonders. The traction company has provided the transportation."

"What becomes of the peak in the power curve?" I snorted. "Are we going to twiddle our fingers?"

"We are—until this evening. Then we will sally forth and endeavor to put an end to this peak."

"We will sally where?" I demanded, "Just take a guess?"

"Yep, but I think we can do some very close guessing, at that. That's all you get 'till tonight."

And so it was that I left the car barn that evening with a party consisting of Davidson, Forbes, a plain clothes man, and

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures but 4¼ Inches Long. Takes Regular .22 Calibre Cartridges

The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability.** It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard 22-calibre cartridge obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 15 ounces. The price of the Baby Revolver is only $6.50 sent by mail, p.pd. to any address.



$6.50

JOHNSON SMITH & CO., Dept. PM27, 3224 N. Halsted Street, **CHICAGO**

AGENTS WANTED



Cut Your Own Hair WITH THIS

Only **50c**

Extra Blades, 5c

SAFETY HAIR CUTTER Can cut your own hair with this marvelous invention. Cuts the hair any desired length, short or long. Does the job as nicely before your own mirror. You can cut the children's hair at home in a jiffy. Can be used as an ordinary razor to shave the face or finish around temple or neck. Sharpened like any razor. **Saves its cost first time used. Sent for 15 cents.**

JOHNSON SMITH & CO., Dept. PM 27, 3224 N. Halsted Street, **CHICAGO**

INVISIBLE INK



The most confidential messages can be written with this ink. Even the writing **MAKES NO MARK.** Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private memorandums away from prying eyes. Great fun for playing practical jokes. **Only 25c Bottle**

VANISHING INK

Writing written with this remarkable ink vanishes entirely in a few weeks, leaving the paper QUITE BLANK. **25c p.pd.**



Dissolving Ink Writing appears and disappears at will. Secret with each bottle. Very remarkable. **25c.**

JOHNSON SMITH & CO., Dept. PM27, 3224 N. Halsted Street, **CHICAGO**

MAGIC FLUTE

Wonderfully Sweet Toned and Musical



The Magic Flute, or Harmonetone, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it, which when once acquired affords a little practice, will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is as charming, as it is surprising. **25c ppd.**

Post Paid **25c**

Good Luck Ring Quaint and Novel Design



A VERY striking and uncommon ring. Silver finish, skull and crossbone design, with two brilliant, flashing gems sparkling out of the eyes. Said by many to bring Good Luck to the wearer, hence its name, **Good Luck Ring.** Very unique ring that you will take a pride in wearing. **ONLY 25 CENTS.**

JOHNSON SMITH & CO., Dept. PM27. 3224 North Halsted Street, **CHICAGO**

LUMINOUS PAINT



Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light, rendering it perfectly visible in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles, make your own Luminous Fishlines, Luminous Buoys, etc. Small bottle, **price 25c.** Larger sizes, **50c** and **$1** postpaid. Johnson Smith & Co.

Mystic Skeleton 10c pd.



A jointed figure of a skeleton 10 in. in height, will dance to music and perform various gyrations and movements, while the operator may be some distance from it.

Serpent's Eggs



Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most lifelike manner. **Price per box, 15c ppd.**

JOHNSON SMITH & CO., Dept. PM27, 3224 North Halsted Street, **CHICAGO**

All the Latest Surprising and Joke Novelties

"Chicken Inspector" Badge	15c	Luminous Skull	25c
Cigaret at its End	20c	Field Glasses	$10.00
Midget Bible (size of stamp)	15c	3 drawer Telescope	$1.75
Anarchist Bombs (Express only)		Invisible Ink (secret writing)	25c
8 boxes for	$1.00	Vanishing Ink	25c
Book on Boxing	35c	Liar's License	15c
Thurston's wonderful Trk Cards	10c	Fish Lure (teaches fish)	25c
Box of 6 Wire Puzzles	75c	Moving Picture Machines	
Conjurer's Casket of Magic Tricks	75c	$3.00, $7,50 and $12.00	
Watch Camera	$3.50	Nail Klippers	35c
Films for Watch Camera	35c	Exploding Matches (Express only)	
Exploding Cigarettes, box	50c	8 boxes for	$1.00
Weather Cottage	$1.50	Stage Money, 50 bills	25c
Seeback scope (see behind you)	25c	False Mustache	10c
Amateur Electrician Book	15c	Inkless Pen, writes with water	15c
Firecrackers (Express only)		Exploding Fountain Pen	50c
10 pkts for	$1.00	X-Ray Novelty	15c

JOHNSON SMITH & CO., Dept. PM27, 3224 North Halsted Street, **CHICAGO**

Increase Your Lung and Chest



Expansion 2 to 3 inches in ONE WEEK

For 25 cents in coin or U. S. Stamps I will send you full instructions with illustrations showing you how to increase lung and chest expansion. These instructions are worth $5 to anyone interested in powerful lungs and chest.

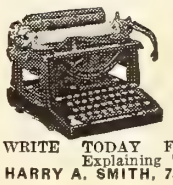
HENRY VICTOR
14-16 Fourth Avenue, Dept. B
New York City

PRACTICE TYPEWRITER, $1



You haven't one of the $100 market typewriters, but you would like to learn the regulation typewriter keyboard. In fact you want something that will familiarize you with the fingering of a regular machine at a nominal price. Well this little prize has a "STANDARD KEYBOARD" You get the regular fingering without the usual tiresome labor of a heavy machine. For typists just beginning it is invaluable. Send $1 and it is yours.

MAINE SUPPLY COMPANY
609 CONGRESS STREET PORTLAND, MAINE



$4 AND a month $5 WILL BUY
A Standard, Guaranteed
TYPEWRITER
With Every Modern Writing Convenience

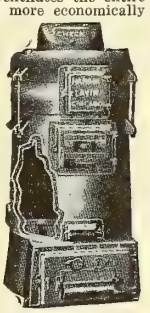
WRITE TODAY FOR ILLUSTRATED CIRCULAR Explaining Try-Before-You-Buy Plan

HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.



BURN LESS COAL

With an improved, all-cast pipeless furnace you can cut your coal bills in two. This efficient, basement installed heating plant heats and ventilates the entire home. It burns any grade of coal more economically than a stove. It needs no expensive piping or other equipment. Anyone can install it in a day. They are described at our wholesale prices in our Handy Man Book. Send for it.



Do Your Own Plumbing and Heating by the Cut-to-Fit Method.

By our new plan anyone can install a complete plumbing or heating plant in his own home. Send us a rough sketch with measurements. Our Engineers will draw your plans, furnish information and see that the supplies you order come CUT-TO-FIT your needs. No waste of time, labor or unused material. Only a few simple tools necessary. **Send for**

The Handy Man Book

It will show you how. It will tell you just what to order and what it will cost at our wholesale prices. It contains plans and useful information for every builder, property owner or contractor. It will convince you. It will increase the value of your property 50%. You can do the work yourself.



We have spared no effort or expense in the preparation of this valuable book. To keep from sending it broadcast to uninterested persons we request a temporary deposit of 25c which will be refunded with your first order. **Send for it Today.**

The Service of
HARDIN-LAVIN CO.
Is guaranteed by 40 years' business at
4510-20N Cottage Grove Avenue
CHICAGO

You Can Have



Strong Arms

POWERFUL BACK, CHEST, MILITARY SHOULDERS, SHAPELY LEGS, and a HEALTHY STOMACH.

All of the above can be obtained by following the instructions in my book, Strong Arms, which contains a complete course in physical culture that will develop all parts of your body to perfect proportion. The exercises are illustrated with 20 full page half tone cuts and require no apparatus. Send 25c in coin.

300,000 COPIES SOLD

Send your order today before you forget.

Prof. ANTHONY BARKER, D. C.
Studio 563
127 West 42d Street, New York City

Discover Your Talents!

Why is it that some men make a success of everything they touch while others work their lives out, and remain failures?

Why is it that some climb to the heights with little effort while others plod along for a lifetime in the same old rut?

It's not luck, nor pull—it's knowing how to direct your energies most effectively. It's discovering where your talents lie, and putting all your efforts along the lines where you can succeed.

Don't struggle along any longer, **against your own personality.**

Let Dr. S. S. George, the eminent psychologist and former U. S. Army expert, help you discover your talents. Dr. George has made his lifework the analysis of men's abilities.

His mental and vocational analysis course with 1,500 vocations classified, will be mailed to you on approval. Don't wait a single day. Get in touch with your abilities. This service may be worth thousands of dollars and invaluable happiness to you. Send only $3.00 for complete course and lists.

MONEY REFUNDED IF NOT SATISFIED

At the end of 5 days, if you are not completely satisfied, we will refund your money in full.

Vocational Guidance Institute, 2255 Broadway, N. Y.

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 771 Bogue Bldg., Indianapolis

Be an Artist

Comics, Cartoons, Commercial, Newspaper and Magazine Illustrating, Pastel Crayon Portraits and Fashions. By Mail or Local Classes. Write for terms and List of successful students.

Associated Art Studios,
111 Flatiron Bldg. New York

ourselves as much in the dark as the rest of them.

Fenner directed our activities. We transferred to a car bound out into the open country.

Noting the mystified look on Davidson's face, Fenner laughed. "Don't look like the road to the City Gas office, does it?" he bantered.

Davidson growled. "If I didn't know you as well as I do, I'd say it was the road to nowhere, with just nothing waiting for us at the end. However," he shrugged, "It's your party."

At Fenner's command, we dropt off from the slowed down car at a dark, lonely spot in the open country. In silence we stumbled single file over a narrow path thru the scrub at his heels.

Then, a hundred yards or so from the track, a clearing—and the river.

There was a quickly extinguished flare from Fenner's electric flash-light, then comparative darkness again.

"Eleven forty-five," said Fenner, in low tones, "We have a couple of hours wait. No talking and no smoking, please."

"See here—" began Davidson.

"Until this expedition fails, I'm in charge, Chief," said Fenner, quietly, and with a grumble Davidson subsided.

And for two hours we crouched there in exquisite discomfort, gazing mournfully out over the river, rather beautiful in the moonlight, viewed from our dark tree-covered bower.

My feet had been asleep about a century when I felt Fenner's fingers closing over my arm. At the same time I sensed Davidson's bulk tensing in the darkness beside me. Both of them heard the rustle of parted branches along the pathway beyond. It had escaped Forbes and me.

Heavy breathing, and a blacker bulk moving in the blackness before us. With bated breath I watched its shadowy movements. Fearful of even the sound of my own breathing, I was half stifled from an effort to live on a minimum of air.

Then the bulk retreated toward the river, and presently, silhouetted in the moonlight at the clearing's edge, we got a glimpse of the man's form. Something about it was familiar. Memory struggled to assert itself.

I felt Fenner lean over me to touch Davidson. Then he stept forward.

"Fish are cheap," he remarked, loudly.

The man whirled, and in that instant I placed him. The fish dealer of the morning. There was a startled oath, a quick gleam in the moon light, a blinding flash, and a red hot sear on my cheek. A thunderous report, and another stunning one at my very temple.

Dazed for a moment, I could not follow clearly what happened in the next few seconds. I was vaguely aware that that second concussion had been the roar of Davidson's automatic.

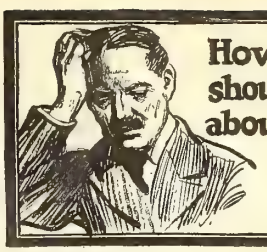
When I saw clearly again, Fenner and Davidson were bending over a huddled form on the river bank. Forbes joined them, and I followed slowly.

He was dead, poor devil. Davidson had drilled him clean in a vital spot. The Chief was shaking his head. "I didn't mean to do that," he said, sorrowfully, "I'm a dead shot, and I shoot before I really get a chance to think. It's automatic."

"Well," said Fenner, soberly, "I had no idea he'd shoot, or I would never have staged this little drama. Anyway, Mr. Forbes, there will be no more peaks in your power curves."

Forbes' voice trembled. "What was it?" he queried, "What was he doing?"

"Fishing," replid Fenner; "fishing with your five hundred and fifty volt trolley wire for bait. He's placed something—an old water boiler, most likely—out there in the stream, and all he had to do was turn on the current and go out and make his haul."



THIS question is being asked by an ever-increasing number of men and women who realize that a better understanding of business law means an addition to their income. One needs specialized knowledge today to be thoroughly successful—whether for one's self or for his employer. You are badly handicapped unless you KNOW JUST HOW TO HANDLE YOURSELF at every turn.

Are you in—or going into—business—entering a partnership—building a house—buying or selling property—employing agents—suing or being sued—in doubt on any legal point?

Ever-increasing opportunities are ahead of the man who keeps himself abreast of the times. During the period of industrial and social readjustment through which we are passing, every man and woman is facing constantly changing conditions. The courts have made new and very definite rulings concerning business relations between employer and employee, and between buyer and seller, and those who remain in ignorance of the fundamental laws on which these rulings are based are in constant danger of committing mistakes which may result in great loss.

Know the Law and Be Safe

While it would be impossible and impracticable for the average man or woman to consult a lawyer concerning the hundreds of questions which are constantly arising in one's daily affairs, the Virginia School of Business Law has compiled a course which makes it possible for every one to gain a complete and thorough knowledge of law as applied to the everyday problems of the individual.

This course, which is divided into ten treatises and which covers Corporations, Partnerships, Contracts, Sales, Agency, Real Estate, Wills, Bills, Notes and Checks, Bankruptcy, etc., has been prepared by the Hon. George Bosman, of the Virginia Bar, a specialist in business law, to meet the needs of the average man and woman. ** It is not cluttered with legal phraseology and does not waste time in lengthy discussions of theories, but in plain, concise language it fully covers all questions. ** A few moments a day, devoted to the study of this course or reference to it when you find it necessary, will put you in possession of facts which may save much litigation and thousands of dollars. ** The COUPONS ACCOMPANYING THE COURSE will save you many an attorney's fee.

10 Coupons for 10 Questions

With each subscription to this course there will be sent 10 LEGAL-ADVICE COUPONS, each one entitling the holder to a legal opinion on any subject and to the same sort of impartial advice which he might expect if he walked into an attorney's office and paid him his fee. These coupons are good for two (2) years and may be used by the subscriber as desired. The service he will receive in exchange for any one of these coupons may alone be worth the entire cost of the course.

A Service of Great Value

A short cut to the exact information you want. No useless instruction or verbiage. No wasted effort. A Practical, Accurate, Complete Guide to Everyday Business Affairs. Prompt advice and guidance in all troublous matters. Dependable counsel on any 10 Questions of Law which may cause you anxiety within the next two years. A direct guide to the correct settlement and handling of any mooted legal question. A sure means of forging ahead by being better informed than your competitor.

Pin $10 to this coupon below and mail it to us today. Your check will do. The complete set of 10 Lessons will come to you by return mail, along with 10 Legal-Advice Coupons, each one of which will entitle you to an authoritative opinion on a single subject. ** If, after five days' examination, you would rather have your money, ship the 10 Lessons and 10 Coupons back to us and we will make full refund—gladly and without question.

Just send in the coupon below (omitting the $10.00 payment if you like) and we will, without cost or obligation to you, send you a full, detailed description of the course and the service we offer.

Virginia School of Business Law

353 New Kirn Building, Portsmouth, Virginia

VIRGINIA SCHOOL OF BUSINESS LAW
353 New Kirn Building, Portsmouth, Virginia.

Enclosed find $10. Send me your complete course of 10 Lessons in Business Law along with 10 Coupons, each one of which will entitle me to an authoritative opinion on some legal point or question of my choosing; these coupons to be used within two years. Should I decide, after 5 days' examination, to return course and coupons you agree to at once refund my $10 payment.

Name _____

Address _____

_____

Date S. I. Oct. 1920

No Money Down

Elgin Watch



14-kt. Gold-Filled Case 20-year Guarantee

On 10-Day Trial

New, thin model Elgin watch, warranted movement in 14-kt. gold-filled case, 20-year guarantee.

Decide for yourself. If you keep it, this beautiful high class watch may be paid for at less than 7 cents a day.

Chain and Knife FREE

A 14-kt. gold-filled knife and chain absolutely free with this offer. State if you wish a Waldemar, (shown in cut), Dickens, or vest chain.

Less Than 7c a Day

If you are pleased when the watch comes send only $5.50 as first payment. Then wear the watch for ten full days. If you do not consider it the greatest value in America, return it at our expense and your deposit will be refunded immediately. If you decide to buy, send $2.00 a month until $22.50 is paid.

Order Today —On Trial

Remember, you are not obligated to buy when you order on trial. Just send your name and address. No red tape or annoyance. State which chain you wish. This offer limited. Act now. Send your name to Dept. 38-H.

Our 128-page catalog shows more than 2000 bargains in Diamonds, Watches and Jewelry. Write for it NOW.

J.M. LYON & CO., 1 Maiden Lane New York, N.Y.



Be an ELECTRICAL SIGNAL ENGINEER

FREE BOOK TELLS HOW

Big positions open now for Signal Engineers. You can qualify for this fascinating, highly-paid work in your spare time at home. Railroads everywhere need men who understand Signal Engineering and electrical safety devices.

$2500 to $5000 a Year

Earn a big salary right from the start—enjoy quick success and swift promotion. We train you in every branch of this great profession, including a complete course in

Practical Electricity

Write today for handsome FREE Book on Signal Engineering and details of our amazing Free Signal Engineers' Outfit. Address

DEPARTMENT OF SIGNALING, DEPT. 1997, 1924 Sunnyside Avenue, Chicago, Ill.

Spirit Return

How Much is True? How Much False? Have You Mediumistic Power Yourself?

Read

YOUR PSYCHIC POWERS:

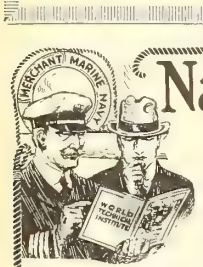
And How to Develop Them

By Hereward Carrington, Ph. D.

Illustrated, $3.00. Sent on approval. Mention Science and Invention.

DODD, MEAD & COMPANY

445 Fourth Avenue New York



Navigation

TAUGHT BY MAIL

Be a ship officer in merchant marine—earn big money—see the world. Captain Warren Sheppard's Course on Ocean, Coast and Lakes Navigation ready. Officially adopted by the U. S. Navy. Endorsed by Merchant Marine. Merchant ship officers earn up to

$412 PER MONTH AND EXPENSES

Whether you are on the sea or intend to go, enroll now. Send today for valuable illustrated booklet, "Your Future Is on the Seven Seas." It is free.

WORLD TECHNICAL INSTITUTE
Dept. 122, Fuller Building, Jersey City, N. J.

"But my linemen examined the line down this way and found nothing unusual," cried the bewildered Forbes. "How did he get the current?"

"Easy enough," rejoined Fenner, shortly. "A sixteen foot bamboo pole with a bare copper wire hook on the end arranged in one of the trees skirting the right of way. He had only to hook it on the trolley wire, and come on down here to his switch."

"And when you saw the fish this morning," I asked, "you could tell they had been caught this way?"

"No," admitted Fenner, "I could not. But the price suggested some easy method of getting them, and it occurred to me that this method would fit in with that one thing I refused to name to you last night."

"Which was that?" I asked, mopping the blood from my cheek with a handkerchief. "I don't get it yet."

"Electrocution," retorted Fenner. "And I knew that was ridiculous. But when I saw the fish and heard the price it set me thinking. I knew this was the only place where the car line touched the river bank, and I came down here tonight on a chance."

Editor's Note: Mr. Wolfe's story is based on well known facts. By directing a powerful current into a body of water containing fish, the latter will be electrocuted by the hundred whenever they come into the path of the current as it traverses the water. The killed fish then float to the surface and are easily gathered. Such a method of "catching" fish is manifestly unfair, as not only full grown but the very small fish are killed alike. If such a method is used frequently, the stream or lake will soon be depleted entirely of all fish.

For that reason most of our states have prohibited fishing by electrocution and many states punish offenders with severe fines and even imprisonment.

CORRECTION NOTICE.

Thru an error in the August issue, credit for the photos accompanying the "Synthetic Ruby" article by Mr. O. Ivan Lee, was given to Heller & Son, whereas the credit for the use of these photos should have been given to L. Heller & Son, Inc., an entirely different concern.

* * *

In the "Synthetic Ammonia" article by Lucien Fournier, appearing in the September issue, the abbreviation "Az" is the French equivalent to our nitrogen, and this should have been explained in the original article; also the word "separation" in next to the last sentence of the first paragraph of this article, should have read *combination.*

ARTIFICIAL WOOL.

According to a Belgian report, there is considerable interest in Germany in a patent recently taken out on a process for the manufacture of artificial wool. Shreds, short fibers and wastes are comprest and then immersed in a viscous solution of cellulose or a cellulose compound, with a small percentage of glue. This product is then cut into thin sheets and strips, which can be twisted and spun very much as paper yarn has been manufactured.

Waterproofing is obtained by treating the wool in the process of manufacture with compounds of chromium and later with formaldehyde and tannin, after which the product will resist the action of boiling water. Glycerine provides sufficient flexibility, and the Germans claim the yarn thus prepared possesses all the properties of real wool. The process is now being modified so that a certain percentage of paper pulp may be mixed with the woolen waste, after which the product is treated with sulfuric acid and zinc chlorid. Various other compounds may be used to give the necessary flexibility and waterproofness.

Let Us Send You A Suit



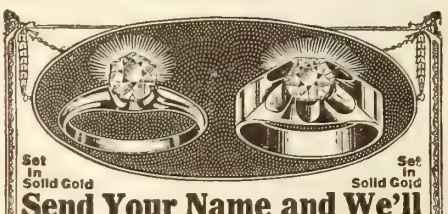
Made to your measure, payable after received, with the clear understanding that if the fit is not perfect or if you are not satisfied in every way, if you are not convinced you have received a fine, high grade, stylish, perfect-fitting tailored suit made to **your** measures and have saved $15 to $20, you are not under the slightest obligation to keep it.

Don't hesitate or feel timid, simply send the suit back, no cost to you. You are not out one penny. Any money you may have paid us is refunded at once.

SAMPLES FREE

Any man young or old interested in saving money, who wants to dress well and not feel extravagant is invited to write us for our free book of samples and fashions explaining everything. Please write letter or postal today, just say "Send me your samples" and get our whole proposition by return mail. Try it—costs you nothing—just a postal, get the free samples and prices anyway. You will learn something important about dressing well and saving money.

PARK TAILORING COMPANY
Dept 214 Chicago, ILL.



Set in Solid Gold Set in Solid Gold

Send Your Name and We'll Send You a Lachnite

DON'T send a penny. Just send your name and say: "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will send it prepaid right to your home. When it comes merely deposit $4.75 with the postman and then wear the ring for 10 full days. If you, or if any of your friends can tell it from a diamond, send it back. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.

Write Today Send your name now. Tell us which of the solid gold rings illustrated above you wish (ladies' or men's). Be sure to send finger size.

Harold Lachman Co., 12 N. Michigan Av. Dept. 1257 Chicago

What a Dime Will bring You From the Nation's Capital

The little matter of 10 cts. will bring you the Pathfinder eight weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for all the Nation; an independent home paper that prints all the news of the world and tells the truth; now in its 28th year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, strongly, briefly—here it is. Send 10c to show that you might like such a paper, and we will send the Pathfinder on probation eight weeks. The 10c does not repay us, but we are glad to invest in new friends. Address:

Pathfinder Election Guide settles all election disputes; chock full of facts and figures. 32 page vest-pocket pamphlet free with every trial subscription.

The Pathfinder, 262 Langdon Sta., Washington, D. C.

You can be an ACCOUNTANT

Get the facts about the most successful home study course ever prepared. Absolutely different in both material and method. C. P. A. instructors in personal charge of every student. Opportunity to specialize in any desired line. Moderate fees; easy terms. Interesting books free. Address

International Accountants Society, Inc.
Dept. A-921 2626 S. Michigan Ave., Chicago, Ill.

Learn Watch Repairing

Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates.

Ask for our Free Book. It explains our system and terms.



THE DeSELMS WATCH SCHOOL
720 Perry St., ATTICA, IND.

Learn to Dance!

You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful Peak System of Mail Instruction.

New Diagram Method. Easily learned; no music needed; thousands taught successfully.

Write for Special Terms. Send *today* for FREE information and surprisingly low offer.



WILLIAM CHANDLER PEAK, M. S.
Room 237, 821 Crescent Place—Chicago, Ill.

Learn Electricity



In the Great Shops of COYNE IN 3 1/2 MONTHS

Thousands of Electrical experts are needed to help rebuild the world. Come to Chicago to the great shops of Coyne and let us train you quickly by our sure, practical way backed by twenty-one years of success. Thousands of our graduates have become experts in less than four months. *You* can do the same. *Now* is your big opportunity. Come—no previous education necessary.

Earn $150 to $500 a Month

in the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position.

Electro Automotive Training Included

Our big new electrical course now includes a complete training on the electrical systems of automobiles: Lighting, starting, ignition and storage batteries. We have complete automobile chassis, motors on the block, thousands of dollars' worth of magnetos, lighting, starting and ignition systems. Every department has been enlarged.

Earn Your Way

Hundreds of our students every year work in their spare time and earn their living expenses. Others work in the day time, earn all their expense and attend our evening school. Our employment department will help you without charge.

Day or Evening Courses

Don't worry about the money. Anyone with ambition can learn here. Our tuition is low with small easy payments if desired. All tools and equipment furnished free. Our students live in comfortable homes in the best section in Chicago—on the lake—just a few minutes' walk from our school.

Drafting
Motion Picture Operating

We also teach these professions quickly and in such a thorough, practical way that when finished you are ready to step right into a position of responsibility and big pay.

Send Today for Big Free Book

Write today, *now*, for the book. It tells what Coyne graduates have done. What you can do. Fill in the coupon, check the trade you are most interested in or send a postal card, do it *now*.

Learn Drafting

Our electrical course includes drafting, but if you want to specialize in this big profession you can do so.

The country is crying for skilled draftsmen in all lines. Thousands of positions open with princely salaries. We give you the advantage of our big shops. No other school can do this. Now is the time to get into this big field. Experts train you under practical working conditions, no books and theory go here. Check drafting on the coupon below and mail it *at once* for full particulars.

BENNETT W. COOKE, *President*
COYNE TRADE AND ENGINEERING SCHOOLS
Dept. 20 39-51 E. Illinois Street, Chicago, Ill.

COYNE TRADE AND ENGINEERING SCHOOLS
Bennett W. Cooke, President
Dept. 20, 39-51 E. Illinois St., Chicago, Ill.

Please send at once your big Free Book—I am interested in
[ ] Electricity [ ] Drafting
[ ] Motion Picture Operating
(*Check trade interested in*)

Name.....

Address.....

MAIL THIS COUPON NOW!



FOR SALE AT ALL NEWS STANDS

ARTISTIC TWO COLOR COVER

"THE 100% WIRELESS MAGAZINE"

Partial CONTENTS OF OCTOBER ISSUE:

Reporting News By Radio

A Mimic War Staged *By Radio Control*

Improved Circuits for Short Wave Communication *By A. S. Blatterman*

Portable Combination Receiver *By Russell H. Robinson*

The Audion—Its Action and Some Recent Applications *By Dr. Lee De Forest, Ph.D., Sc.D.*

A Perfect "Dead-ending" Switch *By Pierre H. Boucheron*

What "Radio News" Is:

RADIO NEWS now in its second year holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO NEWS leads all other wireless magazines. The September issue had 64 pages; there were seventy-four separate purely radio articles and 107 illustrations. *Over forty thousand copies were printed and circulated.*

Each issue of RADIO NEWS contains 64 pages (or more) and an artistic cover in two colors. The illustrations average 120 every month and there are from 60 to 80 up-to-date articles, some by our greatest radio scientists, in every issue.

THIRD $100.00 RADIO PRIZE CONTEST

A new radio contest. The third one offering $100.00 in prizes began in our May issue.

72 PAGES 120 ILLUSTRATIONS

20c The Copy

$2.00 A Year

Canada and Foreign $2.50 A Year

SEND 20c FOR SAMPLE COPY TODAY

SPECIAL OFFER

Gentlemen:

Please enter my subscription for RADIO NEWS for the term of one year for which I enclose herewith $2.00. As a special offer you will also send me for 25c extra your great Wireless Course containing 160 pages, 350 illustrations, size 6¾ x 10" with fine flexible cloth cover. I have written my name and address in margin below.

EXPERIMENTER PUB. CO., 231 Fulton St., New York City

LEARN WIRELESS AT HOME

The Demand for Good Wireless Operators Far Exceeds the Supply

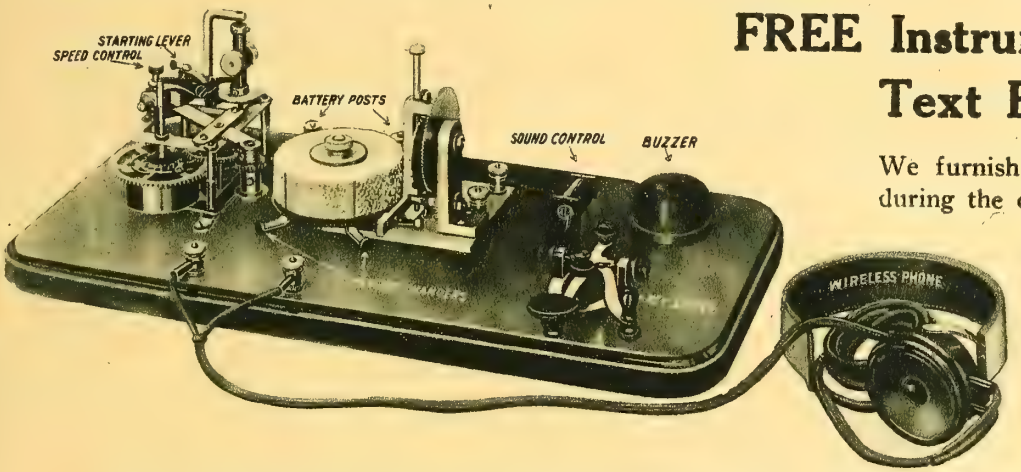
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, Chief Radio Inspector, Bureau of Navigation, N. Y. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way, will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free,* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do,* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* **This set is not loaned, but given to all students completing the course.**

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph,* place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—*but do it today.*

NEW YORK WIRELESS INSTITUTE,
Dept. 12, 258 Broadway, New York City

New York Wireless Institute,
Dept. 12, 258 Broadway, New York City.

Send me free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your *Free Instrument Offer.*

Name .....

Address .....

City or Town.....State.....



$6.00

No. 4889

Chemical Laboratory

We present herewith to our friends our **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform real chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

DESCRIPTION OF THE OUTFIT:

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The Instruction book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the Elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English System and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the **100 Experiments** are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and Smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make Chemical Colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

Price $6.00. Shipping Weight 10 lbs. (Can be shipped by Express only.)
Immediate Shipment

The Boy's Electric Toys

"THE BOY'S ELECTRIC TOYS" contains enough material TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size over all of the outfit is 14 x 9 x 2¾. Shipping weight, 8 lbs.

No. 2002 "The Boy's Electric Toys," outfit as described.....$6.00
IMMEDIATE SHIPMENTS



$6.00

No. 2002

"The Livest Catalog in America"

IN this cyclopedia you will find all about radio. One of the greatest catalogs of its kind in print.

You will find in it dozens of wireless instruments of the famous E. I. Co. make.

Other things you will find listed in this catalog: Electrolytic Interrupters, Bulldog Spark Coils, Chemical Outfits, Code Practice Sets, Primary Batteries, Storage Batteries, Hydrometers, Volt and Ammeters, Batterymeters, Electrolytic Rectifiers, Rheostats, Tesla Coils, Microphones, Loud Talkers, Electro-magnets, X-ray Tubes, Telephones, Magnetos, Low Tension Transformers, Books, etc., etc. IN A WORD THE MOST COMPLETE CATALOG IN PRINT.

FREE with this wonderful cyclopedia —20 coupons for our 160 page Wireless Course in 20 lessons. 350 illustrations, 30 tables. Catalog explains how you can get this Course absolutely free.

The Electro Importing Co.,

231 Fulton Street **New York**

"Everything for the Experimenter"

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

I enclose herewith 6 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 22 as described.

NAME .....

ADDRESS .....

STATE.....S.&I.-10-20



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

IMPORTANT NOTE TO CORRESPONDENTS

We receive from thirty to fifty letters requesting advice on patents every month. Due to lack of space, even tho condensing this department into the smallest type, we can only publish from eight to ten letters, with their answers, monthly. Obviously we are falling back further and further, and it looks as tho we will never be able to publish all the requests.

For this reason we would urge correspondents to avail themselves of our special service, as outlined above. In that case an immediate answer will be assured.

EDITOR.

WALNUT BRANDER.

(410) J. E. Carlson, Edgewater, N. J., says:

Please let me know whether or not a patent can be obtained on a simple walnut branding machine. It is very cheap to manufacture and works perfectly. It can be run by a small motor and is made of two parts, one feeding hopper and one receiving hopper, two rollers, two branding rollers and two automatic inkers.

A. Walnuts in order to be branded do not present very smooth surfaces, and it is necessary that a branding machine be of such a nature to brand *between* the crevices of the nut. Also, it is desirable to brand at least 80,000 per hour.

The machine must not injure in any way the kernel of the nut nor is it allowed to crack the shell.

If your machine lives up to these conditions, we would advise that you have a search instituted by a reliable patent attorney.

SECRET TELEPHONE.

(411) C. F. Cummings, Akron, Ohio,writes:

Has there been invented a telephone box or arrangement which permits two parties to talk over the same wire to which other phones are connected without other parties listening in? Is it possible by this supposed new invention for two of those parties to talk to one another without any of the others being permitted to listen in? A company with headquarters supposedly in Columbus, Ohio, has sold stock in a concern of this kind to some of my friends. I have felt that it was a swindle and would like to get your idea on it.

I do not know the brokerage firm selling stock in this concern, but if such a thing has never been invented I shall certainly get busy and look into it.

A. The writer knows of three or four devices on the market which will prevent anybody from listening in on a private telephone wire. In fact, we would even venture to say that thirty or forty such devices have been patented, but they do not seem to meet with any great favor by the telephone companies, who have refused to allow the installation of such devices, and hence we do not believe that you will profit materially from buying stocks in a concern selling material of this nature.

We do not know of the patent in question, but would advise that you get in touch with some brokerage or other concern of similar nature or write to your local newspaper, who will be able to tell you the actual value of stocks of this nature.

PERPETUAL MOTION.

(412) Arnold Whitock of New Castle, Neb., has the following to say:

What are the requirements of a perpetual motion machine? Has any machine been constructed which would run itself alone? Would a machine run by gravity alone and developing *surplus* energy to an appreciable extent have any commercial possibilities? Please don't dismiss this question by saying that it is impossible, because I have tried it. Are there any awards awaiting the inventor of such a machine? Thanking you, and hoping to see an early answer in SCIENCE AND INVENTION,

A. There is no such thing as perpetual motion on earth. You can no more obtain perpetual motion than lift yourself by your own boot straps. As long as you are dependent upon the gravitational influences of the earth, you cannot hope to produce energy free. The nearest approach to perpetual motion are the heavenly bodies, as for instance, the earth, moon, etc., which keep on spinning without diminution year after year, century after century. Strictly speaking, however, this is not perpetual motion either, because the rotation will stop some time, altho this will be maybe a million years from now.

Some machines have been actually constructed that approach perpetual motion, but they really do not come under this classification, because they use some natural force, and this of course is not perpetual motion, because a perpetual motion machine is supposed to require no outside energy whatsoever, but generate all its own power. For instance, there is a clock in existence at present that works by expansion and contraction of metal rods due to the inequalities of the temperature. Then there is another clock that works on a similar plan due to expansion and contraction of an air body, which again makes use of the difference of temperature during the day and night. But such machines cannot be termed perpetual motion machines for the reason that they are dependent upon an outside force.

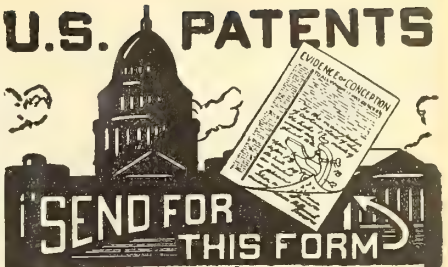
FUSE PLIERS.

(413) Frank Kunert, Detroit, Mich., writes us as follows:

For quite a while I've had an idea for a pair of pliers for extracting 30 and 60 amp. cartridge fuses from panel boards and fuse boxes. Sometimes there is not much extra room in fuse boxes and a man new on the job will shy at taking the fuses out with his fingers, so will try to pry it out by using a screw-driver or a piece of wood, which generally results in a ground, as only one end of the fuse comes out of the fuse-clip and that swings against the side of the fuse box. Would like to know if any such pliers have ever been patented and if there would be a market for them in case a patent was obtained.

A. We have seen some wooden pliers in use that actually did the thing you mention, and these pliers, as far as we are aware, have not been patented. We do not know what sort of pliers you have in mind, and unless they are rather unusual we doubt whether you could obtain a patent on the device.

U.S. PATENTS



SEND FOR THIS FORM

Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St. San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... *Address*.....

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—**"Inventions and Trade Marks, Their Protection and Exploitation"** and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. **A postal will do—it is free.**

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c

Order Your Scientific and Technical Books *Now.*

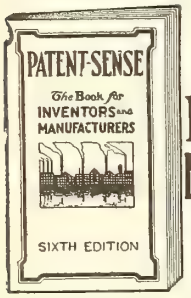
They are difficult to obtain and prices are constantly increasing. We will quote present price on any book of this nature and the price will hold unless the publisher should increase his price in the interim.

Write for our 96-page catalogue—the most complete scientific and practical catalogue now issued. In addition, our 1920-1921 list will be sent you as soon as ready, and the prices in this list will hold good in possibly 80 per cent of cases; but you will be notified of any change before filling order.

There will be no obligation in requesting catalogue for we want you to know our Book Department. Write today. You'll find it valuable for suggesting books you need.

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Room 655, Woolworth Bldg., New York City



"The Book for Inventors and Manufacturers"

SIXTH EDITION.

By return mail FREE. Write LACEY & LACEY Dept K. Washington, D.C.

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?

Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.
1926 Broadway, New York

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

WATCH WINDER.

(414) Archie C. Bowers, Gardenville, N. Y., submits the following question. Do you think that a small motor for winding a watch, with gearing, enclosed within the watch, is a patentable idea? A friend of mine, a jeweler, is making the works for the watch. They are of the size used in a wrist watch. From the winding gear on the spring, gearing is connected to make the motor more powerful. I am making a model of the tiny motor. It is a copy of the small motor described in the "E. E." during 1918 or 1919. A searchlight battery is used for power. Applying power for a minute winds watch.

A. There are at present commercial watch winders on the market, but as far as we have been able to ascertain they are not in great demand. It is such a simple thing to wind a watch that unless you have a jeweler's shop where hundreds of watches are to be wound every day the device will not be in great demand except by jewelers and watch factories. While no doubt you can get a constructional patent on your idea, we doubt whether it would pay you to do so.

FURNITURE ROLLER.

(415) Harry Schiff, Brooklyn, N. Y., sends us the following idea for patent advice: I would appreciate it if you would give me, through your magazine, an opinion on a device I have in mind to take the place of the wheels now used on the legs of furniture such as beds, buffets, tables, phonographs, etc., to make it easy to move such objects. The difference between my wheel and those now in use is that my wheel uses a ball as a means of propelling, which ball is capable of turning in any direction with perfect ease instead of the wheel which other wheels have, thus making it possible for them to turn with ease in only two directions—backward and forward. I am convinced that as wheels are but a trivial item in the cost of an article of furniture, this wheel will quickly take the place of those now in use. The point on which I want to be advised is its mechanical value. I am enclosing sheet containing a description of the device.

A. The device of which you speak is not new. It has been used for many years, but due to the large friction set up it has never come into popular favor, and is not used today. If you can make some special ball arrangement which works easy, and which has not too much friction, we believe you will have a good thing. So far it has not been produced.

TIME SWITCH.

(416) W. A. Kauder, Jamestown, N. D., requests the following information: Please let me know thru your "Patent Advice" columns if it would be practical to obtain a patent on a "time switch." My idea is such that a light will remain lighted for about 20 seconds after the switch is turned off. Would there be much demand for such an article? Its use is obvious, as, for instance: Get ready for bed, push the button and get into the quilts. After you're all "comfy" out goes the light. The "on" button works instantly and the "off" button can be made to do so also at will by placing three buttons in the switch instead of two.

A. There is a good market for a time switch such as you describe. There have been some switches of this sort on the market, but we have never seen one that worked satisfactorily, and which was low enough in price to commend attention from the average public. If you have something new in this line that works well and can be sold at a low price, you should have success.

WAR DEVICE.

(417) Mr. B. P. Hine, Athens, Ala., writes: While "overseas" I had the opportunity of trying out a "listening-in system" that proved very successful. Also had it so prepared that any unknown party handling it, it would explode, throwing into the air poisonous gases. This was of my original make-up, and I could take the sound of footsteps very clearly through this instrument, and all other faint sounds or whispers not heard otherwise in our personal work. As this was just an experiment and not completed or applied for use I would like to know if there is any chance for this as a commercial value or valuable to our army. Give me an idea as to how, when and where I could apply for aid on such an article, as my financial and mechanical conditions limit me in the completing of an actual model, as it takes some few expensive electrical equipment.

A. There are many listening-in devices—the so-called detectophone instruments on the market today. The idea of the instrument giving out poisonous gases when used by an unauthorized person is a pure war device, and would of course hardly be used ordinarily by anyone. For that reason we are almost certain that you would have a hard time to convince anyone to back you financially to produce such an article.

LADDER.

(418) O. R. B., Worcester, Mass., sends in a drawing of a platform to be mounted on a straight ladder, so that paint or other material could be placed on a side platform, or even workmen can stand on the same, instead of using the ordinary straight ladder,—the platform being adjusted to any angle of the ladder and collapsible.

A. Platforms of this nature are nothing new, and we do not believe a patent could be obtained on same. Many hardware companies in Greater New York are selling such ladders at the present date.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, **HOW TO GET YOUR PATENT.** Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.

OFFICES
364 University St. Montreal, Canada
919 F St., N. W. Washington, D. C.

PATENTS & TRADE-MARKS
FREE BOOKLET ON REQUEST
MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES
WARNER I. CUBBERLEY, PATENT ATTORNEY, 22 NATIONAL UNION BUILDING, WASHINGTON D.C.

PATENTS

C. L. PARKER
Formerly Member Examining Corps. U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.

MUNN & CO., 622 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 622 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

MEN

Intensely interesting booklet free.
Wonderful results.

H. Gyde Co., Washington, D. C.



PIGEONS PAY

They build their own nests and work for you 11 months in the year. A few good pair of pigeons now will bring you a good sized, profitable squab farm next season.

Write today for circular.

PIGEON SUPPLY HOUSE. P.O. Box 251. Hanover. Pa.



GET ON THE STAGE

I Tell You How! Stage Work and Cabaret Entertaining successfully taught by mail. Your **BIG** opportunity. Travel, see the world as vaudeville actor or actress. My great Professional Course—only one of its kind—**COVERS ALL BRANCHES.** Develops **Personality, Confidence, Skill** and tells you **just how** to get on the Stage. Send 6c postage for illustrated booklet, **"All About Vaudeville."** State age and occupation. Write for this free Stage Book **today!**
FREDERIC LA DELLE Box 557-W LOS ANGELES, CALIF.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER OVERLAND, MO.

AUTOMATIC FIBRE LIMBS



Easy Payments—Do Nature's Work. AGENTS WANTED who wear leg. Good Pay. FREE Fibre Sample.
Describe Stump to
WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn

Solving the Housing Problem

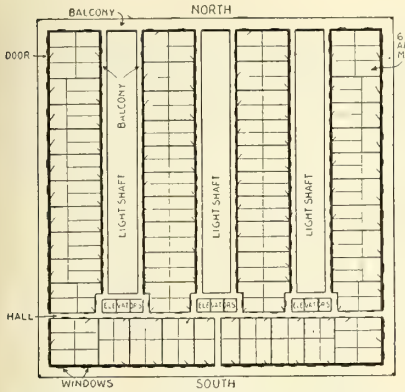
By H. GERNSBACK

(*Continued from page 652*)

are needed badly. The writer who was much imprest with Mr. Edison's prediction is the sponsor of the following plan:

Why not move the city bodily into the country, taking all of the city conveniences with you, yet having all the country conveniences, but neither the inconveniences of the city, nor the inconveniences of the country?

Imagine a big co-operative building set up in the midst of the country, close to the woods if you wish, near a lake or a stream, and not too far away from a rapid transit railway station within commuting distances from the city, let us say twenty to thirty miles from any one of our large cities. Picture a 40 or 50-story building, housing, let us say 2,000 families. From our illustration, it will be noted that there are two distinct sections to this building. *The bottom stories are given over exclusively to business,* while the *upper stories are for residential purposes only.* The entire building is *self-contained.* By the words "self-contained" is meant that the building is like a city unto itself.



Floor Plan of Composite Town and Country House Suggested by Mr. Gernsback as an Aid in Solving the Housing Problem.

2,000 FAMILIES IN ONE HOUSE.

The 2,000 families living in this building will give enough business to the business section to keep it going on a profitable basis. Whether you wish to buy a steak or a pound of nails, whether you desire a hair cut or to cash a check at the bank, whether you wish your vacuum cleaner repaired, whether your clock needs fixing, whether you wish an ice-cream soda, whether you need your chair upholstered, or whether you require a dentist, or a chiropodist, or wish the latest magazine, or whether your wife wants a new dress, or if you need a prescription filled—all of these and more are to be had right in the house. The business section will give good service and sell you merchandise or services vastly cheaper for the following reasons.

In the first place, the cost of delivery is practically nil. You will not see a boy with his delivery wagon and horse nor a push-cart, for that matter, in this co-operative building. Consequently the cost of delivery is at a minimum. All goods sold to tenants of the co-operative house are distributed by means of dumb-waiters, the same as is done now in up-to-date apartment houses. Suppose you wish to order a porterhouse steak. You lift up the hook of your telephone and the *house-central* will connect you with the butcher you patronize. You give him your name and apartment number. He takes the order, and within fifteen minutes you have your steak *via* an electric operated dumb-

Try These "Pay Raisers"
At our Expense ~ Order On 5 Day Trial
DRAKE'S PRACTICAL MECHANICAL BOOKS FOR HOME STUDY

The books will perfect you in your trade—pave the way to the big position. We will send any book postpaid. If not entirely satisfied return the book and your money will be refunded in full.



Modern Electrical Construction
By Horstmann & Tousley. A perfect guide for the beginner. Valuable to the journeyman. Of special value to the inspector. Explains in detail how good electrical work is installed. 440 pages. 263 illustrations.
Leatherette Binding $1.75

Easy Electrical Experiments and How to Make Them
By L. P. Dickinson. Equally valuable to the amateur or the practical electrician. Gives in plain language all the information you want about every kind of electrical apparatus. 220 pages, 110 illustrations. Cloth Binding.....$1.25

Telegraphy Self Taught
By Theodore A. Edison. Clearly and concisely written. Tells how to easily train the ear to receive messages by the audible alphabet system. 170 pages. Fully illustrated. Cloth Binding.....$1.25

Electricians' Operating and Testing Manual
By Horstmann & Tousley. A practical handbook for working electricians. Covers installation, operation, testing, maintenance and repairs of all electrical apparatus. 361 pages, illustrated.
Leatherette Binding $1.75

Operators' Wireless Telegraph and Telephone Handbook
By V. H. Laughter. Describes in detail the construction of a wireless set, the winding of spark coils and the tuning of a wireless station. Written in non-technical language. 210 Pages. Cloth Binding.....$1.25

Order Direct Today On Our Money-Back Plan

Over a hundred pay-raising books for every trade are listed in our big illustrated catalog. Write for free copy.

FREDERICK J. DRAKE & COMPANY, 1009 Michigan Ave., Chicago, Ill.

Drake Books are for sale at all book-stores.



The Alsop-All-Spark Will Keep *Your* Cylinders Free From Carbon, Too

This Test Proves It

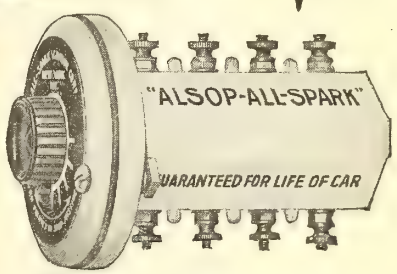
During the war, government officers made comprehensive tests with the Alsop-All-Spark. Several automobile motors were filled with oil and run until the cylinders were so heavily coated with carbon that the motors refused to explode. The Alsop-All-Spark was then attached and the cars started at once. At the end of ten minutes, the spark plugs and cylinders were found to be absolutely free from carbon.

An Alsop-All-Spark on your car will do likewise. It will also save gasoline and make new spark plugs unnecessary.

Why don't you try an Alsop-All-Spark Intensifier at our risk? If you find it unsatisfactory from any reason whatever, you may return it and the full amount of your remittance will be refunded.

The four cylinder type sells for $7.50. Decide at once to at least give the Alsop-All-Spark Intensifier an adequate trial. We take all the risk. Or, ask us to send you a complete report of the government tests mentioned above. Mail the coupon today.

ALL-SPARK IGNITION COMPANY, Inc.
13-X Water Street New York, N. Y.



ALL-SPARK IGNITION COMPANY
13-X Water Street, New York, N. Y.

Gentlemen:

☐ Enclosed please find remittance for $7.50 for which please send me one Alsop-All-Spark Intensifier for a four cylinder engine.

☐ Please send me circular describing the Alsop-All-Spark Intensifier and full report of Government tests, at once.

Name .....

Address .....

City..... State.....



$95 An Hour!

"Every hour I spent on my I. C. S. Course has been worth $95 to me! My position, my $5,000 a year income, my home, my family's happiness—I owe it all to my spare time training with the International Correspondence Schools!"

Every mail brings letters from some of the two million I. C. S. students telling of promotions or increases in salary as the rewards of spare time study.

What are *you* doing with the hours after supper? Can you afford to let them slip by unimproved when you can easily make them mean so much? One hour a day spent with the I. C. S. will prepare you for the position you want in the work you like best. Yes, it will! Put it up to *us* to prove it. Mark and mail this coupon *now!*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6165-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREMAN OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-25 19

Street and No._____

City_____ State_____



Do You Want to Know

HOW TO DEVELOP

Vitality, Energy, Endurance, Nerve Strength, Muscular Strength, Perfect Physique?

My FREE BOOKS, "The Whys of Exercise" and "The First and Last Law of Physical Culture," tell you, if you are weak or underdeveloped, how to grow strong; if strong, how to grow stronger. They explain how to develop the lungs and muscles, a strong heart and vigorous digestion—in short, how to improve health and strength internally as well as externally. SEND TODAY—NOW—for these FREE BOOKS. Enclose 6c in stamps to cover postage.

PROF. H. W. TITUS

56-58 Cooper Sq. Dept. 600 New York City

BE AN EXPERT

Penman

Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. Complete outline FREE. Write C. J. Ozment, Dept. 44, St. Louis, Mo.

waiter. Your wife will not have much marketing to do, and she will not have to run around in a hot sun or blasting cold, wasting one or two hours of her time to buy the various things for the table. Note also from the butcher's or grocer's standpoint that all he has to do is to step into the hallway where the dumb-waiter shafts are located; all he has to do then is to place the goods on the dumb-waiter and press a button which rings a bell in your apartment. The dumb-waiter automatically stops at your apartment, and no other one. You take off the goods, push another button and the dumb-waiter goes down, ready for the next customer.

NO RENT FOR TRADES PEOPLE.

How do we establish the various trades people in such a co-operative building? In a very simple manner. First, we could readily fill the stores and business places of such a house without much trouble, once they were assured that they were to have a community of 6,000 souls to serve EXCLUSIVELY. But we do better. The management of the house will allow these trades people to have their places of business *rent free* as a great inducement. This is done for two purposes. First to reduce the cost of the merchandise or service rendered, and second to make them anxious to stay in such a community. In order to make things interesting, our co-operative building will have two competing lines of trade. In other words, there will not be more than two butchers, two drug stores, two hardware stores, two electricians, etc. The reason is simple. If there was only one, he might not give such good service as if he had a little competition. It will also tend to keep prices at their correct level. Of course, the management or the board of directors or the "mayor" of the house—if you wish to call him such—will see to it that the two butchers or the two hardware stores do not enter into a combine in order to exploit the tenants. *This is also the reason why no rent is charged the trades people.* They have no permanent lease. If the management of the co-operative house finds that unfair tactics are used, the trades people can be dispossest at once on short notice. All these things will tend to keep prices down and service up; far better than is the case today in the average community, where things are handled very loosely, *and only for the benefit of the trades people themselves.*

As for the goods and supplies themselves, these of course come by train direct from the city, and here again we have a saving. Take your present butcher in the city. He buys from the wholesaler, who himself maintains a distributing station. It means a double handling. Your butcher on the other hand in our co-operative building buys his goods directly from the big distributing centers, and they come by train and are therefore only hauled once. Another saving. All this saving goes to the tenants who therefore will be enabled to buy their supplies, goods, etc., at a more reduced figure than is possible now.

YOU ENTER HOME FROM OUTSIDE.

Coming to the apartments, these are laid out in such a manner, that all of the rooms have sufficient light and air. (See illustration of ground plan.) By studying the ground plan of one of the floors, a great innovation will be noted. All elevator halls lead to the outside balcony running around the house on every floor. *Access to any apartment is had only by way of balcony* from the outside. No door opens inside of the house.

An important feature of the co-operative apartments is that they are all built on, what is now called the "California plan" unless the tenant wishes it otherwise. The California plan means that *there are no actual bed rooms in the apartment.* We have nothing but living rooms, dining rooms, parlor, etc., but no real bed room.

Be a Finger Print Detective



Earn Big Pay

Get into this fascinating new profession. Big salaries, rewards and fees are paid in this work. Finger Print experts needed by governments, corporations, police departments, and other institutions. Learn in spare time at home to fill one of these big jobs or go into business for yourself as a Finger Print Detective.

Book FREE Write quick for big, fully illustrated Finger Print Book. Tells all about this wonderfully interesting work and how you can easily qualify. Right now we are making an amazing special offer of a FREE COURSE in Secret Service.

UNIVERSITY OF APPLIED SCIENCE
Dept. 1797, 1920 Sunnyside Ave., Chicago, Ill.

BOYS!

The biggest 25¢ worth ever offered you

Think of it! "Football Training" by Walter Camp, "Flying" by Eddie Rickenbacker, "Athletic Training" by the famous Yale trainer, Johnny Mack. "How to Pole Vault" by world's champion, A. C. Gilbert. Chapters about signalling, wireless, sound and light experiments, how to build a real weather bureau of your own, chemistry for boys, electrical, hydraulic and pneumatic engineering, surveying, practical carpentry—all in one finely illustrated book. It's yours for a quarter and worth dollars to you. Send us 25c today. The greatest book for boys in years.

THE A. C. GILBERT CO., 463 Blatchley Ave., New Haven, Conn.

FACTORY-TO-RIDER

SAVES YOU MONEY



Buy direct and save $10 to $20 on a bicycle. **RANGER BICYCLES** now come in 44 styles, colors and sizes. Greatly improved; prices reduced. **WE DELIVER FREE** to you *on approval* and *30 days trial*, actual riding test.

EASY PAYMENTS if desired, at a small advance over our Special Factory-to-Rider cash prices.

TIRES, lamps, wheels, parts and supplies at *half usual prices.*

Do not buy a bicycle, tires, or sundries until you get our big free **Ranger** catalog, low prices and liberal terms. A postal brings everything.

Ranger Electric Lighted Motorbike

MEAD CYCLE COMPANY Dept. A-107 Chicago

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

SAVE OVER HALF



A few hours interesting work saves over half and gives you a machine to suit your ideas. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. Make fine profit building phonographs for your friends.

Write today for our Blue print offer. **FREE**

AGENTS wanted for Choraleon King Phonographs

Choraleon Phonograph Co.
1020 3rd St., Elkhart, Ind.

FREE



$20 TENOR BANJO Ukulele, Hawaiian Guitar, Violin, Mandolin, Guitar, Cornet or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.

SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 41 - CHICAGO, ILL.

YOU Can Double Your Ability to Earn Money! Hold Friends! Win Love and Happiness! Our System of Personal Efficiency tells you **how!** Success Studygram and Personality Sketch for 10c and birth date. Thomson-Heywood Company, Dept. 350, Chronicle Building, San Francisco.

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service. Guatemala, China, etc. Only 10
Finest Approval Sheets 50% to 60%. AGENTS WANTED. Big 72-p. Lists *Free.* We Buy Stamps. Established 25 yrs.
Hussman Stamp Co., Dept. 67, St. Louis, Mo.

The illustration which we reproduce elsewhere shows this better than a lengthy description. The idea is simply that the bed swings back into a small alcove, which also is used for dressing purposes. Beds at the present time take up a lot of room unnecessarily and all of this is done away with. Such apartments are actually in use in all of our large cities where room is at a premium.

Turning to the kitchen we will have many conveniences. The present housewife, particularly when she has no help to fall back upon, becomes a drudge and slave to her work. No more washing dishes for her; our apartment will have a steam-operated dish washer, which not only washes the dishes, but dries them from the heat of the steam, and the dishes, forks, knives, et cetera, come out sterilized and perfectly dry and clean. Our kitchen besides the usual hot and cold water has running ice water as most up-to-date hotels have now. Nor is there ice in the ice-box. Instead there is a "snake" which supplies freezing cold at any time day and night. If you wish ice, all you need do is to place a dish of water inside of the ice-box, and within three hours ice is formed. Make ice-cream the same way. Such installations are now in use in many New York City, Chicago and Cleveland apartments.

RAILROAD IN BASEMENT.

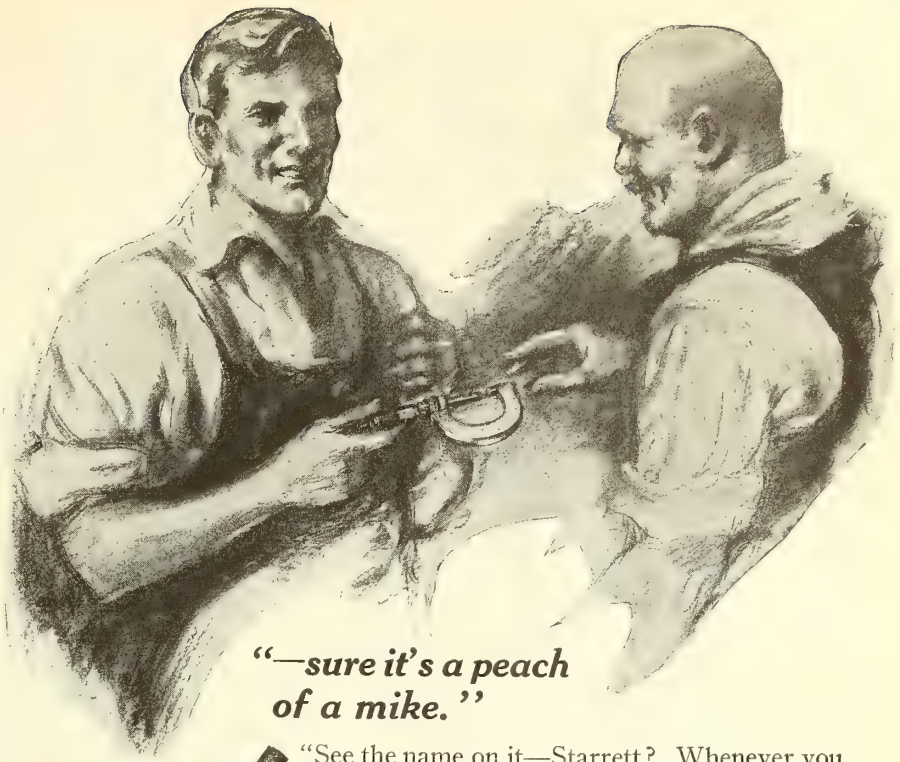
All apartments are of course steam-heated in the winter time, and here again the management will make a big saving for the reason that it is easier to buy coal in twenty carload lots than buying it by the truck-load. Furthermore, the distributing charge again is low, for there is no expensive city trucking. Indeed, a railroad siding runs right into the basement of the house *via* a short "subway," so as not to mar the surroundings of the place. *The coal is delivered from the railroad cars direct into the coal bins of the house.* The cars being dumped automatically, the handling charges are therefore reduced to the very minimum. Ashes and refuse are returned on the same cars. If the house is located near a stream, things will be even better, for then all electricity can be derived by hydro-electric power and the building need not be dependent upon a central power plant nor have to genarate its own electricity by burning expensive coal.

GLASS BALCONY WALKS.

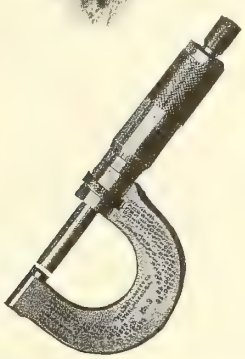
An innovation of the co-operative house is that each floor is surrounded with a glass bottomed balcony. If you wish exercise and do not wish to go down to *terra firma,* you can run a short marathon around the apartments of your floor. Of course, children can play here as well, if the weather permits, and there will not be any dust either. The balcony in the evening is lighted up electrically so you can walk around, or if you care, place a steamer chair outside your parlor, and take the air. The glass bottom is necessary so as not to cut off light from the apartments below.

Due to the fact that most of the apartments are so high up, there will be little bother with either dust or insects. It is well known that neither of these rise very high in the air. The absence of dust, particularly is a boon to the housewife. Thus the present country house must be dusted every day, and even then it cannot be kept clean. All of this is done away with to a great extent.

Of course, all other conveniences of the city are had in this house. We have our own theater, a first-class moving picture house accommodating 2,000 people at one time. We have our gymnasium, our open air dining rooms in the summer time and closed in the winter time; our skating rinks, our indoor tennis courts, dance hall, swimming pools, and finally on the top our conservatory *de luxe* with its own weather bureau. Natural plants and a fairy garden all by itself, as well as a roof garden and a



"—sure it's a peach of a mike."



"See the name on it—Starrett? Whenever you see that on a tool—whether it's a 'mike' or a little old three-inch rule—you can bet it's a tool you can trust to the limit.

"When I was an apprentice, the foreman told me to buy Starrett tools. After I'd learned my trade I found the old boy had handed me mighty good advice—and I've been using Starrett tools ever since."

Catalog No. 21 "LE" sent free on request.

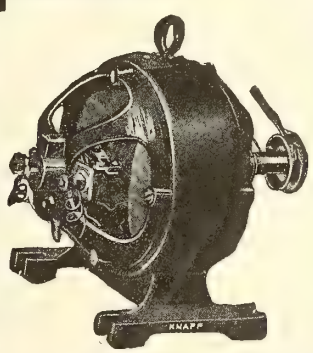
THE L. S. STARRETT COMPANY
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

42-89

Starrett Tools

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

Motors, Electrical Toys and Specialties Are Best



Knapp Goods have stood the test for 29 years. No detail in construction has been spared to make them the best that money can buy. The complete Knapp line includes Toy and Power Motors, Generators and Dynamos. Specialties and Novelties that amuse and instruct. Fans, Rheostats, Compasses, etc. And Knapp prices are always lowest. Always insist on Knapp Goods.

KNAPP "LEARNELECTRICS"

A complete Electrical Laboratory, including a very valuable instruction book by H. P. Gorman, A.I.E.E. Covers all subjects clearly and concisely.



KNAPP DYNAMO MOTOR

Will electroplate, charge storage batteries, run lamps, motors, train of cars, induction coils,—in fact, the number of experiments it can be used for is unlimited. Runs on 4 to 6 Volts or can be connected to run on 110 Volts through a transformer.

Price, Complete, $9.00

Price, Complete, $4.00

Order to-day. Or your dealer can secure them for you. DESCRIPTIVE CIRCULAR and CATALOG of celebrated **KNAPP MOTORS** *and Electrical Specialties from 10c up mailed FREE on request.*

KNAPP ELECTRIC & NOVELTY CO., 523 West 51st Street, New York City

Your Choice 75c a Week



No matter what your occupation, one of the home study sets listed below will quickly fit you for a better job and bigger pay. Any set you select will be sent for seven days' examination, and if you decide to buy you may pay the rock-bottom price at the rate of **only 75c a week.** But you must act now! The rising cost of paper and binding materials won't permit us to continue the present low prices much longer.

These books are the work of recognized authorities. They are written in plain, easily-understood language by recognized authorities, and contain hundreds of photographs, diagrams, tables, etc., that make difficult points as simple as A-B-C. Handsomely and durably bound in half or full morocco leather (except as noted), and stamped in gold.

Pay-Raising Books

At Greatly Reduced Prices

Accountancy and Business Management, 7 vol., 2700 pages, 1000 pictures. Was $52.50.....Now $29.80
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $37.50.....Now 24.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures. Was $67.50.....Now 39.80
Electrical Engineering, 8 volumes, 3000 pages, 2600 pictures. Was $60.00.....Now 34.80
Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures. Was $45.00.....Now 29.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures. Was $45.00.....Now 29.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was $52.50.....Now 29.80
Law and Practice (with reading course), 13 volumes, 6000 pages, illustrated. Was $97.50.....Now 49.80
Fire Prevention and Insurance, 4 volumes, 1500 pages, 600 pictures. Was $30.00.....Now 19.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was $30.00.....Now 19.80
Sanitation, Heating and Ventilating, 4 volumes, 1454 pages, 1400 pictures. Was $30.00....Now 18.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blueprints, etc. Was $30.00.....Now 19.80

Send No Money

Shipped for 7 Days' Trial

Yes, we'll gladly ship any set right to your home or office upon your simple request. Pay only shipping charges when the books arrive. Don't send a penny until after you have used them seven days, then remit only $2.80 or return them at our expense. Pay balance at the rate of $3.00 a month—**75c a week.**

Act now—while these splendid books are being offered at 20% to 50% less than regular prices. This offer is open to every person within the boundaries of the U. S. and Canada. Grasp your opportunity—fill in and mail the coupon **now!**

American Technical Society, Dept. X257, Chicago

American Technical Society, Dept. X257, Chicago, U.S.A

Please send me set of.....

.....

for 7 **DAYS'** examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3.00 each month until I have paid the special price of..... If I decide not to keep the books, I will notify you at once and hold them subject to your order. Title not to pass to me until the set is fully paid for.

NAME .....

ADDRESS .....

REFERENCE .....

small restaurant all rolled into one. Here is where we can entertain our friends, or if we have been sick we can convalesce in the sun parlor with or without our attending trained nurse, supplied from the house hospital.

As for the tenants themselves, for many reasons it would be desirable that *the apartments should be sold outright* as is now done in our great cities. In other words, you do not rent your apartment any longer—you buy it outright, and then of course you can do anything in it you wish—making any alterations that you care to, etc. It is just like buying your own house. You understand that you will have to pay for your electric light, elevator service and other services, and taxes, just as you would have to pay were you to own your own house. This plan has been tried and is now flourishing, particularly in New York City, where many tenants are buying their own apartments. This means that they are independent and no longer have to worry about increases in their annual rents.

FARMERS SELL DIRECT TO YOU.

Now as to the outside, it will be seen from our large illustration that we are right in the midst of the country; farmers are all about us tilling the soil and selling the produce at low cost to our own trades people and *there is no middleman or distributor that costs money.* We get fresh corn, fresh potatoes, fresh fruit, etc., without the usual expensive storage and without hauling them over great distances. Consequently the price is astonishingly low.

Outside, we also have a co-operative garage where all the automobiles of the tenants are housed. Further, we have the children's playground as will be noted, and the tennis court as well as golf links are not missing. We also have a flying field so if you own your airplane, you can land right near home. If you have neither automobile nor airplane, you can take the auto buses that run to the railroad station which meet all incoming and outgoing trains, and which bring you to the city and to your office in less than three-quarters of an hour.

Let us suppose some syndicate with a capital of seven or eight million dollars would erect such a building or for that matter half a dozen of them in the suburbs of either New York or Chicago. Have you any doubt that these houses would not be filled to capacity within two days?

X-RAY NOW ROBS MARRIAGE OF UNCERTAINTY?

Marriage no longer needs to hold terrors and uncertainty for the future. X-rays have scientifically solved the problem of positively ascertaining the character, disposition, tastes and special traits of any individual—so says Doctor Maingot, noted French X-ray specialist, in the *New York Journal.*

The old-fashioned character reading from the human hand is unreliable, whereas X-ray examination of a person's breathing gives an absolutely accurate picture of that person's character as well. The results of such examinations have proved true in every instance. Well! Well!

A jealous woman breathes differently from a good sport.

Would-be brides and bridegrooms should submit to medical X-ray examinations before taking out marriage licenses, in order thus to make sure that they are suited to their respective mates. Photographs of the movements of the diafram never lie.

But what if the M. D. is your rival? What he'll tell "her" about you!!!?

WEATHER BY RADIO.

The University of Wisconsin is working on a plan to give Wisconsin farmers weather forecasts by wireless telephone.

Farmers within one hundred miles of Madison, who install an inexpensive wireless telephone receiving outfit will be able to receive the new service at a certain time every morning.

RADIO APPARATUS

Distributors of Reliable Radio Apparatus for Experimenters in Every Branch of the Radio Field.

"Pittsco" the Sign of service — PITTSCO — **All we ask is a trial!**

HONEYCOMB COILS

Litzendraht Wire. (While they last.)

LL- 75	330- 1030 Meters	$1.60
LL- 250	1300- 4000 Meters	2.30
LL- 300	1550- 4800 Meters	2.50
LL- 600	4000-12000 Meters	3.00
LL- 750	5000-15000 Meters	3.20
LL-1000	6200-21000 Meters	3.50

Note: These are genuine DeForest Litz coils.

TELEPHONES (Pair)

No. 55 Murdock 2000 Ohms	$4.50
No. 55 Murdock 3000 Ohms	5.50
Brandes Superior 2000 Ohms	7.00
Baldwins's Type C Navy standard	16.50
Baldwins's Type E Super-sensitive	18.50

B. BATTERIES

No. 7623 Standard 22.5 V. Small	$1.35
No. 7625 Standard 22.5 V. Large	2.40
No. 7650 Standard 22.5 V. Large Variable	3.25

Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.
12 Park Sq., Dept. D, Boston Mass., U. S. A.

Mail Order Service

We pay special attention to all mail orders and will promptly send apparatus postpaid anywhere.

	Each
22½ V. "B" Batteries	$1.25
RORH Detector	17.00
RORE Amplifier	25.00
CRC Amplifier	65.00
Corwin Dials	1.30
RADISCO Coils	70c to 4.85

For a more complete list of instruments send 10c for catalog, cost will be deducted from first $1.00 order.

RADISCO AGENTS
Open Evenings until 9.30 P. M.
KELLY & PHILLIPS
312 Flatbush Avenue, Brooklyn, N. Y.

Pure Copper Aerial Wire

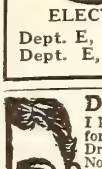
14 GAUGE—2 ft. for One Cent
12 GAUGE—80c for 100 ft. Roll



Postage Must Accompany Order

Send 15c for our big illustrated Catalogue showing scores of bargains in radio apparatus. This may be deducted from your first order of $1.50 or over. High printing costs make free distribution impossible.

ELECTRICAL SPECIALTY COMPANY
Dept. E, 48-50 S. Front St., Columbus, Ohio
Dept. E, 20 N. 9th St., Philadelphia, Pa.



DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my sworn statement of how I recovered my hearing.

A. O. LEONARD
Suite 369, 70 5th Avenue -- New York City

CATALOG J.

Contains 24 pages of reliable apparatus, standardized parts and raw materials. Complete line switch points, knobs, switches, rod, aerial wire, etc.

Send 5c in stamps for your copy today.
Shotten Radio Mfg. Co., P. O. Box 3, Scranton, Pa.

Subscribe to Science and Invention and receive your copy regularly. $3.00 a year.

Radio Power Transmission

By SAMUEL COHEN

(*Continued from page* 637)

the frequency which the equipment has already been designed for. This second problem of frequency conversion is just as important as the problem of transmission from the transmitting source. Of course, it is possible to design motors, controlling apparatus, et cetera, for the frequency of the incoming high frequency currents, thereby doing away with the second problem. This will only hold true for new installations; for old power installations the second problem must be considered from an economical point.

Thirdly, a system of this nature must be directive or else proper legislation must be provided to prevent every "Tom, Dick and Harry" from tapping the transmitted energy which is passing thru our free ether. This could be remedied by the use of properly concealed apparatus which no one can build except the company controlling the system. This, however, is quite impossible and the writer does not believe that apparatus and equipment secrecy can be maintained for any length of time. It is quite possible, however, with proper government legislation to protect the company from being robbed of its ether transmitted energy by unlawful means. This of course will come at the proper time, when the system will be put into effect.

The new art has hardly been touched upon, and it will take quite a number of years before we shall see a workable system for the transmission of energy thru the ether medium without the use of any conducting wires.

ELECTROMAGNETIC TRANSMISSION OF POWER ABOUT 2 PER CENT EFFICIENT.

From data obtained it seems that the greatest efficiency attained was that of 2.27 per cent, energy being transmitted at a distance of *twenty feet*. From the above it is evident that the equipment necessary to furnish electrical energy and transmitted by radio thru medium distances as in present practice would be gigantic, and it is quite doubtful at the present time whether suitable apparatus can be made with our present knowledge of the subject.

In order to fully appreciate the above facts, the author will disclose some of the work he has conducted in this direction. Altho the work was of a miniature nature, the data, experience and knowledge obtained from this work was sufficient to result in some very important findings.

Some time ago the writer was asked to design and build a powerful loop radio transmitter for signal and energy transmission purposes. With no or little data on this subject, it was therefore necessary at first to evolve certain mathematical equations and study the problem from a theoretical point and compute the fundamental requirements for the proposed system.

It was rather surprising when the theoretical computations were completed and the construction of the apparatus followed thru the guidance of the theoretical work that the final result of the tests of the equipment verified conclusively the theoretical assumptions in the problem. Every step of the theory was, therefore, carefully checked by actual tests, and it was rather interesting to note the resemblance of the data obtained from theoretical and actual tests.

DETAILS OF THE APPARATUS BUILT BY THE AUTHOR.

The complete apparatus is shown in the accompanying photographs. Fig. 1 shows the complete installation consisting of power

CONNECTICUT RADIO



Increase Your Range With This Variable Condenser

THE almost complete absence of "effective resistance" in the Connecticut Variable Condenser enables you to receive a signal often ten times the strength of that picked up with a rotary condenser.

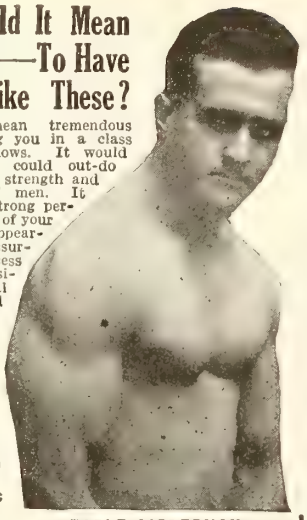
Combined with the finer adjustments given by this Condenser, this stronger signal capacity remarkably increases the efficiency of any set—which means an increased range. Compact, stable, simple, operating smoothly throughout a scale of 360 degrees (twice the scale of the rotary condenser) the Connecticut Variable Condenser is one you should know all about.

We have a brief booklet which tells the whole story. Your name on a postal brings it.

Mention Your Dealer's Name

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut

What Would It Mean —To YOU—To Have Muscles Like These?



It would mean tremendous strength, putting you in a class above your fellows. It would mean that you could out-do them in feats of strength and be a leader of men. It would mean a strong personality because of your commanding appearance, thereby assuring you of success in both the business and social world. It would mean added lung power, unlimited vitality and perfect health; removing all fears of indigestion and disorders which undermine the average man and make him old long before his time.

All These Things Are Yours

I absolutely guarantee to do all this and more for you. I have found the short cut to physical perfection and applied it on my own body, proving its results. I have personally trained many of the world's strongest men by this same method. Why waste your time and money with old-time worthless methods? If you are desirous of being a real robust man, follow the path of those who have already made a success. Come now, get busy, for every day counts.

EARLE LIEDERMAN
The Acme of Physical Perfection

Send for My New Book, "Muscular Development"

It tells the secret. Handsomely illustrated with 25 full-page photographs of myself and some of the world's best athletes whom I have trained. Also contains full particulars of my splendid offer to you. The valuable book and special offer will be sent on receipt of only 10c, stamps or coin, to cover cost of wrapping and mailing.

Don't miss this opportunity. Sit right down now and fill in the coupon. The sooner you get started on the road to health the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon to-day.

EARLE E. LIEDERMAN, Dept. 209, 309 Broadway, N. Y.

EARLE E. LIEDERMAN, Dept. 209, 309 Broadway New York City.
Dear Sir:—I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development."

Name .....

Address .....

City..... State.....

THEORY AND OPERATION OF VACUUM TUBES

in Radio Science and Engineering,

arranged in a complete and comprehensive course of instruction. Every amateur operator, commercial operator, engineer or manufacturer should study this course. Instruction—Lectures—Laboratory Work. Under the personal supervision of an expert who has made a special study for years of the vacuum tube.

Write for Booklet.

Y. M. C. A. RADIO SCHOOL
152 East 86th Street
NEW YORK, N. Y.

"The Best Radio School in the East"

If desired, arrangements can be made for students to enjoy the privileges of our gymnasium—swimming pool—dormitory—employment bureau.

ANNOUNCEMENT

Research laboratory located in Maryland is to be dismantled. Thousands of dollars worth of radiophones, transmitting sets and amateur apparatus is to be sold to amateurs, dealers, etc. Every instrument practically new being used only for war research work. Get on our mailing list.

MODERN RADIO EQUIPMENT CO., Elizabeth, N. J.

source with its controlling elements, the transmitting loop and an auxiliary piece of apparatus which will be described later for denoting the intenstiy of loop field.

The power source consisted of a 5 kilowatt (5,000-watt), 500-cycle (1,000 reversals per second) inductor type alternator, separately excited and driven by a 110-volt direct current motor. Both of these are inclosed in the same frame case as shown in Fig. 3 which is a rear view of the panel. The motor and generator field rheostats are both mounted on the main control panel. The generator armature is protected from high potential surges by means of a condenser protective device. The motor starter is of the remote control automatic type and is mounted on the panel indicated in Fig. 2, being a front view of the control panel. The meter on the panel is a frequency indicator, this being used to ascertain the resonant frequency of the *loop circuit* and that of the generator. The two large fused switches are used to connect the input D.C. supply to the motor and output generator current respectively. The generator field which is externally excited is controlled by the small double pole switch.

The resonant condenser which is linked with the *transmitting loop* is one of the mica dielectric type and both are mounted on the back of the panel shown in Fig. 3. The large grid resistance shown below the condensers is a protective line resistance in the generator circuit. The jack at the base of the power panel shown in Fig. 2 is used to connect the loop proper to the power source, this being by means of No. 4 stage cable, as shown in Fig. 1, which is fitted at each end with a plug. A corresponding jack is placed on the loop frame as perceived.

The transmitting loop which is shown in Fig. 4 is eight feet square and fourteen inches high and wound with No. 6 flexible cable in multiple layer form. The frame was made from one-inch oak and the total loop weight approximated 150 pounds. The total measured inductance of the loop including the connecting cable was .02455 henry. The two large mica condensers, both of which were connected in parallel, had a total capacity of 4.13 mfds. These values of inductance and capacity had a resonant period at 500 cycles. The current circulating thru the coil at resonance was 65 amperes.

RECEIVING APPARATUS LIGHTS LAMP AND RUNS MOTOR

In order to ascertain the intensity of the field surrounding the loop transmitter, an apparatus is shown in Fig. 5 which consisted of a large inductance wound around the frame; within the frame were mounted a bank of five lamp sockets each fitted with twenty-five-watt tungsten lamps. A mica condenser shunted across the inductance, a small series motor and a double-pole switch which connected the lamps and motor across the inductance and condenser were connected in parallel in order to produce current resonance. The measured values of the inductance and capacity were .159 henry and .637 mfd., respectively. The resonant frequency of this combination was 500 cycles.

Having noticed the value of the current transversing the loop coil and the value of its inductance, one may readily ascertain the intensity of the magnetic field. One may picture the intensity of the field, when the writer states that he was able *to light up the five incandescent lamps to normal brilliancy and run the motor at top speed when the receiving frame containing the lamps and motor was moved twenty feet from the transmitting loop!* This of course was accomplisht when the transmitter was tuned to the exact resonant frequency of the re-

(*Continued on page* 690)

"They WORK while you sleep"

Cascarets

Best Laxative for Men, Women and Children.
10, 25, 50c—drugstores.

AFRAID TO EAT

Regulate your stomach so you can eat favorite foods without fear of

Indigestion
Flatulence
Gases
Acidity
Palpitation

A few tablets of Pape's Diapepsin correct acidity, thus regulating digestion and giving almost instant stomach relief. Large 60c case—drugstores.

PAPE'S DIAPEPSIN

GET BIG BUSH OFFER

We do not deal through distributors but County Agents only.



Big Money-Making Offer for County Agents Only

GET OUR BIG MONEY CATALOG TO-DAY. Don't wait! Learn how you, in your spare time can make Big Money, introducing Bush Cars in your County. The cars with Money-Back guarantee. Bush light four and De Luxe six. Don't wait. Write today!

BUSH MOTOR CO., Chicago, Illinois, Dept M-15 Bush Temple



"BOW LEGS and KNOCK-KNEES" UNSIGHTLY

Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.

PERFECT SALES CO.
140 N. Mayfield Ave., Dept. 50, Chicago Ill.





THE A-P ELECTRON RELAY
Price $6

ASK HIM—

ASK THE AMATEUR—HE KNOWS—

"Local operators who have tried the Relays report them the best detector they have ever used, with the result that they are selling like hot cakes. We predict an enormous demand for the tube this coming season."

Extract from a testimonial sent us unsolicited by a large Chicago radio dealer. (Name furnished upon request.)

THESE TUBES

These tubes—the A-P Electron Relay and the A-P VT Amplifier-Oscillator—manufactured under the De Forest Audion and Fleming patents.

Other patents applied for and pending.

A SUGGESTION

A combination of an *A-P Electron Relay* as the initial detector or oscillator with two or more *A-P VT tubes* as amplifiers is the ideal receiving combination for long distance reception. The price of the *A-P VT Amplifier-Oscillator*—designed by Naval radio experts—is $7. "Use the tube the Navy uses."

Ever on the alert for apparatus of greater efficiency, amateur operators have adopted our new type *A-P Electron Relay* so quickly and so enthusiastically during the four months it has been on the market that we merely say now—"Ask the amateur—he knows." The most sensitive detector of damped waves—spark or modulated C W—ever produced, and equipped with the SHAW standard four-prong base, the *A-P Electron Relay* is the logical tube for the amateur who seeks maximum signal strength and highest operating efficiency.

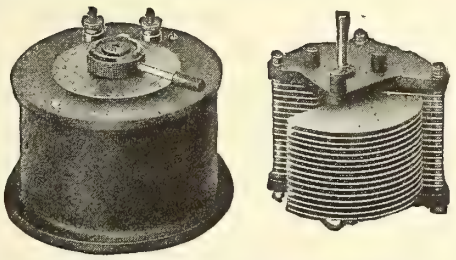
Price $6. Immediate deliveries. Order from your dealer or write direct. Descriptive pamphlet free upon request.

ATLANTIC RADIO SUPPLIES CO.
8 Kirk Place—Phone Market 1575—Newark
NEW JERSEY
Reference—National Newark & Essex Banking Co.

PACIFIC RADIO SUPPLIES CO.
638 Mission Street—San Francisco
CALIFORNIA
Reference—The American National Bank—San Francisco

Sole Distributors for Moorehead Laboratories, Inc.

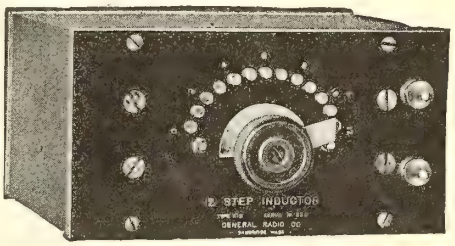
GENERAL RADIO APPARATUS



Variable Air Condenser No. 182

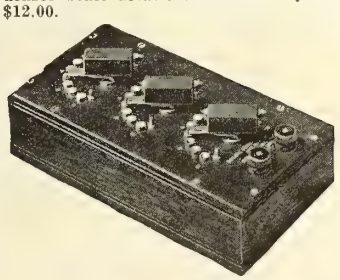
This condenser fulfills the demand for a moderately priced high grade laboratory condenser. Of compact size and excellent construction throughout, it has proved the favorite condenser for all types of oscillating circuits. The shape of the movable plates is such that the capacity varies as the square of the angle of rotation. This results in a straight line variation of wavelength with condenser scale rotation. Price fully mounted, .0007, $12.00.

We carry a very complete line of radio materials at all our stores with competent experts to explain the working of the various instruments. Your patronage solicited.



Variable Step Inductor No. 111D

This instrument has proved itself to be an absolute necessity in the radio laboratory or radio station. It may be obtained in practically any range, and the use of the ten point switch with the "dead end" attachment makes its use possible over the entire range of the coil inductor. Maximum inductance, 10 m.h. $18.00.

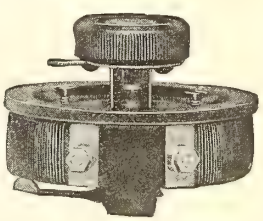


Decade Resistance Unit No. 102F

Of excellent material, workmanship, and possessing a high degree of accuracy, this three dial resistance box is recommended for all radio measurements. Resistance Units are non inductively wound, this renders the use of the box possible on direct and alternating currents of any frequency. Type 102F, current 0-100 Ohms in .1 Ohm steps, $28.00.

Rheostat No. 214A

The careful design and smooth working characteristics of this rheostat have rendered it the most popular of its kind on the market. It is supplied for both front or back of board mounting. It is normally supplied in a resistance of 7 ohms with a current carrying capacity of approximately 1.75 amperes. Price $2.50.



MANHATTAN ELECTRICAL SUPPLY CO., Inc.

New York	Chicago	St. Louis	San Francisco
17 Park Place 110 W. 42nd St. 127 W. 125th St.	114 S. Wells St.	1106 Pine St.	604 Mission St.

MURDOCK No. 55



2000 OHM SET.....$4.50
3000 OHM SET..... 5.50

That these Murdock No. 55 Sets have earned a nation-wide reputation for value, is due, not so much to the fact that they are, without question, the best low priced receivers obtainable anywhere, as it is to the recognized fact that they closely approximate in operation the sensitive performance of the most expensive sets.

The customary assurance of "Satisfaction or Money Back" affords the opportunity of proving the exceptional value of these 'phones at no risk to you.

Other instruments — MURDOCK MADE—of recognized merit at equally reasonable prices are illustrated in Bulletin 19B, a copy of which will be mailed on request.

WM. J. MURDOCK CO
55 Carter St.
CHELSEA (BOSTON 50) MASS.
509 Mission St. San Francisco, Calif.

MEMORIZE CONTINENTAL CODE ALMOST INSTANTLY

This method THE short cut to success

Get Wise. Ask for latest reports from Successful, Satisfied, Gratified, Grateful Users, Maine to California — Texas to Canada. Free on request or

COMPLETE CHART
and full instructions 50 CENTS

C. K. DODGE
Box 300 Mamaroneck, N. Y

LOUD SPEAKING HORNS

Handsome seamless black lacquered horn with nickel-plated specially constructed loud speaking receiver. Desk or wall type $15.00.

Other Type Loud Speakers at $25.00
Write for bulletin A2 and get on our list.

Modern Radio Equipment Co., Elizabeth, N. J.

Radio Power Transmission

(*Continued from page* 688)

ceiver, which was 500 cycles, and when both transmitting and receiving coils were both in a parallel plane.

In accomplishing the above results the input was 6,000 watts and the output measured at the receiving end was 165 watts, or an approximate efficiency of three per cent attained at a distance of twenty feet from the transmitting source. From this figure the reader will fully appreciate the inefficiency of such an apparatus used for energy transmission without the aid of wires. However, this apparatus should not be taken as the criterion for the solution of this important subject by any means; and the final solution of this problem will depend upon the use of powerful electromagnetic waves emanating from the transmitter instead of using the principle of induction upon which the above apparatus was specifically designed and built. But the work accomplisht with this apparatus serves to show in a clear, definite manner that but little is to be expected apparently from further developments along these lines; i. e., by means of electromagnetic transmission of power.

How We Smell

By JOSEPH H. KRAUS

(*Continued from page* 628)

unable to analyze the two. This is particularly demonstrated in the use of what is termed an olfactometer, just a simple tube having a container at one end which is inserted into the nostril when air is inhaled, so that it passes over the odorous substance into the nostril.

Again, certain odors are a good deal more penetrating, perhaps due to their diffusibility. 1/100 mg. of mercaptan diffused in 230 cm. of air is still distinctly perceptible. Each liter of air would then contain only .0000004 mg. of the substance and the amount in contact with the smell cells would be even smaller.

A curious feature is that air containing even such a small proportion of an odorous substance absorbs radiant heat to a very much greater degree than pure air. Perhaps this may be the reason that we distinguish the sense of smell, or perhaps as Aronsohn points out, it is due to the fact that the odorous substance is soluble in the fluid content of the nose. In either event it is the stimulation of the hair cells in the top of the nose which forward such a communication to the brain.

SCIENCE BAFFLED BY SCENTS

Some time ago there was held in England a "Wonders of Science Exhibition" which served to reveal many marvels to the public unfamiliar with the work done with the microscope, the microphone and the micrograph.

The microphone magnifies sound as the microscope does things seen. The micrograph is the instrument used by the scientist in taking pictures of things shown by the microscope. More people are familiar, to some extent, with the microscope than with the microphone. They know it is possible to make objects entirely outside of the range of natural human vision visible by the use of the telescope for great distances, and by the microscope for minute things close by; but few have any knowledge of the device by which it is possible to hear a fly walk or a caterpillar crawl.

Many other wonders of science were shown at Surbiton, but neither there nor anywhere else has science demonstrated its

(*Continued on page* 693)

GENUINE ASPIRIN

Name "Bayer" means genuine
Say "Bayer"—Insist!

BAYER

Say "Bayer" when buying Aspirin. Then you are sure of getting true "Bayer Tablets of Aspirin"—genuine Aspirin proved safe by millions and prescribed by physicians for over twenty years. Accept only an unbroken "Bayer package" which contains proper directions. Handy tin boxes of 12 tablets cost few cents. Druggists also sell larger "Bayer packages."

BAYER-TABLETS of ASPIRIN

Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid

Oh! By Gosh!

ACE

You want our new ACE Unicoil set. Any wave range from 150 to 20,000 Meters, uses unmounted Honeycomb or Duo-Lateral coils, brings the sigs. and the price without coil is only $40.00.

Order coils for wave lengths wanted, we have them. 10,000 to 20,000 Meter coil, $3.35. 1,000 to 3,500 Meters, $2.25. 400 to 1,200 Meter coil, $1.45. Amateur wave length coil, $1.30. We have the best C-W sets going.

REMEMBER—"You may pay more, but you can't buy better"

THE PRECISION EQUIPMENT CO.
2437 Gilbert Ave., Dept. E
CINCINNATI OHIO



WHAT EVERY GIRL SHOULD KNOW!
SENT PREPAID FOR ONLY 50 CENTS

This book is written by Margaret Sanger—the great birth control advocate—and although it was suppressed by the postal authorities, we are now permitted to send it to you.

It contains information never before published, and everyone that reads the book cannot help but be benefited. It is highly endorsed by eminent physicians. Send your order at once. Don't delay.

Truth Pub. Co., Dept. B T., 1402 B'way, N. Y.

AUDIO TRON

The Original Tubular Vacuum Detector, Amplifier, Oscillator

NOW FREE FROM ALL RESTRICTIONS

AUDIOTRONS, recognized as the most sensitive detectors ever produced, are now licensed under Fleming Patent No. 803684 to be used only for amateur and experimental uses in radio communication. They are no longer limited to audio frequency and can now be used as detectors and oscillators as well as amplifiers.

All patent questions have been definitely settled. Vacuum tube patents are basic and have been sustained by the Federal Courts. Be sure to get genuine AUDIOTRONS. They outclass any other form of detector and are absolutely free from all legal restrictions or difficulties. These new uses make it even more necessary to insist on the genuine. You can always tell a real AUDIOTRON by the name stamped plainly on the glass.

Insist on the name AUDIOTRON on every tube you purchase. Fully guaranteed by the AUDIOTRON Mfg. Co. (Read the guaranty).

Your Last Chance To Get An AUDIOTRON *double filament* DETECTOR

Manufacturing reasons make it impossible to continue the present hand made AUDIOTRON.

This type has a double filament of special thorium tungsten and the operating life is over 2,000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40.

The few thousand that will still be produced will be of the same standard of excellence that has characterized every AUDIOTRON. Already recognized as the most sensitive detector on the market, these few that still remain, with all restrictions on amateur use lifted, are undoubtedly the greatest opportunity ever offered to amateur radio operators.
See your dealer at once or order direct. Be sure to benefit by this last opportunity to secure a hand made super-sensitive double filament AUDIOTRON Detector, Amplifier, Oscillator.

$6.00 each (no increase in price)

The AUDIOTRON exclusive guarantee

Each and every AUDIOTRON is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge. The only tube satisfactory enough to stand a guarantee.

Dealers: Get in touch with the AUDIOTRON Mfg. Co. at once. We will give you full information about settlement of all patent difficulties. *You will also be interested in our new proposition for wide awake dealers. Write us today for full details.*

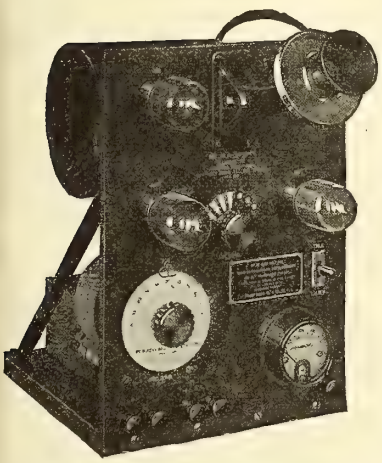
AUDIOTRON MFG. COMPANY (*Successors to the AudioTron Sales Co.*) Dept. A, Lick Bldg., San Francisco, Cal.

DE FOREST

The Newest Radio Development

The DeForest Portable Buzzer "Radiophone"*

Type O. T.—5



DeForest Portable "Radiophone" Transmitter; Buzzer Type O. T.-5
*"Radiophone" Name Copyrighted.

THE latest development of the famous DeForest Oscillion Transmitter (Wireless Telephone). For Automobiles, Motor and Sail Boats, Camps, Surveying and Exploring Parties, Forest Patrol, Farms, and all isolated places, this new "Radiophone" Set offers sure, quick, practical word-of-mouth communication. Operates on two 6-volt storage batteries; no "B" battery or other outside source of high potential is required. Can be easily transported; entire Transmitter, including batteries, weighs less than 60 pounds. Range on ordinary Amateur aerial is 5 to 10 miles, and can be materially exceeded under proper conditions. Operates with any suitable type of Receiver and Audion Detector; with or without an Audion Amplifier, depending on the range to be covered and loudness of reception desired.

Price Without Storage Batteries Including Vacuum Tubes **$135.00**

F. O. B. New York

Investigate this new DeForest production now. Order at once to insure early delivery; either thru your regular dealer or direct from us.

DE FOREST RADIO TELEPHONE AND TELEGRAPH COMPANY

Inventors and Manufacturers of High Grade Radio Apparatus

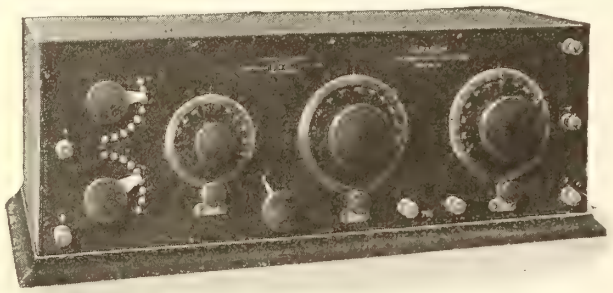
1415 Sedgwick Avenue New York, N. Y.

Lee DeForest, Inc., 451 Third St., San Francisco, Western Distributors

DE FOREST

From Nothing to Something
You Will Do It With This New Paragon RA-10

Signals which on actual tests are inaudible with any other type of receiver, become easily readable. "Coming from Nothing and amplifying to Something."



AND HERE IT IS
The Paragon RA-10

Greatest Improvement in Modern Radio

Do you remember the super service of the old original Paragon RA-6 amplifying short wave receiver? This new set surpasses it in every respect.

And the Original RA-6 Was the Only One of Its Kind.

150% improvement over the old original Paragon, away ahead of all other receivers and excels the most serviceable set on the market today.

Here are the 150% Pointers

A Wave Length range of 150 to 1000 meters.
25% more sensitive and selective than the RA-6.
Coupling has scale of 180° instead of 90°, giving wider range of coupling.
Cabinet of quartered oak, overall size 20⅝ x 8 x 7½"; white filled engraving, bakelite panel, knobs and dials.
A super product of Adams Morgan Co.'s unapproachable engineers.
And the price $85.00.

Remember the old Paragon? This one beats it and all others by miles. Our special bulletin tells you how. Send for it—its free.

Our word of honor to you is our guarantee. Let us prove it.

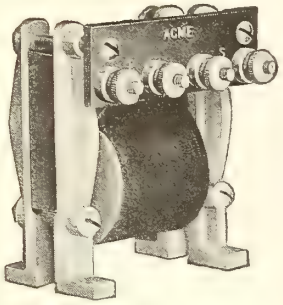
CONTINENTAL RADIO AND ELECTRIC CORP.

Sole Distributors of the New Paragon R.A.-10.

J. DI BLASI, Secretary — J. STANTLEY, Treasurer

DEPT. A.1 — 6 WARREN STREET — NEW YORK

HAVE YOU SEEN THESE?



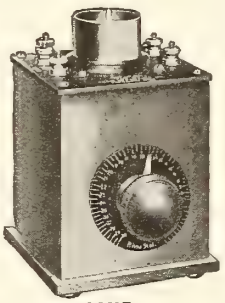
ACME
AMPLIFYING TRANSFORMER } $5.00

Ask your dealer to show them to you
Ask us to send you our bulletins

ACME APPARATUS COMPANY

28 WINDSOR STREET,
CAMBRIDGE 39, MASS.

Transformer and Radio Engineers and Manufacturers



ACME
AMPLIFIER $13.00
DETECTOR 10.00

DEALERS: ***Deliveries are inversely proportional to demand. ORDER NOW!***

IF YOU HAVE DECIDED TO BECOME A DRUGLESS PHYSICIAN OR

a Chiropractor, Osteopath, Psychologist, Mechano-Therapist, or Electrical Therapist, etc., send today for our new catalog which is just out.

Our forty-eight page book has saved many students from a life time struggle.

New Class now forming.

Write NOW. Address Executive Secretary,
BLUMER COLLEGE OF NATUREOPATHY
97 Ann St., Dept. H, Hartford, Conn.

Reporting Yacht Races via Radio

By DONALD McNICOL

(*Continued from page* 639)

Put yourself in the position of one of these men and suddenly hear the rapid dots and dashes being transmitted. The signals read: "*Shamrock* leading, *Resolute* five miles to the rear and off the course." A minute later, "Captain Adams (the skipper of the *Resolute,* the American Cup Defender) has something up his sleeve as the *Resolute* suddenly comes up with a fresh breeze, shortening the distance between itself and the *Shamrock,* gaining one-half. Nine more miles to the finish."

Then the Blimp starts "talking" via radio —"We have swooped down upon both vessels, the *Resolute* having gained another one-half mile over her rival. It seems to be the *Resolute's* race." A minute later, "The breeze falls, *Shamrock* has the advantage. *Shamrock* spreads fiddler jib. The American crew is much faster than the British crew at handling of the sails. *Shamrock* proceeding ahead rapidly, being seven minutes twenty-seven seconds ahead of *Resolute.* The *Resolute* will have to travel a little faster in order to make up the time allowance of a little over seven minutes. *Resolute* jibs at 5:28, *Shamrock* one minute later." And then quite a lull during which time the excitement of everyone at the receiving instruments is such that their eyes are fairly popping out of their heads. Pencils are clutched nervously as the slightest sound disturbs them.

After each message had been recorded it was immediately given to a boy and rushed downstairs post-haste to the pressroom where it was immediately hammered off in presses to get out in the earliest "extra." At last, the intermission is broken again by several more taps and the minutes seem like hours.

One more message and it would all be over. "Here it comes; no, not yet." Another wait and then two words, "*Shamrock* wins!" Thus were the radio messages of to-day transferred to and from the fleet which surrounded the International Cup Yacht Races and are already in the papers long before even those who have actually viewed the races have debarked from the vessels. In fact, those who were there can, by the time they come home, actually obtain copies of the papers containing the complete news of the contest which they have seen perhaps scarcely an hour before.

A key and relay connected the office of the *Evening Post* with the Radio Corporation's transmitting set at West Street, and messages were directly transmitted to the U. S. S. *Goldsborough* from the station shown in the photograph. The relay can clearly be seen in the center of the table.

BORDEAUX RADIO CIRCLES GLOBE.

The first message from the new Lafayette radio station at Bordeaux, France, the product of American inventive and scientific genius, was received at Washington, D. C., August 22d.

A message to Secretary Daniels was the first ever sent from the Lafayette station. It was received here by naval wireless. The message read:

"This is the first message to be heard around the world and marks a milestone on the road to scientific achievement."

The statement that the message was the first to be heard around the world draws somewhat on the imagination. It actually traveled 24,000 miles, the length of the earth's circumference. It went 12,000 miles east and 12,000 west, literally bumping into itself at a point above the earth's surface directly opposite Bordeaux.

Don't Take Our Word for It

Read What Others Say
Then Prove It For Yourself

WE don't ask you to take our word for the superiority of Brandes Matched-Tone Receivers. Thousands of operators have written to us unsolicited letters and all are enthusiastic over the results they got with Brandes Receivers. Read what some of them say, then act on our trial offer below.



"Superior" Set, 2,000 Ohms $7

BRANDES
Matched Tone
RECEIVERS

"They are all and more than you claim them to be."—W. M.—Columbus, Ohio.

"They are the best phones anyone can buy. They bring in the stations you don't hear with other phones and cut out over half the static."—M. B.—Richfield, Utah.

"I have tested very many receivers at various prices and none of them are in the same class with yours. Honest goods, good inspection and testing (previous to shipment) ought to be known."—J. B.—Fall River, Mass.

"I own a pair of your 2,000 Ohm Superior Headsets and have used them for the last two years. They are better than ever, picking up messages when many others have failed."—E. H.—Lowden, Ia.

"I can receive N.A.A. much sharper and clearer with your Superiors than with my ———, 2000 Ohms, and they were good phones."—C. D.—Bellefonte, Pa.

"With average antenna of only 40 feet height, crystal detector, and my 'Superior' phones I have been able to hear ships 1,200 to 1,400 miles at sea and land stations up to 1,200 miles distant—before 9 P. M."—C. S. M.—Concord, Calif.

Here's Our Offer:

Send 5c for catalog *"E"*. Order any pair of our receivers you want. Try them 10 days in comparison with the phones you have now. If they aren't better phones for clearness, sensitiveness and distance than what you are now using, return them to us and back comes your money immediately and without question.

Brandes phones are used by U. S. Gov't experts, colleges and technical schools, and by professional and amateur operators all over the world.

C. BRANDES, Inc.
Wireless Receiver Specialists
32 Union Square New York, N.Y.
Room 814

How We Smell

(*Continued from page* 690)

ability to help the sense of smell. It can do marvels of sight, hearing and touch, but not for the humble and useful nose. In that field the accomplishments of science have been nil.

Let a man stand two miles, say, to windward of the point where a herd of caribou will cross an open plain over which a fresh breeze is sweeping and it must be apparent that only an infinitely minute particle of whatever matter may be given off from his body or clothing can possibly reach the nostrils of any one deer in the herd. Yet, if the man is completely screened from sight by a rise in the surface of the ground the caribou will nevertheless catch the taint in the air. They would be warned of the presence of a wolf in the same way.

Yet science is utterly unable to detect anything which the olfactory nerve of the deer senses and identifies. It cannot see with a microscope anything in the air which came from the man. It cannot find any such substance with a chemical test of any kind. Instead of aiding the sense of smell, it is entirely incapable of matching it. Here is another realm for science to invade and subdue; but would the conquest be altogether desirable? It is a question whether the average man needs to smell more things or sense more acutely the things he smells already. It is thought that the gains would not offset the losses under the prevailing conditions of life.

THE DETECTION OF PLATINUM THEFTS.

The news service of the American Chemical Society has issued a bulletin describing the arrest of two men while attempting to dispose of 280 troy ounces of platinum *sponge*, the porous state of the metal. They had left small lots with two different firms who, having circulars concerning various thefts, notified the authorities. The Bureau of Standards last March had lost 73 ounces in the form of laboratory ware valued at nearly $11,000, while in December, 1919, the Roessler & Hasslacher Company of Perth Amboy had missed $5,000 worth of the metal in the form of sponge. Several universities had also complained of platinum thefts.

The exact composition of definite consignments of platinum is fairly well known to chemists, the slight variations being due to traces of other substances, such as iridium. Chemical analysis indicated that the seized supply had come neither from the New Jersey plant nor from the laboratory of the Bureau of Standards. In its quality it closely resembled the stocks at the War Department plant in Nitro, West Virginia, where the inventory showed there should be 5,800 ounces of sponge, and also the stock of 13,800 ounces at a government military plant at Jacksonville, Tennessee. As some of the platinum at Nitro was known to contain a large percentage of palladium, that supposed to be stolen seemed to have come from Jacksonville. There the metal was of exceptional purity, as it contained 99.58 per cent of platinum, with slight traces of iridium, rhodium and iron. Its texture was uniform except that here and there were lumps of a yellowish brown substance, which on ignition yielded platinum sponge and gave off fumes of chlorine. It was learned that an order had been given at Jacksonville to turn back large quantities of platinum chloride into sponge. Then came a thoro search. In eighty-six cans in the safe was found a substance supposed to be platinum, which on examination proved to be a mixture of mercury with ordinary moist dirt.



HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competion is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

American School of Correspondence
Dept. H-726 Chicago, U. S. A.

American School of Correspondence,
Dept. H-726, Chicago, Ill.

I want job checked — tell me how to get it.

.....Architect $5,000 to $15,000	.....Lawyer $5,000 to $15,000
..... Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Photoplay Writer $2,000 to $10,000
.....Certified Public Accountant $7,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telephone Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....Telegraph Engineer $2,500 to $5,000
.....Electrical Engineer $4,000 to $10,000	.....High School Graduate In two years
.....General Education In one year	.....Fire Insurance Expert $3,000 to $10,000

Name.....

Address.....



DUCK'S

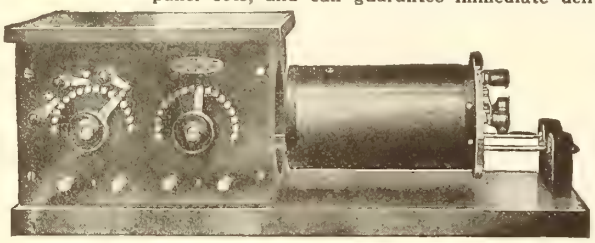
New Big 200-Page No. 14 Wireless Catalog and 100 Page Electrical Catalog

The wireless catalog mailed for 12c and the electrical catalog for 6c, either in stamps or coin, which amount you are privileged to deduct on your first order of $1.00. Catalog positively not sent otherwise.

This edition of our wireless catalog is the most complete and elaborate we have ever put out. It embraces everything in wireless worth while. As an encyclopedia of information it is invaluable. It is printed on excellent paper and with a beautiful cover. Your amateur friend will tell you that there never has been any wireless catalog to take the place of Duck's, and above all that you can absolutely rely on the quality of every instrument listed in this catalog. In a word it is all worth while catalogs in one.

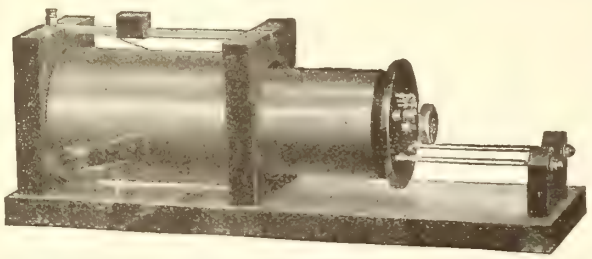
Audio Tron bulbs prepaid $6.00

We discontinued selling Audio Tron bulbs and accessories for a short time but we have again resumed their sale and also panel sets, and can guarantee immediate delivery.



NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER

A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $27.50.



OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

The secondary on our new type Arlington is divided into three sections with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type, permitting a looser coupling. It is a beautifully finished instrument.

Price only $15.00

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio

RADIO CLUBS TAKE NOTICE

Buy Where You Can Get A Discount and Get What You Want— A Most Complete Line of Radio Apparatus and Parts

We have all the **Radio Books & Magazines.** Get your **"Hookups"** from them. **Add the list below to the ones given in previous issues.**

Hotshot Batteries, 6 Volt, **$2.70. Storage Batteries,** 6 V-60A, **$16.00, (Marko), $19.00. Eveready "B" Batteries, $3.25. Cyclone, $2.20. Standard Variable, 3.25**—these batteries have 14 amp. **Small "B" Batteries,** 22 Volt, **$1.00. Special Pittsfield Spark Coils,** without vibrator, **$2.00;** postage 23c. **Special Shocking Coils, 50c;** worth double. We have about 200 going at that price. **Motors,** the kind for your rotary gap, **$10.00. Monicoil Motors, 49c,** work on dry cell. **Hoyt Volt Meters,** 0-3 & 0-5 volts, **$6.50.** Pocket type Volt & Amp. meters, **$1. Roller-Smith Ammeters, Special,** D. C. 0-1 & 0-2, **$6.90. Westinghouse Ammeters, Navy Type,** D. C. 0-3 & 0-5, **$10.00.** Large type, **$6.00. Small Sterling Type Volt Meters,** projecting or flush, **Special Price $4.00. Small Sterling Type Ammeters** to match the above, 0-35, **Special Price $4.00. Variometers, $4.50. Grebe Type, $6.50. Variometer Coupler, $4.50. Primary Switch,** Wilcox type, **75c. Rotary Switches, $20c, 30c, 35c, 40c, 50c, $1.00. Spark Gap Stands** without the electrodes, 2 to a set, **40c. White Metal Dial,** 3" dia. with navy type knob, **70c.** Brass scales, 45 degrees, **10c. Hook-Ups,** the kind that will make any set work, 14 of them for **75c. We have all the parts for the amateur to build his set as he likes.** De Forest and our own Catalog sent upon request and 10c.

AMERICAN ELECTRO TECHNICAL APPLIANCE COMPANY

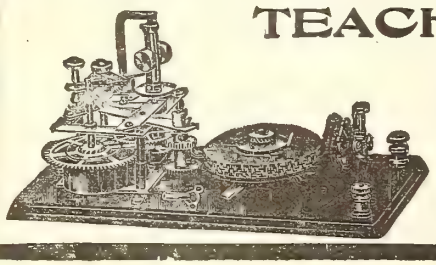
235 FULTON STREET, DEPT. E. NEW YORK CITY

"THERE'S MONEY IN IT"

LEARN TELEGRAPHY AT HOME

MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter, THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.

26 L Cortlandt St. New York

GERMAN RADIO-TELEGRAPH DEVELOPMENTS.

In order to supplement the ordinary telegraph system and to serve as a substitute in cases of extensive breakdowns of the telegraphic communication, the German State Ministry of Posts and Telegraphs is establishing a comprehensive State Wireless System. The State Wireless System is being constantly extended. Bavaria and Württemberg will also be linked up in the system by the establishment of transmitting and receiving stations in Munich and Stuttgart. The Ministry has also established in Königsberg, East Prussia, two transmitting and two receiving wireless stations in order to render independent of the "Polish Corridor" the telegraphic communication of East Prussia with the remaining parts of the State. At the present time the main traffic passes between Königsberg and Stettin and between Königsberg and Berlin. Other developments are projected, and it would appear that the Government is determined to make its telegraphic service as independent and self-contained as possible.

Simplest Long Wave Receiver

By ELLIOTT A. WHITE

(*Continued from page* 641)

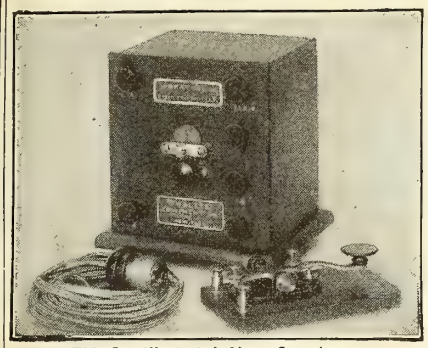
A large antenna cuts down the size of inductance required, to a marked extent. As the author's set is portable, he has carried it around and tried it on several open antennas and has been surprised to see what a small portion of the coil must be in circuit, with a 500 or 600 foot antenna. The figures here given are for an average small sized amateur antenna, of around .0003 mfd. capacity.

The principal novelty in this set lies in the use of a *single, tapt honeycomb coil.* This coil, recently put on the market and widely advertised, is remarkable for its compactness, low resistance losses and low distributed capacity. It has been an ideal coil except for one defect: it is made only of fixt values, necessitating several sets for various ranges of wave length, thus adding prohibitive expense and objectionable complexity of parts and mountings. The idea of tapping these, however, is new, and makes the coils universally useful.

For the long wave set here described, the largest coil, that of 175 millihenrys inductance, is used, in order to make sure that the set will tune to the longest waved stations on any antenna, no matter how small, without loading condensers, tho the next size smaller (and on very large antennas, many sizes smaller) is large enough in most cases, the next size having 125 millihenrys inductance. Of course with loading condensers, as noted above, a much smaller size may be used.

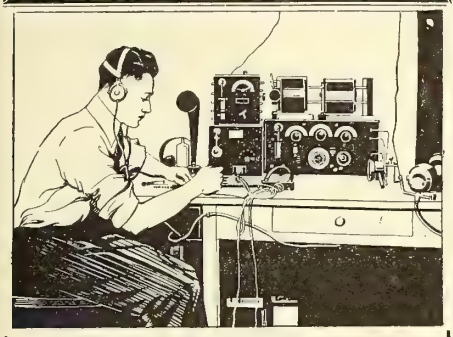
The 175 millihenry coil is wound with No. 28 solid wire or with 5-36 "Litz" (stranded cable). The former, which is recommended, is 2 inches inside diameter, 4 inches outside diameter and 1 inch thick, thus giving a winding section 1 inch square. The wire is wound in layers, crost and spaced, so that taps can easily be taken at the edge of the layers wherever desired (Fig. 3). To make a tap, a smooth sharp point is forced under the wire where it bends out at the edge of the layer (a round divider point is suitable), and enough pressure applied to break the varnish and enable the wire to be bowed out away from the coil about 1/16 inch, for a space of about 3/16 inch. More than this or rough handling will break the wire and ruin the coil. In the case of the solid wire coil, a strip of thin mica is slipt under this loop to insulate the joint and to prevent scraping the insulation of adjacent turns. The loop is then scraped carefully and the

NEW VIBRATONE Jr.
RADIO TRANSMITTING SET



This Set Illustrated Above Operates on
110 VOLTS, D. C., or A. C.
It is absolutely complete as shown. Needs no helix, spark gap, condensers, etc., etc. Simply connect to aerial, ground and electric circuit, and send.

NO BATTERY EXPENSE
Runs all day for 2 cents.
Sends three to five miles.
PRICE $18.00 COMPLETE
With Key, Plug and 8-foot Cord
Send for descriptive circular 149C—To-day
WIRELESS EQUIPMENT CO., Inc.
188 Greenwich St. New York, N. Y.



FALL TERM
NOW STARTING

Registration now open for complete standardized course, preparing you for first grade commercial license and best paying positions. Individual instruction in classes of limited size.

Write for descriptive booklet A

Y. M. C. A. RADIO SCHOOL
Marcy Avenue Near Broadway
Brooklyn, N. Y.
Tel. Williamsburg 3800



Packard

Put the *Pep* into that wireless set by using the **Packard** high voltage transformer making a sending radius of from 450 to 900 miles. The most powerful transformer built for amateur purposes.

Write for our Bulletin on Wireless Transformer. The Packard Electric Company
WARREN, OHIO
Wireless Transformers



Wrestling Book FREE
Be an expert wrestler. Learn at home by mail. Wonderful lessons prepared by world's champions **Farmer Burns and Frank Gotch. Free book** tells you how. Secret holds, blocks and tricks revealed. Don't delay. Be strong, healthy. Handle big men with ease. Write for free book. State age. **Farmer Burns,** 1257 Range Bldg., **Omaha, Neb.**

insulation slipt back, leaving a bare space of about ⅛ inch. No more is necessary. The tap is made of some small wire, such as No. 24, by scraping it clean of insulation for about ¼ inch at the end and bending the end into a small hook. This hook is bent tight around the bared loop on the coil, and neatly soldered, using very little solder. The mica shields the other turns from the heat of the iron. If it is desired to make a dead end at any tap, for a dead end switch (tho this seems superfluous), the wire loop on the coil may be clipt and a tap wire soldered to each of the ends left by the cutting. Altho making these taps is easy, it must be done carefully, for if the wire is broken the whole coil is thereby made useless. Ordinary care is sufficient.

In the case of the 'Litz" coil, the tap is made by prying out the wire at the edge of the layer, as before, and then cutting the loop sharply with scissors or end-cutting pliers. Some flux is then daubed on the ends thus left, and the *ends* of the strands are tinned by putting on a large drop of solder which will make contact with the end of each individual strand of the enamel wire. The tap wire or wires may then be soldered to this drop of solder. It is not possible to *scrape* the individual strands, as the ends are too short, but the cutting bares all the ends and leaves them clean for tinning. However, the solid wire coil is recommended, as the "Litz" offers little advantage at the longer wave lengths, and the longer the wave length the less its advantage, besides there is the increased difficulty of making the taps.

For the set described, to make sure of going down to below 2,500 meters on a fair-sized antenna, the first tap should be made one-sixteenth inch out from the center, measuring from the inside edge of the coil (In these coils it is not possible to count the individual layers, so that the measuring must be done instead.); the next at ⅛ inch, the next at ¼, the next at ½ and the last at ¾ inch from the center. The inside and outside terminals of the coil (A and B, Fig. 3) are already accessible at the soldered plug terminal, which may be removed or not, but is better left to hold the coil together and keep it from being injured. The author received Arlington, 2,500 meters, on the tap ¼ inch and even 5/16 inch from the center, with a loop antenna of considerable size (a 50-turn helix 4.5 feet by 7 feet), but the lower taps are handy to have available if they are wanted, tho three or four taps are usually enough (see paragraph at end of article). Thus a multi-point switch, of from four to seven points, is all that is needed for the inductance—giving a wide range of wave lengths without changing the inductance at all, and leaving practically only the one adjustment, that of the tuning condenser C1.

There are several ways of handling the tap leads after they are made. One way is to run them thru sleeving (old round shoelaces with the string core pulled out make good sleeving) across the face of the coil, then across the outside edge of the coil under the fiber binding strap which clamps them down solidly. Another way is to drill small holes along the edge of the fiber strap opposite the tap points, thread the bared ends of flexible leads thru these holes, solder them into a compact terminal and solder the small tap wires to these, with a strip of mica or tape underneath to prevent injury to the edge of the coil. This makes a good solid job. Small metal punchings, or even small brass paper clips, may be fastened to the edge of the strap instead, for terminals. Another way is to remove the fiber strap entirely; but this leaves the coil exposed to injury. The taps should of course be staggered across the face of the coil to keep them from rubbing and short circuiting on adjacent



How This Man Won Success
As an Electrical Expert

GENERAL MANAGER of his company at 28 years of age! His own boss—owns his home—married and happy and prosperous—that's the remarkable success achieved by Wallace H. Rohrschneider, now General Manager, Secretary and Treasurer of the Hustisford Light, Power and Manufacturing Company of Hustisford, Wisconsin.

Mr. Rohrschneider got his start toward his quick and brilliant success at School of Engineering of Milwaukee. There he received the practical, intensive and specialized training that enabled him to make good in a big way.

Why Don't You Get Into This Big Pay Field?

The same kind of training that put Mr. Rohrschneider into the ranks of the highly-paid Electrical Specialists will qualify you for brilliant success in this fascinating field of unlimited opportunities. **Come to America's Greatest Institution of Electrical Education.** Learn by actual practice in our big laboratories with their magnificent equipment including motors, dynamos, switchboards, ignition and lighting systems, etc. **Over 90 recognized experts** give you personal instruction every step of the way.

Earn Your Way Through This Great College

You can earn money to help defray your expenses while you are learning. Our wonderful co-operative plan brings an Electrical Career within the reach of every ambitious man. Our Free Employment Department secures positions for those students who wish to earn part or all of their expenses. In addition, **the Department will help you get a good position in the Electrical industry when your training is completed.**

BIG BOOK FREE Mail the coupon today for our big new illustrated catalog. Check the course that interests you most and we will send you special information. Read about the wonderful method of training of this great Electrical School that trains men for **practical and quick success.** See how easy it is for you to get the training that will enable you to step to a splendid position and a handsome income. Mail the coupon right NOW. No cost or obligation.

SCHOOL of ENGINEERING of Milwaukee
Dept. I-CK, 373 Broadway Milwaukee, Wisconsin

Mail Coupon Now

SCHOOL OF ENGINEERING OF MILWAUKEE
Dept. I-CK, 373 Broadway, Milwaukee, Wisconsin

Please send me, without any cost or obligation, **full** particulars of the electrical course I have checked and your big Free Book telling about your institution and how it will fit me for a big position in the electrical field. Also tell me about your Earn While You Learn plan.

(Check courses Interested in.)

....**School of Practical Electricity**—1 year course. Complete general course, covering entire electrical field.
....**Institute of Electrotechnics**—12 to 36 months' course. Practical electrical training combined with thorough Academic education.

....**School of Electrical and Mechanical Drafting**—6 months to 1 year course. A general drafting education. Prepares for good position as skilled draftsman.

....**School of Electrical Engineering**—3 years' course. Regular collegiate work granting B.S. Degree. 14 High School units or diploma from our Institute of Electrotechnics required for entrance.

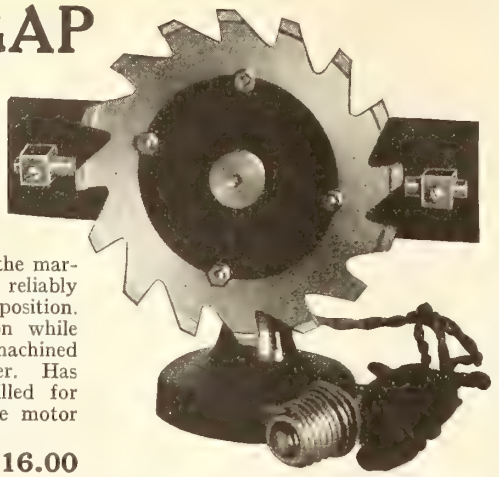
....**School of Automotive Electrotechnics**—3 to 6 months. Covers all systems of starting, lighting, ignition and storage batteries for automobiles, tractors, air-craft, etc. Intensive practical course.

....**Armature Winding and Motor Generator Repair Course**—3 to 6 months' course. Brief, but intensely practical, leading to well-paying positions.

Name .....
Street .....
City..... State.....
Age..... Education.....

ROTARY GAP

Cat. No. YM1



A new development in the rotary line has been made expressly for Young & McCombs. Improvements on the well known saw tooth rotary wheel, make this gap the equal in tone and efficiency to any selling for twice the money. It is the only gap on the market which will run smoothly and reliably in either a horizontal or vertical position. Can be run in a vertical position while screwed to the wall. Rotor is machined cast aluminum with formica center. Has liberal sparking space and is drilled for either 1-4 or 3-16 shaft. Variable motor speed switch in base.

Price, complete - $16.00

ROTORS ONLY

YM1a—Rotor and standards only.....$7.00
YM1b—Standards with base and binding posts 2.50

ROTORS AND STANDARDS

YM2—Plain rotor, as illustrated.....$4.50
YM3—Saw-tooth rotor, designed for Harmonic Chord tone..... 4.75

Send 4c in stamps for 50-page Catalog

Young & McCombs
L. P. BEST PRES.
ROCK ISLAND, ILL.

Address Orders to Dept. 67

WIRELESS TELEPHONE COURSE

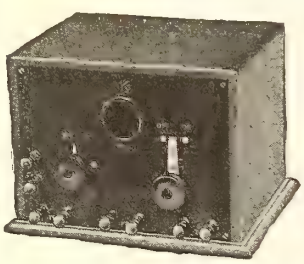
Covering Theory and Practice of Electricity—Radio—Blue Print Reading and Wireless Telephony. 4 in 1 Course. Our easy payment plan places this course within reach of anyone who wishes to better themselves. Immediate action will assure you of a good future. Don't delay.

FREE Audion tube, experimental electrical outfit, and other apparatus furnished each student, FREE. Write TODAY to

CHICAGO ELECTRICAL ENGINEERING CO.

Dept. W. 1000 Diversey Parkway Chicago, Ill.

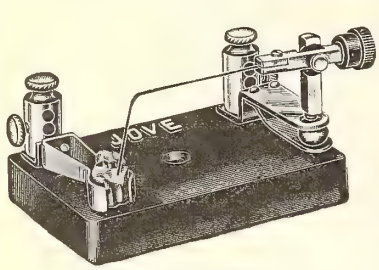
Audion Control Unit only $13.75



The K. & G. Wireless Supply Co., in its efforts to place technically correct and reliable wireless apparatus well within the price reach of critical amateurs, announces its new Audion Control Unit, Type A1. This new unit is absolutely reliable and can be used with every known circuit. It is designed and built for exacting service. It combines the very latest ideas in design with the best of material and workmanship. The cabinet, 8½x6¼x6½, has a highly polished mahogany finish and with its well mounted panel will add much to the attractiveness of your station. The unit contains these instruments: vacuum tube socket (for standard 4-prong tube) filament rheostat (10 ohms), grid condenser, grid leak, and filament switch. Panel has binding posts, suitably marked in white, for secondary, tickler, phones, and filament battery. Whole back of cabinet swings open on hinges and thus permits easy insertion of tube and batteries and complete inspection of the interior. Efficiency guaranteed, or money refunded.

Price $13.75, without tube or batteries. If your dealer can't supply you, order direct. Dealers: Write for proposition.

K. & G. WIRELESS SUPPLY CO.
Dept. 15A, 152 Chambers Street New York



(GHEGAN PATENT)

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

Send stamp for new edition 42E Catalog.

J. H. BUNNELL & CO., 32 Park Place, New York

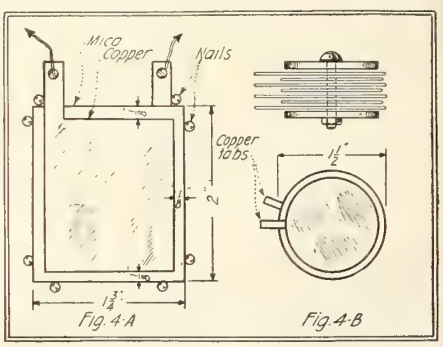
How and Why of Radio Apparatus, by H. W. Secor. A book every Radio Operator should have—$1.75. Experimenter Publishing Co., 236 Fulton Street, New York City.

tap-loops. The mica strips slipt under the loops, under the soldered taps, should be made long enough to extend clear across the face of the coil, so that the tap wires may lie on them, as the coil is not very heavily insulated and is easily damaged, in spite of the thin varnish. Shellac may be put over the mica and tap wires when the job is finished.

It should be noted that this scheme of making taps on the honeycomb coils applies equally advantageously if a more complicated set is used, with primary and secondary, or primary, secondary and tickler, thus saving several sets of coils and saving the change of coils for various wave lengths. In that case the flexible tap-leads may be bunched and taken to switch points on a multi-point switch on the base or panel, whichever mounting is used. It also applies to making a short wave set of these honeycomb coils, where a tap may be taken from every layer, since No. 24 and No. 25 wire are used in the solid wire coils of 20 millihenrys inductance and under.

BUILDING THE TICKLER COIL.

The design of the *tickler coil* depends on individual taste, whether it shall be of the push and pull, slide, swing, hinged or rotating type. It may be a flat pancake that slides or swings across the face of the

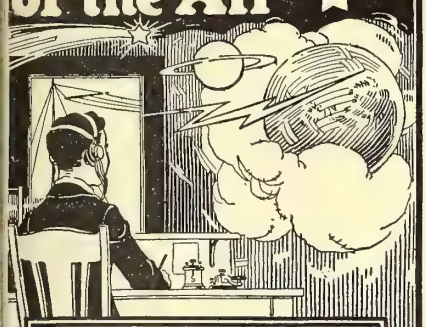


Details of Condensers Used in Long Wave Audion Receiving Set.

coil or hinges against it; or a small ball or tube may rotate inside the center; or a small tube may push into the center. Either of the latter is probably preferable to the first, on account of compactness. It is only necessary to remember that the hole in the center of the coil is 2 inches across and 1 inch deep, and that the tickler should have from 150 to 175 feet of wire on it.

The one in this set as illustrated is made of 170 feet of No. 32, enameled wire, tho No. 30 or No. 28 would probably be better on account of their lower resistance, wound on a little stiff paper cylinder 1½ inch long and 1⅝ inch outside diameter. (See Fig. 3.) A wooden, hard rubber or fiber rod or cylinder is good. The wire is wound on this in lump form, but spread out enough so as not to be of too large outside diameter. This may be rotated horizontally in the opening on one side of the inductance coil, or, very conveniently, it may push into the center on a brass rod or wooden skewer or dowel, or in a paper cylinder. In the set described the tickler was shellacked into a stiff paper tube which slides in a larger stiff paper cylinder shellacked into the center of the coil (2 inches inside diameter), which it exactly fits. The two cylinders fit each other tight enough so that the tickler will stay where it is put, whether the coil is standing up or lying down, *but not so tight as to make it move hard.* The tickler leads may be brought out thru a hole in the handle which is fastened to it. The tickler coupling is very important in bringing out loud signals; therefore it should not have a fixt degree of coupling, as is sometimes done. The coupling, however, may be left fixt and the

Boys! Learn the Hidden Secrets of the Air ★



Listen in! Startling news flashed from far corners of the earth —or boy operators chatting with each other by wireless. No wonder large numbers of boys have taken up wonderful wireless. Be one of them Yourself. Catch messages.

Send Messages!

Our New Wireless Manual Tells You How

Tells all you want to know about wireless. Describes how messages travel. How to put up equipment, "aerials", "wave lengths", receiving, sending and all other points. Gives the codes, too. A handy text book and catalog on wireless. The finest ever published.

Send 25 cents. Ask for Wireless Manual W 12. We credit the 25 cents on first order. Thus you can **get this splendid book FREE**



Write at once—address nearest office

Manhattan Electrical Supply Co., Inc.
New York, Chicago
St. Louis, San Francisco

lo Seals-No Secrets —*But Service!*

Inspection of the interior of any Radio paratus bearing the mark:

GREBE RADIO

eals design and workmanship fully in keeping h its outward appearance.
REBE RADIO apparatus is licensed under the ginal Armstrong and Marconi patents.
Our guarantee is absolute and unconditional. ch instrument must give satisfactory service. r interest in the purchaser does not terminate h the sale.
Ask your dealer to show you our line of super- de apparatus. If he doesn't carry it, write —mentioning his name—for catalogue.

A. H. GREBE & CO., Inc.,
Van Wyck Blvd., Richmond Hill, N.Y.

Arnold **Loose Couplers**
Combination Loose Coupler Parts and accessories.
Send 3c stamp for literature which is sure to interest you.

I. F. ARNOLD **2082 Lexington Av. N.Y. Established 1910**

corresponding adjustment made by having the bridging condenser C3 a large variable, or a fixt and a smaller variable, or a fixt condenser variable in steps; but this increases the expense and complexity of the set and is unnecessary. In connecting up the set the leads from the tickler may have to be reversed, as the proper lead must be connected to the plate in order to secure the proper polarity of feedback and make the set oscillate. This can be quickly determined by trial. It can be determined in advance, but this will not be gone into here.

THE FIXT CONDENSERS.

The fixt condensers C2 and C3 are made of any construction or dimensions to give the desired capacity. Figure 4A shows a convenient size and construction. The plates are of tin, aluminum, copper sheet or foil; the dielectric of paraffined paper, empire cloth (oiled linen), or mica. The best mica (and none but the best should be used) can be purchased quite cheaply, either in large sheets or already cut to the size given, and then split with a knife into sheets of about the stiffness of a thin visiting card (accurate measurement of thickness can be made with a micrometer). Altho only trial will determine the number of plates to use, as the capacity varies inversely as the thickness of the dielectric, it may be stated that condensers of 2 and 2, and 5 and 6 plates were required for C2 and C3 respectively, to give capacities of about .00015 and .004 mfd. This means that for C2, alternate plates being connected to opposite sides, with mica between, and all the tabs brought out on the same side being connected together, 2 plates together on the left and 2 plates together on the right (the number of opposite surfaces is always one less than the number of plates) were correct; and for C3, 5 on the left and 6 on the right. This means that the average thickness of the mica must have been less in the latter, since the area of the latter to that of the former is as 10 to 4, but the capacities are in much higher ratio. If the mica sheets are half as thick they will give twice the capacity, and vice versa. Trial, however, will quickly determine the right number of plates. Paraffined paper is thinner than mica is usually split, but is likely to cut thru. Aluminum plates are good, but copper foil is better, as it can be soldered. In case the mica has been purchased in large sheets, the sheets should be cut with sharp shears first and split afterwards. The metal plates can be cut with shears, and the whole condenser stacked up conveniently by driving finishing nails in a board so that the mica sheets will fit between them, as in stacking up a transformer core. This will make a neater job. Two strips of friction tape should be laid on the board first, or even four, two in each direction, and the condenser built on them. After the condenser is finisht the bottom tapes can be folded over and wound tight, to remove the whole from the board. It can then be wound tightly with more tape, or clampt between pieces of hard wood or brass and dipt in sealing wax, paraffine or other insulating compound, tho both clamping and dipping are not important for ordinary purposes. Leads may be soldered to the tabs if they are of tin or copper; or riveted or twisted tightly thru holes drilled in the ends of the tabs if they are of aluminum. Figure 4B shows another type of fixt condenser which some prefer, wherein the dielectric and the plates are round washers with a hole in the center thru which passes a clamping bolt screwed up tight against two end washers of thick brass. This makes a neat little condenser, and the tabs can be soldered to switch points to make a fixt condenser, variable in steps; but this type is more difficult to construct.

(To be concluded in November issue)

Telephone Men Use These a WEEK FREE

ACCEPT this **free** offer and use these great up-to-date books on the telephone in your own home or shop a whole week free.

We will send you all four volumes bound in genuine red morocco leather, 1728 pages and 2000 pictures, without one cent in advance.

Cyclopedia of TELEPHONY AND TELEGRAPHY

Everything about the telephone is explained in them in simple and plain language — theory—practice—operation—from the first experimental line to the modern equipment and complicated switchboards. Not one detail has been overlooked. Every vital fact that you need to make you an expert is in them.

Free Consulting Service

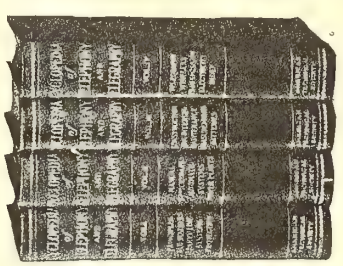
If you wish to keep the books on our easy terms of $3.00 a month, we will include FREE a year's Consulting Membership in the American Technical Society, and you can have the services of our engineers and experts for one year as often as you wish to write in and ask for their help on any subject within the scope of the books.

Send the Coupon Now

Don't send any money. Just mail the coupon properly filled out and the books will come to you at once by express collect. Keep them a whole week and use them as if they were your own. Send them back to us if you want to, but give them a trial anyway, and if you keep them send us only $2.80. You can send the balance of the special $19.80 price the same way—$3.00 each month.

Give yourself a chance to make some real money—right now. Send the coupon before you turn this page.

American Technical Society
Dept. T-257 **Chicago, U. S. A.**



If you would rather have one of these sets for free examination instead of the one described above, cross out the name and price in this coupon and indicate your choice here by placing an (X) in front of the set you want.

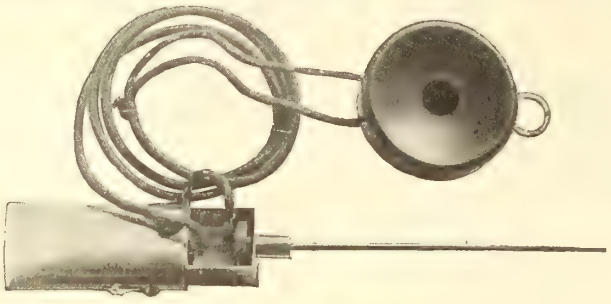
[ ] Law, 13 vols., $49.80.
[ ] Electricity, 8 vols., $34.80.
[ ] Auto Engineering, 6 vols., $29.80.
[ ] Civil Engineering, 9 vols., $39.80.
[ ] Steam Engineering, 7 vols., $29.80.
[ ] Sanitary Heating and Ventilating, 4 vols., $18.80.
[ ] Fire Prevention and Insurance, 4 vols., $19.80.
[ ] Machine Shop Work, 6 vols., $29.80.
[ ] Accounting, 7 vols., $29.80.
[ ] Carpentry and Contracting, 5 v., $24.80.
[ ] Telephony and Telegraphy, 4 vols., $19.80.

AMERICAN TECHNICAL SOCIETY
Dept. T-257 **Chicago**

Please send me a set of Telephony and Telegraphy in 4 volumes, express collect. I will send you $2.80 in 7 days and $3.00 each month until I have paid $19.80. If I don't want to keep the books I will return them to you in one week.

Name.....
Address.....
Reference.....

Skinderviken Mechanical Stethoscope



Detects Knocks or Defections In All Running Machinery

THE ONLY INSTRUMENT FOR TESTING THE MOTOR OF YOUR AUTOMOBILE

Battery 25c extra **$5.00**

Orders filled same day you remit

Battery 25c extra **$5.00**

SKINDERVIKEN

414 Broadway New York



Tube Control Detector Panel Z. R. D. $12.00. One Stage Amplifier Panel Z. R. A. $18.00

Tube Control Panels

of unit size, 5¼" High 4½" Wide

Beauty and convenience have been incorporated in the design of these Panels to an unusual degree. The detector panel has a plug connection for the telephones which takes your regular 'phone tips. The amplifier panel has binding posts making it very easy to connect two of these together as a two-stage amplifier. Both instruments will give you the utmost value for your money, and the name Clapp-Eastham Co. engraved on the bakelite panel carries with it almost 13 years' development experience in the Radio Field. Catalogs mailed for 6c stamps.

Order one or both panels from your dealer today.

CLAPP-EASTHAM COMPANY
131 MAIN STREET :: CAMBRIDGE, MASS.

OUR GRADUATES

NOW WITH

Independent Wireless Telegraph Co.
Ship Owners Radio Service
Radio Corporation of America
International Radio Telegraph Co.
U. S. Army Transport Service
American Hawaiian Line
United Fruit Co. (Tropical Radio Co.)
Panama R. R. S. S. Co.
Cutting & Washington (Mfg. Co.)
U. S. Shipping Board

AND NUMEROUS OTHERS

The Radio Operator aboard American vessels is paid One Hundred and Twenty-five Dollars ($125.00) per month. Aside from this, he is also furnished food and quarters. He is an officer of the ship and consequently enjoys the privileges that go with such a position.

Call or Write for Booklet

Y. M. C. A. RADIO SCHOOL

152 East 86th Street, New York City

"Best Radio School in the East"

10¢ OR 25¢ AK **Anti-Kamnia** FOR HEADACHE, NEURALGIA, INFLUENZA AND ALL PAIN — Ask For A-K Tabs **TABLETS**

READ THE CLASSIFIED ADVERTISEMENTS ON PAGES 700-703, YOU'LL FIND MANY GOOD THINGS THERE.

Building "Your Own" Phonograph

PART 2

(*Continued from page* 630)

The efficacy of the valve or modul shown at C is approximately like "B," wh is used on one of the best makes of tall machines. This modulator comprises metal base-piece, as shown and to whic riveted or secured a piece of thick felt al ¼ inch in thickness and extending al ⅜ to ½ inch from the metal all arou The shaft on which this valve is moun passes thru two tightly fitted brass bushi or bearings, secured in the two side w of the throat of the amplifying cham The action of this modulator is eviden the tonal strength being a minimum w the valve is in the vertical position, blo ing off the chamber completely, and a maximum when it is turned to the ho zontal position.

SOUND-BOX DETAILS.

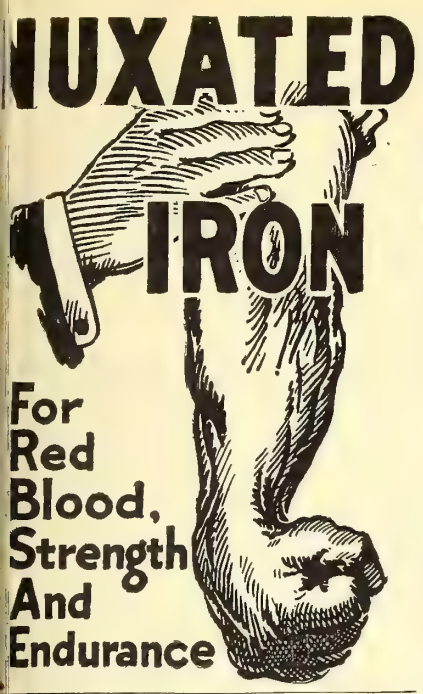
For those endeavoring to build a ta ing machine as cheaply as possible, a g sound-box costs quite a considerable amou and if you have a lathe or machine sh facilities you can build a first class sou box yourself, or have the necessary pa machined up by a machinist at a nomi cost.

One of the simplest sound-box desi we can make, can be constructed from watch-case telephone receiver as shown Fig. 6. A metal hub forms one of the b ways of joining the receiver, whether be metal or hard rubber composition, the tone-arm tube. The diafram, either mica, fiber—yes and tin has been used some cheap machines—is clampt secur by the usual screw cap. Making a n cap of metal and threading it to fit t threads on a *metal* shell, will permit y to tighten it up, so as to hold very firm the diafram; this is one of the all-importa things in phonograph sound-boxes if y want it to be free from rattling and oth unwanted noises when certain notes chords are played, which noises often a the symptoms of a loose diafram, even the best machines.

The support carrying the upright pi for the pivot screws, which may be or nary binding posts, is readily bent by hea ing the brass, or iron stock, it is to formed of. The stylus arm can be cut fro sheet brass or other material and cement or riveted to the exact center of the di fram. The needle holder or chuck may fashioned from a small binding post, b this is best made, of course, of the sha shown in the drawing.

Before going further, it may be said th the average diameter, that is, the *free v brating diameter* of the diafram, in th average phonograph sound-box measur two inches, some a little less, while othe are appreciably greater. The greater th diameter, the lower the pitch of the ma chine, while the smaller the diameter, th higher the pitch. A mica diafram usual measures about 6 mils or six-thousandth inch in thickness and is held between rub ber gaskets as shown at Fig. 7. The soun box design shown at Fig. 7, is one use a great deal among competition tone-arm and as will be seen, it is very simple t make from brass or other metal,—the dia fram being clampt between rubber gasket which may be formed of the two pieces o rubber tubing cut so as to exactly mee end to end. The stylus pivot shaft can b the tempered steel shaft from a discarde alarm clock balance-wheel. With a litt ingenuity, the tempered steel pivot cup screws can also be used, by mounting the in larger screws which pass thru the stylu bearing posts as shown in the diagram.

The upper end of the stylus arm is i some cases, both riveted and cemented t



NEW DIAL INDICATOR



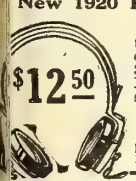
Fits standard ¼" Shaft. Made of same quality as our smaller dial. Black composition. White filled engraving. Bevelled edge.

⅜" Dial.....$0.75. With Knob.....$1.30 Postpaid
⅞" Dial..... 1.00. With Knob..... 1.70 Postpaid
Moorhead Electron Relay New Style....$6.00
Moorhead V.T. Amplifier..... 7.00
Moorehead Extra Hard V.T..... 7.50
Shipping weight 1 pound. Guaranteed. Licensed under Fleming and De Forest Patents.
Our new Catalog now ready, send 10c for it.
For sale at all RADISCO Agencies and by

A. H. CORWIN & CO.
West Park St., Dept.E-1, Newark, N. J.

RADIO MEN
THE
Mutual Purchasers Association
will save you money on all
WIRELESS APPARATUS
Write Dept. E. E. for details
MUTUAL PURCHASERS ASSOCIATION
2-4 Stone Street, New York

New 1920 RED HEAD PHONES



$12.50

We announce the new model of the famous Red Head Radio Receivers, greatly improved, 3200 ohms, $12.50 the pair. Write for Bulletin F6 for information on these supersensitive receivers.

THE NEWMAN-STERN CO.
Dept. E.E. Cleveland, Ohio
Distributors for DeForest, Murdock, Signal, Bunnell and other famous lines.

LEARN WIRELESS
the OLDEST, LARGEST and BEST EQUIPPED school of its kind in New England. Thousands of satisfied graduates all over the World. Splendid opportunities now in the Merchant Marine. Day and Evening classes. Start any Monday. Illustrated Prospectus for the asking.
EASTERN RADIO INSTITUTE
109E Boylston St. Boston, Mass.

WONDERFUL WIRELESS TELEGRAPH



Two Instruments & 2 Codes, with which you can Telegraph from house to house without wires. 10 CTS.
UNIVERSAL CO., DEPT. K Stamford, Conn.

the diafram. Suitable cement such as that used for repairing china, etc., can be obtained from any drug store. Red sealing wax is excellent, too.

An excellent stylus and sound-box is illustrated at Fig. 8, and in the writer's opinion it is one of the most desirable. Here the diafram clamping ring is simply a circular brass ring threaded on its perifery to fit the threads which have been turned on the inside of the reproducer shell, and the finer the threads the better, as the pressure can be applied more firmly and evenly. To tighten up the ring or to release it, use is made in this case, of a special wrench to be made for the purpose. It is fitted with from two to four steel pins, depending upon how many holes are used in the ring. In the average phonograph sound-box, the distance between the diafram and the surface of the inner wall is about ¼ inch. Any sound-box made like that at Fig. 8, with a diafram having a free vibrating diameter of about 2¼ inches, gives excellent results and corresponds in size to the one now in use on the writer's phonograph.

Rubber gaskets, not shown around the diafram at Fig. 8, are invariably to be used to absorb extraneous vibrations.

Among the substances which have been used are fiber, silk tightly stretched, goldbeateers' skin, Bristol-paper, tin, and particularly German silver which gives very good results indeed.

A friend of the writer's recently obtained a patent on a novel improvement in sound-boxes which enables any machine to be adjusted as to pitch for different ranges of sound, thus adapting any given diameter diafram to low, medium or high pitch records. Briefly explained, it comprises an adjustable ring fitted over the diafram and reducing its free vibrating diameter; the smaller the diameter, the higher the pitch, such as for playing soprano or tenor selections; while the larger the diameter permitted, the lower the pitch, such as for playing baritone or base selections. Finally, if you want the sweetest music, try fiber needles, or cactus points.

The Electric Shoes

By J. MAC-RICHARD

(*Continued from page 624*)

package under my arm when a carriage past me in the Rue Varnier and I heard voices which seemed familiar. I recognized the officer and the Englishman. They were sitting close together and laughing boisterously.

That aroused my suspicions. At my hotel I put on the pair of shoes intended for the King of Italy and hurried down to the dinner table. I toucht several people with my toe. But none of them showed any signs of electric shock. They merely seemed annoyed at my awkwardness. I had to admit myself that my famous shoes were no more *electric* than any other shoes. I had been the victim of a comedy played by two clever conspirators.

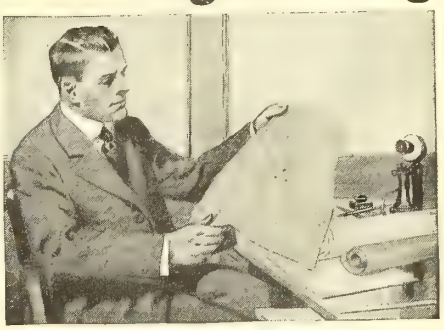
My first impulse was to make a complaint to the police. But since the story would certainly have raised a laugh at my expense, I thought it wiser to say nothing.—*New York Tribune.*

EDISON AT TELEGRAPH KEY AFTER NINETEEN YEARS.

Using a telegraph key for the first time in nineteen years, Thomas A. Edison recently sent from Orange, N. J., to a committee of the Old Time Telegraphers and Historical Association a message to be inscribed on an imperishable phonographic disc to be placed in the association's archives as a record of his style of "sending."

The last time Mr. Edison used a telegraph instrument was in 1901, when he sent a message to Chauncey M. Depew at the opening of the New York Electrical Exposition.

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6104-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE — Spanish
Sheet Metal Worker	Poultry Raising — French
Navigator	Automobiles — Italian

Name_____
Present Occupation_____ 7-26-19
Street and No._____
City_____ State_____

WANTED



$1600 FIRST YEAR
Examinations Everywhere Soon
Common education sufficient
Every man or boy over 16 should get ready.
LIFE JOB

COUPON

FRANKLIN INSTITUTE
Dept. C-181
Rochester, N. Y.
Sirs: — Send me at once, free of charge, sample of Railway Mail Examination questions, list of other U. S. Government positions, now open and free book describing them.
Name.....
Address.....

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section ten cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the December issue must reach us not later than October 22.

The Circulation of Science and Invention is over 150,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York, N. Y.

Auto Accessories.

Fords run 34 miles per gallon with our 1920 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all Motors. Runs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee. 30 days' trial. Air-Friction Carburetor Co., 270 Madison Ave., Dayton, Ohio.

Battery Charging Profits $100 to $250 clear monthly with HB equipment. Your lighting current or engine operates. No expense to you. Easy payment plan lets outfit earn own way. Satisfaction guaranteed. Write Hoberts, Troy, Ohio.

Auto Motor Supplies—Buick, Michigan, Stoddard-Dayton, Cadillac-Overland, E. M. F. Continental and Buda Motors, all types, $50 each and up. Special high-tension, 2 and 4 cylinder magnetos $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Tire Agents. Exclusive representatives to use and sell the new Mellinger Extra-Ply Tires. (No seconds.) Guarantee Bond 8,000 miles. Wholesale prices. Sample sections furnished. Mellinger Tire Co., 980 Oak, Kansas City, Mo.

Aeronautics.

Propellers for Aeroplane Propulsion, small propellers for motorcycle-driven snow and ice sleds, road speedsters and hydroplanes; 5-foot diameters $12, others in proportion. Hub mountings, bearings, sprockets and countershafts complete. Crawford Motor and Aeroplane Mfgr., 142 South Rampart St., New Orleans, La.

Automobiles.

Build your own speedster or racing body. Write today for money-saving pamphlet showing different styles. Floege's System of Body-Building, North Chicago, Ill.

Agents Wanted.

Agents. Sell our accident and sickness policies in your spare time. Pay $5,000 death, $25 weekly benefit. Premium $10 yearly. Permanent income from renewals. Easy seller. Liberal commission. Insurance Co., Dept. N-1, Newark, N. J.

Something New and Guaranteed. Write in metal with Overlin's Electric Pencil. Price $2.75, postpaid in United States. Dealers wanted. Western Accessories Co., Artisans Bldg., Portland, Ore.

Live Agents Wanted—In every city. Handle our complete line of fast selling products. No fakes or tricks. Everyday necessities. Big profits. Write today. Serviceable Merchandise Co., Dept. (B), 30 N. Michigan Ave., Chicago, Ill.

Make $30.00 next Saturday. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Co., 1047 Hayward Bldg., Detroit, Michigan.

Big Money varnishing floors, woodwork, etc.; $1 brings you directions for making brilliant oil varnish at 75 cents per gallon. C. Parker, Box 1234, Seattle, Wash.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Agents—$40-$100 week; free samples; gold sign letters; anyone can put on store windows; big demand; liberal offer to general agents. Metallic Letter Co., 433-Z, N. Clark, Chicago.

How to Mix 50 Different Colors; chart, $1 postpaid. Martineks Paint Co., 405 Lexington Ave., New York.

Make and Sell Your Own Goods. Formulas by expert chemists. Manufacturing processes and trade secrets. Write for formula catalog. Chapin Mystic Company, Washington, D. C.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

(Agents Wanted—Concluded.)

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, Glen Ridge, N. J.

Men—Get into the wonderful tailoring agency business; big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 759, Chicago.

Insyde Tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts; quickly applied; cost little; demand tremendous; profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, Ohio.

MARTINEK PAINT COMPANY
405 LEXINGTON AVENUE
NEW YORK

August 19th, 1920.

SCIENCE & INVENTION,
236 Fulton Street,
New York, N. Y.

Attention: Classified Advertising Dept.
Gentlemen:

Please cancel all existing orders and substitute five advertisements enclosed herewith to run "till forbid." Charge our account as usual.

With this increase in advertising in your medium, we hardly need to point out to you the satisfactory results obtained.

Yours very truly,
MARTINEK PAINT COMPANY,
(Signed) LOUIS MARTINEK.

Help Wanted.

Men—Get into the wonderful tailoring agency business; big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 760, Chicago.

Detectives and Investigators are in demand. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. American School of Criminology, Dept. E, Detroit, Mich.

Get a Business College Course at Home. Prepare to earn $100 to $200 month. Graduates placed in good positions. Details free. Brown's Home Study School, 310-R, Peoria, Ill.

Prominent Concern manufacturing commercial radio equipment requires the services of aggressive, intelligent sales engineer. A technical knowledge of undamped wave transmitters essential. Only those with selling experience considered. Salary and commission, also wide territory for sales promotion to right party. State fullest particulars. Box 90, Science and Invention.

Firemen, Brakemen, Baggagemen, $140-$200; colored porters by railroads everywhere. Experience unnecessary, 897 Ry. Bureau, East St. Louis, Ill.

U. S. Government wants railway mail clerks. Men—women, over 17. Commence $135 month. Quick raise. List positions free. Write immediately. Franklin Institute, Dept. C-25, Rochester, N. Y.

Money in Mirrors. Tells how to cash in big. All or spare time making and resilvering mirrors. Our formula best on market. Booklet free. Wear Mirror Works, Excelsior Springs, Missouri.

We will Start You in the cleaning and dyeing business. Little capital needed. Big profits. Write for booklet. The Ben-Vonde System, Dept. H, Charlotte, N. C.

Mr. Job Hunter. Let me help you get that job. Inside information by experienced employment manager. E. Quinn, 2448 Leland, Chicago.

Boys—Men. Become automobile experts; $45 week. Learn while earning. Write Franklin Institute, Dept. C-806, Rochester, N. Y.

(Help Wanted—Concluded.)

Be a Mirror Expert. $3-10 a day; spare ti home at first; no capital; we train, start y making and silvering mirrors French metho Free Prospectus. W. R. Derr, Pres., 579 Decat Street, Brooklyn, N. Y.

Detectives Earn Big Money. Excellent oppo tunity. Particulars free. American Detecti System, 1968 Broadway, New York.

Secret Service Men Earn Big Money. Trav easily learned. Write for our copyrighted boo let. Johnson's Detective School, 232 Sheld Ave., Grand Rapids, Mich., Desk A.

Earn $25 Weekly, spare time, writing for new papers, magazines. Experience unnecessary; d tails free. Press Syndicate, 5665 St. Louis, Mo.

Business Opportunities.

Men—Get into the wonderful tailoring agen business, big profits taking orders and your ov clothes free. We furnish fine sample outfit a everything free. No experience needed. Wri today. Banner Tailoring Co., Dept. 761, Chicag

Dollar for Seven Valuable Formulas; list, cents. Martineks Paint Co., 405 Lexington Av New York.

If You Want to Sell or Exchange your far unimproved land, city property or patent, wri me. John J. Black, 194th St., Chippewa Fall Wis.

Make $30.75 Profit on $2.50 outfit, gold transf monograms for automobiles, etc. Free sample National, P. O. Box 41-E, Station D, Brookly New York.

Enter a new business. Earn $3,000 to $6,0 yearly in professional fees making and fitting foot specialty, openings everywhere with all t trade you can attend to; easily learned by an one at home in a few weeks at small expens no further capital required; no goods to bu job hunting, soliciting or agency. Address St phenson Laboratory, 18 Back Bay, Boston, Mas

I Made $30 a Week evenings with a small Ma Order Business Home. Free Booklet tells ho 2c postage. Alex Scott, Cohoes, N. Y.

Be Independent—We teach by mail how t manufacture unexcelled toilet goods. Particula free. School of Cosmetics, Box C, Omaha, Ne

Patents for sale. To sell, buy or obtain patent write Patent News-309, Washington, D. C.

Turn Your Spare Time Into Money for that a paratus you want. Start a profitable, permanen home business. Steady weekly income. No in vestment but your brains and spare time. Pos tively no soliciting, agency proposition. Writ today. Address Opportunity, Box 175, Fredoni N. Y.

Dollars Yearly in Your Back Yard. No gi seng, mushroom dope. New ideas. Investigat Particulars free. Metz, 313 East 89, New Yor

Publish a Magazine of your own and start a advertising agency on $1 capital. Sample mag zine and plan, 25 cents, coin. Lowe Agency, 21 Warren Ave., Detroit, Mich.

"Money-Talks." The Business magazine pub lished for progressive people. Send for sampl copy. P. O., Box 236-B, Newark, New Jersey.

3,384 Moneymaking Plans. Formulas. Trade Secrets. "Encyclopedia Business Opportunities. 3 volumes $1. Ideal Book Shop, 5501-EV Nort Robey, Chicago.

New discovery! Establish a good, steady profitable business of your own. Whole or spar time. No canvassing or mail order propositio Everything necessary furnished. Write immedi ately. Ferber Company, 296-C Broadway, Ne York.

Substantial manufacturing corporation want capable men to establish branch and manag salesmen. $300 to $2,000 necessary. Will allow ex penses to Baltimore as explained. Address, Mr Clemmer, 603 N. Eutaw St., Baltimore, Md.

Breed Canaries. Profitable pastime. Particu lars free. Bird Farm, Lynnhaven, Virginia.

Unemployed Young Men. Earn $5 daily, dis tributing, collecting. Experience not necessary Sample outfit, 12 cents, coin. Business Builders 632 Warren Ave., Detroit, Mich.

Volume VIII.
Whole No. 91

Science and Invention

H. GERNSBACK – EDITOR
H.W. SECOR – ASSOCIATE EDITOR

NOVEMBER
1920
No. 7

NOV 5 - 1920

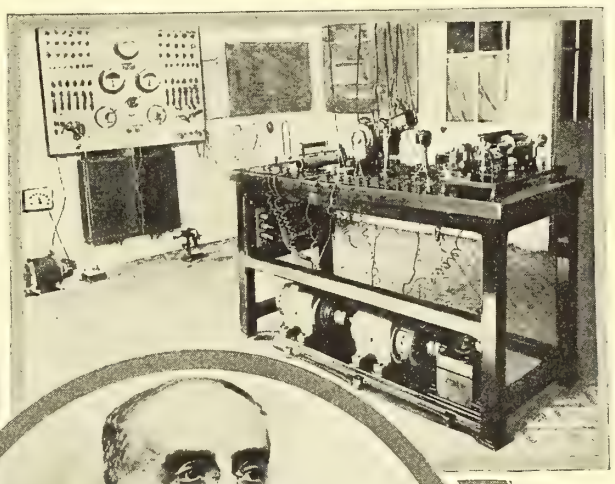
The Belin System of Telephotography

HOW PHOTOGRAPHS ARE TRANSMITTED AND RECEIVED OVER A TELEGRAPH OR TELEPHONE WIRE.

EDOUARD BELIN, a French inventor and electrician, has invented an apparatus for transmitting autographic writing, photographs and the like, by what may be termed a telegraphic process. In a few minutes a photograph or other design may be sent hundreds of miles; an occurrence of any sort or an important personage may be photographed and the picture may be received hundreds of miles away inside of an hour.

To do this the inventor uses a varying electric current, whose variations are produced mechanically at the sending station, and due to this current a mirror is caused to vibrate at the distant receiving station. The spot of light from the mirror is received on a sheet of sensitized paper and a photographic reproduction of the object at the distant station is produced on development of the latent image.

The transmitting apparatus comprises a cylinder on which is mounted the picture or script to be transmitted. This may be a sheet of gelatine, which has been so treated that the dark parts of the image on it are in relief. It may be a sheet of manuscript so prepared that the writing is in relief.

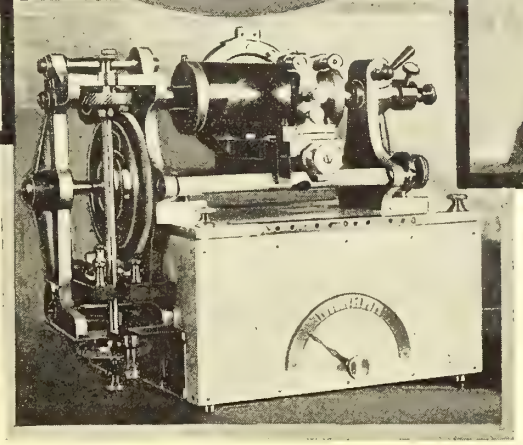


At Left: The Perfected Receiving Apparatus Used in the Belin System of Telephotography, Which Recently Transmitted Successfully Photographs and Hand-writing Over a Long Distance. Center Picture Shows the Inventor of the Newly Perfected Telephotography System, M. Edouard Belin.

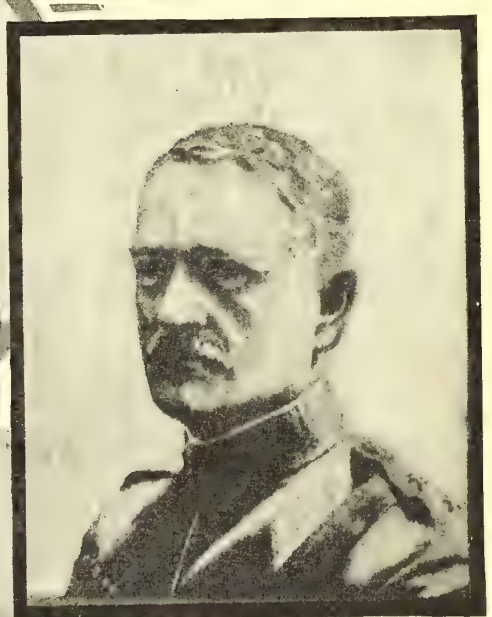


Half-tone Reproduction of Film on Which General Mangin's Portrait Was Received Over the Belin System, Without Retouching.





Portable Sending Instrument Used in the Belin Telephotography System. The Cylindrical Negative Causes a Microphonic Contact to Transmit Impulses Over the Circuit to the "Receiver," Which Records the Image Photographically on the Film, as Here Reproduced.



General Pershing's Photograph as Transmitted by the Belin Telephotograph. (It Has Not Been Retouched.)

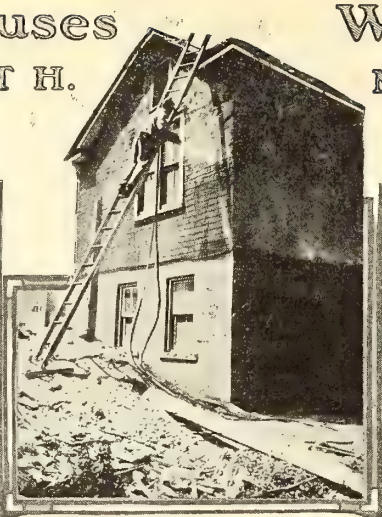
In transmitting, the cylinder rotates and an arm rests upon it and is caused slowly to traverse the length of the cylinder, exactly like the needle in the old-fashioned cylindrical phonograph. Thus the arm is thrown into vibration and the vibrations act upon a microphonic-type resistance by which a varying current is caused to pass over the telegraph line connecting the two stations. This current varies in (*Continued on page* 805)

Shooting Up Houses With Cement Gun

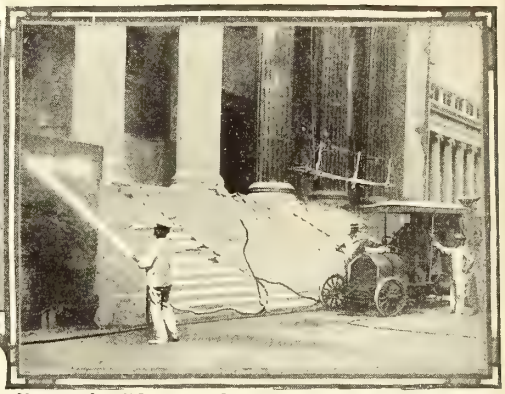
By ROBERT H. MOULTON



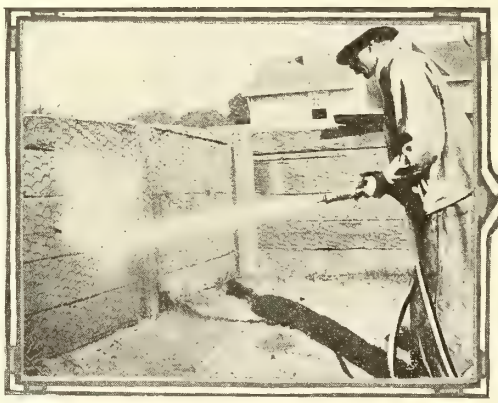
Illustrating Vividly What May be Accomplisht in Building Out in Relief, With But One Application of the "Cement Gun."



The Illustration Above Shows an Old Building Being Renovated With the "Cement Gun," After Covering the Walls With Wire Mesh to Support the Stucco.



Using the "Cement Gun" on the Field Museum at Chicago. Note the Difference Between the Two Columns at the Left Which Have Been Renovated and Those at the Right.



Very Rigid and Desirable Fences Are Quickly Constructed From a Wire or Wooden Slat Base, Afterward Treated with the "Cement Gun," as Shown in the Accompanying Picture at the Right. It Is Surprising How Rapidly Such a Fence or Wall Can be Covered By This New Process.



The "Cement Gun" Finds Another Rôle of Usefulness in "Tree Surgery." It Proves Particularly Efficacious for Such Work, as the Cement Is Blown Into the Holes Under High Pressure, Making the Joint Absolutely Air and Water Tight.

DURING the war *guns* were not only used for destroying buildings, but for erecting them, paradoxical as this may sound, and now the same principle is being applied to peace-time uses. This remarkable constructive shooting was effected by what are called "cement guns," used to apply cement stucco with great speed and in huge volume to steel or timber framing covered with wire network. The type of cement used for this purpose has been appropriately named "gunnite." In building army warehouses at various points a battery of "guns" was used, and as many as ten were sometimes projecting their sticky missiles at one time.

The cement gun, which looks more like a fire-hose squirting out a semi-liquid mixture than like a gun, consists essentially of a hopper into which the dry cement and sand, or other materials, are placed, a hose connected to the bottom of the hopper thru which the dry mixture is forced by air pressure, and a nozzle at the other end of the hose to which another hose supplying water is attached for hydrating (mixing with water) the cement. The hydration takes place while the materials are all in motion, and, leaving the nozzle, the mixture is "shot" upon the surfaces, or into inter-spaces of any aggregate. As the combination of the elements necessary to produce a plastic product takes place in transit, it will be seen what an advantage this is in connection with quick-setting materials. It not only obviates the use of a retardant, thereby increasing the quality of the product, but materially lessens its cost.

Heretofore the most serious criticism that has been made concerning plastic products has been their lack of uniformity, due to the human element in mixing them and in the methods of application. It is a well known engineering fact, that the instant moisture is brought into contact with plastic materials the initial *set*, or crystallization, begins, and that any subsequent manipulation or handling tends to disturb this initial crystallization, thereby weakening the entire product. The only way by which this fault could be corrected would be to have the hydration take place in such a manner that crystallization would begin only at the moment of the actual emplacement of the material on the place where it belongs. This is what the cement gun actually accomplishes.

Another advantage claimed for the gun is that only the amount of water actually necessary for hydration is used, the materials being projected with sufficient force to expel all surplus water and air, and the resulting product is denser, more homogeneous, and, consequently, more water-proof than anything yet attained by hand or machine processes. The labor involved is also said to be considerably less, while the saving in time is so great that the total cost of making and applying any plastic mixture by means of the gun is reduced to a minimum.

There would seem to be a very large field for the practical use of the cement gun. Foundation work and water-proofing below grade should be well adapted to this process. As a means of coating steel to prevent rust and corrosion it should prove superior to the ordinary method of painting, for a cement coating will wear much better and longer than one of paint.

Tree surgery is another thing that seems destined to undergo a revolution. There are hundreds of torn, cracked and decaying trees in the private yards, on the streets, and in the public parks of every city that could have their years of usefulness and ornament doubled, if they were given proper attention. The trouble is that it doesn't pay to go around and patch them up with hand-made cement or plaster, as it might be termed.

In the case of fences and other similar structures, and the interior and exterior walls of entire buildings, a special design of frame work is required. This consists of a wire mesh of the required size, with a wooden backing. The cement is shot upon this and after it has hardened the wooden backing is removed, leaving what is practically a reinforced cement wall. Such walls are claimed to be as fire-proof as they can be made by any known method.

In order to demonstrate this, a small building of two-inch by four-inch wood was constructed. Both the inside and outside were covered with building paper and over this was placed a wire mesh reinforcement with one inch of cement-sand stucco, leaving a four-inch air space between the walls. A scientifically built fire was then allowed to burn in it for fifteen minutes, after which buckets of water were thrown on the inside hot walls, with the result that only a little of the surface scaled off, and not a single crack developed. The outer coating of the rear wall was left off in order to determine whether or not the wooden studding would be affected by the heat, and it was found to be not even charred.

The cement gun is, of course, not adapted to the use of concrete, or other mixtures in which coarse gravel or stone forms one of the ingredients. But a solution of this problem may eventually be found in the construction of a "Concrete Cannon," and future generations may yet witness the unique spectacle of whole towns literally "bombarded" into existence in the same length of time that it now requires to erect one building of moderate proportions.

Super-Silkworms and Super-Silkworm Food

By RICHARD HOADLEY TINGLEY

ALMOST everybody knows that silkworms feed on mulberry leaves and, in some mysterious manner, spin the beautiful and delicate threads that our manufacturers weave into such popular and expensive garments. But the mulberry is a little leaf, and a little leaf is quickly consumed by the worm which has a truly Gargantuan appetite.

If some "Burbank" were to come forward with a tree which would grow a leaf fifteen or twenty times the size of the mulberry, and that the silkworms liked just as well, and spun just as good silk from feeding on it, wouldn't you think it was quite a discovery?

Almost everybody knows that silkworms spin their delicate threads around and around themselves an infinite number of times, and so encase themselves in cocoons from which the raw silk of commerce is unwound and skeined. What would you think if some genius had, by a process of domestication and breeding, developed a super-silkworm which, feeding on the big "Burbankized" leaves, would spin a cocoon twice as large as an ordinary cocoon, containing, of course, double the quantity of silk thread? Wouldn't you say he was "some inventor"?

And once more; if some inquiring mind had worked out a process of feeding silkworms by "doctoring" these big leaves in such a way that the worms would spin any color of silk desired, wouldn't you take off your hat to that man?

That all of these things have been successfully demonstrated, both experimentally and commercially, is the claim of the inventor, Dr. Vartan K. Osigian, an Armenian by birth tho a naturalized American citizen, who makes his home in New Orleans.

The wonderful tree that grows this big leaf is a cross between the mulberry and osage orange. The leaf is almost as big as your hat. The tree, which is known as the "Osigian Silktree," grows with great rapidity and is very prolific in leaves. A yearling tree produces from 5 to 10 pounds of leaves; a two-year-old, from 15 to 25 pounds; a three-year-old, from 35 to 40 pounds, and when eight to twelve years old, from 175 to 200 pounds. In his nursery at the Crescent City Dr. Osigian has two and a half million of these trees planted and growing which he sells to farmers who want to go into sericulture. It took years and years of trial and experiment to develop this tree and the doctor claims it will thrive in almost any soil.

A Giant Silkworm that Spins Silk in Any Color



Dr. Vartan K. Osigian and Specimens of American Grown Cocoons and Raw Silk.



Famous Osigian Silk Tree Leaf in Center, Others Shown are Japanese, Chinese, Italian and French. This Shows the Osigian Silk Tree Leaf to Be Ten Times Larger Than Leaves Produced in Any Other Country



Silk Worms Sleeping Fourth or Last Sleep.

It takes from seven to nine pounds of cocoons made by the ordinary silkworm to yield a pound of raw silk. A pound of raw silk can be spun from four and a half pounds of cocoons made by Dr. Osigian's super-silkworms. The super-silkworm is fifty per cent larger than the ordinary worm and the cocoon it makes is double the ordinary size and contains twice the quantity of silk thread. The reason for this is that the glands of the super-silkworm are larger, and the "Burbankized" leaves are so much more tender and nutritious than those of the mulberry. This tenderness causes the worm to eat more, hence the increase in quantity of thread. A single cocoon made by the super-silkworm will spin rather more than a mile of double strand silk thread. The product of 25,000 such cocoons would reel a thread that would encircle the globe at the equator.

The development of the Osigian Silktree is no secret. It is a simple grafting process and can be done by anyone familiar with such things. But the doctor has the ready-made super-silktree by the millions in his nursery in New Orleans, which make it unnecessary for farmers going into the silk business to take that trouble.

Neither is the development of the super-silkworm a secret. Dr. Osigian sells the eggs to anyone caring to buy. That, and the sale of his silktrees, is his business. But the coloring process he keeps to himself. He claims he can produce eighteen separate and distinct colors of silk by special feeding of the worms. I have not seen eighteen, but can vouch for at least half a dozen that I have seen. Not only this, but, the doctor tells me, *the progeny of silkworms producing red, green, blue, etc., will always spin threads of the same color as their parents.*

Dr. Osigian tells me he intends to keep the coloring secret to himself for a while yet—until he has proved to America the commercial benefit of this and his other inventions. "When this is done," he says, "I will make it known as a free gift to the people of the United States."

Japan is the greatest producer of raw silk in the world, and China comes next. The United States produces more manufactured silk than any other country, but is entirely dependent upon foreign countries for its

(*Continued on page* 786)

Leonardo da Vinci

By PROF. T. O'Conor Sloane, Ph. D.

IN the September number the life and achievements of Archimedes of the old-time Syracuse were described, and he was cited as the world's first great inventor. But now we come to a period between four and five hundred years ago, when Leonardo da Vinci (born 1452—died 1519) did his historic work. His father had four wives and a numerous offspring, and the position of his first-born, Leonardo, with the presumably rapid succession of stepmothers and half-brothers and half-sisters, is not supposed to have been a very happy one.

He entered, as a young man, the studio of the artist Verocchio, who, like the other artists of that day, was painter and sculptor, and practised other branches of more technical art as well, for those were the days of many-sided men. The story is told that the young student, Leonardo, painted an angel in one of Verocchio's pictures which so much surpast his master's work that Verocchio abandoned painting in color. This, like some of the other rather vivid stories in Vasari's "Lives of the Painters" is possibly fictitious; it is taken from this work.

Comparatively few of Leonardo's pictures are extant. They have suffered with the passage of years, or have entirely disappeared and been lost. Yet there are in existence today two of the most famous pictures in the world, which are his, "The Last Supper" and the "Mona Lisa" or "La Gioconda." The latter, it will be remembered, was stolen from the Paris museum some years ago, taken to Italy and afterward restored to its original place in the Salon Carré in the Louvre.

But it is another side of his character and another class of his wonderful genius that are to be touched upon here, for this unsurpast artist and sculptor (for such he was also) was one of the world's great inventors. His mechanical designs for all classes of machinery antedated by generations the work of the supposed modern inventors of the same things. There was absolutely nothing in the engineering field at that date which he did not touch upon. And the machines which he designed and left drawn and commented upon in his very voluminous memoirs could do excellent service in the shops of today.

He was greatly troubled by the fact that there was no prime motor in those days. The practical steam engine was not in use, altho in his sketches Leonardo shows the elements of a steam engine, which lacks only the condenser or even a jet of water to be periodically injected below the piston to constitute a single-acting steam engine. A jet thus employed, with simple gear to operate it, would give the Newcomen engine, which did good work in England for many years. This engine appeared centuries later than Leonardo's.

Accordingly he used manual power and animal power to drive his machines. Sometimes it would be a treadmill; in one case an animal and driver went up an inclined plane and descended in a platform or cage, elevator-fashion, and thus drove heavy mechanism.

A number of his inventions relate to war. Much of his attention in this line was given to the construction of cannon and small arms—some of the cannon he proposed to build up barrel-fashion, with hoops, because the powder of those days was far weaker than the present explosives. In his breech-loading guns the mount on the carriage and the elevating device in some cases are almost modern. One of his designs shows the screw breech block, similar to the present device.

The Edison of the Middle Ages--

In the War of 1870, the French brought into use the *Mitrailleuse*, a collection of rifle barrels bunched together, so as to discharge a quantity of small projectiles at once. But Leonardo was ahead of France in this respect. He arranged his barrels, parallel in some constructions and in other cases they were radially disposed, so as to cover a longer line in their discharge—and in still other cases he mounted them in sets on a rotating and sometimes on a rocking frame or block, so that one set after the other could be brought into action. He devised mortars for discharging bombs, and what is represented in one of his drawings, is a close approach to shrapnel.

In those days the walls of forts were scaled by ladders, so he got up an arrangement to push the ladders over, away from the wall, so that they would fall backward—undoubtedly greatly to the discomfort of the heavily armed soldiers who might be attempting to scale the walls. He had this all worked out in detail, even to the securing of the fulcra of his levers by a dovetail arrangement in the masonry. He also had chariots armed with the most vicious scythes, armed tortoise-like cars (something like the modern tanks), and a treadmill arrangement for discharging very powerful crossbows.

He also designed forts. These were adapted to withstand the methods of attack of those days, and are quite different, for that reason, from modern designs.

One example of his heavier engineering machinery is a clamshell dredger, which is not far different from what may be seen in use today, and which by a very ingenious arrangement of screws could be adapted for different depths of water. His knowledge of the multiplying of force by gear wheels and screws is excellently shown in one of his presses, which will produce an immense pressure—a long lever working a small pinion in its turn, meshing with a large gear wheel, which forces down the screw of the press, indicating an enormous power. In this line the printing press, coming right on the track of Guttenberg's invention of type, is shown in the illustration—almost a reminder of Benjamin Franklin's press of generations later date.

Then we find many other ingenious machines, such as the thread-cutting machine. Here we have lead screws such as are in use on large machinery, and the pitch of the screw being cut, is regulated by the changing of the gears as on modern lathes. He has shown the different gears lying on the floor, and his machine in some ways is almost more up to date than the modern lathe, for certainly the balanced travel of the die or thread-cutting tool, with the two lead screws, is a highly perfected type of construction.

There are any number of minor devices in line with mechanics due to him, such as the *lewis*, the well-known instrument for getting a hold on a block of stone for raising it. The instrument which we may call the "come-along" (borrowing an electrician's term) is termed by Leonardo *an instrument for opening a prison from within;* but the electrician uses his "come-along" for the more peaceful purpose of straining the wires taut on the poles. His drawings of chains for chain-drives are astonishingly modern, and the chains as he draws them would fit the modern bicycle or automobile. He even investigated the compass and constructed gimbels for keeping the bowl level, exactly as they are used today.

Another sketch of his shows a man with *water-shoes* gliding on the surface of the water, something which has often been attempted in recent times.

Flying machines excited great interest with him, and he made so many sketches of them in such varied designs that it is merely a question of choice as to which to reproduce. One of the most interesting ones is really the helicopter, but outside of that fact it shows an aerial propeller, and what has made the flying machine a possibility is an internal-combustion engine and the rapidly rotating aerial propeller. Leonardo possest the latter, but had no internal-combustion engine to turn it.

But Leonardo never departed from the idea of wing-beat, and in his drawings of flying machines the idea appears that he wisht to move the wings of the machine like a bird, and our aeronautical experts may yet succeed in making this type of machine fly.

Articles For "December"

The Fourth Dimension—What It Is, and What It Is Not.

Von Guericke, Torricelli and Pascal—Discoverers of the weight of the atmosphere and of apparatus for showing and measuring it—including the barometer.

Radium in the Treatment of Cancer. By Joseph H. Kraus.

The Truth About the Divining Rod. By Prof. T. O'Conor Sloane, Ph. D.

Do the Lungs Circulate the Blood—And Not the Heart? By George Anston.

Colloids and Colloidal Fuel—A recent development of an old chemical principle of immense economic possibilities, involving the use of coal dust and culm.

How Hollow Copper Statuary and Other Articles Are Made by Electrolysis. By Samuel Wein.

The Sun's Unknown Rays. By Rogers D. Rusk, M.A.

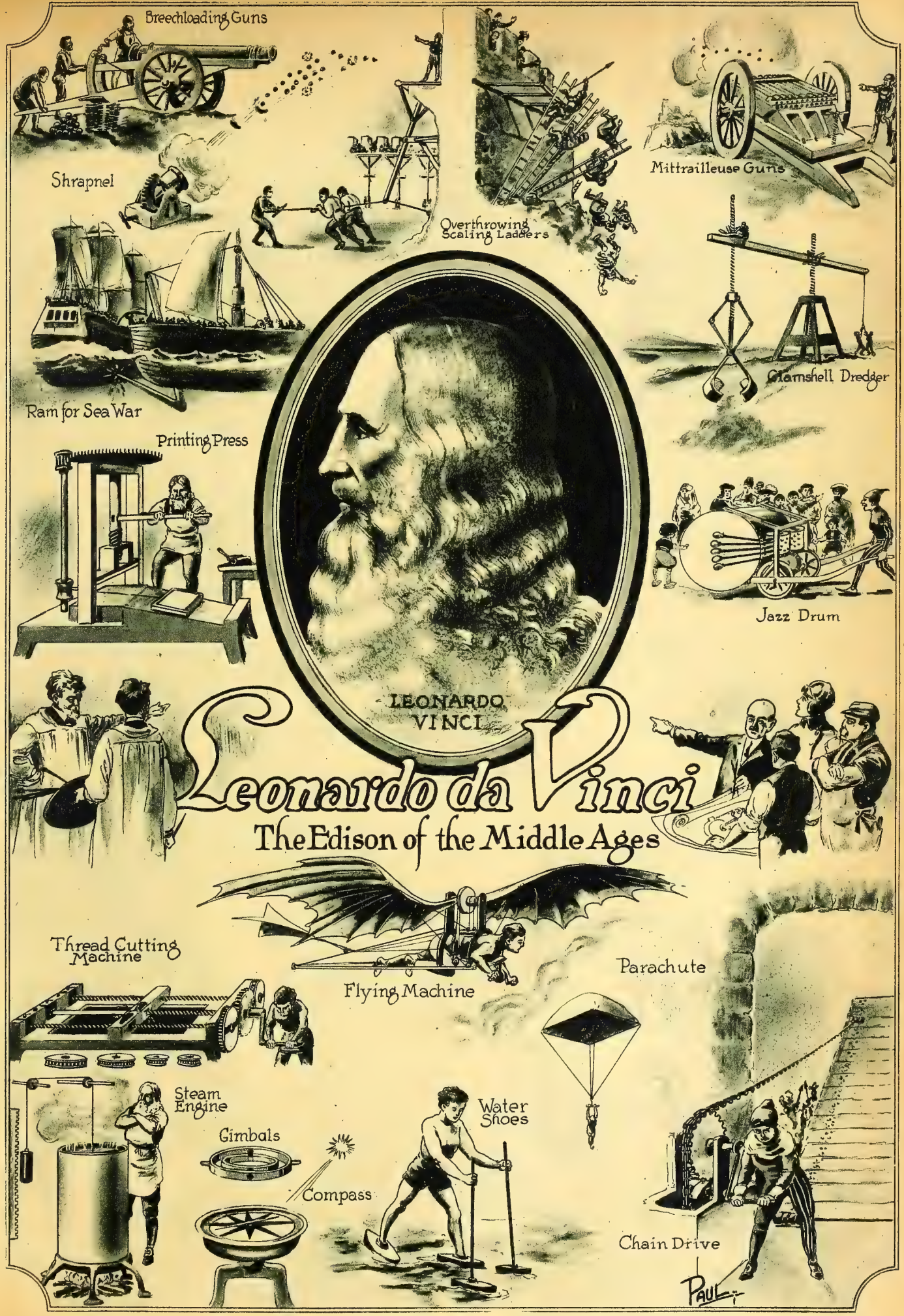
Some Fascinating Experiments in Chemistry. By O. Ivan Lee.

Easy Experiments in Glass Blowing. By Charles S. Wolfe.

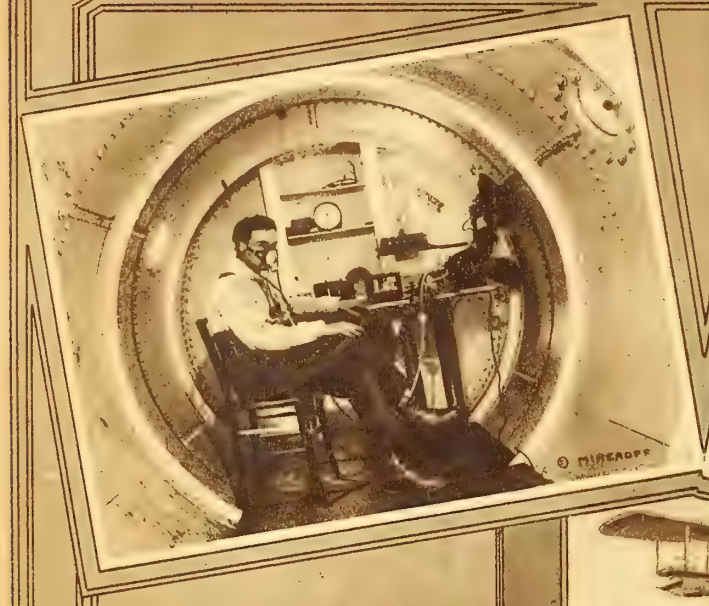
The Sense of Touch—How We Perceive the Difference Between Hot and Cold, the shape of objects, etc., popularly explained.

New Motion Picture Machine for the Home.

The Fastest Things in the World.


Breechloading Guns
Shrapnel
Overthrowing Scaling Ladders
Mitrailleuse Guns
Ram for Sea War
Clamshell Dredger
Printing Press
LEONARDO VINCI
Jazz Drum
Leonardo da Vinci
The Edison of the Middle Ages
Thread Cutting Machine
Flying Machine
Parachute
Steam Engine
Gimbals
Compass
Water Shoes
Chain Drive
PAUL

SCIENCE



How French Aviators Are Tested for Aptitude Fitness. An Ingenious and Unusual Device in Use at the Institute of Aerotechnique At St. Cyr, France. Within This Tunnel-like Affair Aviators (As Well as Their Planes) Are Put, and Exact Pressure and Velocity Conditions Artificially Duplicated.



By Means of Gages the Resistance of a Plane or Altitude of an Aviator Can Be Ascertained, Doing Away With the Great Danger of Death or Stupor Caused By Unusually High Altitudes When In Flight.



The Curtiss Entry in the Gordon Bennett Aerial Derby. Roland Rohifs, Chief Test Pilot for the Curtiss Co., Is Shown With the Plane. The Plane Was Especially Designed for This Race and Is Said to Develop a Speed of 200 Miles an Hour.



Washable Paper Clothes From Austria Introduced to American Manufacturers. The Exhibit Includes Workmen's Suits, Tablecover, Collar and Cuffs, Laundry-bag, Wall Decoration, Twine and Other Articles. This Photo Shows Two Men Wearing Paper Suits. They Are Shown Displaying a Brief-case, Knitting Bag and Table-cloth.



The New Automatic Liquid Poison Gas Gun Now in Use in Paris. Puts One Asleep At Once. Being Used Against Bandits. In the Last Few Months There Have Been Many Hold-ups In the Paris Streets. The Latest Terror Has Been Taxi Bandits Who Get Into the Taxi Cabs As Passengers, Suddenly Hold Up the Driver, Rob Him and Then Steal His Car. The Latest Protection Against These Many Hold-ups Is This New Gun.

IN PICTURES



A Ford Agent in San Francisco Built An Airplane Model for Advertising Purposes. It Is a Ford Chassis With An Airplane Body, With the Wings As Wide As the Motor Vehicle Law Will Allow. He Was Pinched By a Motorcycle Cop for Speeding and Tried To Get Out of It By Saying It Was An Airplane and Not Liable Under Ground Laws.

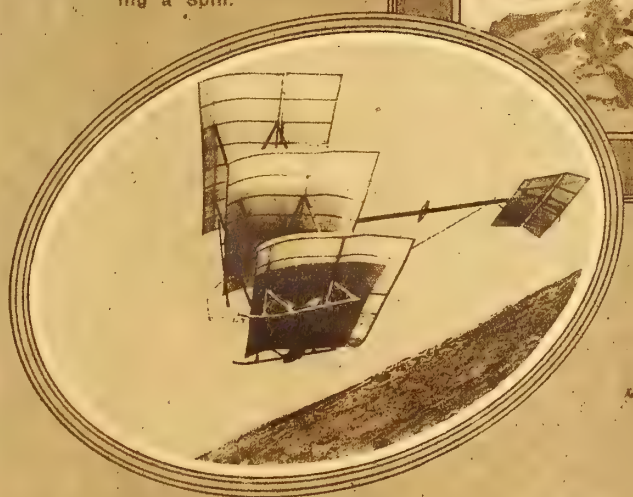


A Swiss Inventor, Emil Lowe, Who Recently Lost An Arm In An Accident, Determined To Overcome His Handicap In Driving a Car By Inventing a Device Which Would Enable Him To Steer and Run An Automobile With Perfect Safety. He Has Succeeded Admirably As the Photo Shows and Has Recently Received a License To Drive a Car After a Most Thoro Test of His Invention.



One Of the Strange Contraptions Recently Shown at the Military Circus Held In Chicago, Was a Double-headed Flivver With An Engine on Each End and So Arranged That the Two Drivers Can Go In Either Direction. The Photo Shows Two Soldiers Taking a Spin.

An Imperial Crown Made Instead of Glittering Gems Out of Thousands of Insects and Butterflies. The Effect Is Said To Be Most Colorful and Pleasing and To Suggest Varied Colored Precious Stones.





Frederick Richter Heuenstein, the Inventor of a New Motorless Glider, Proving the Practicability of His Invention in Germany. The Speed of the New Motorless Flying Apparatus Is Dependent on the Velocity of the Wind.

Tapping the Earth's Heat

By PROF. T. O'CONOR SLOANE, Ph.D.

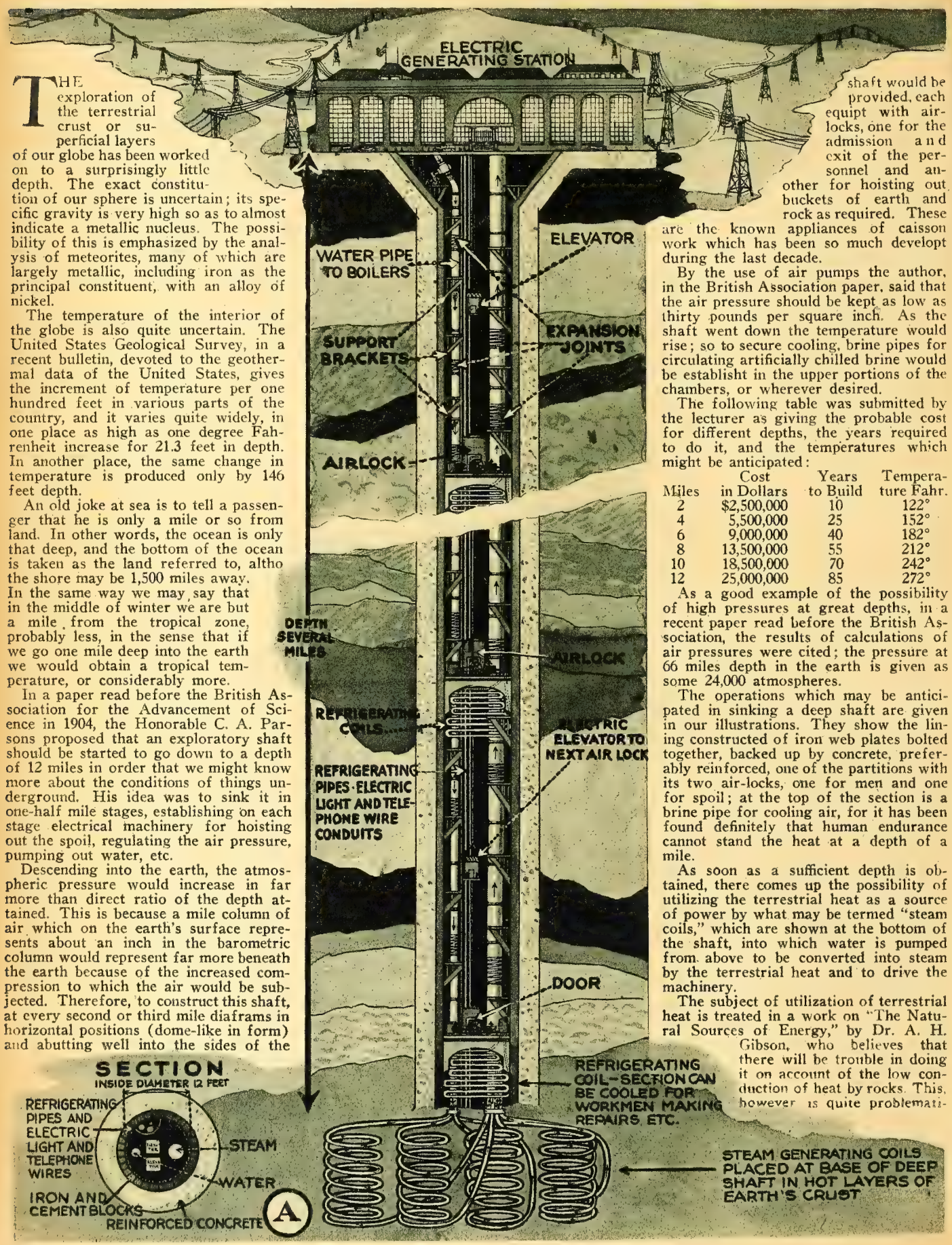
THE exploration of the terrestrial crust or superficial layers of our globe has been worked on to a surprisingly little depth. The exact constitution of our sphere is uncertain; its specific gravity is very high so as to almost indicate a metallic nucleus. The possibility of this is emphasized by the analysis of meteorites, many of which are largely metallic, including iron as the principal constituent, with an alloy of nickel.

The temperature of the interior of the globe is also quite uncertain. The United States Geological Survey, in a recent bulletin, devoted to the geothermal data of the United States, gives the increment of temperature per one hundred feet in various parts of the country, and it varies quite widely, in one place as high as one degree Fahrenheit increase for 21.3 feet in depth. In another place, the same change in temperature is produced only by 146 feet depth.

An old joke at sea is to tell a passenger that he is only a mile or so from land. In other words, the ocean is only that deep, and the bottom of the ocean is taken as the land referred to, altho the shore may be 1,500 miles away. In the same way we may say that in the middle of winter we are but a mile from the tropical zone, probably less, in the sense that if we go one mile deep into the earth we would obtain a tropical temperature, or considerably more.

In a paper read before the British Association for the Advancement of Science in 1904, the Honorable C. A. Parsons proposed that an exploratory shaft should be started to go down to a depth of 12 miles in order that we might know more about the conditions of things underground. His idea was to sink it in one-half mile stages, establishing on each stage electrical machinery for hoisting out the spoil, regulating the air pressure, pumping out water, etc.

Descending into the earth, the atmospheric pressure would increase in far more than direct ratio of the depth attained. This is because a mile column of air which on the earth's surface represents about an inch in the barometric column would represent far more beneath the earth because of the increased compression to which the air would be subjected. Therefore, to construct this shaft, at every second or third mile diaframs in horizontal positions (dome-like in form) and abutting well into the sides of the shaft would be provided, each equipt with air-locks, one for the admission and exit of the personnel and another for hoisting out buckets of earth and rock as required. These are the known appliances of caisson work which has been so much developt during the last decade.



By the use of air pumps the author, in the British Association paper, said that the air pressure should be kept as low as thirty pounds per square inch. As the shaft went down the temperature would rise; so to secure cooling, brine pipes for circulating artificially chilled brine would be establisht in the upper portions of the chambers, or wherever desired.

The following table was submitted by the lecturer as giving the probable cost for different depths, the years required to do it, and the temperatures which might be anticipated:

Miles	Cost in Dollars	Years to Build	Temperature Fahr.
2	$2,500,000	10	122°
4	5,500,000	25	152°
6	9,000,000	40	182°
8	13,500,000	55	212°
10	18,500,000	70	242°
12	25,000,000	85	272°

As a good example of the possibility of high pressures at great depths, in a recent paper read before the British Association, the results of calculations of air pressures were cited; the pressure at 66 miles depth in the earth is given as some 24,000 atmospheres.

The operations which may be anticipated in sinking a deep shaft are given in our illustrations. They show the lining constructed of iron web plates bolted together, backed up by concrete, preferably reinforced, one of the partitions with its two air-locks, one for men and one for spoil; at the top of the section is a brine pipe for cooling air, for it has been found definitely that human endurance cannot stand the heat at a depth of a mile.

As soon as a sufficient depth is obtained, there comes up the possibility of utilizing the terrestrial heat as a source of power by what may be termed "steam coils," which are shown at the bottom of the shaft, into which water is pumped from above to be converted into steam by the terrestrial heat and to drive the machinery.

The subject of utilization of terrestrial heat is treated in a work on "The Natural Sources of Energy," by Dr. A. H. Gibson, who believes that there will be trouble in doing it on account of the low conduction of heat by rocks. This, however is quite problemati-

cal, and there is every possibility that steam can be produced if we once obtain a low enough depth. The contraction and expansion of the long pipes and tubing are to be provided for by long expansion joints plentifully placed along the pipe lines.

There would be apprehension of seismic disturbances, and while it may seem far-fetched, it is quite possible that intense radio-activity might be encountered from which the operators would have to be protected by heavy lead screens. Again, if the temperature was not high enough to make steam from water before the requisite depth was reached, a sulfur dioxide, ether or gasoline engine could be employed. This would mean low efficiency, but if it were possible to really draw upon the terrestrial heat the efficiency would be quite a side issue.

In one of the illustrations we show what may be termed a possibility, the heating of a house by terrestrial heat. Cold water descends thru a pipe coated with asbestos composition to a heating chamber at the bottom of a deep shaft. It is here warmed and by thermo-syphonic action ascends thru another asbestos coated pipe so as to force a flood of hot water into the house.

Variations of this method could be introduced by circulating steam in the same way so as to get a steam heating apparatus.

Should quicksand or very wet ground be encountered, the well-known freezing process would be available to freeze a zone, so as to exclude water and enable the treacherous soil to be treated as rock until the lining was in place.

A depth of 7,579 feet is the greatest that has been attained by man, and this was by drilling, so that the well had a diameter of but a few inches. No law explaining the increase of temperature with depth has yet been discovered. In the wells in which tests have been made 168.6 degrees F. have been found at a depth of 7,500 feet. It is (in round numbers) 44 degrees short of boiling. The well that attained this depth, the Lake Well, West Virginia, collapsed at the bottom where it had been left unlined, reliance being placed on the natural rock to hold its own shape. It is evident that the mere support of the wall at the sides of a twelve-mile shaft might entail considerable difficulty.

There is one peculiar feature to be encountered in this operation of sinking a deep shaft into the earth. The pressure of the air in the shaft would increase in far more than arithmetical ratio, so that the engineers would be, as it were, between two fires. In caisson work, air is pumpt in, in order to expel water by its pressure, and when three atmospheres are exceeded, the condition in the caisson is very severe for the workman; but in our deep shaft, without any pumping in of air, the air pressure will increase, so that if the great depths thought of by Mr. Parsons were attained, the problem would be not to maintain pressure in the different chambers, but rather to diminish it. But this again would involve the admission of water, as the atmospheric pressure would be reduced. If the water pressure in the rock and sand of the earth at these depths had any reference to its hydraulic head, as represented by the distance from the earth's surface, the pressure would be so tremendous that air pressure could not cope with it, without exceeding many times the power of human endurance. Roughly speaking, a head of two feet of water represents a pound pressure, so that a mile of water would represent about 150 atmospheres.

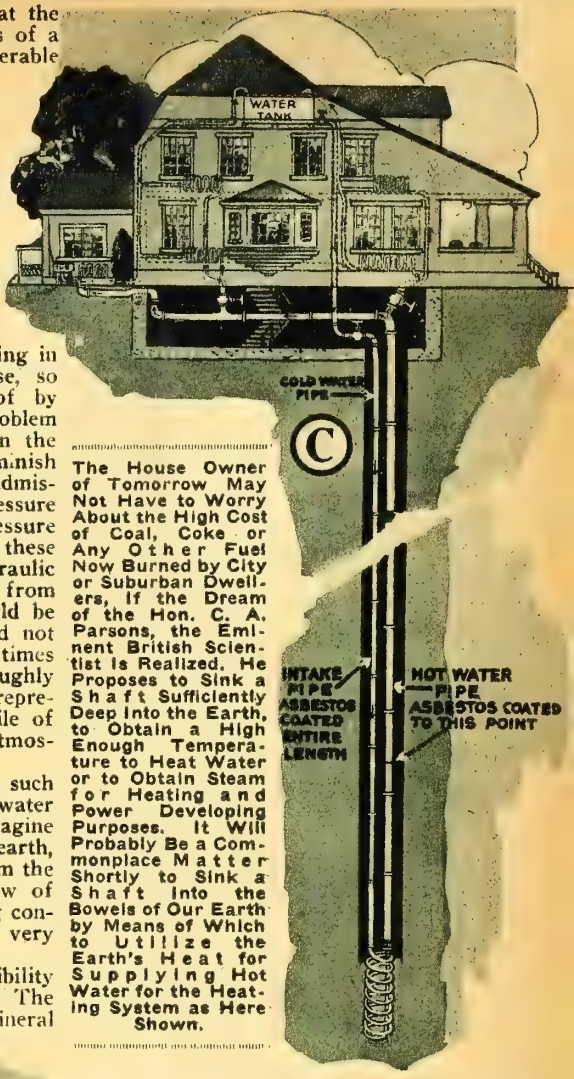
It is perfectly true that in mines, no such trouble is experienced because when water enters, it is pumpt out; but if we imagine a closed chamber, miles down in the earth, under pressure differing not widely from the hydraulic head, and with a large flow of water into it, the maintenance of living conditions within that chamber might be very difficult.

Allusion has been made to the possibility of manifestations of radio-activity. The great benefit attributed to natural mineral water, and which benefit in the popular conception at least is not present in artificial mineral water, has been attributed to the presence in it, of radio-active substances, so that when the water is imbibed, emanations may be taken into the system along with it. The presence of this radio-activity in spring water definitely indicates the presence of radio-activity in the crust of the earth. Therefore it is not going too far to indulge in the supposition that the phenomenon may be encountered at relatively high intensity, as unknown subterranean strata are penetrated.

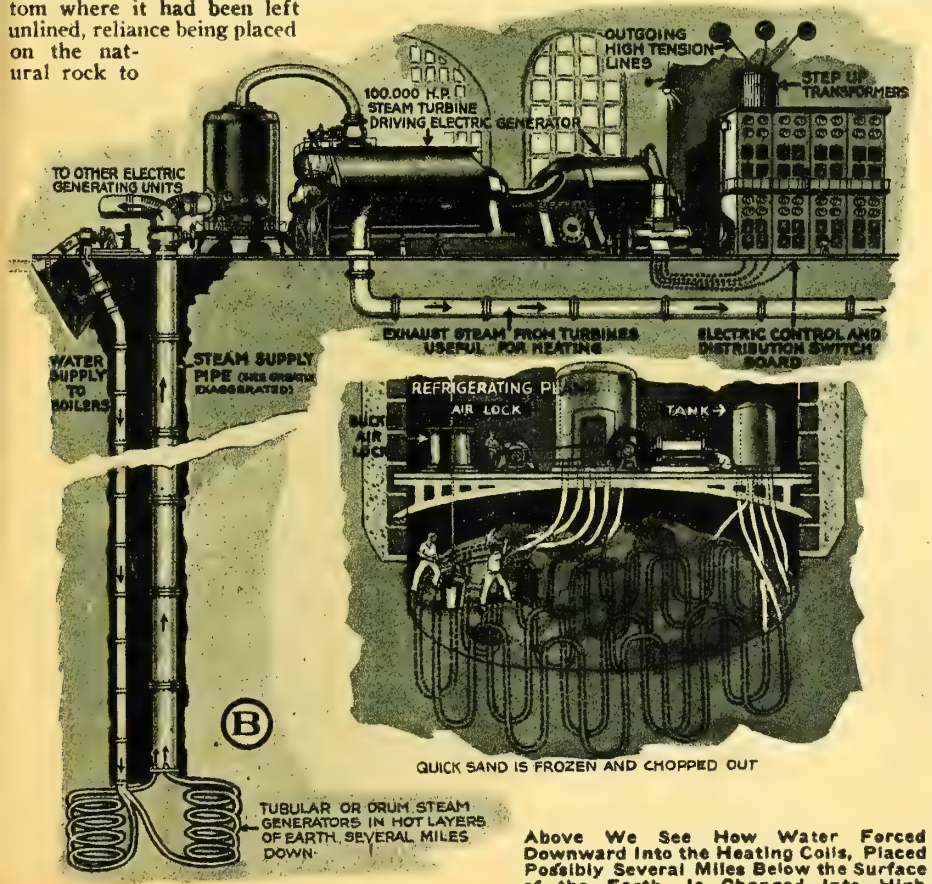
As we talk of the exhaustion of oil and coal, the most striking feature is the small depth of the earth's crust which we have been able to exploit,—and it is quite possible that the Parsons deep shaft might reveal sources of coal and oil unknown to us. But it seems probable that the presence of carboniferous substances is not to be looked for or anticipated at depths exceeding two miles, altho in our ignorance of the conditions, we do not know how deep down what we may term geologic ages may have formed their deposits on the earth's surface.

Little has been said about the lateral pressure of the rocks and it is far from certain that rock may not be encountered of so friable a nature as to threaten to crush in the sides of the strongest shaft which could be constructed. The whole subject of these uncertainties, possibilities and difficulties, would be worthy of treatment by a Jules Verne or a Rider Haggard.

Certain it is that the engineers of today are quite capable of sinking a shaft down into the earth far deeper than any so far constructed. It is only a few years since under-river tunnels were looked at with awe, even by engineers. Now they are mathematically designed and constructed.



The House Owner of Tomorrow May Not Have to Worry About the High Cost of Coal, Coke or Any Other Fuel Now Burned by City or Suburban Dwellers, If the Dream of the Hon. C. A. Parsons, the Eminent British Scientist Is Realized. He Proposes to Sink a Shaft Sufficiently Deep Into the Earth, to Obtain a High Enough Temperature to Heat Water or to Obtain Steam for Heating and Power Developing Purposes. It Will Probably Be a Commonplace Matter Shortly to Sink a Shaft Into the Bowels of Our Earth by Means of Which to Utilize the Earth's Heat for Supplying Hot Water for the Heating System as Here Shown.



Above We See How Water Forced Downward Into the Heating Coils, Placed Possibly Several Miles Below the Surface of the Earth, Is Changed Into High Pressure Steam Which Is Carried Upward to Huge Electric Generating Units, the Power To Be Distributed Over Great Areas by Means of High Voltage Transmission Lines. The Lower Figure Shows Men Working on the Shaft Construction at Great Depths by Freezing the Quicksand and Working Under Air Pressure as in Building River Tunnels.

Dr. Pringle Discusses Life

By JOHN DE QUER

"LIFE is an electrical phenomenon," said Dr. Pringle in reply to my question as to what he considered life to be. "It is, as must be evident to every one, a manifestation of energy—a mode of motion, so to speak." He leaned back in his office chair and watched the ringlets of smoke from his cigar float away toward the ceiling. In a few moments he continued: "Yes, that is it, a mode of motion, akin to light, heat, electricity, magnetism, gravitation, attraction and repulsion; it is, an as not yet understood, co-mingling of atomic matter, and know what life is until we know what matter is, for life and matter are interdependent. They are in themselves not basic, but effects of antecedent causes. The answer to either the question, What is Life? or What is Matter? in the present state of our knowledge can be answered only speculatively. It is my opinion that scientists will have to cease their quest for an explanation of life in the domain of chemistry and mechanics, for this search has so far been fruitless and for the very good reason that life is associated with matter in a way not unlike that by which electricity is associated with a charged body or a live wire. It is in what happens in this vacuum tube, or in the blue flame which just now leapt between these two poles, that we must look for the doorway beyond which lies the source of all phenomena, material and dynamic.

"In order that we may come to a rational understanding anent the problem of life, I would suggest that we begin our investigation at either the lowest depths, or the highest peak which science has reached in its quest after the ultimate truth concerning the physical universe.



© 1920 by Science & Invention

"He Walked Across the Room to His Aquarium, and Presently Returned With a Large Living Frog. Holding the Web Of the Creature's Foot, He Showed Me Its Blood Corpuscles Trailing After One Another In Perfect Chains Thru Its Capillary Structures. 'Like the Granules,' Said He, 'It Looks As If They Might Be a Sort Of Secondary Generator,—These Blood Cells. They Are Cutting Magnetism, Making Electrons—That's the Business Of Living. Life Is the Process of Generating That Particular Series Of Electrical Phenomena Which Enables An Organism To Survive.' . . . ."

what, for want of a better name, may be called the proto-material forces." He paused in his conversation, whirled leisurely around and pulled a switch on a powerful electric transformer connected with an X-ray apparatus. A buzzing noise was the result. A few minutes later he closed another switch and a blue flame, or spark, leapt across a gap between two poles six inches apart. He let it flash until a pungent smell reached our nostrils. "Smell that?" he asked, and then, answering his own question, he said. "That is tri-atomic oxygen, commonly called ozone. It is due to a recombination of the oxygen atoms in the air, consequent upon a stream of electrons or, as they might be called, ether vortices, passing thru it."

Running his fingers meditatively thru his hair and methodically flicking the ashes from his cigar, he continued: "I have come to the conclusion that we will never

WE have in the past publisht a good many scientific stories which not only have been a source of enjoyment to our readers, but which have instructed them as well.

In the present story, Mr. DeQuer has managed to put into his story an unusual amount of scientific wealth that will be greatly enjoyed by everyone in quest of scientific knowledge.

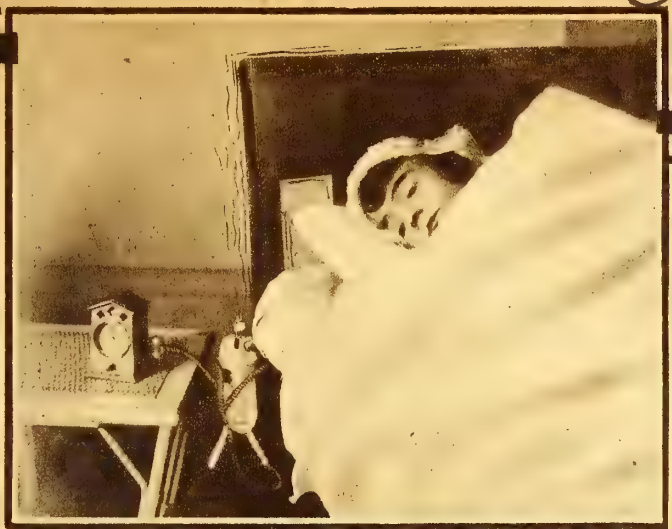
As a matter of fact, Mr. DeQuer has come closer to explaining in popular language what electricity really is than any writer we know of.

While we personally do not endorse Mr. DeQuer's explanation of life, we think our readers nevertheless will find the story highly interesting.—EDITOR.

"The heights are approached by ascending the following steps. First, we deal with solids at ordinary temperatures. Notice, I say ordinary temperatures, for if we reduce the temperature, we follow the descending scale in which water solidifies into ice and ultimately air becomes fluid and perhaps, as we approach absolute zero, solid. But we are discussing the ascending scale. When we increase ordinary temperature but a few degrees, water turns to vapor and ultimately to gas. Increase the temperature still more and one after another the metals liquefy and ultimately, if the temperature is still further increased, volatilize and become gas. This law is like that of the Medes and the Persians, unalterable. It postulates that the physical state of matter, whether solid, liquid or gaseous, depends upon temperature. Many concrete things in nature obey this law. Such have their melting, boiling,

(*Continued on page* 793)

Awakening de Luxe



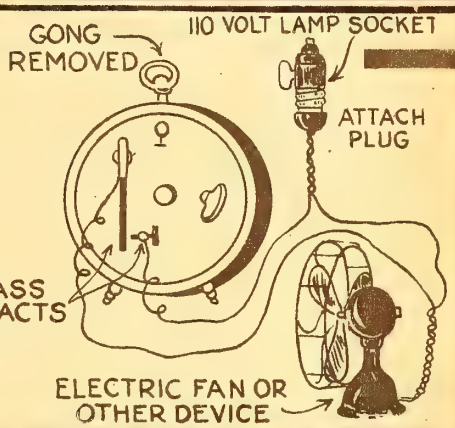
Not Pleasant, But Surely Effective, Is the Vibrator Method Of Awakening—a Clock Attached Properly To An Electric Vibrator Which Is Clamped To the Bed Will Waken the Most Scandinavian Farm Hand.

Sea Breezes Electrically Produced By An Alarm Clock and An Electric Fan Make One Especially Happy and Agreeable the Remainder of the Day.









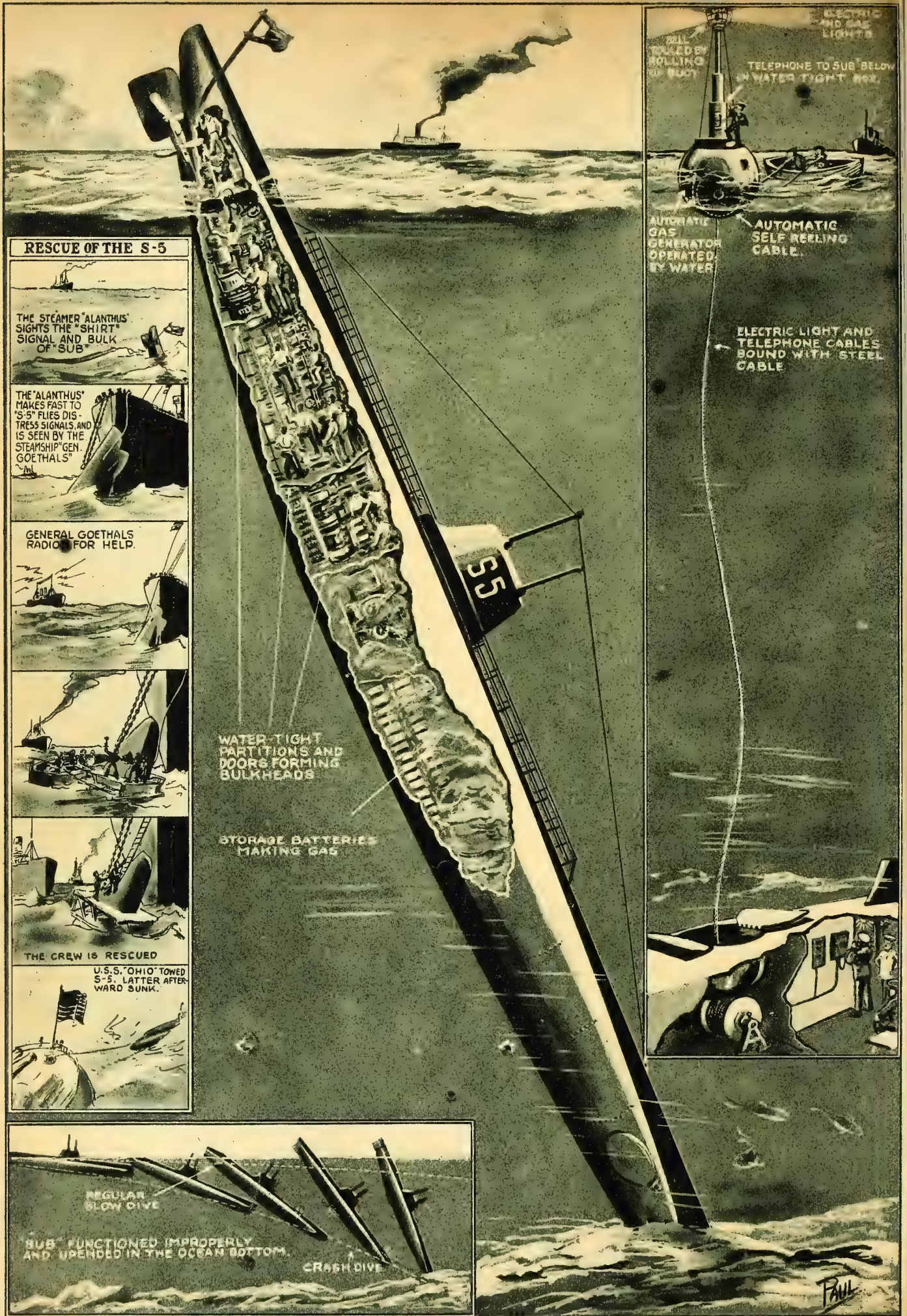
The Sense of Smell Is An Ideal Route By Which To Waken. A Clock Properly Connected to the House Current and Also To Incense Coils, May Be Electrically Started In the Morning So That One Is Wakened By His Favorite Incense.



An Electric Light Thrown In the Eyes Is a Pleasant Way of Being Awakened. A Little Clock Can Be Easily Connected To the Light. For Night Nurses, This Method Is Especially Good, As There Is No Noise In Connection With It To Awaken the Patient.



Let Music Waken You By Attaching To the Phonograph This Little Clock. It Has An Arm Which Releases the Record At a Predetermined Time.


RESCUE OF THE S-5
THE STEAMER "ALANTHUS" SIGHTS THE "SHIRT" SIGNAL AND BULK OF "SUB"
THE "ALANTHUS" MAKES FAST TO "S-5" FLIES DISTRESS SIGNALS, AND IS SEEN BY THE STEAMSHIP "GEN. GOETHALS"
GENERAL GOETHALS RADIOS FOR HELP.
THE CREW IS RESCUED
U.S.S. "OHIO" TOWED S-5. LATTER AFTERWARD SUNK.
S5
WATER TIGHT PARTITIONS AND DOORS FORMING BULKHEADS
STORAGE BATTERIES MAKING GAS
TELEPHONE TO SUB BELOW IN WATER TIGHT BOX.
AUTOMATIC GAS GENERATOR OPERATED BY WATER
AUTOMATIC SELF REELING CABLE.
ELECTRIC LIGHT AND TELEPHONE CABLES BOUND WITH STEEL CABLE
REGULAR SLOW DIVE
"SUB" FUNCTIONED IMPROPERLY AND UPENDED IN THE OCEAN BOTTOM.
CRASH DIVE
PAUL

When The "Sub S-5" Sank

Why Science Failed to Indicate the Plight of the S-5

LIEUT.-COMMANDER CHARLES M. COOKE, commander of the ill-fated "S-5," the submarine in which he and his crew were imprisoned for thirty-seven hours at the bottom of the sea off the Delaware Capes, gave the following vivid account of the disaster:

"We left Boston on what was to be a seventy-two-hour endurance run to Baltimore. On Wednesday, shortly after noon, in the ordinary routine of practise, the signal was given for a crash dive. We were about fifty-five miles east by south of the Delaware Capes. The "S-5" is to be suddenly submerged.

"The tanks were flooded, elevating rudders set at a slight diving angle and we commenced the dive. The vessel seemed to take to her new inclination with more than usual speed. In a moment one of the men from forward ran into the central compartment and reported the torpedo compartment was flooding. Water had also been made from overhead aft, and I realized that the forward induction vent had not been closed when we submerged and that we were being flooded thru the ship's ventilating system.

"I gave orders to close the valve, but attempts to do this had already failed, the volume of water entering preventing the men from operating it.

"This all was a matter of very few seconds.

"The vessel now inclined at a steep angles, despite the rudders being put at 'hard rise,' and in another moment the bow struck bottom with a shudder that ran thru the ship. The conning tower depth gage showed 170 feet.

"The men under Chief Gunner's Mate Fox were ordered from the torpedo compartment and the bulkhead doors between that and the battery compartment next aft was secured. There was already considerable water in this second compartment.

"Several tons of water rushed forward against the forward bulkhead and also what loose gear there was dropt down about us in an indiscriminate heap. The door between the central control compartment and the engine room had been closed, separating the engineering force and Lieutenant Grisham. The main pumps of the vessel were now put to work, but owing to the angle of the vessel, the gear about the suctions and other causes they availed nothing.

STORAGE BATTERY CAUSES CHLORIN GAS FUMES.

"The inclination of the vessel caused the electrolyte solution to pour from the battery jars, and this, now mingling with the salt water rolling about the battery compartment, began to generate strong chlorin gas fumes which began to smoke and gag the men in that compartment and with me."

Professor T. O'Conor Sloane thus explains the action whereby poisonous gas was produced on the submarine "S-5."

"The batteries on the submarine 'S-5' were lead plate storage batteries. In the charging process the positive plate becomes coated with lead peroxide, produced, as batteries are now made, from the paste of lower lead oxides, which is applied to the plate in the process of construction.

"In the forming and in the subsequent charging, the lower lead oxides on the positive plate are changed to the higher oxide, the peroxide, PbO_2, and the plate assumes a chocolate color. Lead peroxide has two atoms of oxygen in the molecule, where the protoxide or litharge has but one.

"If hydrochloric acid reacts upon lead peroxide, chlorin is set free with the formation of lead chlorid; the liberation of free chlorin is due to the extra atom of oxygen in the lead peroxide molecule. When sea-water gets into a lead plate storage battery the sulfuric acid reacts upon the salt (sodium chlorid) in the water forming sodium sulfate and setting free hydrochloric acid. This reacts as described above, and chlorin, an irritant deadly gas of intolerable odor is generated. A small percentage makes air non-respirable. It can be guarded against by gas masks. Chlorin was one of the first poison gases used in the World War.

"In charging a storage battery, hydrogen gas is evolved, especially in the latter stages of the charging. Not only does this evolution affect the atmosphere by carrying sulfuric acid spray into it as the bubbles burst, making it very irritating, but if enough gas is evolved with insufficient ventilation, an explosive mixture of air and hydrogen is formed, which will be exploded by a lighted match or other flame.

"There have been some very bad explosions on submarines due to this cause.

"In the submerged submarine 'S-5' the crew suffered from chlorin gas and seem to have had no provision against it effects."

Commander Cooke continues:

"The battery compartment was abandoned, the water-tight door closed and efforts bent to open the engine room door against this head of water. We were in speaking communication with the after part of the vessel and with the co-operation of the engine room force the door was pusht open, several tons of water pouring down over the men in the central control room.

"This was several hours after the accident, and thru the good work of electricians the lights, tho diming, were still in commission. The men were all moved aft, which meant climbing hand over hand thru the ship, and the engine room door was again secured, shutting off the flow of deadly chlorin gas, and placing the whole crew in the three after apartments; the engine room, the electric motor room and the tiller compartment at the extreme stern.

"Knowing the depth of the water, I assumed there might be a reasonable chance of the ship's stern protruding above the surface, and, with that in view, the outside skin of the vessel was carefully sounded. We heard the waves lapping the side a few feet from the stern, and to prove our conclusion got a breast drill and a small bit and drilled an eighth-inch hole.

"All our strength was then directed to cutting out a hole thru the skin of the vessel with the tools at our command. Breast drills and ratchet drills were brought up from the engine room, and in the narrow space of the tiller room the men fought like heroes for their freedom and lives.

ELECTRIC DRILL SHOCKS CREW.

"To expedite the work, to which had been added cold chisels, hack-saws and hammers, a heavy electric drill, boring a three-eighths-inch hole, was brought into play. The men were all in soaking clothing and all of the power circuits that still worked were badly grounded.

"When the current was turned on the drill a large part of the power past thru the body of the man operating it, knotting his muscles, binding his arms to his side and subjecting him to excruciating agony. The men did not falter, one after another taking up the slow work, and held in his place by companions. This drill bored only four holes, working all Wednesday night. They were cut thru by saws without handles from one to another.

"At dawn Thursday as I worked at the hole, I saw a vessel pass some distance off, but did not notify the men, as it would have done no good. By that time we had a jagged triangular hole some six inches by five, shaped not unlike a high shoe cut thru the ship's skin.

"The men were by this time almost exhausted and, due to the vitiated air, could work only in one or two-minute shifts at the hole. Work was kept on, however, and a watch at the same time was kept for ships, two more of which past in the morning, but too far away to notice us for more than a piece of floating wreckage if they saw us at all. The hole did not relieve the bad air, very little air coming in, the bad air merely passing out.

PIECE OF CLOTH THE SIGNAL THAT BROUGHT HELP.

"A sailor's undershirt was rigged on to a length of brass pipe and put out thru the hole as an improvised distress signal. Toward noon a vessel appeared nearer and nearer, and our shirt was waved vigorously, using the pipe as a lever and the hole as a fulcrum. The ship moved toward us, apparently to investigate us, and as she neared I pulled the signal violently in and out and finally shouted with all the strength that remained. The ship, which afterward proved to be the *Alanthus,* came quite close, changed course suddenly and finally past out of sight ahead.

"After what seemed an interminable length of discouraging wait the *Alanthus* again appeared quite close and around our stern and the men's spirit revived. Presently we got a hail which we answered, and a boat came alongside. I talked to the men thru the hole and told them our situation.

"They brought water in buckets from the *Alanthus* which was poured thru the hole with a funnel and caught by us inside. The *Alanthus* then crept up close to us and Captain E. C. Johnson assured our upright position by making cables fast to our stern which were drawn up tight.

FRESH AIR PUMPT IN THRU HOSE.

"A wash-deck hose was raised to one of his deck pumps, led thru the hole and forced pure air down to us. This in a short time had a revivifying effect on the men who at this time had had nothing to eat or drink in about twenty-eight hours.

"A staging was floated alongside our stern and the *Alanthus* attacked us from the outside with what meagre tools she had for that work. Then the Pan-American liner *General George Goethals* came up and reinforced the Alanthus. Chief Engineer W. R. Grace of the *Goethals* brought over cold chisels, drills and hammers. This was Thursday evening.

"Mr. Grace worked himself at breast drills and chisels continuously for eight

(*Continued on page 786*)

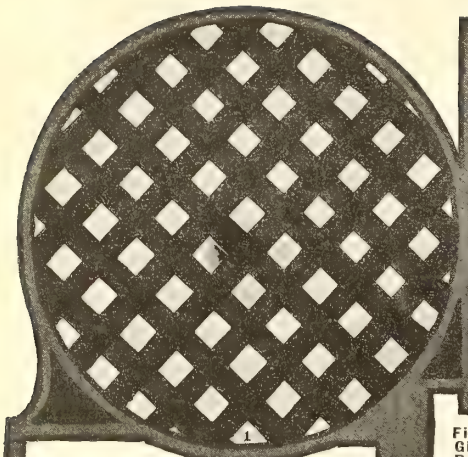


Fig. 1. Enlarged Section of a Half-tone Screen Placed in Front of the Photographic Plate to Break Up the Picture Into the Dots Composing Half-tones.

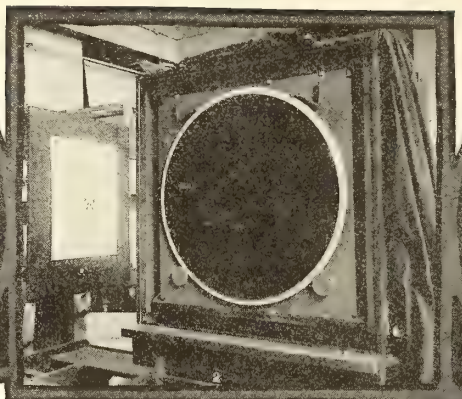


Fig. 2. This Shows the Rear View of the Giant Camera With the Half-tone Screen in Position Ready to Photograph the Subject, but Without Plateholder.

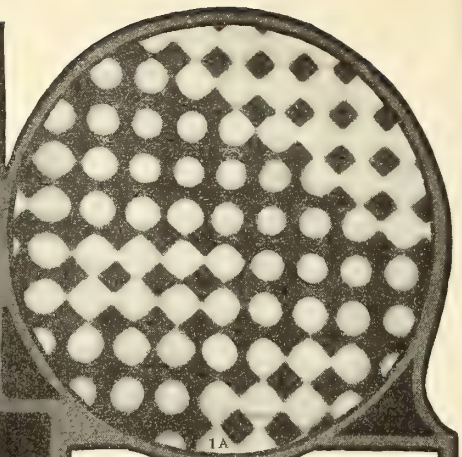


Fig. 1-A. This Shows a Microscope Enlargement of a Section of a Half-tone Negative.



Fig. 3. View of Front of Camera Taking One of the Color Negatives of the Present Cover Subject. A Prism Is Used to Reverse the Image.



Fig. 4. A General View of the Vacuum Printing Frame for Holding the Object, and Electric Lamp In Operation Making the Print.

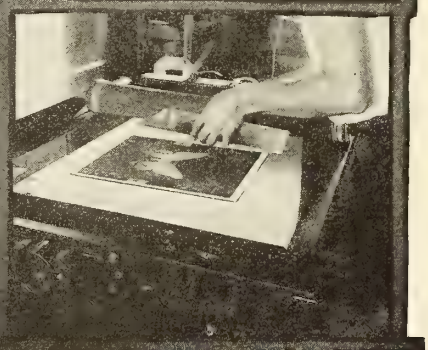


Fig. 5. Showing the Operator in the Act of Laying Sensitive Copper Plate on the Photo Negative. The Two Are Firmly Established in Contact by a Vacuum Pump.

What Makes A Magazine Cover

By CHARLES A. GROTZ*

THIS should be an absorbing subject to all who are interested in Art and Science. Thousands of people buy magazines month after month and look at the beautiful covers, but very few know what process is necessary to produce a million copies for an issue and all exactly alike.

THE CONCEPTION OF THE COVER DESIGN.

The first conception of a magazine cover is evolved from the mind of the Editor or Publisher. He must convey his idea to the artist, who makes the original painting. Especially in the case of a cover like that of SCIENCE AND INVENTION it is sometimes difficult to convey to the artist just what is in the mind of the Editor.

After the cover design is finally satisfactory to the Editor, it goes to the Photo Engraver where it starts its journey thru a process which is a combination of both Art and Science. This process is based on the fundamental principle of the three primary pigment colors in nature; namely, *yellow, red,* and *blue.* If these colors could be used absolutely pure, i.e., a yellow slightly toward a chrome, a red of a magenta shade and a greenish shade of blue, any color in nature could be reproduced by superimposing or mixing. For example, let us take our primary colors and mix them to secondary colors. If you superimpose yellow and red full strength, you get orange, yellow and blue produces green, and red and blue produces violet. These are called secondary colors, and with the different proportions of primaries you get the various shades of secondaries, such as scarlet, yellow green, blue green, various shades of purple, and if *all colors are superimposed* full strength, *you get black.*

THE FIRST STEP—COLOR PHOTOGRAPHY.

The first step in the reproduction is Color Photography. Here the "copy" is photographed on special color-sensitive plates thru *color filters,* which retain the particular color value wanted. These filters are orange, green and violet. These are the secondary colors which we get by mixing two primaries together, and if you will remember that all three primaries mixed together produce black, you will understand that, if, for instance, an orange filter is placed between the lens and the sensitive plate, the missing primary is blue and since blue and orange make black and a photographic plate is not sensitive to black, we are able to suppress all the blue values in the original drawing, while all of the red and yellow values will come thru and act on the plate, thus producing the *blue value negative.* If we use the green filter the missing primary is red, we produce the red value, and if we use the violet filter we produce the yellow value.

Now we come to another important feature in the photographic department, namely, that the negatives which we make must not only be color values but also what is known as "half-tone" negatives. We must now understand that we are making plates to be printed on typographic presses, and since this method of printing will not give us any intermediate tints, but only solids, it is necessary for us to obtain negatives made up of dots or lines, the gradation being produced by the dots being larger or smaller. The larger dots naturally carry more color than the smaller ones, so we are able to get all the gradations of the original. The large reproduction on our cover illustrates this very well.

These half-tone color negatives are made by placing a screen or grating in front of the sensitive plate, so that when making the exposure the light travels thru the lens, then thru the color filter which is usually directly back of the lens, and then thru the screen to fall upon the sensitive plate. These screens are made up of parallel rulings on glass. Two such rulings are cemented together at right angles to each other. This forms little square clear parts on the screen thru which the light can travel. Now the screen is not placed in contact with the sensitive plate, but a space of about 1/16″ is allowed between them, so when a powerful ray of light such as would come from the white parts of the original forms a part of the image, the dots are made small on that particular part of the image while the middle tones are kept larger and on the shadows there will be little or no action. These screens are used in various rulings from as coarse as 65

* *Of the Trichromatic Engraving Co.*

lines to the inch to as fine as 400 lines to the inch. The finer the screen the better the reproduction, but fine screens cannot be used on coarse newspaper stock so the proper screen must be selected to suit the printing conditions.

Figure 1 illustrates an enlarged section of a halftone screen.

Figure 1A shows a microscopic enlargement of a section of a halftone negative.

Figure 2 shows the rear view of the camera with the screen in position ready to photograph the subject, but with the plate holder not yet in position.

Figure 3 shows the front of the camera in the operation of making one of the color negatives, and here a word of explanation is necessary. It will appear as tho the camera is not pointing directly at the subject to be photographed, but seems to be shooting around the corner or at right angles. You will notice tho that the lens has a right angle prism in front of it, which has the effect of reversing the image on the negative much the same as if you hold a mirror at 45 degrees to the eye. You will be able to see things at direct right angles to your line of vision, but you will also see everything reversed from right to left. A prism is used so that a negative will read right, so that a plate made from this negative will be reversed, and the final print on the paper will thus be right.

OF all the covers we have printed during the past eight years, the present one probably is the most unique as well as the most original and instructive one of them all.

Not only is it unique but—so we have been assured by experts—it is the very first time in the annals of the engraving art that a three color picture has been made in this way.

The large butterfly as well as the small one are both identically the same. Take a magnifying glass and look at the small butterfly—any part of it. You will see hundreds of small dots in yellow, red and blue—the basic three colors used on all colored magazine covers. What you see here with the lens, you see exactly by viewing the big butterfly without the magnifying glass. The large butterfly then is simply an enlargement of the small one, printed so that you may inspect the whole color printing process, as it were, with the naked eye. Then by viewing the big picture from a distance of 15 or 20 feet you will see the colors properly blended just as you see the small one, when viewed normally one foot distant.

Next view the cover thru a REVERSED full extended opera glass at a distance of about three feet. The colors will blend perfectly. You will be surprised at the result.

To make the big butterfly, a set of three-color process plates only one-half inch square was first made. These miniature plates were then enlarged 16 times, which gave us the big butterfly.

The small butterfly on our cover has 133 "dots" to the inch, the big enlarged one has only 5½ dots per inch, a thing never attempted before by any color engraver. The coarsest picture made heretofore had 65 dots to the inch.—Editor.

PICTURE PRINTED ON COPPER.

After the negatives are made and have been finally tested for "register" and approved for proper color values, the job passes to the printing department, where *prints are made on copper* from the respective color negatives. The polished copper plates are coated with a special acid resisting enamel and the negatives are printed by powerful arc lights. This enamel is sensitive to white light and the clear dots of the negative; and these, which are finally to be the printing dots, allow the light to strike the sensitive copper plate, thereby making the enamel insoluble in water. After the prints are made, the plates are washed in running water. This removes all of the still soluble enamel from the plates, retaining only those portions which have become acted upon by light. The copper plates are then dried, after which they are subjected to an intense heat which makes the enamel absolutely insoluble in the acids which are used in finally etching or eating out the copper between the dots.

Figure 4 is a general view of the vacuum

(*Continued on page* 768)

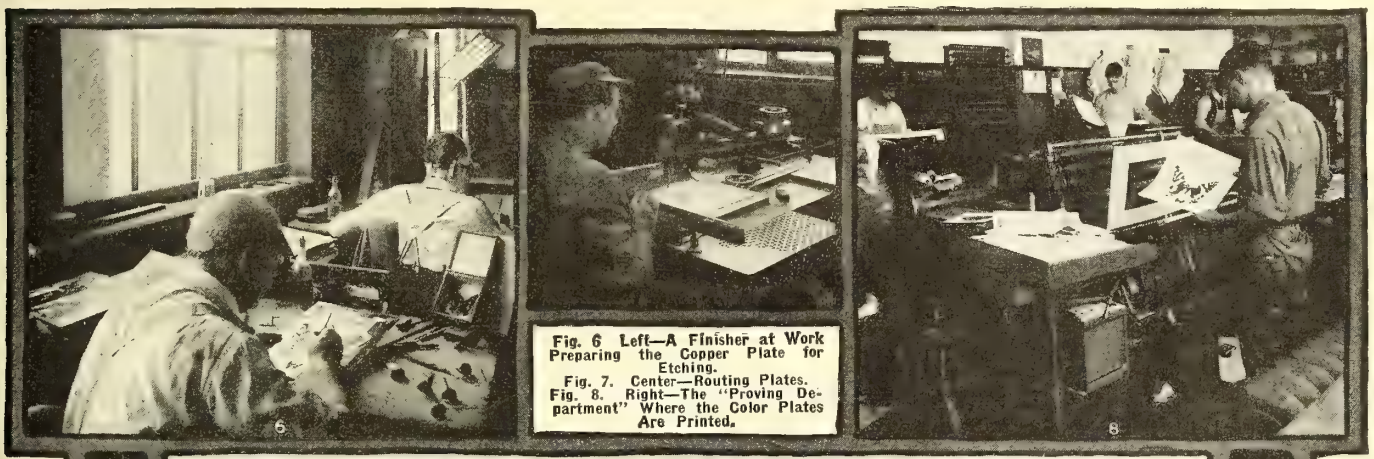


Fig. 6 Left—A Finisher at Work Preparing the Copper Plate for Etching.
Fig. 7. Center—Routing Plates.
Fig. 8. Right—The "Proving Department" Where the Color Plates Are Printed.

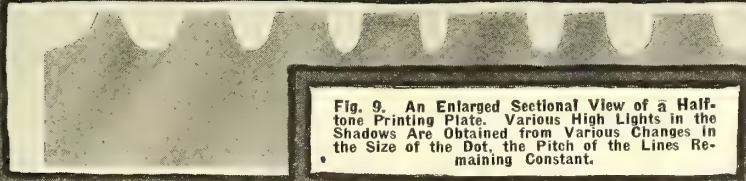


Fig. 9. An Enlarged Sectional View of a Halftone Printing Plate. Various High Lights in the Shadows Are Obtained from Various Changes in the Size of the Dot, the Pitch of the Lines Remaining Constant.

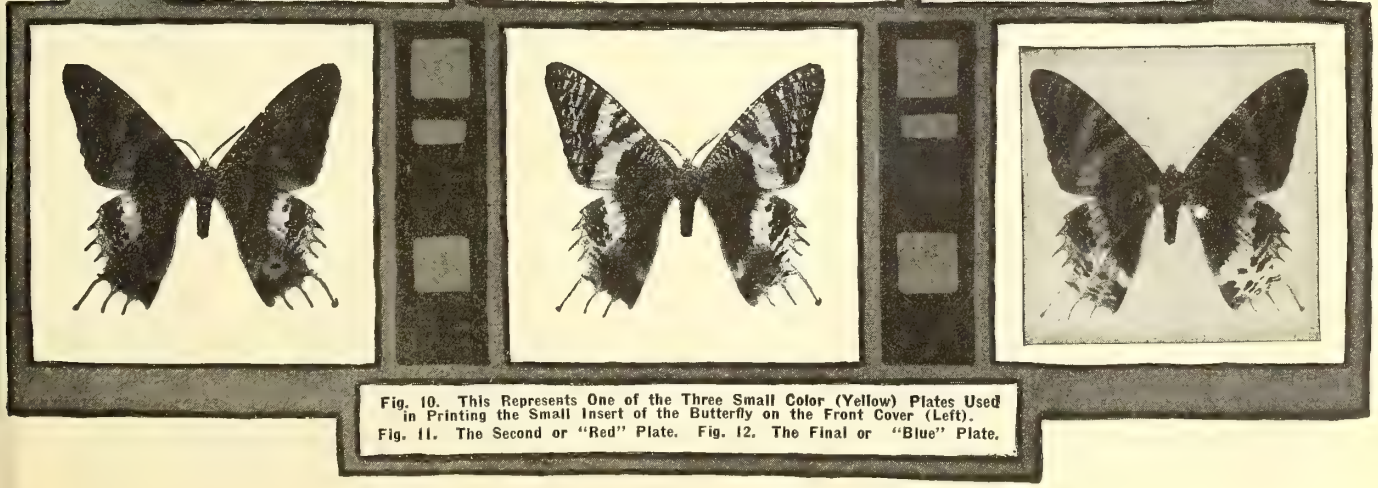


Fig. 10. This Represents One of the Three Small Color (Yellow) Plates Used in Printing the Small Insert of the Butterfly on the Front Cover (Left).
Fig. 11. The Second or "Red" Plate. Fig. 12. The Final or "Blue" Plate.

Making Life-Like Animated Cartoons

By E. G. LUTZ

Process Described of Making Cartoon Figures That Move Like Living Beings

A NEW screen miracle has recently made its appearance. It is one that is distinctly different as it combines actual photographic views of reality with hand drawn animated figures. To elucidate by an episode of a recent film: The scene opens with the artist seated before his easel; he has just finisht sketching a whimsical little dwarf, a clown, or say, a comical pixie. Next, when the artist is called away from his easel this graphically rendered pen and ink pixie suddenly gives a slight tremor as if a vital force were agitating his body. Then he moves his head, shows a slight bewildering expression, bends a knee, moves his leg and wiggles his toes, and still further shows by his pleased countenance that he is surprised and delighted in being alive. Soon he tries his other limb and with a preliminary essaying of his joints walks off the paper to the cross piece of the easel along which he runs to jump to the arm of a nearby chair. Here, after first going thru a litle comic pantomime as if he were about to lose his balance, he proceeds to clamber down the side of the chair to the floor. Mind you he is the work of the artist's hand rendered in pen and ink and the background over which he moves is a photograph of reality, a somewhat mysterious procedure. We all of us know how the ordinary movie is made and the methods of creating animated cartoons no longer puzzle us. But how are the two combined?

Continuing the recital of the pixie's adventures, we discover him, no higher than the wainscoting, running along the floor close to the wall. As he approaches a table he climbs up a leg, scrambles to the top and then getting into some sort of mischief is scared and jumps to the back of a chair and then down to the floor again. His capers, as the story is prolonged, is only limited by the artist's powers of fantastic invention.

One of the things in a film fantasy of this sort that is noticeably different from the ordinary animated cartoon is the quality of the action, or animation, of the figures. It will be observed that they proceed in movements somewhat naturalistic,—photographic in fact, and yet the figures are drawn. That the aid of the camera was brought in to effect this is a safe conjecture as the movement is so life-like. This being so, the business of the remainder of this article will be in explanation of how it is accomplisht.

The story of a cartoon comedy is at first, of course, all planned in the manuscript, with the whole series of pantomimic action pretty well considered in detail. We will in our explanation confine ourselves to one incident only of this action and try to describe its working out from the beginning to the termination of the work when the film is ready for screening.

First a boy is found whose body proportions are those that we generally consider as proper to this imaginary creature, the pixie. That the boy be costumed as a pixie is not essential but if his dress comes near that of the little fantastic figure so much the better. Now this boy is placed before a movie camera and told to go thru the action phases wanted. He is to act, for instance, as described above,—the tremor as he feels the coming to life, the walking across the easel, jumping to the arm of the chair, his antics there, and then the sliding to the floor. It is all very simple, in the studio he merely walks along some timber placed across two boxes, jumps to the floor and goes thru a few queer postures there. For the clambering down the side of the chair, he is told to make his way down a pole in the studio, or perhaps to clamber down a tree trunk out in the open.

During all this performance the camera has been working and the agile boy has been taken on a film in the customary mode of studio procedure with the resultant negative used to make a positive print that could be projected on a screen in the usual method. But the positive is not used this way, instead it is threaded into the gearing of a patented apparatus for making drawings for cartoon films. This invention, that of Mr. Max Fleischer, is a machine by which he carries out a part of the work to produce his cartoon comedy of the clown that is drawn, dip by dip, from the inkwell, and then gambols and romps all over the screen, and as a punishment for some mischievous trick is poured back into the inkwell again. This arrangement of Mr. Fleischer consists of a projector that throws a film image upon a ground glass where it can be conveniently observed and traced. One of the features of this invention provides that only small sections—the miniature photographs—move slowly into place one at a time and not intermittently and rapidly as in the screen projector. When the film depicting the consecutive movements of the boy is placed in the machine, the artist with a sheet of paper over the ground glass traces the first position, then he operates the mechanism that moves the film and another phase of the movement is imaged on the glass which is also traced on another sheet of paper. This is followed by the third position and its tracing on a third sheet of paper. The rest of the film with its miniature photographs is proceeded with in precisely the same way until all of it, or selected parts, have been traced.

As the boy wore only ordinary dress, the artist changes his little sketches to conform to whatever style of grotesque array he has decided for the character. All this seems like going to a great deal of trouble involving an immense amount of labor, but when it is remembered that the most vexing matter in animating is sketching the sequence of poses that give the screen illusion of movement, this method solves a big problem for the artist. It becomes merely mechanical "copy-work"—and more important—the action is absolutely life-like.

Now that we have a complete set of drawings for the depiction of our particular pantomimic action, the next step is that of procuring the background. For this an ordinary photograph, a "still," of the easel, chair, and surroundings is made of a size to fit the field of the animator's camera. This is put in its proper place and the photographer gets ready to arrange the series of animated pixies in their positions over the photograph. But the drawings that have just been completed are on paper and as that is more or less opaque, are of no use here as the opacity hides the photographic details. Had they been made on tracing paper, they would have been nearly available. Tracing paper was, in fact, what Mr. J. R. Bray, preferred and used in making moving pictures by his patent process of 1915. But tracing paper is translucent and only moderately transparent, and so has been discarded for celluloid. This material is now in common use in the craft.

The next step is that of re-tracing all the pixie figures on the surfaces of sheets of clear celluloid. This material, on account of its transparency, enables the artist to locate the exact positions of the sequence of drawings over their corresponding details of the photograph. After the tracings have been made in ink on this celluloid the outlines are filled in with paint,—white, or black, or gray, just as the artist wishes.

Now the artist, provided with a consecutively numbered series of celluloid sheets holding drawn figures, and a background consisting of a photograph of the easel, chair, and surroundings, is ready for the camera work. In following out this he proceeds by putting the celluloids one at a time over the background as he turns the camera handle for the exposure. At the termination of this work, and that in the laboratory, he will have a positive film that when projected shows a pen and ink pixie going thru a series of actions over a photograph of reality.

Supposing, now, as an example of another kind of cartoon, that the desired effect is one showing an imaginary drawn character performing with a living creature? The making of this is easy to describe but an exceedingly laborious process to carry out. The pixie, as an illustration, is to jump to the back of a sleeping cat, who is to leap up and run across the room with the pixie perched like a dare-devil cowboy on her back. To bring this about a cinematographic negative is *taken of the cat only* going through the performance of jumping up and running across the floor. From this negative a certain number of enlarged photographs are made of a size to conform to that of the field under the animator's camera. This seems like a pretty big job, but as the action takes place rather rapidly, say requiring only about five feet of film, with but every other photograph selected, this means only about forty photographs. These are used in the same manner as the artist uses his animated drawings, placing them in their numbered order under the camera and photographing them. The little pixie figures are made in a similar way as those for the scene with the easel. That is, drawn on celluloid, or perhaps cut out as little dummies, and fitted in their proper places over the photographs. The result on the screen is that of a blended animation of a photograph and drawings giving one a very puzzling illusion.

Perhaps you have seen one of the latest cartoon movies wherein the movements of a comic figure drawn by an artist are combined with a photographic view of a real object. The effect is very puzzling indeed, and the editors have been greatly interested in this development of animated cartoons—so much so in fact, that they have prevailed upon Mr. E. G. Lutz, a well known producer of this class of motion picture subjects, to write the present article describing how the trick is done.

Mr. Lutz is the author of the authoritative, and only book dealing with this subject entitled, "Animated Cartoons."

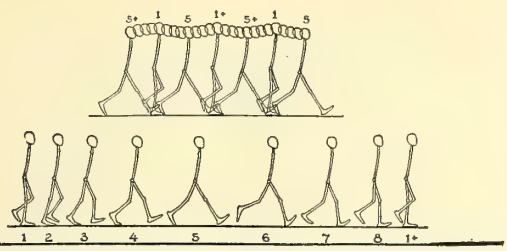
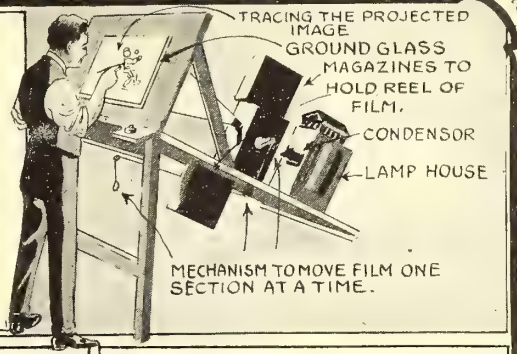


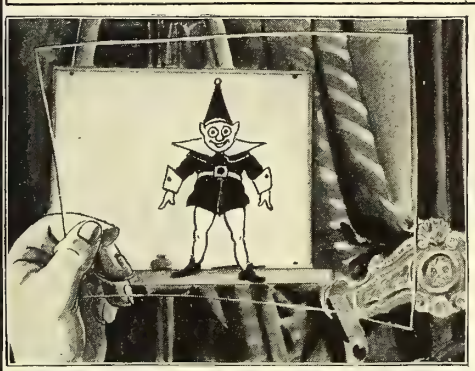
Diagram Study of a Man Walking,—the Head Describes an Undulatory Wave Motion as Is Made Evident.

Projection Machine Specially Devised for the Projection of Animated Cartoons. A Person Is Photographed with a Movie Camera; the Positive Film Is Then Projected on a Screen and Then Drawn.





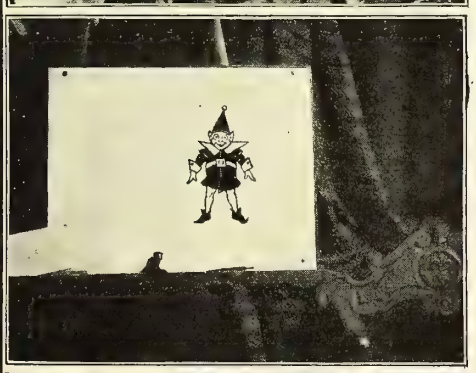
In the Six Pictures Above, We See One of the Most Important Stages in the Development of the Animated Cartoons Here Discust. The Three Top Poses Are Sketched by Means of the Projection Machine Shown Above, and Later the Three Lower Drawings of the Pixie in Costume Are Drawn on Celluloid Sheets Placed Over the "Action Drawings."



The Pixie or Other Comic Figure Is Drawn on a Celluloid Sheet, Which Is in Turn Placed Over an Actual Photograph of the Easel and Chair, as Shown at the Left.



In the Left Center Picture We See the Pixie as Photographed by the Movie Camera and Represented as Standing on the Artist's Drawing Board, Just After the Artist Has Completed the Figure and Has Laid Down His Pen.



In the Lower Left Hand Picture We See a Progressive Stage of the "Movie,"—Here a Celluloid Sheet Containing the Pixie Is Placed Over the Photograph of the Easel and Chair and in This Particular Position We See the Pixie Walking Toward the Leg of the Easel.



The Top Right Hand Picture Shows the Pixie (Drawn on Celluloid Sheet) Starting to Climb Down the Leg of the Easel. The Edge of the Celluloid Sheet Can Just Be Discerned, but in the Actual Movie This Is Hidden So as Not to Show, Leaving the Spectator Wondering How It Is All Done.



A Still Later Stage of the "Pixie and the Ink-Bottle" Adventure—the Pixie Here Being Shown Half-Way Down the Easel Leg. See Center Picture at Right.



Lower Right Hand Picture Shows the Pixie After He Has Slid Down the Easel Leg and Standing on Cross Bar, About to Jump to the Arm Chair.

Why We Remember Things

By William M. Butterfield

THE remarkable power of the mind to recall events, vividly portrayed, and thus bring to memory people, buildings, landscapes and the like has caused many persons to ascribe the faculty to some superior attribute of man. This is only partly true, for such impressions are caused by mechanical operations that are more or less common with all animals. To describe the hundreds of thousands of individual parts in the sense organs and brain, responsible for any mental sensation or impression had by an individual, and thus to make these mechanical operations clear to the reader, is, of course, impossible in a popular article of this kind.

Let us, therefore, consider this interesting subject in a less ambitious way. We will suppose, for the sake of illustration, we know of a person born without taste, touch, sight, hearing or smell. Such a misfortune will, perhaps, if we visualize such an individual, make us realize that sensation is really the part of our physical machinery that provides us with our understanding, or knowledge, as it is called, of the world around us. A very little consideration will demonstrate that a person without sensation can have neither impression, thought or recollection of the world or of themselves, for we shall find that we know nothing whatever of our own inner body, and that all of our knowledge, such as it is, *is of things outside of it,* hence, every bit of knowledge, thought, or recollection, must have come to us, or have been received by our senses.

The senses, therefore, in a separate, machine-like way, convey impressions to the brain, where other operations make records in a rather mechanical manner of each delivered message. In this fashion, ideas are formed of things, events, or of facts that are reached by the senses of the individual. To illustrate, let us take a rose; one learns its shape, color and size by the sense of vision, its odor by the sense of smell, and its texture by the sense of feeling. The original impressions, which are recorded and thus form a part of our knowledge of the flower, are said to be spontaneous, and the storage of all such ideas in this manner, spontaneous knowledge.

The storehouse of ideas we call the mind is situated in the brain, and it is plain to us that some form of mechanical fixing process must take place here to establish the above association of impressions, thus to enable us to know a rose when we see one at some future time. Indeed, such a development we know occurs, and the recalling of the spontaneous impressions, in part or whole, is what constitutes memory. Memory, when thus aroused, is said to be normal, but when an event or an act is recalled by an effort made for the purpose, it is recollection.

Let us observe a sense impression at work. We will take sight, the sense most responsible for the development of mind. In the drawings which we have prepared we show a dramatic incident in the life of a woman, seen in an attic store-room in the act of recalling the bygone drama shown in the opposite panel. The incident portrayed,



Recalling an Incident Which Happened Years Ago, Is Very Complicated When One Considers the Changes Necessitated in Impressing Such an Incident Vividly Upon the Recipient. The Accident Shown at the Left in the Above Diagram, Is Transmitted Thru the Lens of the Eye to the Retina, Where by Means of the Optic Nerve Tract, It Announces the Scene to the Brain. Here Various Nerve Fibers Transmit the Impression to the "Memory Center," Where Years Later It May Be Unconsciously Recalled. or Also Recalled at Will. What Changes in the Nerve Cells in the Brain Take Place, or How These Record, Is the Subject of Much Experimentation and Investigation. As Yet Nothing Definite Has Been Ascertained.

was an actual one in which two young people played their parts before the eyes of the young man's mother as she stood, paralyzed with fear, in an upper window of her home situated a short distance from the scene of the romantic adventure. In the center panel we show the mechanical operations that develop a spontaneous or original impression.

In early life most of our impressions are spontaneous, for the mind and body are developing together, and the ideas obtained, varied and undevelopt as they may be, form

(*Continued on page* 788)

What Your Hands Reveal

By DR. W. de KERLOR

Your Hands An Index to Your Mind and Life's Events

DID you ever stop to think that the hands by their shape, their motions, their lines and the thumb in particular formed an invaluable index to a Man's Heart, Mind and Soul?

Did you experience the feeling of warmth, truth and kindliness that came over you while you held a broad, masculine and substantial palm in your grip? And on the other hand, did you not get a feeling of reprehension or disgust when shaking hands with a "clammy," lifeless hand, very much like a dead fish's tail? Hands, like faces, have their own individual power of expression. They are the revealers of that mass of impulses which animate our unconscious selves. From cradle to grave, our hands instantaneously obey every thought of our brains, even before these thoughts have been grasped by other senses.

The new born babe instinctively pushes its fingers into its mouth, even before it utters its vocal protest against the pangs of hunger. It is unable to control the action of its hands when it attempts to grasp the objects it sees, for the simple reason that its sense of sight, here, interferes with the direct inspiration from the brain. And at the approach of death, the first signs to the watchers at the bedside that life has departed lie in the action of the thumb. Man in the primitive state used his hands to communicate with his fellows, even as savages do to-day. Before his invention of words, he invented the "language of gesture." A remnant of this is to be found, at the present time, in the Roman numerals I, II, III, IV, etc. In the early days of Civilization, when man lived closer "in tune" with Nature than he does at present, he expressed himself accordingly. He may, or may not have noticed the "falling-in" of the thumb at the approach of death, but at any rate he seemed to have observed the phenomenon, for in later years, as among the Romans, he used the gesture of "thumbs up", or "thumbs down" to express his defiance or to acknowledge his subjection when vanquished.

A celebrated divine, once called upon to give his definition of a Man, replied: "A man is a being capable of walking erect upon his hind legs, and possessing the prerogative of a Thumb." And, indeed the Thumb is the one distinctive mark which differentiates Man from the brute.

THE ART OF GESTURE.

The art of gesture, employed by the Greeks of three thousand years ago, placed them for all times as the greatest exponents of Art. They understood the potentialities of "hand postures" as a means to express grace and beauty of movement in the relationship of everyday life. As a matter of fact, all of the drawings left by the early Egyptians upon the walls of their Pyramid chambers and Temples express a far deeper meaning, based upon psychological mysteries which escape our understanding to-day.

Really, it must be confest that the Ancient Civilizations knew far more about the psychology of the hands than ourselves. Their writings are replete with references to them, both from the medical, psychological and prophetical points of view. The Mystery of Human Nature is and will always remain the most fascinating of studies; and any form of science or art which will bring us to a closer understanding of its hidden recesses cannot fail to be welcomed.



Chart Showing the Principal Lines of the Human Hand and Their Significance: 1—Vital Line or the Line of Vitality; 2—Cephalic or Head Line; 3—Cardiac or Heart Line; 4—Median or Fate Line; 5—Annular or Fame Line; 6—Auricular Line, Also Called the Literary Line.

There are already many medical men who, to-day, use the human hand as an index to diagnosing the patients' inherent diseases. For by the formation of the nails, the finger joints, the skin, the red or white blotches formed upon the skin of the palm, as well as by the shape of the fourth finger they endeavor to ascertain the various tendencies to which man is liable. Paralysis, *locomotor ataxia,* throat and bronchial troubles, consumption, rheumatism, nervous ailments, blood disorders are now diagnosed from the hands. So much for the physical aspect of it. This aspect. alone, if fully described would fill a whole volume.

Th psychological aspect is that which interests us here, however, and upon which I shall dwell more fully.

The study of the hand is divided into three distinct phases:

First. Its motions as an index and in relation to the unconscious expressions of the Inner-self.

Second. Its formation as guide to health, temperament, character, and latent faculties.

Third. The structure of the lines upon the palm as indices to the evolution of the Individual Life.

The use and motions which an individual makes with his hands will instantaneously produce, in the mind of the careful observer, appreciation or reprobation. While working, eating, speaking, smoking and even sleeping the hands assume attitudes that convey: order, neatness, disorder, laziness, determination, dejection, refinement or vulgarity, laboriousness, self-control, nervousness, frankness or insincerity.

YOUR CIGAR BETRAYS YOU

Did you ever watch how some men hold their cigars in their hands? The "stingy man" spikes his cigar on a pin or toothpick, to smoke it to the last puff. The "combative" holds it in his fist. The "secretive" holds it tight. The "loose tongued" holds it by the tip of his fingers. The "bluffer' and self-contented holds it by the length of arm and fingers, in the intervals pulling large puffs from it.

Nationality above all things can be easily recognized in the gestures of the Italian banana-peddler, as in the east-side Jew of the "three ball" avocation, the Scotchman by his soberness and closeness of motion and the Irishman by his exuberant gestures. So also the Frenchman, and who cannot recognize a German a mile away by his "strafing," wave-like motion, and a spit on the ground, accompanied by his *"Schweinhund"* guttural.

Women of the Madonna, Sappho, Bacchante, Butterfly or Vampire type, each have typical motions and expressions of hands. Each bear their own stamp of vice or virtue, which make them an easy mark to the observer in drawing room, street car, or office.

The hand of the man "who serves," and the hand of the man "who commands" do not escape detection, either. There is the hand that compels and the hand that repels. You can "spot" them by just observing them.

Hands smooth and velvety to the touch, firm and normally warm indicate youth, health, consistency and fine sensibilities of the heart. Other hands, dry, bony or "raspy" to the touch show the lack of the finer sensibilities, a cold and calculative intellect.

It is thru the hands that the sensations of

A NEW ART

OUR readers are well aware of the fact that a man's character is now revealed easily by his hand-writing, a comparatively recent art. They also know that there is the art of physiognomy. Thus, the general contour and setting of your face, the shape of your skull, your forehead, all reveal the inner man. Our largest firms today select their employées by hand-writing tests, as well as physiognomy.

But did you know that the lines of your hands reveal your character as well? This is now an exact science, of which Dr. de Kerlor has made a life study. The new art has nothing whatsoever in common with palmistry, but is an exact science, just the same as the science of modern finger printing.—EDITOR.



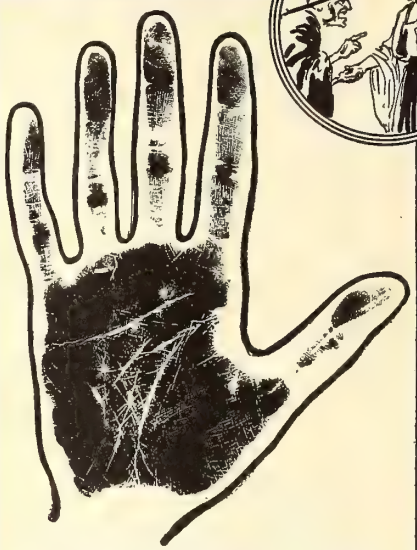


Typical Human Hand with All the "Lines." This Hand Is Remarkable as It Includes All the Classical Lines Well Formed. The Subject Was Born in India, and Had an Unfortunate Love Affair at Twenty-One.



Left Hand of a Chimpanzee "Prince Charles." While the Heart Lines May Appear Human-Like, the Rest of the Lines Do Not Compare in Intelligence.





Hand of a Young Woman Showing Presence of Headaches and Impairment of Hearing and Sight, as Indicated by the "Head Line," Which Is Broken.



Indicating Consumption — Right Hand of a Consumptive Taken Three Weeks Before Patient's Death.



The Typical Hand of Lunacy. Note the Extraordinary Whirlpool Formation of the Lines in the Palm.



The Hand of Dramatic Love Affairs. Note the Small and Wide Thumb; Also the Widely Diffused Lines and the "Head Line" Which Is Far Too Weak to Regulate the Passions.



Right Hand Of the Congenital Idiot. Note the Very Short Monkey-like Thumb, Showing the Lack Of Self-control.



Extraordinary Hand—That of a Poor Girl of the Slums of London, England.



The Hand Of An Extraordinary Man—a Frenchman Noted for His Imagination, Authorship, Daring and Resourcefulness.







The Successful Hand. The Owner of This Hand Made a Fortune Thru the Sale of Inventions of His Own Making. The Successful Hand.



A Remarkable Palm Indeed, That of Mr. H. Gordon Selfridge, of Marshall Fields, Chicago, Who Raised Himself From a $5.00 Per Week Job to a Position Yielding Ten Million Dollars a Year.



Representing the Hand Prints of a Boy Two Years Old, Altho Hand Prints Are Not Always Considered Successful in Children, These Prove Otherwise.



Clear Thinking Is Exemplified In This Palm and Represents the Hand of a Clear-Thinking Man. The Line Formation Shows Inexorable Logic.



The Hand of "Dr." Arthur Warren Waite Who Poisoned His Mother and Father-in-Law for Their Wealth. Note the Short "Head Line" Denoting the Criminally Inclined Mind.

"Personal Magnetism," and that our cordial feelings toward our fellow men, find their articulate expressions.

When the palm is thick and hard to the touch it shows a prevalence of coarse instincts, when thick and flabby, selfishness and sensuality. When the palm is, in size, proportionate to the fingers and is firm without much elasticity, it shows: stick-to-itiveness, plodding and dutifulness. When elastic, but not flabby, it indicates: imagination, resourcefulness, reliability; when flabby and moist: laziness, procrastination and all its attending weaknesses.

As a rule you will find that the flexible, elastic hand, thick and warm, reveals a taste for sensuous pleasures, while the firm, hard hand is industrious and active.

When hollow it is a sign of love of action; when too hollow: tendencies to violent temper, and excessive love of arguments. When excessively flat, it reveals the "fatalist," one inclined to be ruled by circumstances without power or inclination to react. There are, however, many exceptions to the rule.

WHAT YOUR THUMB TELLS.

Before completely judging a man's character, you should look at his thumb; for the sign of superiority of Man over Beast is the thumb. And the sign of distinctiveness between man and MAN is their Thumbs. All great men, men of genius, men whose power of Individuality influenced the masses to Thought or Action, had large and powerful thumbs. Galileo, who discovered that the Earth Revolves round the Sun; Newton who discovered the Law of Gravity; the philosophers Kant and Leibnitz; Voltaire "the Father of Revolution", Napoleon; and Washington the general, patriot and president all had big thumbs.

Monkeys have very small thumbs that hardly reach the root of the first finger. In primitive man, the thumb is thick and short. Murderers and criminal inmates have clubby short thumbs. Hence the expression: "a murderer's thumb." Often we hear, also: "he has crooked fingers." In this case it refers particularly to the fourth finger, which when crooked, nine times out of ten, belongs to the inherently dishonest, or crooked. So look out! If you do not believe it you should go and study the fingers of pickpockets, while you have the chance.

The thumb being in direct relation with the brain centres of Volition, naturally expresses the "dynamic" force in a man, his Will power. Its length will therefore determine the "quantitative and qualitative" conditions of the Will. The well balanced Will is found in a thumb that reaches the line formed by the first and second phalanges of the first finger. A forceful Will, by a slightly longer and larger thumb, while the very selfish and ambitious-willed man is detected by a thick, fat base of thumb, upon a hard, thick and callous hand. Not until the child develops its own power of Conscious Volition does it refrain from sucking its thumb. Idiots and microcephalics cover their thumbs with their four fingers. Those who have secrets to conceal do likewise.

But the Man of courage, fearlessness, independence of Mind, holds his thumb well out. The mean and timid hold it close to the side of the hand, while the stubborn has it curling back.

THE LINES OF YOUR HAND.

Speaking of—the much misunderstood—lines of the Palm, you will find on examination that approximately 85 per cent of the business organizing minds, clear thinkers, builders and engineers have straight, well defined and unobstructed Cephalic; otherwise called, the "head line." This same line in artists, musicians, actors, authors, orators: people of Imagination-and Moods, is slanting and wavy. Whereas, among the shy, diffident, nervous, deprest and melancholy, this line goes down the palm at a sharp angle. Among the discontented of the "Trotzky" type, the militant suffragette, the revolutionary of the hysterical temperament, the eternally dissatisfied, the "head line" does not only slant downward, at all kinds of angles, but is also intercepted by many breaks and loop-holes.

Where the Mind is untramelled by all kinds of non-essentials; where it is virile, creative and industrious, you will find a palm absolutely free from the cob-webs graven in the palms of the dissipated, the immoral liver, the "worry cuss," or the physically delicate.

The strong and healthy, clear-minded Man has a clearly lined hand. It stands to reason, since it is now a recognized therapeutical fact that Mind rules Matter. The sickly Mind has a sickly Hand, and vice-versa.

Men whose Successes in Life are all of their own making have unusual clear lined palms with forceful thumbs. But the politician or "diplomat" who thrives on the maxim, *divide et impera*, have palms strewn with a maze of detailed lines. They have so many things in their Minds to carry. . . .

(*Continued on page* 790)

Popular Astronomy

By ISABEL M. LEWIS, M. A.

Of U. S. Naval Observatory

Has the Earth an Undiscovered Moon?

SCARCELY a year passes that additions are not made to the long list of catalogued members of the sun's family. Usually the newly discovered body is a small planetoid possibly five or ten miles in diameter picked up by photography at a distance of one hundred million miles or more from the earth. Yet so thoroly does the astronomer canvass the heavens, so powerful are modern telescopes and so highly developed are modern methods of observing that it is probably safe to say that no undiscovered object even as small as fifty miles in diameter exists inside of the orbit of Jupiter or within four hundred million miles of the earth.

Tho the discovery of small bodies in close proximity to the planets is more difficult than the discovery of bodies of the small size against a dark sky, owing to the blinding glare of light reflected from the surface of a planet, extremely small satellites of the outer planets have been discovered close to their primaries.

The innermost satellite of Jupiter (Satellite V), discovered by Barnard in 1892, is only one hundred miles in diameter and lies so close to the brilliant planet (sixty-seven thousand miles from its surface) that it can only be seen by the most skilful observers with the most powerful telescopes. Phobos and Deimos, the two tiny satellites of Mars, revolve respectively 3,680 miles and 12,480 miles from the surface of Mars and it is estimated that Phobos, the brighter of the two, *is only ten miles in diameter.* To discover such a tiny point of light is a far more difficult feat than to find it again when the exact point at which to search for it has been predicted.

It must be remembered that in addition to being close to a brilliant planet the tiny moons of Mars are distant from the earth never less than thirty-five million miles while Satellite V of Jupiter is nearly four hundred million miles away at the nearest approach of the planet to the earth. Phoebe, the outermost satellite of Saturn, is two hundred miles in diameter and it never comes closer to the earth than seven hundred and forty-four million miles. Yet it is observable visually as well as photographically in the most powerful telescopes.

If such minute bodies have been discovered close to bright planets at distances of millions of miles from the earth, what is the probability that a body as small as one mile in diameter would escape the astronomer's watchful eye if it were a satellite of our own planet, Earth?

The power of the earth to hold a satellite against the force of the sun's attraction ceases at a little less than four times the distance of the moon from the earth or 930,000 miles from the earth's center. Beyond this point any object would yield to the superior attraction of the sun and forsake the earth to become a satellite of the sun, thus becoming itself one of the planets.

Now, any object one mile in diameter on the surface of the moon, can be made out with ease even with moderate size telescopes, while in powerful telescopes objects one-quarter of a mile in diameter are distinguishable. At the distance of the moon, then, any object a quarter of a mile in diameter could be picked up against a dark sky with a powerful telescope either by visual or photographic means far more easily than such a minute point of light as the satellite Phobos, ten miles in diameter and some forty or fifty million miles from the earth, bathed in the rays of a brilliant planet.

Certainly no object within the field of the earth's gravitational attraction as great as one mile in diameter could elude the astronomer's eye under favorable observing conditions.

An object ten miles in diameter at one-half the distance of the moon, or 120,000 miles from the earth, would subtend an angle as great as that subtended by the planet Mars when near its opposition to the earth and would appear to be fully as brilliant an object if viewed at night against a dark sky.

A moon *one* mile in diameter at a distance of 12,000 miles from the earth's center or 8,000 miles from its surface, would subtend the same angle, but it would always be lost in the earth's shadow at night, which at a distance of 8,000 miles from the earth's surface has a diameter only a few miles less than that of the earth itself. Yet when transmitting the sun in the daytime, a phenomenon which would occur twice a year, the little moon would easily be picked up as a black dot on the surface of the sun, and it could be found in the twilight hours in low latitudes with the smallest telescopes.

We feel safe in concluding, then, that *there can exist no undiscovered object revolving about the earth as great as a mile in diameter within* 930,000 *miles of the earth's center* which represents the limit of its gravitational field.



There Is Hardly an Hour That Some Meteorites Do Not Fall Upon the Surface of the Earth. Of Course, We Do Not See Them During the Daytime for the Reason That the Sunlight Interferes, but During the Night We Often See Hundreds of Them Shooting Across the Sky, Many of Them Falling on the Earth in a State of Meteoric Dust. It Is Now Thought That These Meteorites Belong to an Old Satellite or Moon of the Earth, Which Broke Up when the Earth Was Still Young. When This Satellite Approached the Earth Over a Certain Critical Point, the Gravitational Tidal Stresses Disrupted It, and the Entire Satellite Was Broken Up Into Small Pieces. These Fragments Then Continued to Revolve Around the Earth in the Form of a Flattened Ring Similar to What Constitutes the Rings of the Planet Saturn Today, Which Are Mute Evidence of Some Former Disintegrated Satellites. Our View Above Shows How This Ring Would Have Looked Somewhere Near the Equator on Our Earth in Pre-historic Times, Looking South

Now there exists a critical point close to each planet's surface within which it is impossible for a satellite to exist intact. For a non-rotating satellite this limit is 2.44 radii of the planet (called Roche's limit L); for a rotating satellite it is somewhat greater as the centrifugal force due to axial rotation increases the tidal strains and causes the satellite to become disrupted at a greater distance from the planet than if it were a non-rotating body. The critical point also depends upon the relative densities of the planet and satellite and upon whether the planet is homogeneous thruout or not. At the breaking point the satellite is drawn out into a prolate ellipsoid of revolution with the major axis about four times the minor axis and satellites near the critical limit for their primaries should appear noticeably elongated in the telescope.

For Mars the critical point at which a satellite would break up is less than 2.70 radii of the planet—for Phobos is intact at his distance. For Jupiter the critical limit must be less than 2.55 radii which is the listance of Satellite V from Jupiter. The outer rim of the outermost ring of Saturn s 2.32 radii from the center of Saturn and so it comes well within the critical limit even for a non-rotating satellite.

The rings of Saturn furnish a good example of the dissolution of a satellite into minute meteoric particles and of the symmetrical distribution of the resulting particles in the plane of the planet's equator where the gravitational attraction is greatest owing to the equatorial bulge of the planet which results from rapid axial rotation.

It has been demonstrated mathematically hat close satellites and meteoric rings *must* revolve in or close to the equatorial planes of their primaries and that they are radually being drawn in toward the planets they encircle by differential attraction exerted upon them by the planet. Once inside the critical limit a satellite must be disintegrated into a ring of meteoric particles and be distributed symmetrically about the planet in the plane of its equator. The size of the fragments will depend upon the force of molecular cohesion. Iron fragments would be greater in size than fragments of surface rock for the molecular cohesion for iron is greater than for stony substances. The largest meteorites are for this reason the meteoric irons. Stony meteorites are more easily disrupted by tidal strains.

The majority of the satellites in the solar system *do* lie in or close to the equatorial planes of the planets they encircle. This is true of the two small satellites of Mars, of the five inner satellites of Jupiter (the four outer satellites being extremely small and distant from the planet), of the rings and seven inner satellites of Saturn and probably of the four satellites of Uranus and the single satellite of Neptune, tho the positions of the equatorial planes of these two planets is not known. It is *not* true for our own moon which lies in an orbit highly inclined to the earth's equator but then it is believed that our own moon is unique in its origin owing to its great size relative to its primary, the earth. Certainly in the light of the above facts it is impossible that the moon was ever torn from the side of a fully formed earth—for being within the critical limit at the time of the rupture it would have been reduced to meteoric particles by tidal strains and distributed about the earth's equator in a meteoric ring.

Since all near satellites are gradually being drawn in toward their primaries, Phobos the inner satellite of Mars and Satellite V of Jupiter, which are now close to the critical limits for their planets, will doubtless be ruptured at some future day and gradually transformed into meteoric rings similar to the rings of Saturn. Moreover the rings of Saturn also are being drawn in toward the planet by inter-collisions of particles and tidal forces and are being gradually absorbed by Saturn. It is quite possible that other planets have in the past possessed rings that have been absorbed gradually in the course of the millions of years that have elapsed since the planets were first formed.

Is it possible, then, that the large meteorites that are continually striking into the earth's atmosphere are remnants of a meteoric ring that once encircled our own planet in its equatorial plane? Also, is it possible that a ring of meteoric matter is still encircling our planet within the critical limit at a distance say of 4,000 miles from the earth's surface? If so what are the chances that such a ring of meteoric fragments would be visible from the surface of the earth?

Owing to the curvature of the earth's surface no object revolving about the earth in the plane of its equator could be seen north of 60° North Latitude or south of 60° South Latitude. A glance at Diagram II will make this clear. At 40° North or South Latitude an object in the plane of the equator 4,000 miles from the earth's surface could never appear at a greater altitude above the horizon than 22½° and no object within 1,222 miles of the earth's surface *in the equatorial plane* would appear above the horizon. At 30° N. or S. Lat. an object 4,000 miles from the earth's surface in the plane of the equator would attain an altitude above the horizon of about 36°. At night a ring of meteoric matter, assuming it were existent within the critical limit for the earth, could not be seen because it would lie entirely within the earth's shadow. In the day it would

(*Continued on page* 777)



View of the Planet Earth in Pre-historic Times as Seen From the Moon. This Phase Shows the Earth When "Full," the Sun Illuminating the Entire Half of the Globe. Here We Also See the Supposed Pre-historic Ring Surrounding the Earth, Which Ring Is Made Up of Fragments of a Shattered Satellite, Which Scientists Now Believe Existed When the Earth Was Still Young. This Ring in Time Disintegrated Entirely, the Fragments Falling Upon the Earth in the Form of Meteorites. There Are Still Small Portions of This Ring Left, and From Time to Time These Pieces Fall Upon the Earth and We See Them as Shooting Stars.

Phonograph Prize Contest

Announcement of Prize Winners

IN our July issue, we announced our *Phonograph Prize Contest,* which has now come to a happy conclusion. As is usual with our prize contests, the present one too may be termed a huge success, judging by the thousands of entries received by the Editors. It has indeed been a difficult task for the judges to assign the prizes, because so many real good ideas were received.

As announced in our July issue, the purpose of the contest was to devise something *useful* that can be done with your phonograph outside of using it for playing records. We felt that a valuable machine that is only used at an average of one-half to one hour a day could be used for other purposes as well, and in this, our judgment was right, as is amply proved by the thousands of ideas that flooded our offices. Over 4600 entries were received, and of course most of them were duplications, or ideas that had been publisht and known before.

In awarding the prizes, the judges have been guided mainly by the *utility of the device.* For that reason the first prize was awarded to Mr. Ralph C. Moses, because he showed us how we may construct a simple fan that can be used for various purposes, such as cooling the room, drying your sister's or wife's hair, and other purposes. Besides, it fulfilled our conditions ideally, namely, that the device should be readily attachable to the phonograph without marring it up, or using screws, etc., to pierce the wood.

Right here we would say that many entries were received for fans of a similar nature, but not one of them had the clever constructional features of Mr. Moses' fan, and none were quite as simple and as efficient to the minds of the judges.

On the opposite page we illustrate some of the devices which have been awarded prizes, as well as those having received honorable mention. We could publish a magazine three times the size of SCIENCE AND INVENTION if we were to describe and illustrate all of the devices that were submitted. We will, however, content ourselves with enumerating here some of the good ones that were submitted. These ideas, however, did not seem to us very practical and for that reason neither prizes nor honorable mention were made, altho we admit that there are some good ideas among them. Here is a partial list:

Beverage mixer; toy dancing device; wireless coil tube winder; attachment to operate motion picture machine; wireless rotary spark gap attachment; phonograph burglar alarm,—this device is supposed to scare the burglar by operating the phonograph as soon as the door is opened and the burglar enters. We are afraid, however, that most burglars would be wise to the device immediately, and let the phonograph play on; stereoscope motion picture device; blower and air blast attachment, operated by the phonograph motor with flexible rubber tube going to sound box; the air blast blows off the dust as the record is played—a good idea but rather complicated; shoe polishing attachment; roulette game; panoramic lighting device operated by the turntable; advertising schemes whereby merchandise is placed on the turn table in show windows to attract passers-by; knife sharpener; attachment to operate sewing machine; telegraphic code teaching device; attachment to operate miniature dynamos; cream whipper; yarn winder; ring toss game with pegs on revolving disc; electrically lighted Christmas-tree holder; electrically operated phonograph stopping device; storage battery charging appliance in connection with dynamo (?!!); power transmission attachment; alarm clock and bell sounding attachment; small cabinet phonograph with revolving fan made of paper strips to be placed on dining table to chase away flies! Then we have the automatic phonograph lighting device which lights the record spot-light as soon as the cover is lifted. Several good omnigraph devices also were submitted. There was a very good idea of a static machine built right on to the phonograph, using the record itself as the revolving pla _ of the Whimshurst machine

The humorous element was of course not lacking as usual. Mr. Riza Young of Detroit, Mich., probably takes the cake by making an attachment to rock a cradle by means of a crank attachment on the turntable.

Frances Fogarty of Cornwall Landing, N. J., comes forward to move the phonograph out in the kitchen with which to operate a dish washer, telling us minutely how it is all done. But we doubt if many people would like to have their Victrola in the kitchen.

Now for the prize winners:

FIRST PRIZE $25.00

Utility Motor Attachment.

By Ralph C. Moses, Gideon, Mo.

The drawing shows a small utility motor attached to a phonograph, to which the power is transferred by means of friction between the power wheel of the motor, which is either made of rubber or of felt so as to eliminate slipping, and the turntable of the phonograph.

The power wheel is attached to the shaft of the motor by means of a metal collar and setscrew centered in the wheel, as shown in the drawing.

By lengthening the shaft the power and speed of the motor may be increased or diminished at the option of the operator, or the power may be controlled by the speed indicator on the phonograph. When the power wheel of the motor is moved towards the center of the turntable it gives the motor more power but less speed, but as the power wheel is moved towards the outer edge of the turntable the power is diminished and the speed is increased.

Besides a fan attachment for the motor, a small emery wheel for sharpening knives, etc., may be attached in the same way as the power wheel and fan are attached. A buffer may also be attached for polishing silverware, etc., and many other uses can be made of the small friction motor as are at the option of the operator.

The felt-lined spring clamp makes it possible to secure the motor to the phonograph firmly, and without marring the instrument in the least.

SECOND PRIZE $15.00

Razor Blade Sharpener.

I hereby submit to your "Phonograph Contest" an idea which I know will be appreciated by the *"hairy sex."* In the drawing will be seen a thin board (wood or fiber) or even an old phonograph record will do. I use a strip of felt a little wider than the ordinary safety razor blade. On this felt a mixture of very fine pumice powder and oil is placed. Do not make the mixture too thin or it will fly all over. In the drawing is also shown a leather strip used to "hone" the blade.

The holder is constructed of ribbon brass ⅝" wide bent over lengthwise into "U" shape to fit the blades; it is as long as the blade. The wire is of brass, the top of which is ground to the thickness of a phonograph needle and is fastened to the strip with solder. This holder will make the sharpener practically automatic. All that is necessary is to fasten the arm with a string or wire in a steady position over either the felt or leather and crank the machine and "letergo."

FRED SKROTZKI.

THIRD PRIZE $10.00

Chimes or Dinner Gong.

A Chimes cut from ¾ x 1-16" steel.
B Spring.
C Hammer.
D Wood disc ¼ to ½" thick.
E Pins, nails or screws.
F Weighted base.

A "record" or wood disc can be used in place of ordinary record. Pins engage spring hammer and as they pass release it, allowing hammer to strike chimes. Position of pins determines melody.

A. G. KALMBACH.

HONORABLE MENTION.

Cleaning Brush.

There are devices on the market for cleaning records, but none that I know of do their work while the record is playing. By means of a simple clamp, two thumb screws and a little brush, rigged up as shown in the figure, the sound groove of a record is cleaned free of dust just before the needle passes thru it, thereby insuring a perfectly clean record at all times, without trouble of any sort, such as wiping records. The hairs of the brush must have a proper stiffness to remove dust and not mar the record or produce sound.

J. LOUIS LENORE.

HONORABLE MENTION.

Bagatelle Game.

In this game the centrifugal force created by the rotation of a disc placed on a phonograph make the balls rotate and climb from the center to the outer edge. The disc is provided with numbered recesses into which the moving balls fall.

To play the game. Each player selects balls of one or two colors according to the number of players. The balls are shaken up in a pot and poured round the inner rim. The phonograph does the rest and is stopt when the balls cease to move and count is made according to their position and recorded on a cribbage board or otherwise.

CHAS. H. NEWTON.

HONORABLE MENTION.

Sound Distorter.

I have found much amusement for myself and friends in drilling a hole thru a record from one-half to three-quarters of an inch from the center and using THIS hole for the post of the machine instead of the one in the center. The effect of playing a record in this manner, especially if it be a love song, is highly amusing.

F. G. SWARTZ, D.D.S.

HONORABLE MENTION.

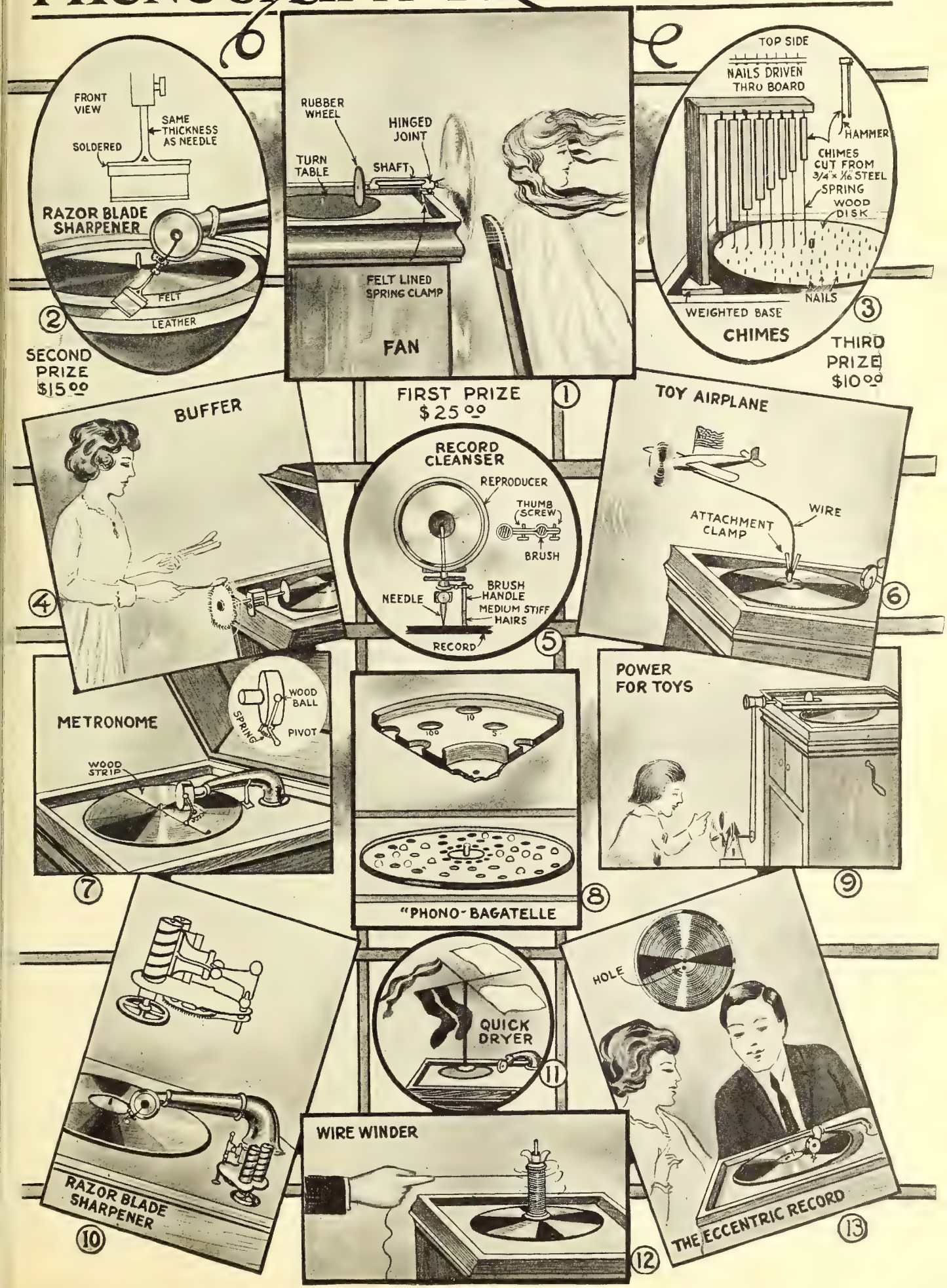
Buffing Wheel.

The device is for polishing silver spoons and in fact any silverware about the house. It is simply a friction wheel running on the turntable. The other end of the shaft mounts a small buffing wheel made from several discs of cloth clampt together.

A padded clamp holds the shaft firmly to the edge of the phonograph.

(*Continued on page 772*)

PHONOGRAPH PRIZE CONTEST

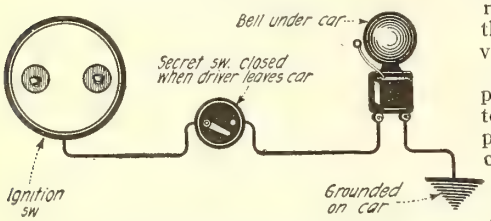


MOTOR HINTS

FIRST PRIZE $25.00.
AUTO THIEF ALARM.

After his car which was "locked" had been stolen from the front of Wanamaker's Store in Philadelphia, the winner of the first prize came to the conclusion that automobile thieves in the proverbial words *"Like love, laugh at locks."*

Our illustration shows an alarm which our correspondent thinks will defy the best



A Secret or Hidden Switch, Connected With a Large Electric Bell Under the Car May Prevent Its Theft.

of thieves. He placed under his car a large electric bell and his ignition switch wires have this bell connected in circuit with them.

In a secret place there is a second switch. If this is closed, nothing can take place as long as the owner's switch is open, but if a thief desirous of stealing the car, closes the ignition switch, the bell rings and attracts everybody. Our correspondent says that he has tried it on public streets, and the minute it starts to ring, all eyes are turned his way.

[As a little suggestion, it seems to us, that to make the story more complete, he should have been arrested for stealing his own car.—Ed.]

Contributed by
CHARLES E. ST. CLAIR.

SECOND PRIZE $15.00.
SIMPLE SUBSTITUTE FOR A "FUELIZER."

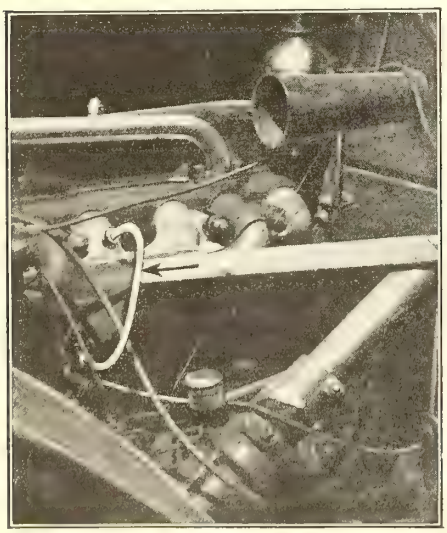
Our illustration shows the device whose inventor has been awarded the second prize. He terms it as a substitute for a gasoline *fuelizer*. A small caliber piece of copper tube is connected to the exhaust manifold and leads directly to the intake manifold.

The tube is made as short as possible to save heat and the user is advised to cover it with sheet asbestos so as to keep the exhaust gas on its way to the intake manifold, at as high a temperature as possible. Of course, there is a certain danger of igniting the gas before entering the cylinder.

This writer says that tests which he made indicate a reduction in fuel of about 8 per cent, and he found that in starting on cool mornings, the operation of the car was much smoother and quicker. Our illustration makes the construction of this device, very clear. A dash adjustment for regulating the flow of the exhaust gas to the intake manifold, is said to be an advantage in some cases.

It was found that in throttling down, especially in very hot weather, there was a temporary lag in operation, indicating a poor mixture, and by closing the suggested cock, the mixture could be enriched.

Contributed by H. T. KRAFT,
Ass't Aero Engineer, Goodyear Akron Air Station.



A Simple "Fuelizer" Substitute Formed by a Piece of Copper Tube Connected to the Exhaust Manifold and Leading Directly to the Intake Manifold.

$50.00 IN PRIZES
Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

FIRST PRIZE	**$25.00**
SECOND PRIZE	**15.00**
THIRD PRIZE	**10.00**

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor. "Motor Hints," care of this publication.

RECHARGING "RUN DOWN" IGNITION BATTERY.

Sometimes a careless motorist leaves his ignition switch closed or the lights burning or perhaps finds a "shorted" wire which results in his battery being discharged. He usually discovers this accident when he wishes to use his car. He will then call a service station for an expensive repair man to bring him out a charged battery so that he may use his car. All this expense and inconvenience can be eliminated by the following method.

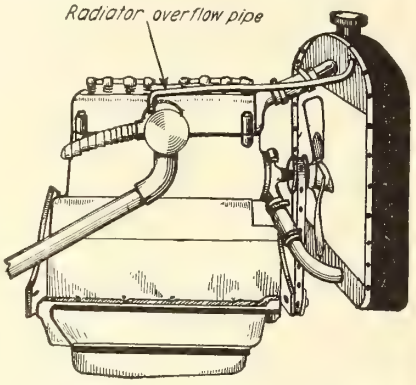
Have a neighboring motorist drive his car beside your own and connect his battery to yours. This can be done with a short piece of lampcord. Loosen the terminal bolts on both batteries, being careful not to push the leads out of the terminal lugs. Remove the insulation from the ends of the wire and wind the bared wire around the bolts; then tighten down. The motor will readily start if the connections are tight. The positive post of one battery should be connected to the negative post of the other. When the motor has become "warmed" up, carefully loosen the bolts, being careful not to break the connection between the discharged battery and the running motor. Remove the lampcord and tighten bolts. If your generator is working properly, a few hours' driving will put your battery back into shape.

Of course, this method would be successful only when the battery has become discharged from conditions arising outside the battery. The author has successfully started automobiles by the above method.

Contributed by NILES HAGELSHAW.

THIRD PRIZE $10.00.
CARBON PREVENTER.

The object of this device is to prevent the deposition of carbon in the cylinders of a gasoline engine. The contributor proposes to introduce the lower end of the radiator overflow pipe into the hot-air suction pipe. This suction pipe should rise as it approaches the carburetor, so that any condensed water will run away and nothing but steam or water vapor will enter the carburetor.



A "Carbon Preventer," Formed by Introducing the Lower End of the Radiator Overflow Pipe Into the Hot-Air Suction Pipe.

The end of the overflow pipe in some engines may be run to the hot air casing surrounding the exhaust pipe. The effect of this would be to convert any water present, into steam, and economy in gasoline resulting from increased power is claimed for this arrangement, in addition to the elimination of carbon in the cylinders.

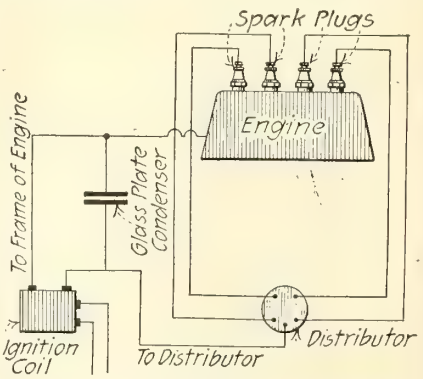
By either of these arrangements a certain amount of water vapor is drawn into the mixture, so as to produce the desired effects.

Contributed by WALLACE C. MILLS.

IMPROVED AUTO IGNITION SYSTEM.

I present herewith a diagram of my automobile ignition system which is the Atwater Kent system, as shown in the diagram.

I connected a glass plate condenser, made of four plates 5 x 3", coated on both sides with tin-foil, across the secondary leads, which gives a much hotter spark. This device proved very efficient on my "Pullman" car, I get more power and more mileage per gallon of gasoline.



The Contributor Claims That He Obtains a Much Hotter Spark With Condenser Connected Across the Secondary Wires, as Indicated Here.

Contributed by RUDOLPH YOUNG.



Telephone Wiring



By G. L. HOADLEY, M. E.

How to Install Telephones

PEOPLE nowadays look upon the telephone as a necessity in the home. The housewife uses it for "visiting"; for reminding her husband at the office to perform certain shopping duties during the lunch hour; for giving orders to her groceryman; and for divers other purposes. The people in the country use it perhaps even more. In case of sudden sick-

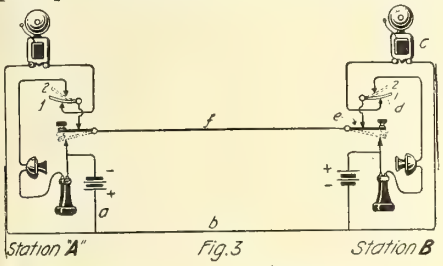


Fig. 3

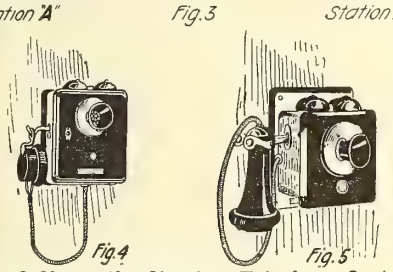


Fig. 3 Shows the Simplest Telephone System With Ringing Circuits,—Which Represents a "Series" Telephone, Without Any Induction Coils. Figs. 4 and 5 Show Two Types of Wall Telephones for House Use.

ness or accident, the doctor can be summoned quickly—and many times a life is saved by prompt action. As a quick means of securing aid in case of fire, robbery, etc., its protective value is unquestioned. As a time saver between the house and barn, garage or other buildings on the farm—or as a means of communication between the vestibule or janitor's room and the tenants of an apartment building, its value is not so generally appreciated, but its usefulness can be easily shown.

How often, when at work in the barn or garage, have you gone back to the house for something forgotten or overlooked—and then walked back again? How often has your wife gone to the barn to find you for some important matter—and then walked back again? How often have you, Mrs. Housewife, chased down three or four flights of stairs to get the janitor to fix a faucet or to tell him to give more heat—and then walked back again? Do you enjoy climbing stairs? Is the time you spend in these trips of no value to you? It is a safe bet your answer is "No".

A telephone line, illustrated in Fig. 1 and Fig. 2, leading from the house to the barn, garage or other buildings puts a quick stop to this useless waste of time or energy. An intercommunicating phone hooked up to an existing bell system in an apartment building gets quick and efficient service from your janitor, does away with precious time lost in talking to pernicious agents, peddlers, and other undesirables.

Wiring:—The average person is apt to look upon the telephone as being too complex for him to understand. He is apt to feel that only an expert can install a phone successfully. You or your fourteen-year old boy can put up an interphone outfit in a couple of hours. You do not need experience to perform the work satisfactorily. Simply follow the directions given later.

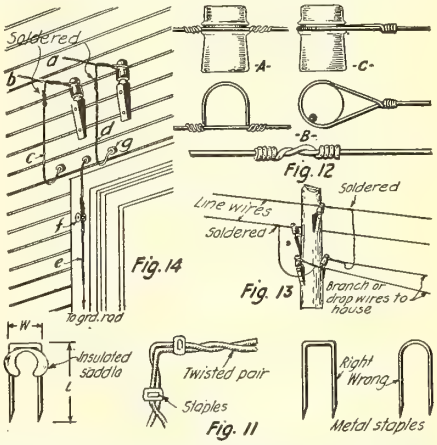
Systems:—There are two main classes into which telephone systems may be divided; that done by the owner of a building and that done by the telephone company. Under the first-mentioned class should come the installing and wiring for any phones required in the building only; between buildings; for a short line between your home and a neighbor; and for extension bells. Under the latter comes the installation of outside commercial telephones by the local Telephone Co. and private branch exchanges.

Fig. 3 shows perhaps the simplest type of an interior phone system between two parties. Reference to the figure shows the signaling as done with two batteries, double contact push-buttons, and ordinary doorbells of the vibrating type. Removing both receivers from the hooks closes the circuit through the transmitters, receivers, and batteries. In connecting up the two batteries be careful to avoid having them "buck" each other when the talking circuit is made.

Operation:—To ring Station B press the double contact pusher at Station A down to dotted position 2. Current may flow then thru wires a, b, bell c, hook switch d, e, f, and back to Station A battery, thus ringing Station B bell.

Talking Circuit:—Removal of each receiver from its hook allows the hook switches to rise to dotted position 2, breaking the lower contact and making an upper contact. At the same time, removing pressure from the push-button at Station A allows the pusher to assume its former position 1. Current then may flow from the positive pole of the battery at Station A through wires a, b, Station B battery, receiver, transmitter and hook switch, and upper pusher contact, e, back through line wire, f, Station A pusher, hook switch upper contact 2, transmitter and receiver to negative pole of battery, thus completing the talking circuit.

Two Party Commercial Set:—Fig. 4 and Fig. 5 show typical interphones of the wall type made by two of the leading manufacturers. The outfit consists of two such instruments and is suitable for a private line between two rooms in a building, and for house to barn or garage, where dis-



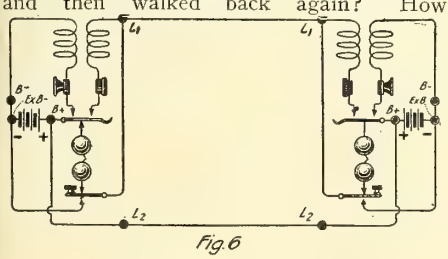
Figs. 11 to 14 (Above) Show the Simple Practical Details to Be Followed in Running Telephone Wires Both Inside of House and Out-of-doors.

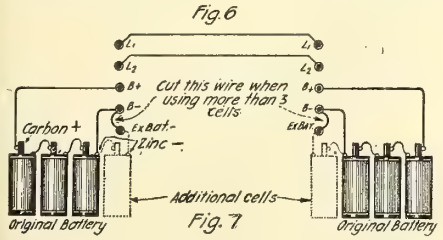
tances do not much exceed 1,500 feet. Either station can ring and talk to the other. Fig. 6 shows a *wiring diagram* for the connections of the Western Electric set and Fig. 7 shows another diagram for installation purposes. Three dry cells are sufficient to operate this set satisfactorily for distances up to 750 feet, using No. 18 B. & S. gage copper line wire. Between 750 feet and 1,000 feet an additional cell is required; and 5 cells at each Station are necessary between 1,000 and 1,500 feet.

Installation:—To fasten the wall phone set properly to a brick, cement or stone wall, drill holes into the wall at the proper location for the screws. Then plug the holes with wooden plugs and fasten the wall set to them with wood screws. Use dry wood for these plugs and make certain the plugs are large enough to hold securely.

Lightning Arresters:—Fig. 8 shows a type of arrester suitable for use where there are no neighboring power or lighting circuits. Fig. 9 shows a typical arrester

(*Continued on page* 804)





Diagrams Showing Connections of Battery and Induction Coils in Common Type of House Telephone. The Transmitter Is Connected in the Primary Circuit of the Induction Coil, and the Receiver in the Secondary Circuit.

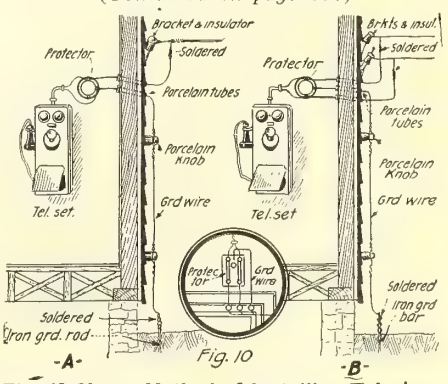


Fig. 10 Shows Method of Installing Telephone in House, Together With Lightning Protectors and Ground Wire for Both Grounded and Full Metallic Systems.

Blind Now Read By Musical Sound

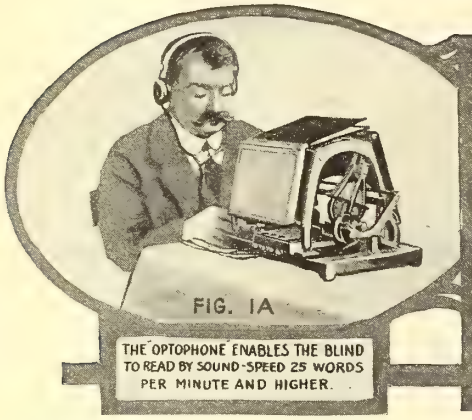


FIG. 1A

THE OPTOPHONE ENABLES THE BLIND TO READ BY SOUND-SPEED 25 WORDS PER MINUTE AND HIGHER.

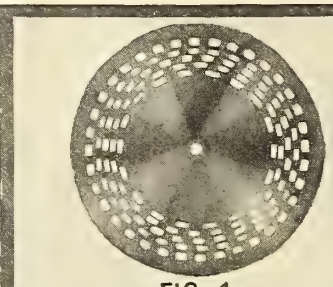


FIG. 4

ROTATING TONE DISC. WITH PERFORATIONS

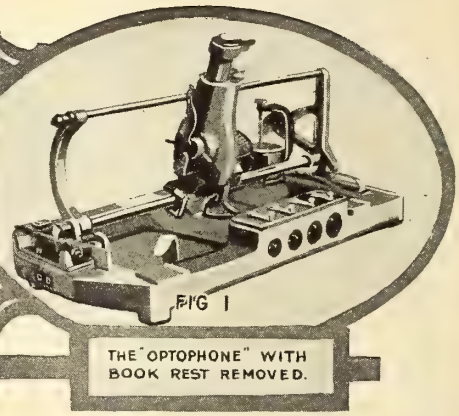


FIG 1

THE "OPTOPHONE" WITH BOOK REST REMOVED.

"Optophone"—Combining Optics and Selenium—Is Now Available, Whereby the Blind May Read—by Sound Code

THE Optophone, the invention of Dr. E. E. Fournier d'Albe of London, has been modified and developed by an electrical engineering concern of Glasgow, Scotland. Its purpose is to enable the blind to read ordinary printed matter—such as books or newspapers. This is accomplished by producing in a telephone receiver series of musical notes forming tunes or musical motifs, representing the various letters as these are past over by the instrument in traversing a line of printing.

Up to the present time the only means available for enabling the blind to read have been raised type systems, such as Braille and the Moon, adapted to be read by the sense of touch. These methods are subject to considerable disadvantages, such as the necessity for having specially printed, expensive and bulky books and the consequent limited amount of literature available, and the difficulty of acquiring the necessary sensitiveness of touch, especially by adult blind persons.

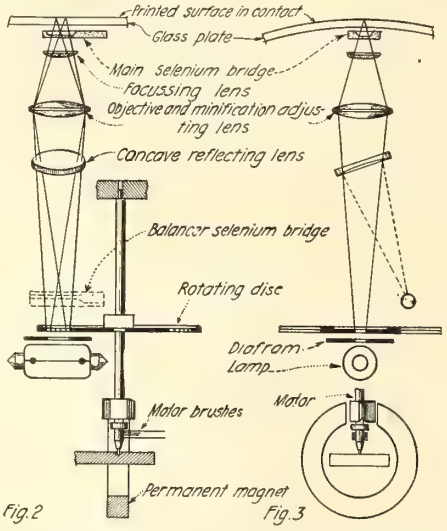
These disadvantages are overcome by the *Optophone.* It renders all ordinary printed works, including type-written matter, available to the blind. It depends not upon the sense of *touch,* but upon *hearing,* which is usually quite sufficiently sensitive with the majority of blind persons, and reasonable facility in reading by its use can be attained after comparatively few lessons.

SELENIUM SOLVES THE PROBLEM.

The instrument depends for its action upon a remarkable property of the chemical element *selenium,* the electrical conductivity of which in one of its physical forms (grey crystalline) varies greatly in accordance with the amount of light to which it is exposed.

If a telephone receiver (essentially an instrument sensitive to changes in electrical currents) is connected in series with an electric battery and a porcelain tablet having on its surface two separate conducting lines of grafite connected together or bridged over by light-sensitive selenium, a current will pass thru the telephone, and *the current will vary as the lighting of the tablet is varied.* The prepared tablet is called a "selenium bridge." When flashes of light are thrown on to the selenium bridge at a rate of 256 per second, the current will rise and fall at that rate and the telephone will sing out the note C (middle C of the piano). If the pulsations of the light are at half that frequency, that is, 128 per second, the telephone will sing out C an octave lower, and with 512 pulsations per second, the C one octave higher and so on. The telephone can therefore be made to sing any tune by the proper succession of sets of pulsations of light applied to the selenium bridge.

In the Optophone a selenium bridge is exposed to successions of sets of light pulsations, which vary according to the forms of letters as these are past over in traversing a line of printed type, each letter being indicated in the telephone by a characteristic motif comprising successions of single notes and chords. Printed letters are thus translated by the Optophone into a *sound alphabet,* which can be readily learned.



Figures 2 and 3—Illustrate Diagramatically the Optical and Selenium Cell Arrangement, as Well as the Position of the Rotating Tone Disc and Its Motor in the "Optophone,"—the Instrument That Enables the Blind to Read by Sound.

ARRANGEMENT OF THE OPTOPHONE INSTRUMENT.

The arrangement of the Optophone is illustrated diagrammatically in Figs. 2 and 3. The printed page to be read is placed face downward on a glass plate supported on a suitable stand. Beneath the plate is a tablet of porcelain pierced with an aperture to permit the passage of light upward and so through the glass on to the paper. The upper surface of the tablet—around the aperture—is prepared as a sensitive *selenium bridge* and connected up to a battery and a telephone. The selenium bridge receives only light reflected from the page. The light used is obtained from a small straight filament electric lamp placed beneath a rotating disc perforated with small holes arranged in five concentric circles near its edge. This disc is illustrated in Fig. 4. For the sake of clearness and simplicity in the diagrammatic arrangement, Figs. 2 and 3, the lamp is shown immediately below the rotating disc. In the instruments now being made the lamp is so arranged, in conjunction with a reflecting prism and cylindrical lenses, that an image of the filament is produced in the plane of the disc, radially across the circles of holes.

The disc is kept in rapid rotation by means of a tiny magneto-electric motor driven by current from small secondary cells. Above the disc there is an optical system which throws on to the paper an image of the lamp filament as it would be seen thru the perforations in the disc. By

(*Continued on page* 782)

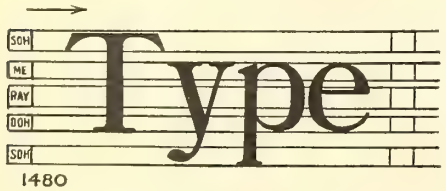


Figure 5—This Illustration Shows the Various Tones Used in the "Optophone," Each Tone Having a Different Frequency and Forming Together, What Is Called a "Scala." The Position of the Scala With Respect to the Type Lines Is Here Clearly Illustrated.

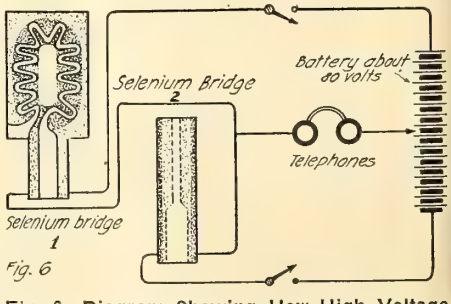


Fig. 6—Diagram Showing How High Voltage Battery Is Connected Up to Telephone Receiver, in Conjunction With the Main Selenium Bridge and the Balancer Selenium Bridge.



© 1920 by Science & Invention

Next Summer, Visitors to New York's Playground, Coney Island, Will Be Amused by This Giant 150-Foot "Dip-the-Dip" Wheel, Which Combines All the Thrills of the Scenic Railway, the Ferris Wheel and the Chute-the-Chutes.

Coney's New Topsy-Turvy Wheel

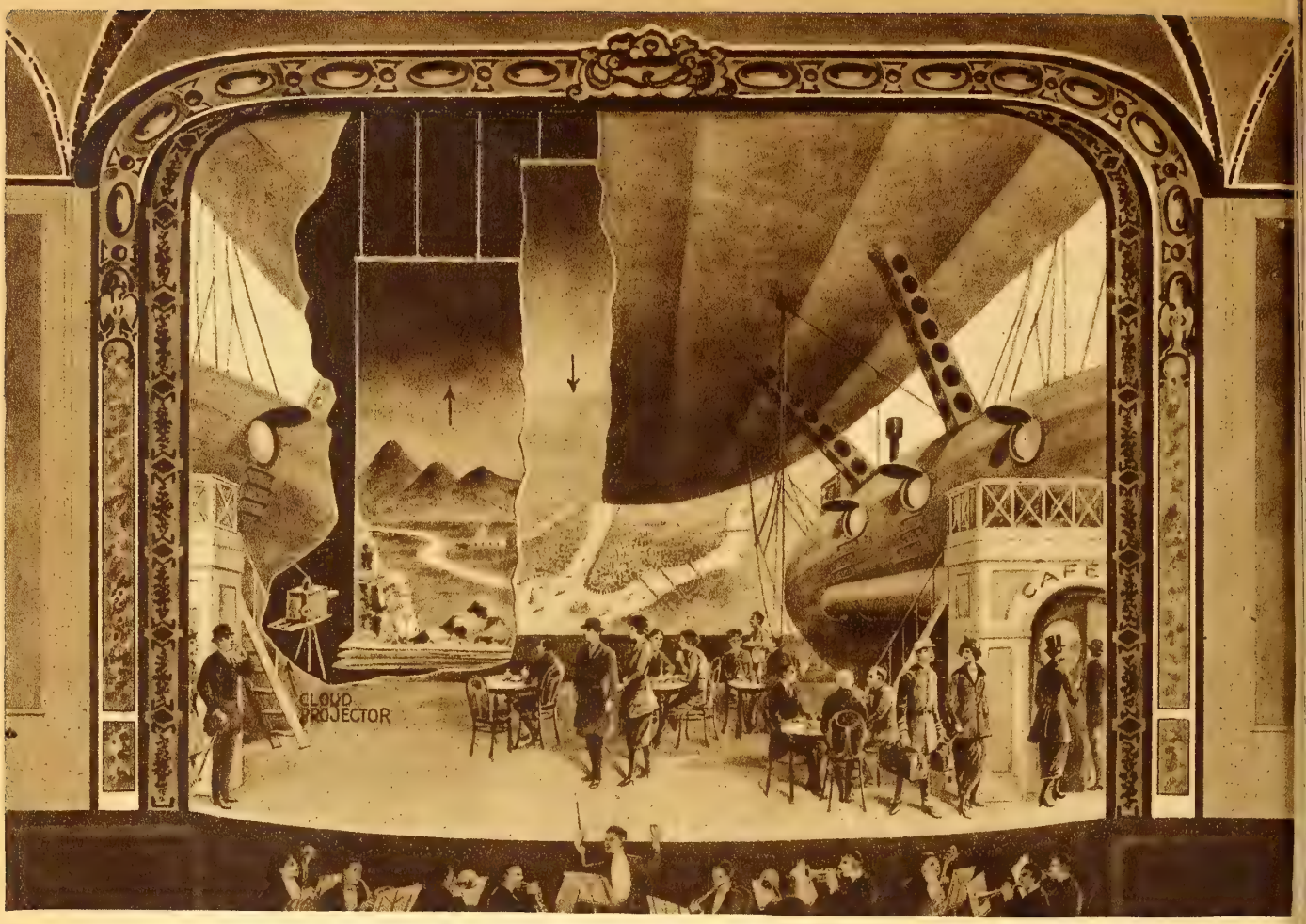
By I. KUTTNER

IMAGINE that you are making your first visit to Coney Island, New York's greatest amusement resort, via the boat from the Battery that takes you down the bay and gives you a dash of the ingy salt sea air. Also let us imagine nat this is a night boat, so that you will xperience the full pleasure of seeing Luna 'ark and Steeplechase all decked out in neir myriads of electric lights, ablaze gainst the black mantle of night.

You've just left the pier at the lower end of New York City and are sailing along happily on your way. After you have progrest for several miles your attention is arrested by a mammoth illuminated star on the horizon—clearly outlined against the sky. As you approach the Island, the giant star rapidly increases in magnitude. Before long your eyes begin to ferret out the details of this mammoth display which evolves itself into a huge, revolving wheel carrying the star with it, across the center of which there flashes the legend "DIP-THE-DIP," and as you gaze in wonderment at this greatest of great amusements afforded by the world-famous "Coney" you can hardly rest until you get there and make your way toward it.

You have mastered your nerve by this time and have made up your mind that no matter what the charge may be, you are

(*Continued on page* 803)



© 1920, by Science & Invention.

A Wonderfully Realistic Airship Scene Appears in a Recent New York Theatrical Production—George White's "Scandals of 1920" in Which Dainty Ann Pennington Is the Star. The Audience Is Given the Effect of An Airship Rising Above New York City, the Ship Later Becoming Lost In a Storm, and Finally the Sky Brightens Once More and a Mexican Scene Comes to View or Rises as the Airship Settles. The Manner In Which This Is Done by Means of Two Extra Long Back Drops Painted With the New York City and Mexican Scenes Is Clearly Shown in the Illustration Above. To Give the Effect of the Airship Rising the Front Curtain Is Slowly Lowered. For the Storm Scene the Stage Is Darkened Almost Completely While the Dark Portion of the Curtain Appears and Overlaps With a Similar Dark Portion on the Rear Curtain, and When the Scene Is Illuminated Once More the Audience Beholds the Mountains of Mexico Coming Into View.

Science "Stars" In New Plays

QUITE startling, and clever indeed, is the airship scene from the George White's "Scandals of 1920," starring Ann Pennington, a recent metropolitan production. In one of these scenes we see before us the two rear gondolas of a gigantic Zeppelin, suspended from the gas bag above by appropriate structural aluminum trusses; the ropes also being suspended from the gas bag above and are ostensibly used for the regulation of the various devices.

The execution of this scene is such that all the construction faithfully resembles the remarkable Leviathans of the air. The scene of action takes place between the two gondolas. At the right hand side is a cafe which has many worthy members, including Mr. William J. Bryan, who enter for something stronger than 2.75, after the three-mile altitude has been reached. Even the height which the dirigible attains apparently makes the actors groggy.

Now comes the strange part of the play. The propellers are heard to whirr, while the background scenery, containing a bird's-eye of New York City, moves away or downward rapidly as the Zeppelin reaches a very high altitude. The audience actually imagine that they are on a giant airship flying upward. The illusion is well nigh perfect. Finally, the Zeppelin reaches the three-mile level and the "cafe" is opened—and while the clouds roll by, the actors get their fill of liquors, while the long suffering audience looks on.

Lightning Scene Changes and Realistic Airship That Appears to Fly

A storm now breaks and the scenery is only lit up by the intermittent flashes of lightning, and above the roar of the thunder the Captain shouts that they are drifting off their course. At last the ferocity of the storm subsides and the airship "descends," and the passengers find themselves in a new country, namely, that of Mexico.

How the entire scene change has been effected in four seconds can be readily explained in a few words. The airship and and other scenery in the front, as can be seen in our illustration, is painted on canvas. On the background between the two gondolas is painted a bird's-eye view of New York. This background is twice as high as the portion viewed by the audience. The clearest detailed view is toward the bottom; then Brooklyn lies above it and this enveloped in more or less of a fog; even this detail gradually dies out until at the top of the drop the scene is completely black. Behind this drop is placed a second drop similarly painted, except that a scene from Mexico occupies the most important position, with the top part of this drop also blackened.

When everything is set, the action proceeds rapidly by allowing the first drop to be lowered gradually and slowly. At first, the audience imagines that it is passing over New York, then Brooklyn, and finally the fog commences to show while the detail is lost; the lights gradually go out and clouds are projected on the first background from behind the stage, giving an unusual electrical effect of moving clouds.

Even these darken as the storm approaches and lightning flashes illuminate the setting at short intervals. Meanwhile, the first drop has been lowered to the greatest extent which the scene will allow. Between one lightning flash and another, the first backdrop is suddenly released and cords holding it in place are unclampt. No change seems to have taken place, at least, not from the audience's point of view, but now the second backdrop occupies the position held by the first, and as this second scene is gradually raised and the lights turned on, Mexico comes into view.

Finally the airship is landed and the occupants come out to an entirely different scene, and even the atmosphere seems to have changed, while the action takes place in the country of internal commotions.

Another astonishingly quick change of scenery is being exhibited at the Central Theater in New York City, in the play



(c) 1920 by Science & Invention

n Astonishingly Quick Change of Scenery—in Fact, the Quickest on Record—is Made in Another New York Theatrical Production ntitled "The Poor Little Ritz Girl." The Heavier Set of Scenery is Mounted on Two Pivoted Platforms Which Roll on Felt-covered all-Bearing Roller Castings. A Squad of Stage Hands Quickly Pull the Two Halves of This Scenery Set Back and Out of Line With ie Proscenium Arch as Shown Above. The Scene Changes from a Massive Interior With Real Book Cases and Books, Tables, Piano, tc., Within Two Seconds to a Beautiful Japanese Garden Scene. The Lights Are Extinguished for This Short Period, Leaving the udience Gasping in Wonderment at the Miraculous Change in Such a Short Time. Part of the Scenery for the Garden Scene is Lowered from Aloft.

ie "Poor Little Ritz Girl," where an entirely different method is employed. As hown in our diagram in this scene, the ntire stage set is mounted on two movable atforms which open like doors rotating out two giant "king pins" mounted at the rners. The secondary stage is moved out noiselessly on 95 felt covered, ball-earing, roller casters. This scene is so nstructed that there is no fraud to the age settings, whatsoever.

Everything has been built solidly and not opt up or simply painted on canvas in ny way whatsoever. There are real books on the shelves and an open hearth with owing logs is found on the left hand side. At the right is a large and massive piano.

The total weight upon the stage is a little over five tons, and yet none of this is shifted in order to allow for the rapid change at the opportune moment. Even the actors and actresses retain their places. Within two seconds, this scene changes to a Japanese Garden. The lights go out, the stage splits in half and each half is rotated outwardly, while simultaneously, eight drops are let down from the gridiron above the stage to occupy the place formerly occupied by the library.

These drops are mostly made up of silk gauze, beautifully painted and bolted together permanently, so that they descend as one. Two seconds on a stop watch for a scene change such as this is a remarkable undertaking indeed.

At the end of the last act the audience gets an insight into the "workings." Just before the final curtain is rung down and just as the chorus music reverberates at the final note, the stage in full view of the audience splits into two parts, each section receding from view, one side to the left, the other to the right.

The entire company of some 50 persons thus vanishes into space inside of two seconds, right under the eyes of the dumfounded audience.

Throw Away Your Eyeglasses!

How to avoid wearing glasses was explained at the annual convention of the American Osteopathic Association in Chicago. The most spectacular feature of the convention was the first public demonstration of the newly discovered method of treating the eyeball osteopathically, for the purpose of correcting errors of refraction. Dr. James D. Edwards of St. Louis, the discoverer of this technique, gave a demonstration.

He claims that it is possible to avoid the use of glasses in 90 per cent of cases, if the treatment is begun early enough. The same treatment he has discovered will cure a large percentage of cases of glaucoma, which heretofore has been classified by medical oculisfs as an incurable disease. Incipient cataracts, retinal detachment, iritis, crosseyes, conjunctivitis and optic nerve atrophy have responded to this technique.

With the exception of the specific and malignant diseases, which should be carefully differentiated, Dr. Edwards claims almost every morbid condition of the orbital cavity can be considerably benefited, if not entirely cured. Finger surgery is what the doctor calls it, as the osteopathic operation is performed by inserting the carefully prepared finger in the orbital cavity and adjusting and manipulating the eyeball. Dr. Edwards says he has never had any bad results or postoperative discomfort. In fact, he says there is a sedative effect from this seemingly harsh yet scientific treatment.

A French invention described in the American press some months ago, involves the principle of applying physical pressure to the eyeballs for myopia or elongation of the eyeball. The machine just mentioned for the treatment of myopic ailments of the eye comprises two spherical cups, one of which fits over each eye so as to press against each eye-ball. These cups are mounted on two rods which are under spring pressure and which pressure can be adjusted and increased as the treatment may require. The technique for applying this method of coaxing the eye-balls back into their normal condition consists of applying this machine to the head and putting pressure on the eye-balls periodically.

"Applied Chemistry"

By CHARLES S. WOLFE

THE flickering, cold beams of their electric hat lights dancing weirdly on rocky cavern wall and ceiling, the five gazed in awe on the spectacle before them.

A short silence fell, each busy with the task of stabilizing his architecturally acrobatic brain as gigantic air castles soared skyward.

At last, in a voice that he strove to make calm, Small spoke, the sound reverberating fantastically in the tunnel.

"And so you see, gentlemen," and in spite of tremendous effort that voice trembled, "my Indian did not lie. Our hunt is successful. Here is an abundance of gold."

Archer, the geologist, spoke without taking his staring eyes from that amazing vein. "Without an assay, I can say with no fear of exaggeration that the world knows no other vein that can compare with this. Boys, we are plutocrats."

Benson, soldier of fortune and rolling stone, turned to Small. He was probably the coolest one of the group. "Old man, I apologize for what I have thought. When you rounded up the four of us in that hotel lobby in Mexico City and sprung that dying and grateful Indian's tale on us, I was sure the old heathen had been delirious. I only chipt in my ante and came along for the fun of the thing. I never expected this."

"Nor I," Brown, the stranded traveling salesman was feasting still doubting eyes on the bulging pay rock, "I put in my share to help an American who was down on his luck in this outlandish country. Great Lord, Professor, would you have thought it?"

Their attention called to him, all turned to the middle-aged, bald-headed scholar who made the fifth member of the party. For a long time he did not reply. They waited expectantly. Finally he sighed. "Maybe Mrs. Groin will leave me alone in my laboratory now, and I'll get a chance to do a little work," he said, and it came from the bottom of his heart.

The walls hurled back their laughter, as, the spell broken by the unexpected viewpoint of the pedagogue, they flung their packs to the cavern floor, and prepared to tackle the many tasks that lay before them.

"You boys go to it," Brown called, kneeling before the packs. "All I know about rocks I learned in thirty days which I won on a D. and D. (drunk and disorderly) charge. I'll take your word for all results. And while you're working I'll cook."

"Admirable suggestion." Professor Groin was flourishing a hammer. "We will be very hungry when the reaction sets in. Archer, shall I sample for you?"

Archer, tenderly drawing from their swathings chemical glassware, called a warm assent. "Go to it, Groin, old top. Something tells me that you are going to be a regular ace in this game."

Groin paused, a fragment of rock from the rich ledge in his left hand. "I am not wholly unfamiliar with the principles of metallurgy," he said, modestly, "altho this is my first excursion into the field, so to speak. Most of my time has been spent in the laboratory. I only came down here to get away from Mrs. Groin."

Brown, mess gear spread before him, paused to remark sarcastically, "You picked a nice, quiet locality."

Groin sighed, and attacked the ore vigorously. "To me it seems quite peaceful," he replied, pathetically.

Benson, his hands on his hips, stood erect in the middle of the floor space, his eyes roving restlessly here and there, in the manner of a man who is seeking something which eludes him.

"Fellows," he said, slowly, "listen to me. I don't know anything to speak of about mines. This thing is all new to me. But I do know one thing. I've knocked about a bit, and I've been in some damned tight corners. And I'm subject to—a hunch. Every time that I'm threatened with danger, I get a feeling . . . I can't describe it to you. I just get it, that's all. And I've got it right now—strong."

They all gazed at him uncertainly. No one raised a ridiculing voice. There was an earnestness in those tones that carried conviction. Finally Small spoke.

"I don't see anything threatening around here, old fellow," he began, "I—"

(*Continued on page* 806)



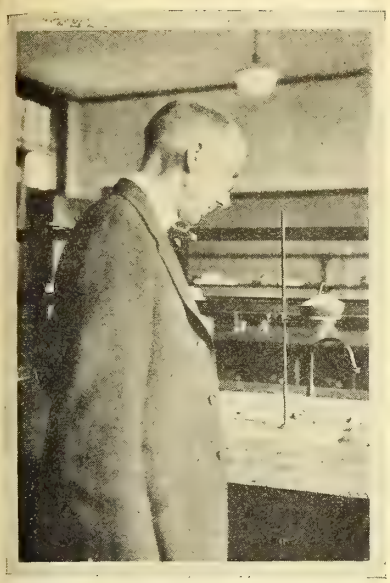
". . . Groin Dropt to His Knees Before the Little Hole. 'Out With the Lights,' He Snapt, and Silently Benson Obeyed. He Could Hear Groin Fumbling in the Darkness. Then Came the Scrape When the Professor Arose. The Single Flickering Beam From His Now Carefully Shaded Electric Torch Revealed Him Moving Slowly Away From the Spot Where the Bottles Stood, Methodically Laying a Train of Bagging Strips Along the Cavern Floor. 'Bagging Soaked in Acid,' He Explained Shortly —'The Fuse' . . ."

© 1920 by Science & Invention

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

Fire and High Temperature Experiments Including "Thermit"



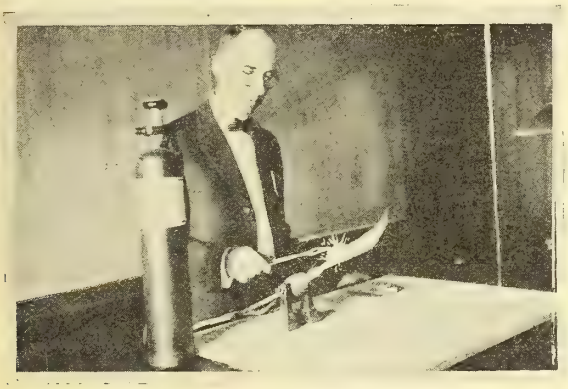
Making Quicklime in Home-Made Electric Furnace.



Preparing Hydrogen by Passing Steam Over Hot Iron Filings in an Electric Combustion Furnace.

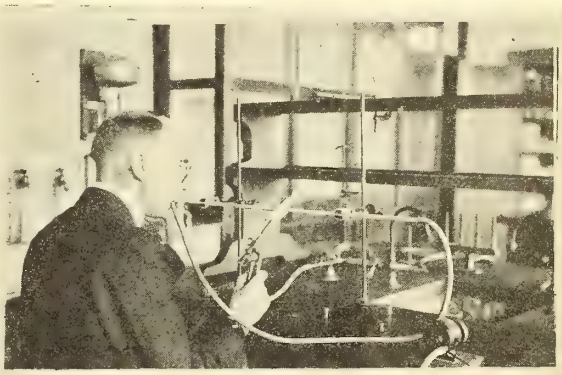


Ignition of "Thermit" Giving Molten Iron at 3,000 Degrees Centigrade.



At Left:—Burning Iron Wool in the Oxy-Hydrogen Flame. The Cylindrical Tank Contains Oxygen.

At Right:—Making a Joint by Sealing Two Glass Tubes Together. A Delicate but Valuable Experiment.



FROM the days of the *Cave man* to the present moment, the mastery of fire and the attainment of high temperatures have been indispensable to progress in the arts and industries. By its aid primitive man cooked his food, fashioned his implements and lighted his cave. The glare of the open camp-fire lured wild animals within his range. Very gradually thru his experiences with fire he acquired a rudimentary knowledge of the arts of pottery, glass-making and the metallurgy of the simple ores. With each advance in the degree of heat obtainable in our furnaces, have come additional triumphs of science and new commercial processes. The alchemist in his vain endeavor to transmute the baser metals into gold, knew no higher temperature than that obtained from the burning of good beech wood. Then came coal and gas with the forced draft, to be followed by the oxy-hydrogen blowpipe, the electric furnace, thermit, the oxy-acetylene torch and the explosion of cordite. Temperatures rivaling those of the sun are now within our grasp and subject to our control. In this article we shall take up some of the sources of high temperatures and experiments that can be performed with their aid.

The Oxy-hydrogen Blowpipe: For three-quarters of a century the oxy-hydrogen blowpipe represented the acme of high temperature attainment. The heat of its flame was used for glass-working, for making artificial gems, for melting platinum and wherever the "highest" temperatures were required. Its construction is shown in Fig. 1. As will be noted, the oxygen passes thru the inner tube and the hydrogen thru the outer one, the two gases mingling at the nozzle and burning with a fierce heat.

In the absence of a cylinder of comprest hydrogen ordinary illuminating gas may be used with excellent results and in place of a hand blowpipe an ordinary blast lamp will be very satisfactory. A cylinder of comprest oxygen, however, will be indispensable and this can usually be had in any city from companies that use it for welding purposes.

Having wired the rubber tubing securely to the cylinder of oxygen and to the blast lamp, turn on the hydrogen gas and light it. Then very gradually admit oxygen to the blast lamp and regulate the supply of gas and oxygen until you have a small blue flame.

Into this flame thrust the end of a nail or long iron wire and note the vigorous shower of sparks. If this can be done in the dark the effect is exceedingly brilliant. To protect the table from the falling globules of molten iron place beneath the lamp a sheet of asbestos paper or a layer of sand.

The Limelight: First don a pair of smoked glasses. Grasping a piece of quicklime with a pair of tongs hold it in the oxy-hydrogen flame. Almost immediately the quicklime will be heated to brilliant incandescence—dazzling in its brightness. Not so many years ago before the use of electricity had become so universal, the calcium light was the sole source of illumination for stereopticon pictures and the stage. From this latter use comes the familiar expression of "being in the limelight."

It will also be found interesting to try the flame upon other substances such as aluminum, copper and various minerals.

Sealing Glass Tubing: To make a successful joint by sealing together two pieces of glass tubing is a rather difficult operation but frequently one of very great practical importance.

For this purpose either gas and hydrogen may be used or gas and comprest air. For obtaining comprest air a small blower and electric motor are essential. A foot bellows may of course be used but it is never as satisfactory. Instead of the blast lamp a small hand blowpipe, or brazing torch, will be necessary.

First see that the ends of the two pieces of glass that are to be sealed are squarely cut. Then clamp each to a ringstand and bring them into perfect alignment with the ends about a quarter of an inch apart, as shown in Fig. 2. On the opposite end of one piece of the pieces of tubing place a short piece of rubber tubing and clamp it tight with a screw clamp. On the corresponding end of the other piece of glass tubing connect a three-foot length of small-bore rubber hose and take the end of it in the mouth. Now start the blowpipe and reduce the flame to as small a size as possible. First soften the ends of the glass tubing thoroly and evenly and then very carefully bring them together. With the fine needle-like flame of the blowpipe quickly and skillfully soften the glass about the joint, being careful to soften it uniformly about the whole circumference. If the glass sinks in at any point very gently blow thru the rubber tubing held in the mouth. If a bubble appears at any point use very gentle

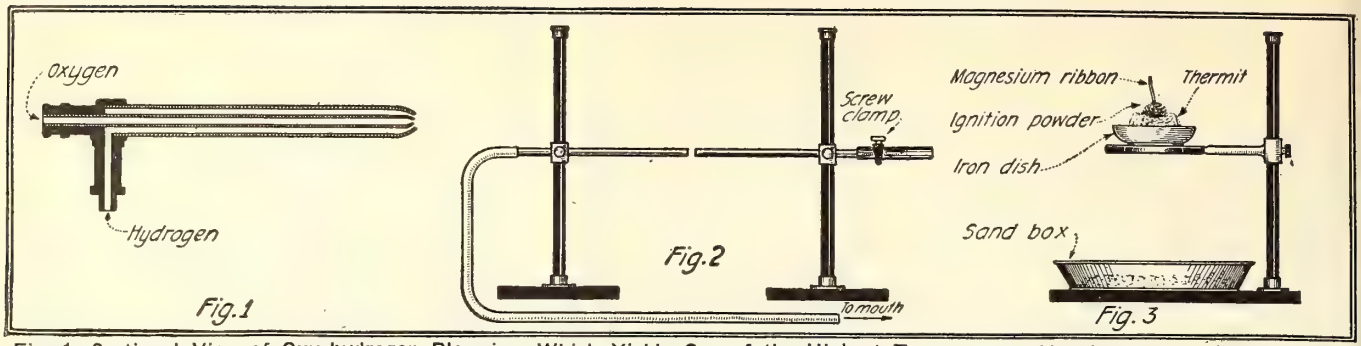


Fig. 1—Sectional View of Oxy-hydrogen Blowpipe, Which Yields One of the Highest Temperatures Yet Attained in Chemistry for Welding, Brazing and Analytical Work. Fig. 2—Showing Two Pieces of Glass Tubing Clamped in Position for Sealing, as Illustrated in One of the Accompanying Photographs. Fig. 3—Apparatus Set Up for Experiments with "Thermit," Which Produces One of the Highest Temperatures Known. Street Car Rails and Many Other Steel and Iron Junctions Are Welded by "Thermit."

suction. The object should be to leave the glass as thick as possible at the joint and slightly larger in diameter than the glass on either side of it. If this can be accomplished the joint instead of being a weak spot will actually be stronger than the rest of the tubing.

A little patience and persistent practise will bring success and skill.

Thermit: Among the most notable triumphs of high temperature achievement is that of *thermit welding.* If you go into the locomotive repair shops of any great railway terminal you will find men wearing large, colored glasses at work tapping white-hot molten steel at a temperature of 3,000 degrees Centigrade from a conical vessel into a sand mold built about the broken parts of some locomotive drive wheel or portion of the frame. These men are employing the "thermit" process and this disabled locomotive will be ready for service within twelve hours after its arrival in the shops. Furthermore, the welded part will be stronger than it was originally.

But what is thermit? The name suggests heat and this is the meaning of the term. Soon after the production of aluminum and the determination of its properties in 1854, it was discovered that, if this metal were heated with one of several metallic oxides, a chemical change of explosive violence would take place, liberating vast quantities of heat and blinding light together with the molten metal at a temperature much higher than its melting point. One of the first metals experimented with was iron and the result was the production of the superheated, liquid metal at nearly double the temperature of molten steel.

The thermit mixture consists of aluminum dust and iron oxid and the chemical change which takes place is exprest by the following equation:

$$2Al + Fe_2O_3 = Al_2O_3 + 2Fe.$$

Homemade Thermit: These high temperatures may be easily produced in the home laboratory and very striking demonstrations carried out.

Mix about equal quantities of aluminum dust and red iron oxid, or ordinary rouge, and place the mixture in a small iron or tin dish mounted on the ring of a retort stand, as shown in Fig. 3. Beneath it place a small box containing an inch-layer of sand. In a little depression in the top of the mixture place a half teaspoonful of ignition powder, made by mixing equal parts of magnesium dust and powdered potassium chlorat, and into it thrust a short length of magnesium ribbon.

Light the magnesium ribbon and with great rapidity the reaction will spread thruout the mixture, producing intense light and liberating white-hot molten iron, which will melt a hole thru the iron dish and flow in a stream of dazzling brilliancy into the sand box below.

Melting a Hole Thru a Sheet of Iron Beneath Water: A unique variation of this experiment consists in arranging apparatus as shown in Fig. 4. In the bottom of a good-sized battery jar place a 2-inch layer of sand. On this layer of sand place a small tripod covered with a thin sheet of iron. Fill the jar two-thirds full of water, set it on the base of a retort stand. On the ring above place a folded filter paper containing a mixture exactly like that used in the previous demonstration. Upon igniting the thermit the molten iron will drop thru the water and striking the sheet iron will melt a hole thru it.

Thermit Welding: Obtain a 2-inch length of hollow tiling about an inch and a half in diameter and place it on a sheet of soft iron or steel about a quarter of an inch in thickness. Fill the tile with a mixture of thermit with ignition powder and magnesium ribbon at the top. Upon ignition the molten iron will run to the bottom and fusing with the sheet of iron beneath will weld upon it a boss which cannot be removed by the most vigorous hammering. It will be noticed, too, that the sheet of iron has been softened clear thru.

Electric Furnace: Still higher temperatures than any already described are obtained with the electric furnace. Electric furnaces are of two kinds—*arc* furnaces and *resistance* furnaces. Either type of furnace can be made by the amateur but the former more readily than the latter, principally for the reason that the Nichrome wire necessary for the resistance furnace is controlled by patents and it is practically impossible for anyone other than a licensed manufacturer or an educational institution to obtain it. Resistance furnaces, however, of both the combustion and the crucible types can be purchased, and they will be found exceedingly useful.

Making an Arc Furnace: The materials necessary for this furnace are fire clay, asbestos fiber and water glass. A mixture of these ingredients will quickly dry and harden into a fireproof mass of low heat conductivity.

First select a box about 8 inches long and 4 inches square. Bore a hole a little above the center of each end just large enough to take a standard arc light carbon. Then mix some of the fire clay, asbestos fiber and water glass until a doughy mass is obtained, and pack a layer one inch thick in the bottom of the box, forcing it down as firmly as possible. Now insert an ordinary glass tumbler in the center of the box and thrust two wooden pins the size of light carbons into the holes at the ends. Around these pack as tightly as possible more of the mixture, completely filling the box. See Fig. 5. Smooth off the top and fill in the cavities with a mixture of fire clay and water glass alone. In similar manner make a cover of the same size and about an inch thick. Place the box and contents together with the cover in some warm place, preferably on the top of a furnace and allow them to dry for several days. At the end of that time the box may be broken away and the tumbler and pins removed. The rough appearance of the outside may be removed by retouching with a little fire clay and water glass.

Now insert in the holes at the ends two electric light carbons to which stout pieces of copper wire have been securely fastened. With a suitable resistance in series the furnace may be connected directly to a house-lighting circuit. Upon striking the arc by bringing the carbons together and then slightly separating them, a blinding light and intense heat will be obtained.

Try its temperature by placing in the arc pieces of various metals, lime, quartz, etc. In a small fire clay crucible placed into the cavity just beneath the arc, metals may be melted and fusions made.

Producing Hydrogen With the Combustion Furnace: If your laboratory affords a *resistance furnace* with a silica combustion tube, a number of very interesting experiments may be performed.

(*Continued on page* 814)

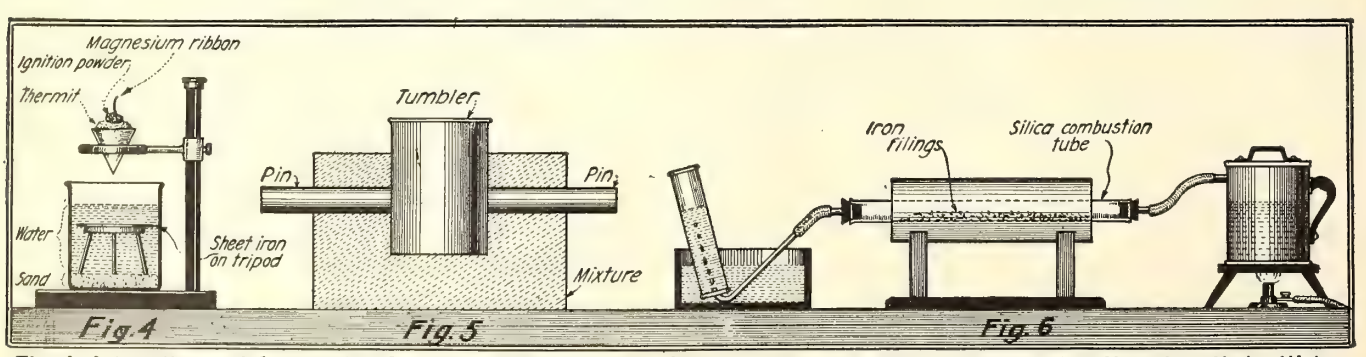
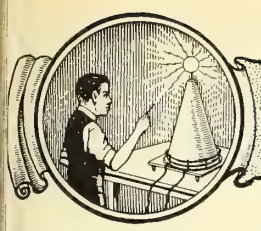
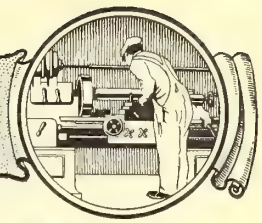


Fig. 4—Interesting and Spectacular Experiment Demonstrating that a Hole May Be Burned or Melted Thru Sheet Iron Under Water. "Thermit" Is Used in This Experiment. Fig. 5—Extremely Simple Plan for Constructing an Electric Arc Furnace Employing Two Arc Lamp Carbons for Electrodes. Fig. 6—Making Hydrogen by Passing Steam Over Hot Iron Filings in an Electric Furnace.



THE CONSTRUCTOR



Constructing a Demonstration Motor

By C. A. CLARK

THE accompanying diagrams and photo show a simple form of electric motor which I have used considerably in demonstrating the principles of motors to high school classes in physics and which students of electricity will find of interest, I am sure.

To operate the motor with a permanent magnet field, the horseshoe type steel magnet is mounted in an upright position as shown in the drawing. A powerful magnetic field is induced between the north and south poles, as we know. In this field is supported in a freely rotating manner the armature, which is formed of several turns of No. 14 B. & S. gage bare copper magnet wire. A piece of wire 28 inches long is sufficient usually. The armature turns are held together at A and B with a few turns of silk thread, or fine insulated copper wire.

The upper bearing is made of hard rubber or fiber, and the lower bearing of brass or copper with a cup-shaped depression formed into it, in which the pointed end of the armature wire may rest, and also to make contact with one side of the circuit, as is evident from the diagrams. The upper end of the armature is bent slightly so as to make contact once in every revolution with the contact brush held in the brass side-screw shown. This motor will operate at high speed on one cell of battery. Those wishing to experiment with or demonstrate the principle of the series and shunt wound motor, may do so by substituting a soft iron bar of the same shape as the horseshoe magnet, the legs of which are wound with cotton covered magnet wire, or simply annunciator wire, using about No. 18 or 20 gage wire for the purpose.

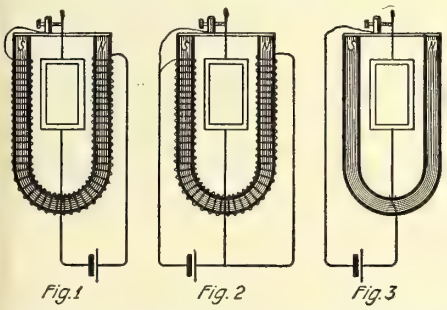


Diagram at Fig. 1 Shows How to Connect Up Field Coil and Armature to Make a Series Motor.
Fig. 2—Shows Connections for Shunt Wound Motor with Wound Field and Armature.
Fig. 3—Shows the Simple Connections for Usual Form of Demonstration or Toy Motor, Having an Armature of Several Turns of Wire and a Simple Field, Composed of a Steel Horseshoe Magnet with No Coils Wound Upon It.

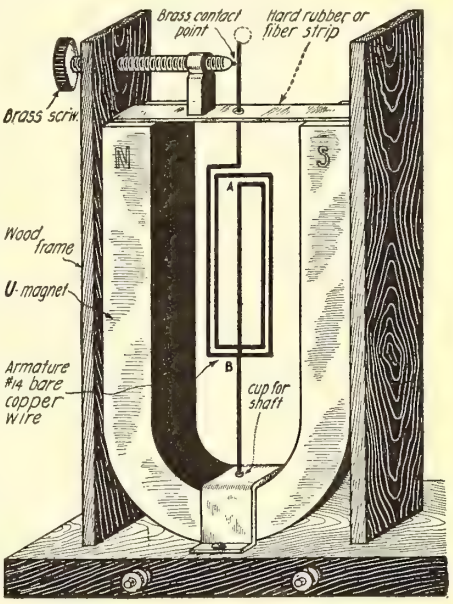


Illustration to the Right Shows How Author Constructed the Simple Demonstration Electric Motor Which Will Prove of Interest to All Electrical Students. It Operates on the same Principle as the Larger Motors Which Run Our Trolley Cars and Various Other Machinery and Devices.

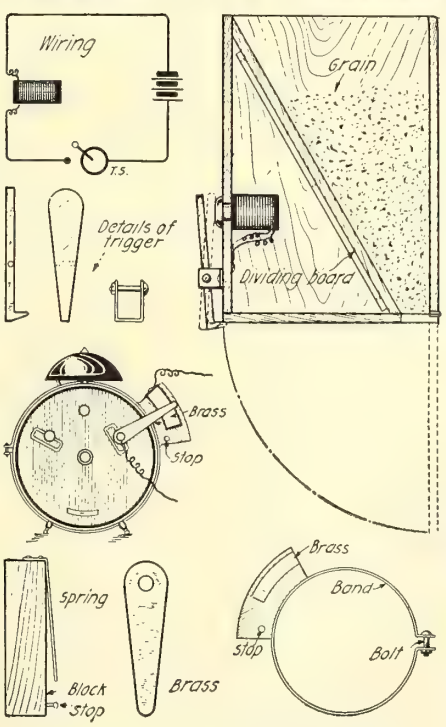
Electrically Operated Poultry Feeder

By GEORGE E. PERKINS

WHEN keeping poultry and it is necessary to go away for the day, arriving home late at night, it either means that the birds lose their evening meal or the neighbors have to be troubled with feeding them. A feeder that will automatically feed the birds at a predetermined hour does away with all this bother and it can be used even when at home, as the hopper can be filled in the morning when feeding and at night the chickens will be fed at any hour decided on. The following describes such a feeder:

A box is made in the shape shown, with a hinged door at the bottom and a thin board dividing it into two parts. This is done for two reasons, first to prevent the grain from running too fast and second to take the weight off the trap door, for if the entire weight of the contents was allowed to come on the door it would require an extra large magnet to trip the device.

The tripping device consists of an electromagnet, which attracts an iron armature, which has a hook at the end to hold the door in place. When the magnet is energized it attracts the armature pulling the hook from the door, allowing it to open and the grain to flow. The magnet may be obtained from an old bell or telegraph instrument or else made from a soft iron core ⅜" dia., by 3" long, wound with 14 layers No. 20 cotton covered magnet wire. The grain dropping from the hopper strikes a cone shaped tin deflector, which is fastened to the hopper by means of two strap irons, and is spread in a fairly large circle, thus allowing the hens to get it without crowding.



When You Wish to Go Away, but Still Do Not Wish to Deprive the Poultry of Their Regular Meal, This Alarm Clock and Electric Switch Arranged for Dumping the Grain at a Predetermined Time, Is Just the Thing. A Few Dry Cells Furnish the Necessary Power for Actuating the Elecro-Magnetic Trip on the Bin Door.

The time switch which operates the device is easily made and can be used for a number of uses other than this device. The principal part consists of an ordinary alarm clock. To the top of the key that winds the alarm spring a binding post, taken from a discarded dry cell, is soldered. This is used to hold the switch blade and also for a connection for the wiring. A block of wood is cut to the shape shown and a flat piece of brass is fastened to it as shown for the second contact. This piece should be allowed considerable spring, so that the blade when passing over it makes good contact. A screw below the spring acts as a stop for the blade. This block of wood is clampt to the side of the clock by means of a band of metal drawn tight by a bolt.

The action of the device is simple. The alarm is set in the ordinary manner, with the switch blade in a vertical position. The hopper is filled with grain, the trap door being held up by the hook. When the hour for which the alarm is set arrives the blade passes over the brass spring, as the key which holds the blade commences to revolve, the circuit is completed, the magnet energized and the armature attracted, tripping the door and allowing the feed to flow. After passing over the spring the blade is stopped by the screw and as it is not in contact with the spring no current is used except for the second in which the blade is passing over the spring.

The clock and battery may remain in the house or the clock with the battery may be contained in a box located near the hopper. The clock may be used the same as usual when it is not in service as a time switch.

The Chemists' Flower Garden

By DR. E. BADE

IF science continues to advance as rapidly in the future as it has in the past, man will not depend upon methodical Nature to produce life. Chemistry will supplant her and with the aid of diabolical mixtures it will be able to produce living things. Why should we plant seeds, patiently wait for germination to take place, coddle and care for the delicate seedlings, only to have them killed by the frost, burned by the sun, or mown down by the hail, when the chemist can produce and deliver the finisht product to the consumer?

These and similar baseless opinions are often heard among all classes of people. But it is an absolute fact that plants can be produced artificially, altho not as the fantastic hopes of the most enthusiastic optimist have pictured. That which science has produced resembles the plant in appearance, grows and develops as one, has twigs, leaves, and protuberances which closely resemble fruits. *But the vital spark of life is absent.* They are as dead and as cold as the stones themselves. The divine touch of giving life to inanimate things has not yet been given to man. But science can produce seeming life. A seeming life so realistic that the uninitiated are dumb with wonder.



The Chemical Plant Structure Shown Below Resulted From Dropping a Small Crystal of Cobalt Nitrate Into a Portion of Water Glass Solution, Formed by Mixing Two Parts of Sodium Silicate to One Part of Water.



By Dropping a Chemical Seed Into a Clear Transparent Liquid, the Seed Begins to Germinate After a Few Seconds. The Plant Above Resulted From a Crystal of Aluminum Sulfate Dropt in a Water Glass Solution Diluted with Water.

Such an effect can be produced with the chemists' flower garden. A chemical seed dropt into a clear transparent liquid *begins to germinate after a few seconds of expectant watching.* The impossible has been accomplisht. *Spontaneous germination* is a fact! But watch! Already a long shoot has been developed, it grows momentarily longer, it stops, seems to hesitate, when suddenly a protuberance is formed. The fruit! Another shoot has meanwhile reached the surface of the liquid, begins to spread, and a leaf or two has been developed.

The Jar Shown Below Contans a Chemical Tree Grown From a Manganese Sulfate Crystal.



Center View Shows a Typical Chemists' Flower Garden, While the Lower Picture Shows Chemical Tree Grown From Cobalt Nitrate.

The liquid used is ordinary water glass slightly diluted with water. (Two parts of sodium silicate to one part of water.) For seeds, crystals no larger than one half or one quarter of the size of a pea are taken of the following substances: Cobalt nitrate, a red crystal which slowly changes its color to a chlorophyl green as it grows; nickel nitrate which produces fine laminated tendrils with lightning like rapidity, manganese sulfate which produces protuberances from which other shoots make their appearance, and ferric chlorid which develops thick gnarled twigs and thin laminated shoots from which leaves soon begin to grow. Aluminum sulfate, which are white crystals, form thin delicate shoots in this liquid.

The Specimen of Chemical Plant Growth Shown Below, Resulted From Dropping a Crystal of Ferric Chlorid Into a Beaker Containing Some of the Water Glass or Sodium Silicate and Water Solution. Some of the Prettiest Growths Imaginable Result.





The Vessel Shown Above Contains a Very Beautiful Specimen of Chemical Plant Growth, Formed by Dropping a small Crystal of Nickle Nitrate Into a Beaker Nearly Filled with Water Glass Solution. It Is Surprising How Quickly This Grew.

A number of these crystals placed into a tumbler of the liquid soon begin to sprout and the heterogeneous mass with its varicolored bands, threads, knotty twigs, and leaves give a fine example of marine plant life among the corals.

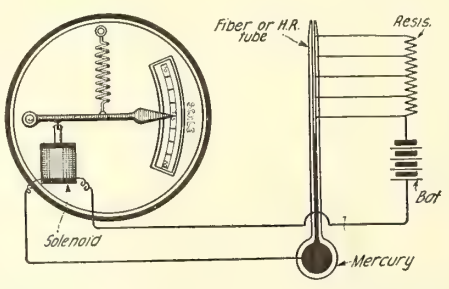
All the plants which have been produced with these chemicals are one-celled just as are the plants of the ocean.

Automatic Temperature Indication

Herewith is a description of an automatic temperature indicator which I have found useful. A glass tube of the desired length is obtained; about eight inches is the right length. It should have an internal bore of about ⅛ inch. A bulb is blown on one end by means of a Bunsen burner flame. A scale is now made for your thermometer. Place the tube against the scale in the position in which it will be permanently placed. Now determine as accurately as possible the temperature of the room. Then pour enough mercury of the same temperature into the tube till it rises to the height on your scale corresponding to the temperature of the room. Scratch on the glass tube this exact point and pour out mercury. This will help in mounting.

We will assume that you wish to have your indicator show all temperatures between seventy and eighty degrees in two degree increments. On your tube then mark off with a file five places corresponding to the divisions of your scale between seventy to eighty degrees.

At each of these places seal a short platinum wire so that the mercury will make contact with these wires as it rises and falls in the tube. A wire must also be sealed in the bulb.



Simple Form of Electric Thermometer, the Temperature Being Indicated by the Successive Positions of the Needle, Actuated by the Solenoid Magnet Coil.

The indicator is made in the following way: A piece of wood circular in shape and about ¼ inch in diameter is procured. A diameter of three inches is about right.

An indicator arm is mounted so that it is free to move back and forth. A solenoid is mounted so that an arm moves downward when the current is turned on. A spring is mounted on the upper circle of the base. The diagram will explain this arrangement better than words.

The top of the thermometer tube is left open. It must, of course, be kept in an upright position.

The hook-up is given in figure. The pointer will, when at rest, point to 70 degrees or the lowest temperature on your indicator scale. A low resistance coil is connected between the thermometer tap points.

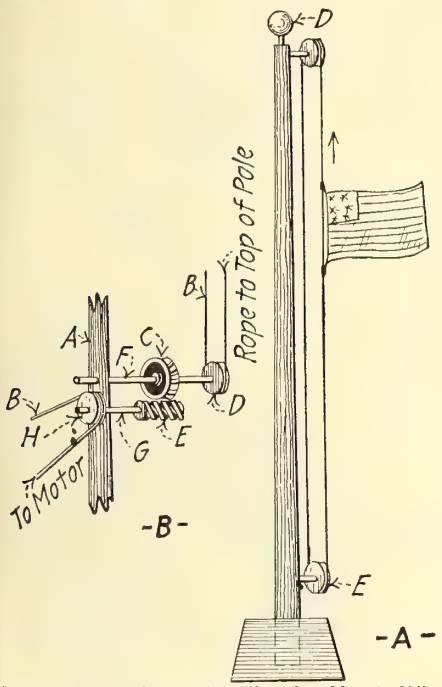
Some little experimenting will be required to accurately calibrate the instrument.

I use my instrument to tell me when my "hot-house" is getting too warm. The thermometer is of course placed in the hothouse. The "indicator" may be placed anywhere. Thus you can tell the temperature of a room in one part of the house, down in the basement, etc.

Contributed by BURT CLARK.

RAISING THE FLAG "BY MOTOR."

Here is an idea that might interest some patriotic experimenter. It is an idea for raising and lowering "Old Glory" by motor. Fig. A shows a method of fixing the flag to the pole. Fig. B shows how to



Instead of Raising the Flag by Hand, Why Not Raise It by Motor? The Gearing Required for the Purpose Is Simple, and the Motor Power Required Is Quite Small in Most Cases. By Balancing the Flag with a Weight, However, the Power Required Will Be Small.

arrange the gears. The flat gear C and pulley D are placed on the axle F. The axle G has a worm gear meshing with gear C. The pulley H is connected by belt B to the motor.

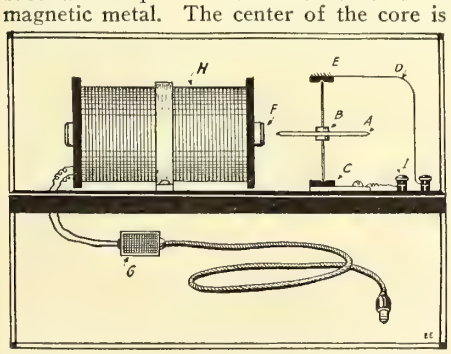
Of course any system of gears can be used. If no reduction is desired, the motor can be placed where pulley E is in Fig. A. If no pulleys can be had, a pin or nail can be used in place of pulley D in Fig. A. The pole can be of wood.

If the gear system shown in B is used, the ratio can well be twenty to one.

A SMALL SYNCHRONOUS MOTOR.

Upon a base about three inches long is mounted a brass support, D, with 3 screws, I. It is made of a strip of brass bent at where the screws go in, at the top bearing, and the bottom bearing, where only one thickness is drilled and a small piece of glass is inserted between the upper and lower thicknesses. This makes a good bearing.

An electro-magnet, H, is fastened to the base with a piece of brass or other non-magnetic metal. The center of the core is



The Simplest Form of Synchronous Alternating Current Motor Is Probably the One Here Shown. Altho Small in Size and Power, It May Be Used for Many Scientific Laboratory Requirements Such as for a "Time Shutter," Et cetera.

arranged a little above the armature, so it will not bear so heavily on the bottom bearing. The core is about ⅛ inch away from the armature. A small transformer is used (this motor cannot be run with batteries) to run the motor. The armature is a piece of clock-spring or other hard steel, A, about 2 inches long. A hole is punctured for the shaft, which is a large sewing needle, E. The armature is fastened on the shaft with an eraser, B, from the end of a pencil. It is cut in half and forced on the shaft. The steel armature is magnetized by a horse-shoe or other magnet.

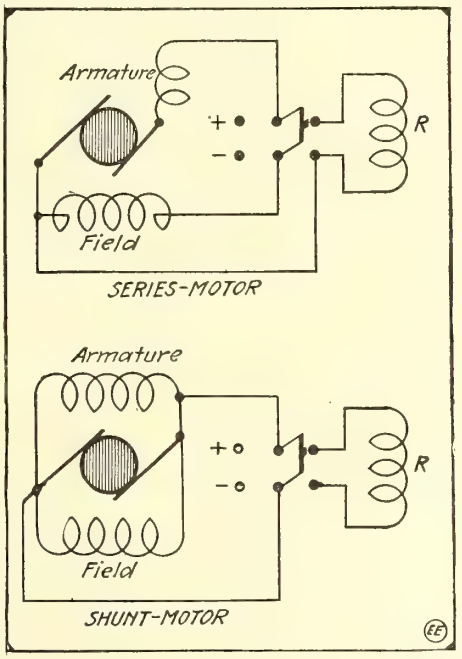
To start the motor turn on the current and give the shaft a twist. You may not be able to make it do much for the first time, but after a while you will be able to make it go any one of two or three different speeds.—Contributed by

THEODORE D. PECK, Jr.

ELECTRIC BRAKE FOR SMALL MOTORS

Often it is necessary to have a motor stop immediately as in the case of a rotary spark gap. This is best accomplished by the use of an electrical brake very simple to construct. For small motors the resistance "R" should be of 60 ohms value or more, accurately obtained by experiments. When the motor is to be stopt the power switch is drawn out and thrown in on the opposite side. The counter E. M. F. developed by the armature is taken up by the resistance "R" and the motor is brought to a quick stop. Connections for two kinds of motors are shown in the diagram.

Contributed by MONTE COHEN.

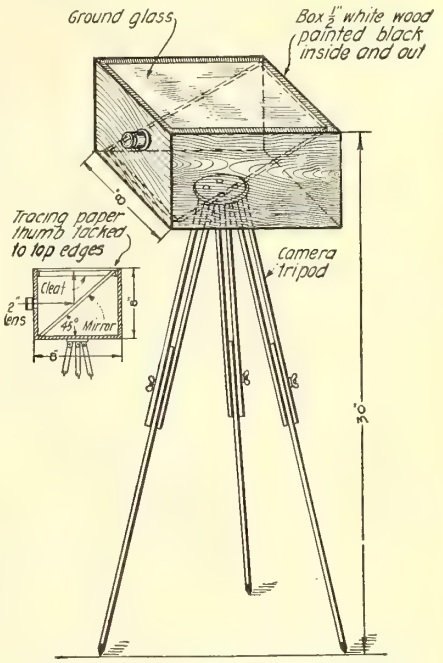


One of the Most Powerful Brakes Available for Stopping Electrical Machinery Is the "Electro-Dynamic" Brake, and the Method of Adapting It to Series and Shunt Motors Is Shown Above.

ENGINEERS' PERSPECTIVE OUTLINER.

In checking up perspective work and complete layouts of factories, and any work in fact, a great help is to have a tracing of the outline as is existent. Make a box of ½" white wood 8"x8"x8" (bottom only), insert a cheap lens, adjustable or not, and fix in place a piece of good mirror glass, set at 45° and held in place by thin strip of wood and glued fast. Set in the top a piece of ground glass flush with top. Use old camera tripod and screw fast to bottom. A small pocket level laid on top glass will simplify the leveling of the box. Place the instrument in position so that the object is shown on the top glass; stretch across the top a piece of tracing paper (oiled paper), and sketch off the object, after which, in completing the drawings this sketch of the general outline will serve as a help to all engineers and draftsmen. The principle is the same as a camera "finder".

Contributed by P. P. AVERY, M. E.



Herewith Is Illustrated a Simple and Accurate Form of Perspective View Outliner for Engineering and Other Sketches, the View or Object Being Thrown Up by the Lens on to the Ground Glass Screen, Over Which the Tracing Paper or Cloth Is Secured.

MUSIC ELECTRICALLY

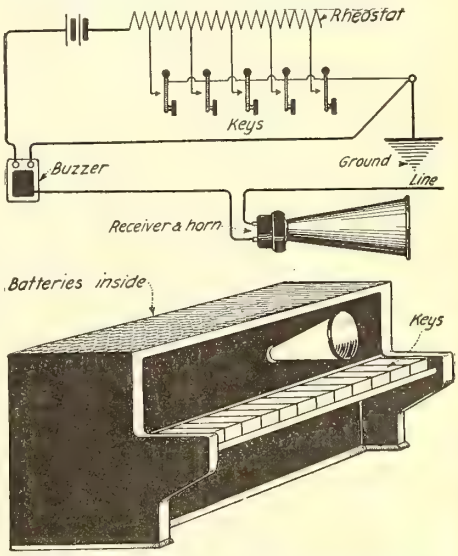
Radio Bugs, wake up, for here is something new to put your wireless instruments to, or some of them at least. Suppose you were reading and your wireless instruments began to play music. Ten to one you would stop reading and listen to them. You can do this if you have a mind to, and still have your wireless instruments with very little trouble.

This is a new sport. Instead of sending messages you send your friend music over the telegraph line, and he sends you music back. It is very entertaining.

Pictures show clearly how it is done. The following instruments are used: rheostat, receiver and horn or head-set, buzzer, batteries, and keys which are home-made, or else use old doll piano.

Tap rheostat as in diagram to get different notes and pitches.

Contributed by H. SCHLIESTETT.



By Means of a Graduated Resistance or Inductance Used in the Way Here Shown, Musical Notes Can Be Sent by Wire or Wireless, in Connection with a Buzzer Used as a Generator.

Electrical Machinist

By H. WINFIELD SECOR

NO. 12—CONSTRUCTION WORK DETAILS.

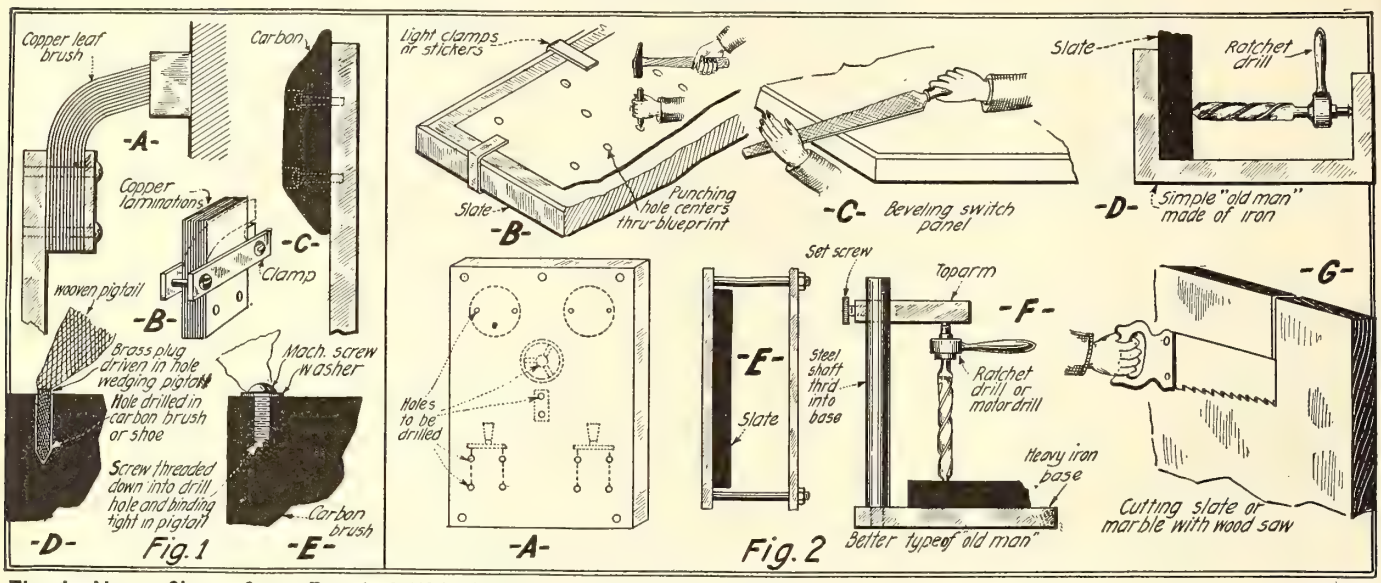


Fig. 1—Above—Shows Some Practical Wrinkles in Attaching Pig-tail Connections to Carbon Brushes and the Forming of Circuit Breaker Multiple-Leaf Contacts. Fig. 2—Illustrates Some Practical Details Met With in the Construction and Drilling of Slate and Marble Switchboards.

SEVERAL hints of practical value and useful to the man who has to do the work are given below. At Fig. 1 several wrinkles are shown, covering carbon brushes and multiple-leaf contacts on circuit-breakers. Figs. A and B show a multiple-leaf brush for circuit-breakers and other electrical switch gear, and the method of clamping the leaves while they are filed true on their face and then bent to the desired shape. Usually the outside sheet is of heavier copper, polisht or buft up and lacquered, which serves to help hold the contact leaves in their curved form. The end of the multiple-leaf contact where it bears against the brass or copper contact block on the base of the switch, as shown at A, must be filed very evenly and carefully, in order that all of the leaves shall touch the block.

At C is shown the method of attaching carbon break blocks to circuit-breakers. D and E, Fig. 1, show two methods of attaching woven wire pig-tails to carbon brushes by means of a block driven into a pig-tail down into a drill hole, or else threading a screw into the pig-tail after being pusht into a tight-fitting hole.

BUILDING SWITCHBOARDS.

Some practical shop wrinkles followed in building slate and marble switchboards will probably be found of use by the electrical machinist and several suggestions in this direction are clearly illustrated at Fig. 2.

At Fig. 2-A a typical layout for a small lighting plant switchboard is indicated. At B is shown a very good method of laying out the holes that are to be drilled thru the switchboard. Here a blueprint, which is often furnisht with apparatus to be mounted on a switchboard by the builders, is laid out on the face of the slate or marble slab and is best anchored in its proper position by means of paper stickers or light clamps. When it has been properly set, and the holes to be drilled finally decided upon, they can be prick-punched thru the paper with a steel punch and a hammer.

Where holes are to be accurately drilled, such as those for accommodating the studs of voltmeters and ammeters, knife switches, etc., which applies to practically all switchboard work in general, it is best not to attempt to drill the large full-size holes required at first, but to drill all of the holes thru the panel from the prick-punch marks with a small drill about one-eighth inch in size. Where very great accuracy is desired in the spacing of the holes it is good practise to drill the hole with increasing sizes of drills, until the largest drill necessary is finally brought into play. This method will also be found valuable in drilling holes accurately thru metal. Always drill the holes in switchboard plates or marble panels from the front—that is, the polisht face or the one having a bevel around its edges —and not from the back, as invariably when the drill comes thru the stock a piece will be broken out. Water can be used as a lubricant in drilling or cutting slate and marble.

It is difficult to bevel the edges of large size switchboard panels with a file, unless a jig is made for the purpose, so that the bevel can be cut evenly; but on small panels the operation can be carried out with a coarse file, as at C, Fig. 2, the bevel being finisht off with a sandpaper block.

D and E, Fig. 2, show a simple and also a more substantial method of providing an iron support frame between which and the switchboard panel to be drilled a ratchet drill can be placed in order to obtain the necessary pressure to pierce the stock. Such drilling frames are frequently called *"the old-man,"* and a typical old-man is shown at F, Fig. 2. This type has an adjustable arm which slides along an upright standard formed of a piece of steel shafting threaded or riveted into the iron base plate.

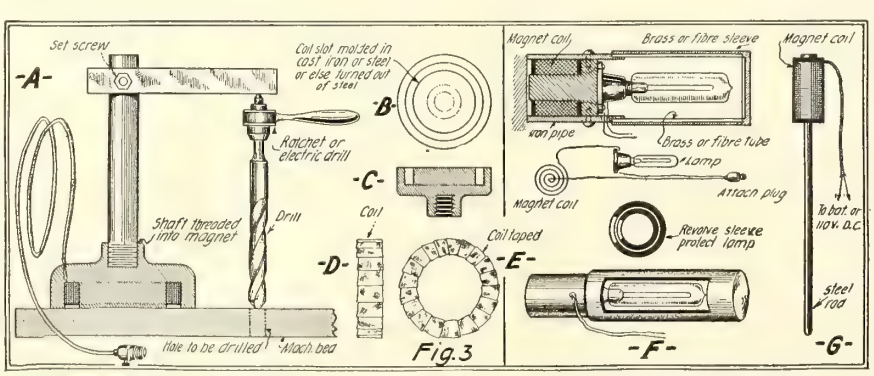
These drilling appliances will be found of the utmost value, and, in fact, are of great importance on outside jobs, shop work and in the factory, where switchboard panels have often to be drilled.

At Fig. 2-G an operative is shown cutting a slate panel with a wood saw. An old wood saw is generally employed for the purpose, and water is constantly applied while the cutting operation goes on. If a buzz saw is used in the shop for the purpose it should have fairly coarse teeth, as if the teeth are too fine they will fill up so rapidly that the saw will simply heat and not progress thru the stock. This remark applies to slate, marble and soapstone panels.

ELECTRICAL HELPS FOR THE MACHINIST.

A magnetic old-man is shown at Fig. 3, A, B, C, D and E. There are many locations, especially in drilling holes in difficult positions on various machines, away from the shop or in the factory, where this device will be found extremely practical and useful. Not only is it convenient, but it will save time frequently lost by the machinist or his helper looking for bolts.

The working details for building this magnetic old-man will be readily obtained from the drawings. The design of the base (*Continued on page* 800)



Above Are Illustrated Details for Constructing an "Old Man" With Magnetic Base to Hold It in Place While Drilling Operations Are Carried On, and Also Details for Constructing a Magnetic Base "Trouble Lamp" As Well As a "Search Rod" for Removing Steel Particles From Drill Holes.

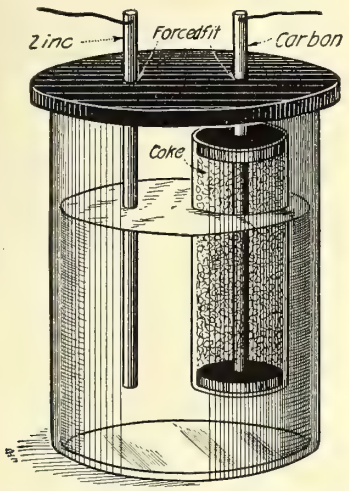
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; Second Prize, $3.00; Third Prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

A CHEAP BATTERY.

The materials needful for the battery are a rod of zinc, a piece of arc light carbon, two round pieces of wood about three inches in diameter and half an inch thick,



Experimental Wet Cell Having a Zinc Pole and a Carbon Pole Surrounded With Coke.

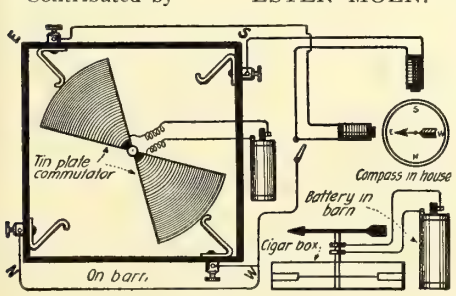
a little powdered coke, and some flannel. In the diagram the way in which the parts are assembled is shown. The round pieces of wood have holes in them large enough to admit the carbon. The flannel is tied around the carbon. Often it has been filled like a bag with coke; this should be tightly packt into place. The zinc and carbon rods can be supported by a cross piece of wood with two holes resting on the top of the jar. Wires are attacht to the ends. of the two rods. Finally fill the jar about two-thirds full with a solution formed of three ounces of sal ammoniac to half a gallon of water.

Contributed by
S. LEONARD BASTIN.

A WIRED-UP WIND VANE.

The diagram shows quite clearly all connections, and the only problem to conquer is the winding of the coils; also, when putting in new batteries, be careful not to change the polarity.

Contributed by ESTEN MOEN.



An Electric Wind Vane Constructed From a Compass, a Two-pole Switch, Two Magnet Coils and a Battery

SECOND PRIZE, $3.00

"WIREFENCE" TELEGRAPHY.

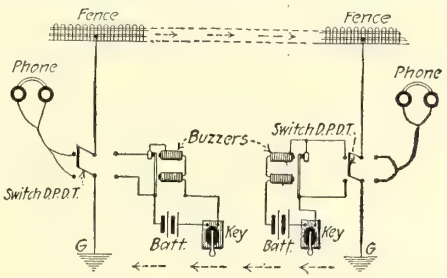
QST! QST! QST! Hello! fellow "bugs." Hope there won't be too much QRM when you read this. Did u kno that wirefence telegraphy is "coming in"? It is.

In the country we are often far apart, but I believe I have now spanned the difficulty and the "Country Bugs" may hold communication and practise code between themselves, even tho they may be two or three miles apart. This is not merely a suggested experiment, but a tried system. A fellow "Bug" and I, about two miles apart, have been racking our "cocos" for some time to find a suitable telegraph system that would not drain the purse on account of the H. C. W. (High Cost of Wire). So I have finally discovered the following cheap and simple means.

To most amateur experimenters I believe the diagram will explain itself, but I will help out by describing and explaining the system.

As per the subject of this article you will likely infer that a wire fence has something to do as a medium of connecting stations, and so it has, as you will soon see.

Most farms now have wire fences surrounding and dividing them. So with few connections between stations a continuous connection may be had by connecting joints and corners with telephone wire, after points have been scraped bright. Connecting two fences on opposite sides of the road may be done by passing a wire under the road



"Wirefence" Telegraphy Is Quite Common in the West, Where Long Wire Fences Are Used To Separate the Great Cattle and Agricultural Tracts.

thru a culvert or sewer pipe where convenient.

As per the diagram all that is used in sending the signals is a common buzzer, key and battery of one or two dry cells. A high frequency buzzer, like the Radiotone, is much better than the common buzzer. Receiving equipment is simply a set of phones of low resistance, preferably of about 75 or 80 ohms, altho wireless phones will do; but the low resistance phones respond much louder.

For convenience a D. P. D. T. switch is used to transfer from *sending* to *receiving* and vice versa. A good ground, such as used for wireless, is important for longer ranges than two or three miles.

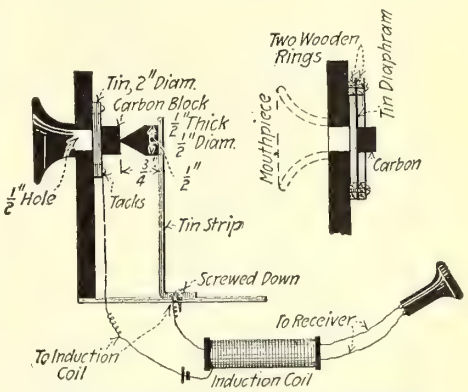
Altho the fence is grounded to some extent in many places, it does not hinder the signals from coming in perfect and strong.

Contributed by
RALPH D. STURIN, de 8AJ.

THIRD PRIZE, $2.00

MAKING A SENSITIVE MICROPHONE.

Take a cigar box and cut a hole ½ inch in diameter in the back of it. Then get a piece of tin 2 inches in diameter and glue a piece of carbon ½ inch thick and ½ inch in diameter on it in the center and then tack



Simple Experimental Form of Microphone—Particularly Sensitive When Used With An Induction Coil.

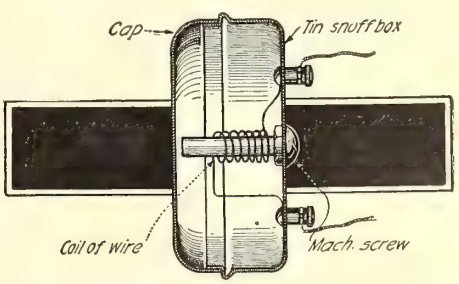
(best to evenly clamp with a second wooden ring) the tin with carbon over the hole in the box. Now take a pointed piece of carbon as per illustration and glue it on a strip of tin that is long enough to reach from the base to the center of the hole; then assemble as the diagram shows.

Contributed by
THEODORE FORTENBAUGH.

A "TIN BOX" TELEPHONE RECEIVER.

First procure a clean snuff box made of tin (A-1) and drill or punch a hole in the bottom, ⅛" in diameter. Into this, fasten a stove bolt with two burrs, one inside and the other outside, and have the end of the bolt just a fraction of an inch from the cover. Now insulate the bolt and wind on some fine magnet wire, about No. 34 to 36 B. & S. gage. Bore two more holes and insert a pair of binding posts, and attach the two terminals of the coil. Now put on the cover and she's "O. K." Simple, eh?

Contributed by ESTEN MOEN.

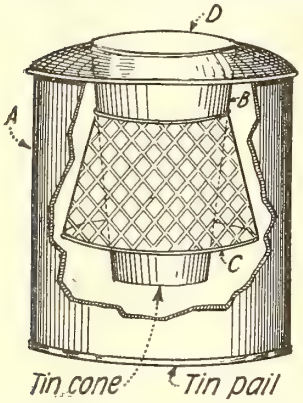


Ever Want a Telephone Receiver in a Hurry? Here's How To Make One—and All You Need is An Iron Stove Bolt, a Tin Can With Cover and Some Magnet Wire.



AUTOMATIC ICE CREAM FREEZER.

Herewith is a description of a freezer I made last summer which produces a fine ice cream or ice, without turning or stirring. Take a candy pail, the size depending on the builder's requirements. Now get some heavily tinned plate and make a cone-shaped vessel, similar in shape to a lemonade shaker, about six inches in diameter at the top and one inch at the bottom and fourteen inches long, is a good size. Now get a piece of heavy screen wire and make a cone-shaped container, C, as shown, which goes around the top of the freezer can, B, and extending half way down the sides. Next make a light lid, D, and the freezer is finished. To use, fill the salt sieve, C, with crushed rock salt and slip on the container, B, as shown. Then place in the bucket, A, and pack all around with crushed ice to which has been added 25 per cent salt. Then put the ice cream mixture in the container, B. Put on the lid and allow it to set about an hour. The ice cream made is exactly similar to that frozen in any freezer. The cone shape prevents the ingredients from separating and the heavier parts from settling to the bottom.



The Latest Thing in Ice Cream Freezers—the Kind You Do Not Have to Turn for Half an Hour or So. In the Accompanying Article the Author Describes How to Build One. It Comprises Three Simple Parts Which Anyone with a Little Ingenuity Can Readily Construct or Else Have Made at Small Expense by Their Local Tinsmith. Cracked Ice, to Which Has Been Added a Considerable Quantity of Salt, Serves to Freeze the Liquid Placed in the Container B, in About One Hour.

Contributed by A. H. WAYCHOFF.

A LEAD TREE.

Put an ounce of sugar-of-lead in a quart of water; shake it well, let it remain for three or four days. Pour off slowly the clear solution only, into a bottle and suspend a piece of zinc in it. Do not disturb this and in a few days the resemblance of a tree in crystalline form will be seen in the bottle.

Crystallized Tin: Mix half an ounce of nitric acid, two of water, and six drachms of muriatic acid. Pour this over a hot tin plate, and feathery crystals are thus produced on the surface.

Contributed by EXWYZED.

MAKING METAL PATTERN LETTERS.

To make metal pattern letters, the letters are first cut out of heavy cardboard and glued on a strip of wood, as shown in Fig. 1. A thin strip of the board runs from one letter to the other as shown, with a gate and riser print at each end. These letters are now oiled and a plaster of Paris cast taken of them. After the plaster has set they are lifted off. Now get a soft pine board and drive the points of fine tacks in it, taking care that the heads of the tacks come down where the moulds for the letters are. Lay this board on the plaster as shown in Fig. 2, and cut a gate A and riser in it. Pour melted lead into the gate A.

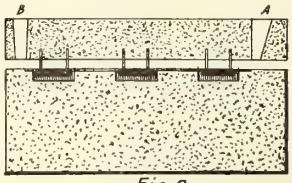


Fig. 2



Fig. 1

To Cast Metal Letters, the Latter Are First Cut Out of Heavy Cardboard and Glued on a Strip of Wood as at Fig. 1. A Channel as Well as a Gate and Riser Are Made at Each End of the Mould. The Tacks Shown Are Moulded Into the Lead Letters and Serve to Anchor Them in Place Wherever They May Be Used.

The lead runs the letters, and around the head of the tacks. The board is then removed which leaves the letters with tack points, ready to push into the patterns, doing away with trying to fasten them with brads. This is a foundry kink I've used for years.

Contributed by A. H. WAYCHOFF.

How to Use a Chemical Balance

By THOMAS W. BENSON

THERE are certain methods of using a chemical balance that add appreciably to the speed and accuracy of the weighing. Those taking up the study of chemistry or whose duties demand the use of a balance may find these paragraphs of assistance.

A sensitive balance should rest on as firm a foundation as posible. Excessive vibration renders difficult the accurate determination of the zero point and may injure the knife edges.

The balance should be protected from heat or cold. The arms should at all times have the same temperature so they will expand and contract equally. Unequal expansion will cause the zero point to change and the balance will not weigh correctly. If a lamp is used to light the balance it should be located above and back of the operator's head so that any heat rays falling on the balance will affect both arms equally.

When mounted in a case some basic substance such as lime or an alkaline carbonate should be kept in the case to neutralize acid vapors. Where the room in which the balance is used is excessively humid it is customary to place some drying agent such as calcium chlorid in the case. Sulfuric acid should never be used for this purpose.

PRECAUTIONS IN WEIGHING.

See that the balance is level.

Sit directly in front of the center of the balance to avoid parallax while observing movements of the pointer.

Release and arrest the movements of the beam and pans with a smooth steady movement. Jerky movements will in time injure the knife edges.

If practical, arrest the beam when in a horizontal position. The pads or supports placed under the pans while placing and removing the loads should be lowered before releasing and raised again after arresting beam and pans.

Avoid giving the pans a rotary motion in a horizontal direction. This will cause the knife edges to scrape.

Place the object to be weighed and the weights in the center of the pans. This will prevent the violent displacement of the pans when released with the weights to one side of the pans.

If the beam does not begin to swing as soon as it is released, set it in motion by wafting the air over one of the pans with the hand.

All objects to be weighed should be at the same temperature as the surrounding air to avoid upward air currents and moisture condensation when the object is warmer or colder than the operating room.

Hygroscopic, volatile, powdery and porous substances should be weighed in close vessels. This is to prevent absorption of moisture or loss in weight due to evaporation.

If the substance is hot when put in the closed vessel and then allowed to cool, remove the cover for an instant before weighing to bring the reduced pressure inside up to normal.

An object likely to become electrified by friction should not be brushed or wiped immediately before weighing.

Long objects such as tubes not easily centered in the pans should be suspended from a hook above the pans.

WEIGHING.

There are in use several methods of weighing but two most common are the usual balancing method and the method of Borda, also called the substitution method.

In the first method the zero point of the empty balance is first determined. If the substance is to be weighed in containers it is best to place similar vessels or in the case of powder or crystals, a sheet of paper on each pan and then determine the zero point.

Place the weight desired in the right hand pan and then pour into the left hand pan the material to be weighed. Slowly release the balance, pans first then the beam, until the way the pointer turns is seen and then as slowly arrest it again. Remove or add material as found necessary and again release and arrest as before. Continue these trials until the pointer coincides with the zero point of the empty balance.

The substitution method has the advantage of eliminating errors due to unequal arm lengths and changing sensibility of the balance.

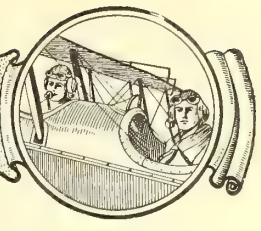
The exact method differs slightly according to whether it is desired to determine the weight of an object or to weigh out a desired amount of material.

In the first case place a weight greater than that of the object in the left hand pan and the object in the right hand pan. Add weights to the latter until a balance is obtained and the zero point determined. Remove the object and add additional weights till the pointer is again on the zero point. The difference between the final weights and that of the weights with the object is the true weight of the substance.

In weighing out material a weight greater than that of the substance desired is put in the left hand pan, a balance obtained and the zero point noted. Then remove weights from the right hand pan equal to that of the substance desired and replace with the material till a balance is obtained on the same zero point.

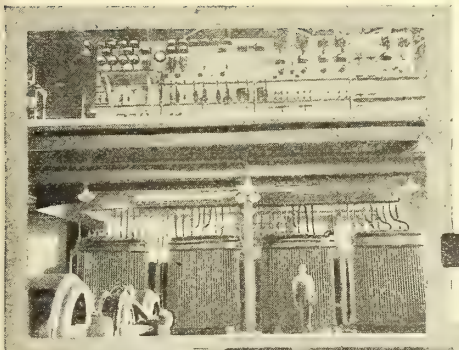


RADIO DEPARTMENT



300-K.V.A. Transmitter at Bolinas, California

By ALLAN C. FORBES, Assoc. I. R. E.



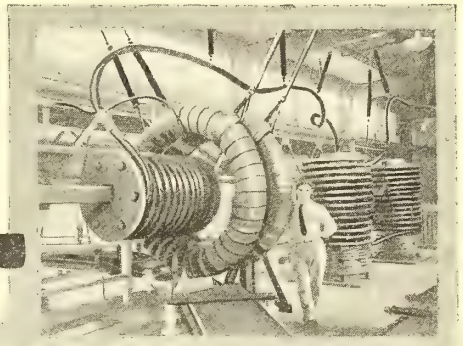
Left: General View of Switchboard Gallery and Bank of Four 11,000 to 440 Volt Step-Down Transformers. Note Comparative Size of Man.

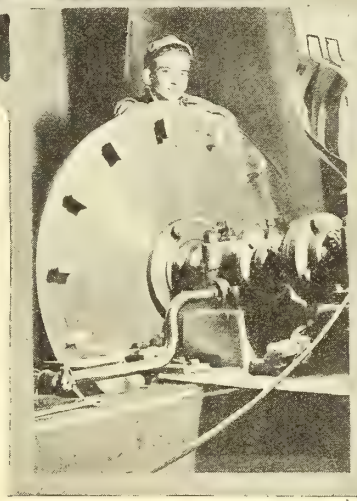
At Right: Jigger Gallery Showing a Gigantic Oscillation Transformer.

Lower Left: Close-Up View of Main Spark Discharger, Showing Relative Height.

Below: Side View of 500 H. P. Electric Motor Showing Relative Size.

Lower Right: Looking East from Power House Showing Full Length of Antenna.







THERE is no doubt many have heard of Bolinas, Cal. (K. E. T.), but it is very doubtful if any of them know just exactly where it is located, what the power is, whom they work with or what kind of apparatus is installed. I shall, therefore, try to convey to the reader a mental picture of the station, so that in the future when speaking of high-power radio stations, NAA will not always be referred to as the "largest spark station in the world." How many times have I heard amateurs, as well as professionals, radio engineers, speak of Arlington as the most powerful spark station in the world, and yet it is, as we all know, only a 100-K.W. Fessenden synchronous outfit. Bolinas has a 300-K.W., 2,000-volt, single-phase, 210-cycle generator, manufactured especially for this station. The generators have been overloaded 25 per cent successfully without any signs of heating, thus making the station transmitter input 350 K.W.

The station is rated at 300 K.V.A. input and can be operated on three wavelengths; namely, 5,000, 5,860 and 7,000 meters. The normal wave is 5,860 meters, and, altho it was thought that the two other waves would be used to transmit on when encountering heavy static, they are never used now, as it has been found by repeated trials that changing the wavelength this small amount, together with varying the input of power, did not help to any appreciable extent.

Power is obtained for the station from a specially constructed transmission line 27 miles long, carrying 3-phase current at 11,000 volts potential difference from the Pacific Gas and Electric Company's substation near Alto (Marin County), 5 miles from Sausalito, Cal.

Power is received at Alto 66,000 volts, 3 phase, 60 cycles, transformed down to 11,000 and supplied over the above line to Bolinas. At the power-house it is further stept down to 440 volts and led to the terminals of a 500-H.P. induction motor, which is direct connected to a 300-K.W., 2,000-volt, 150-ampere, 210-cycle, single-phase generator, having a rotary field of 14 poles.

The current is led from the generators thru a 7,500-volt, 300-ampere, double-pole General Electric A. C. oil switch to the buses, connecting with the low side of the 75-K.W., 2,000/13,000-volt, 210-cycle, single-phase transformers, which are connected in parallel. The current from these transformers is led thru specially made reactance coils to the high-tension air-brake switch keys, thence thru two specially made extra large choke coils, on to the high-frequency bus, which connects with the bank of high-voltage oil-plate condensers, consisting of sixty rows of six jars per row, or a total of 360 separate condenser units. These may be connected from two to six in series, or parallel, the best connection being four in series for 5,860 meters wavelength.

The secondary circuit is broken for sending purposes by specially designed high-tension air-break relay keys, which in turn are actuated by a small sending key thru a source of direct current, this current being furnished from a small motor generator set.

Arcing at the contacts of the main signal key is prevented by a heavy blast of air forced directly at the contact point by a specially designed electric blower motor.

The advantage derived in interrupting the secondary circuit lies in the fact that it permits 300 K.W. to be handled at various speeds of transmission, exceeding 100 words per minute, without error, by reason of the fact that it has been found much easier to break the high voltage of the secondary circuit in preference to the large current in the primary, to say nothing of the eliminating of surges due to breaking the primary and the inductive strain on the generator.

The transmitting aerial is of the inverted "L" type, consisting of thirty-two wires in four sections of eight wires each, with a flat top, approximately 2,500 feet in length. It is supported on three rows of steel tubular masts (three masts in each of the outside rows and two in the center row), which are approximately 325 feet high. The rows of masts are separated about 250 feet. An extra mast is placed on the end of the nearest row, so that an extension can be run out for a *receiving aerial*, should necessity arise, that would cause operation, *both sending and receiving* to take place from Bolinas. The natural wavelength of the antenna is 4,035 meters; when working on 5,860 meters (which has been found to be

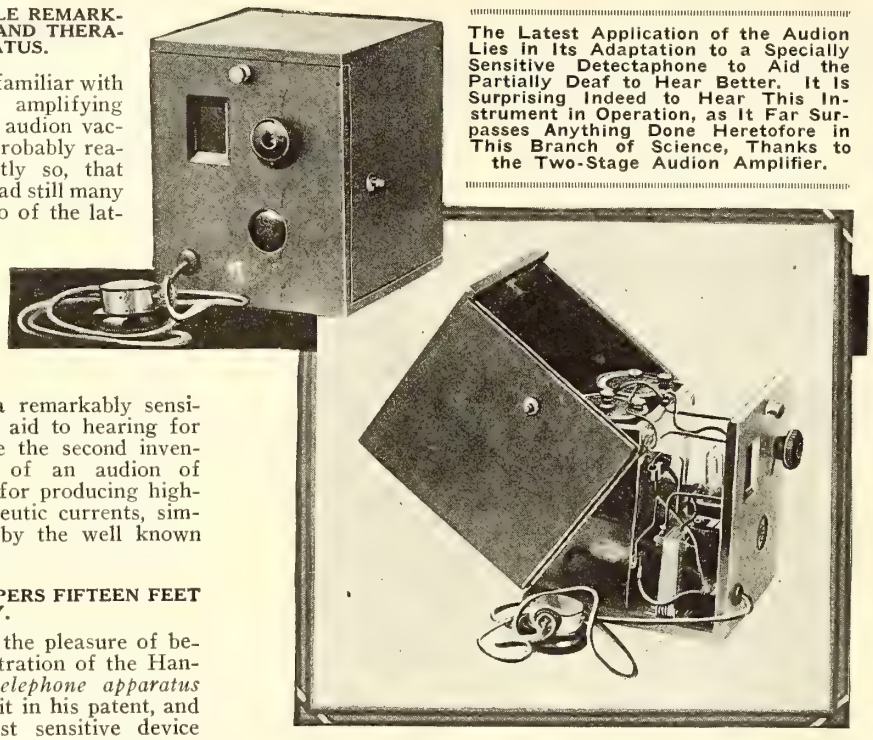
(*Continued on page* 780)

The Audion in a New Rôle

AUDION MAKES POSSIBLE REMARKABLE DETECTAPHONE AND THERAPEUTIC APPARATUS.

THOSE who are familiar with the wonderful amplifying properties of the audion vacuum tube have probably reasoned, and rightly so, that this clever little device had still many new rôles to essay. Two of the latest novelties in scientific apparatus due to Earl C. Hanson and Wendell L. Carlson, are shown in the accompanying photographs and diagrams.

The first of these instruments comprises a remarkably sensitive detectaphone as an aid to hearing for the partially deaf, while the second invention involves the use of an audion of medium or high power for producing high-frequency electro-therapeutic currents, similar to those produced by the well known Tesla and Oudin coils.



The Latest Application of the Audion Lies in Its Adaptation to a Specially Sensitive Detectaphone to Aid the Partially Deaf to Hear Better. It Is Surprising Indeed to Hear This Instrument in Operation, as It Far Surpasses Anything Done Heretofore in This Branch of Science, Thanks to the Two-Stage Audion Amplifier.

AUDION DETECTS WHISPERS FIFTEEN FEET AWAY.

The editors have had the pleasure of being present at a demonstration of the Hanson detectaphone, or *telephone apparatus for the deaf* as he calls it in his patent, and certainly it is the most sensitive device of its kind that they have ever listened to. When a person with normal hearing listens at the receiver attached by means of a flexible cord to the amplifying cabinet of the Hanson apparatus, he can readily interpret *whispers spoken fifteen to twenty feet away,* and ordinary strength of speech when the speaker is located seventy-five to one hundred feet away and more. When tests were made by covering up the transmitter in the front of the cabinet with the hand, it did not apparently lower the strength of the received speech.

In a few words, the Hanson audion detectaphone comprises a two-stage amplifier with two audion bulbs of miniature size (smaller than anything heretofore commercially employed except by the army and navy), together with two iron-core step-up transformers, as shown in the diagram below. A carbon ball microphone has been employed to modulate the primary current of the first transformer, but owing to the imperfect manner in which the best of carbon microphones transmit or interpret speech, Mr. Hanson is considering improving his apparatus by using either a new form of microphone, or its equivalent such as the Bell type receiver which as is well known, represents on of the most perfec forms of voice trans lator we have.

With this apparatus it is remarkable t note that the audio filaments simply glov a dull red, the curren passing thru the fila ments—which are, b the way, connected i parallel to a commo battery comprisin two standard size dr cells—being regulate by a rheostat from control handle mount ed on the exterior o the cabinet. The hig voltage battery i made up of a numbe of small flashligh cells. The "baby audions used are o a new type and meas ure about 1¼" lon by 7-16" in diameter

THE AUDION ELECTRO-THERAPEUTIC GENERATOR.

In the patent issue to Messrs. Carlso and Hanson on a electro-therapeutic apparatus involving th use of an audion exciter, a clever circuit i shown for producing and utilizing steady and constant high frequency currents by us of a stabilizing capacity, which works simi lar to the manner in which radio circuit are attuned for similar effects—that is pro ducing constant, high frequency oscillations

As pointed out by the inventors, presen day high frequency apparatus is quite like ly to give severe shocks to patients, due t the currents being of varying frequency

(*Continued on page* 819)

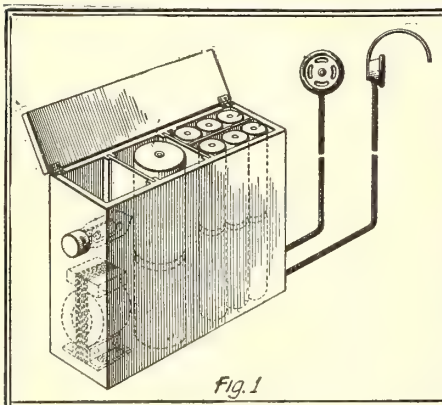


Fig. 1

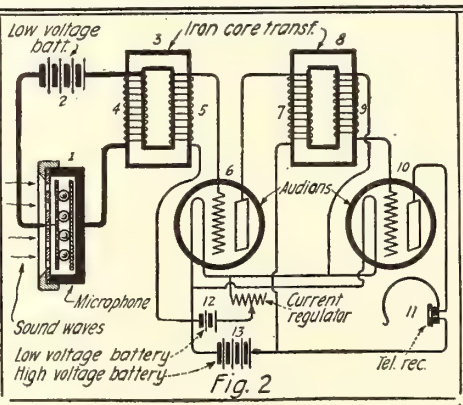


Fig. 2

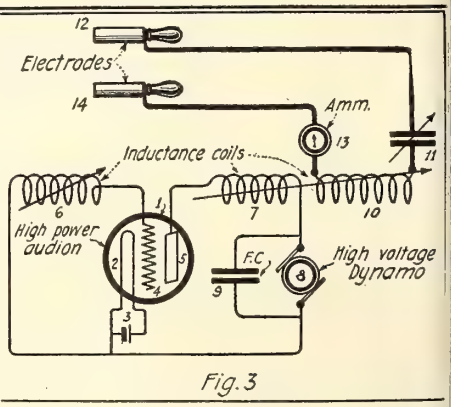


Fig. 3

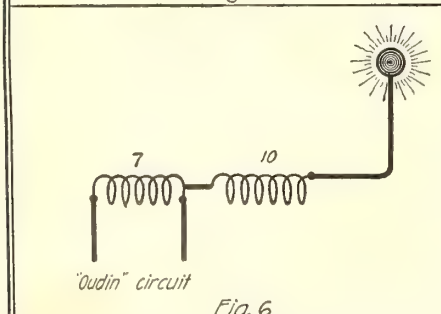


Fig. 6

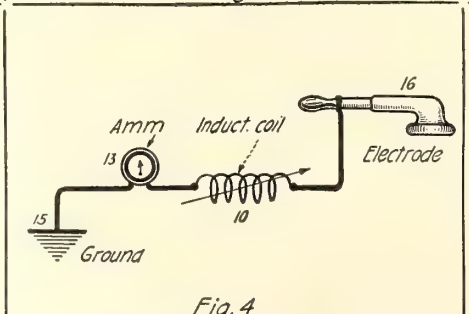


Fig. 4

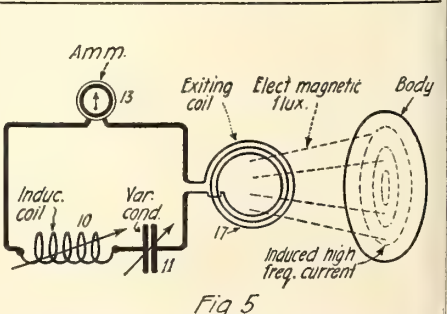


Fig 5

Figures 1 and 2 Show the External Appearance of One Type of Audion Detectaphone, as Well as Hookup of Two-Stage Audion Amplifier With Transformers, Microphones, Common High Voltage Battery, Etc.

Fig. 3 Shows One Form of Audion Electro-Therapeutic Apparatus, the Vacuum Tube Acting as the Oscillation Generator in This Case. Fig. 4 Shows Hookup to Produce Uni-Polar Discharge.

Fig. 5 Shows Method of Inducing High Frequency Currents in the Body of a Patient, From a Coil Thru Which High Frequency Oscillations Are Passing. Fig. 6 Shows Oudin Circuit Arrangement.

nd receiving. Whether you are attending school or learning at home, your progress nd the length of time before you will be ble to secure a license depends materially pon your operating speed.

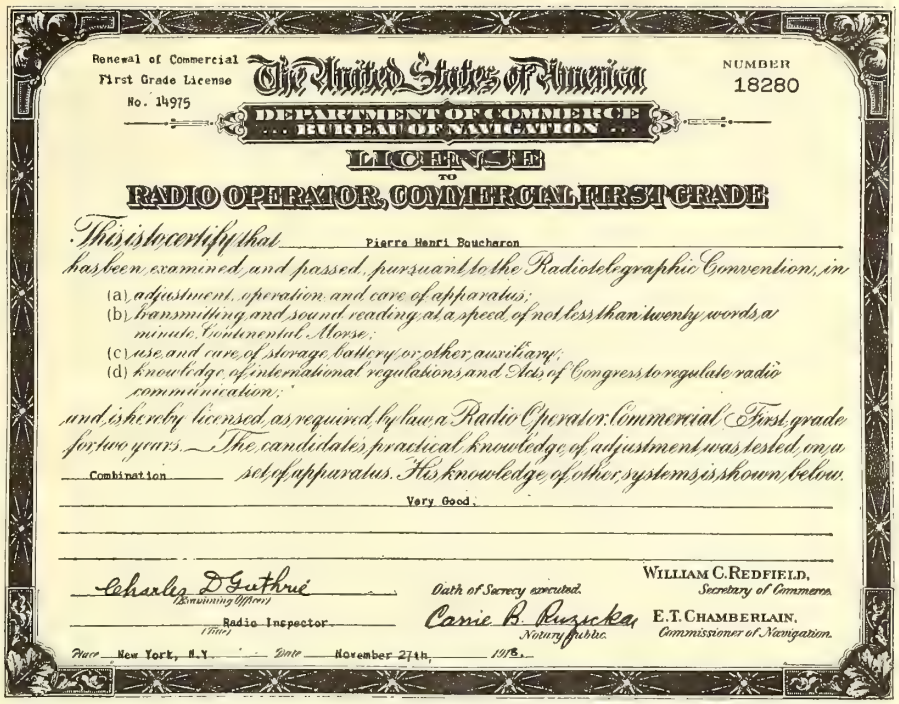
The home student who has erected an mateur receiving station has an excellent dvantage in the fact that he is able to isten-in" upon actual operating and thus e can learn to copy the many styles of ending as well as intercept the several asses of radio traffic which are:

1. The commercial paid and service messages.
2. Daily weather reports transmitted by naval coastal stations and others.
3. Press news items also sent out by coast stations.
4. All manner of code messages transmitted by war ships, merchant vessels and others.
5. The copying of foreign language messages such as French, Spanish, Italian, German, etc.
6. Hydrographic and obstruction reports as well as occasional S. O. S. messages where you have an opportunity to listen-in and learn exactly how the procedure of these important messages takes place.
7. Learning to copy thru static and interference—a most desirable accomplishment.

THE ART OF SENDING.

The home student must take great care code practise, as it is very easy to acuire undesirable mannerisms and poor yle of sending. You should constantly e on guard and if possible check yourself by an occasional visit to a professional, here you can have him listen to your nding and judge as to its accuracy. any beginners make the mistake of tryg to send as fast as they can. That is ot the right idea. Start by sending slow nd clear. Let speed come with practise nd under no circumstance try to send ster than you are able to receive at any me.

Concerning the matter of sending speed, little personal incident is perhaps not out place here. When I started out as a telgraph operator I developed an uncontollable mania for "fast" sending which practised, however, only when conversg with a distant operator. When the erator at the other end would "come ack" at me in lightning speed using a broplex (often called a "bug"), I was nable to even read two words in succesion. Nevertheless, I would O. K. and go ght along on some new topic. In other ords, I "bluffed" it out.


Renewal of Commercial First Grade License No. 14975

The United States of America

NUMBER 18280

DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION

LICENSE
TO
RADIO OPERATOR, COMMERCIAL FIRST GRADE

This is to certify that Pierre Henri Boucharon has been examined and passed, pursuant to the Radiotelegraphic Convention, in

(a) adjustment, operation and care of apparatus;
(b) transmitting and sound reading at a speed of not less than twenty words a minute, Continental Morse;
(c) use and care of storage battery or other auxiliary;
(d) knowledge of international regulations and Acts of Congress to regulate radio communication;

and is hereby licensed as required by law a Radio Operator, Commercial First grade for two years. The candidate's practical knowledge of adjustment was tested on a Combination set of apparatus. His knowledge of other systems is shown below.

Very Good.

Charles D Guthrie (Examining Officer)

Radio Inspector (Title)

Oath of Secrecy executed.

Carrie B. Ruzicka, Notary Public.

WILLIAM C. REDFIELD, Secretary of Commerce.

E. T. CHAMBERLAIN, Commissioner of Navigation.

Place New York, N.Y. Date November 27th, 1918.

Present Style of License Which Must Be Secured By All Radio Operators Before They Are Permitted to Board a Seagoing Vessel. A Brief Outline of the Examination Requirements is Printed upon the Face of the Document. On the Reverse Side Appears the Secrecy Oath and Pledge of Faithful Service, and Beneath This is Written the Operator's Service Record, Which Must Be Signed By the Captain of Each Ship He is Assigned to.

Articles to Appear In November Issue of "Radio News"

Comparison of Modulation Methods in Radio Telephony
By A. S. Blatterman

The Radio Compass on Board Merchant Vessels
By Arthur H. Lynch

New Amplifying Apparatus

Registering Radio Messages on Tape

A New Continuous Wave Type Transmitter

New Radio Amateur Calls

The Mystery of the Dampt-Undampt Messages *By H. L. Moulton*

Building a Honeycomb Winding Machine
By Raymond Roof

Several Other Features—Look for Them



Ex-service Men Learning to Read and Copy Radio Signals at One of the Knights of Columbus Radio Schools. A Regular Mode of Procedure is to Have Each Student Do a Certain Amount of Sending, Which is in Turn Read and Copied By the Others.

One day while engaged in this pleasant pastime of bluffing the distant operator, a gentleman who had been standing at the counter apparently preparing a message for transmission, called me over to where he stood and handing me a telegraph blank said in a very ominous voice, "take care of this message immediately, young man"; he then turned and walked away rapidly.

This was an unusual request so I quickly glanced at the message, where I found the following lines:

"The young man should govern his sending speed according to his receiving ability. We must all creep before we can walk."

It was signed by the vice-president of one of the largest telegraph companies in the U. S., which incidentally controlled the system employing me. He was himself an expert operator and had been quietly listening to my little comedy. No, I was not fired, but I never forgot the advice.

The recognized method of holding and manipulating the sending key is known as the *Catlin Grip*. Use the first three fingers of your right hand, grasping the forward part of the key knob with the end of your thumb, while the other two fingers reach out to the backward part of the knob—thereby insuring a firm and yet pliable grip of the key. Then, too, the up and down motion should be controlled from the wrist and not from the finger ends, as is done by beginners. The principle is the same as that employed in the *Palmer Handwriting Method*—it is a wrist motion and is meant to relieve the fingers from the strain of too concentrated muscle action, thereby preventing "writers' cramp" or "telegraphers' paralysis." Too much cannot be said concerning this important subject. Remember one thing, it is just as easy to form *right* habits of sending in the beginning as it is to acquire *wrong* ones.

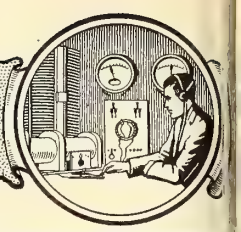
THE ART OF RECEIVING

The most discouraging period for the beginner is from the time he first starts, up to the point where he can begin to copy a few consecutive words without error; when this point is reached he takes on new life, so to speak, and immediately begins to gain confidence in himself, which fact comes in good stead when he finally attempts to copy actual signals straight out of the air.

(*Continued on page* 816)



WITH the AMATEURS



Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficien of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owne Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Addre the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

This Month's $5.00 Prize Winner—Walter Holey



HERE are some pictures of myself and my "Labs,"—chemical, electrical, and radio. The first photo shows my "Chemical Lab." I have about one hundred and twenty-five chemicals not including solutions. I have apparatus for making chlorin, H_2S, SO_2, etc., and also chemicals and apparatus for qualitative analysis. I have some "patent" formulas for gun powder which I will send to the "Science and Invention" magazine soon.

The second photo shows my radio station and "Electrical Lab." The radio station consists of: Receiving set,—three loose couplers, two short and one long wave; a variometer; a galena detector; and 3,000 ohm 'phones. The couplers are connected by a switch, so that they can be used alone or with the primary windings in series, one acting as a loading inductance for the other.

I also have extra detector condensers and inductances. With this set I have had very good results, having heard "N.A.A." fifteen feet from the 'phones. I have also heard "N.A.A." using a tin rod for an aerial. I have also in my possession an indoor aerial and loop, both of which work very well.

The antenna is enclosed in the left-hand corner of the box, as is the sending set, which consists of a two-inch coil, a secondary condenser, gap, key, etc. The antenna switch handle extends thru the slot in front of the box. All of the instruments, except coil, are of my own construction.

In the lower right corner can be seen my home-made vacuum bulb and panel. The bulb is a twelve volt auto headlight, with plate on the outside.

Near the center of the picture is a battery switchboard, with polarity reverser and rheostat. I also have a ¼" coil, a galvanometer, a Leyden jar, a helix, a goniometer, coherer, etc. In the upper left corner is a microphone with which I can hear a fly walk! I possess an ultra-violet light generator which operates on a 2-inch spark coil.

I am a subscriber to both the "Science and Invention" and *Radio Amateur News*.—Walter Holey, Norwich, R. F. D. No. 3, New York.

Honorable Mention—Horace Fletcher, Jr., $2.00 Prize



I AM sending some prints of my "Chemical Laboratory." The pictures were taken with a Premo film pack camera. I use my own flash powder, consisting of K Cl O_3, C, S, Mg, and Al. This is by far, more of a chemical "Lab," than an electric "Lab."

In photos number one and two is shown the alcohol making apparatus, from which I made three ounces of alcohol from one gallon of the ferment as previously described in Prof. Darrow's series on "Practical Chemical Experiments." I have a small box holding eight batteries, from which I get a current strong enough to decompose water, and you also need a little current for certain experiments. The bottles are kept in good order and are all properly labeled as can be seen.—Horace Fletcher, Jr., 3430 Crawford St., Falls of Schuylkill, Phila., Pa.

What to Invent

By JAY G. HOBSON

$1,000 PRIZE FOR A PRODUCT TO MANUFACTURE.

A LEADING manufacturer of intricate and accurate stampings, screw machine work and mechanisms made therefrom will pay $1,000 to the person submitting plans for a product to be manufactured if the product is adopted by the manufacturer. No product will be accepted for which the demand is less than $500,000 per year.

Here is an excellent chance for the reader to cash in on some practical idea, invention or device that will be in universal demand when made in quantities and advertised to the public.

While the requirement that said product must have a demand of $500,000 yearly is indicative of great profits to the manufacturer of same, and on the surface it may appear the inventor should share more in such profits than to the extent of $1,000, yet in point of fact the risk the manufacturer must assume investing his capital, time and the like in advertising and marketing the article, is deserving of the lion's share because the inventor's only risk is his idea or invention which has no commercial or tangible value until it has been placed on the market thru the expensive financial efforts of men involving expenditure of their money.

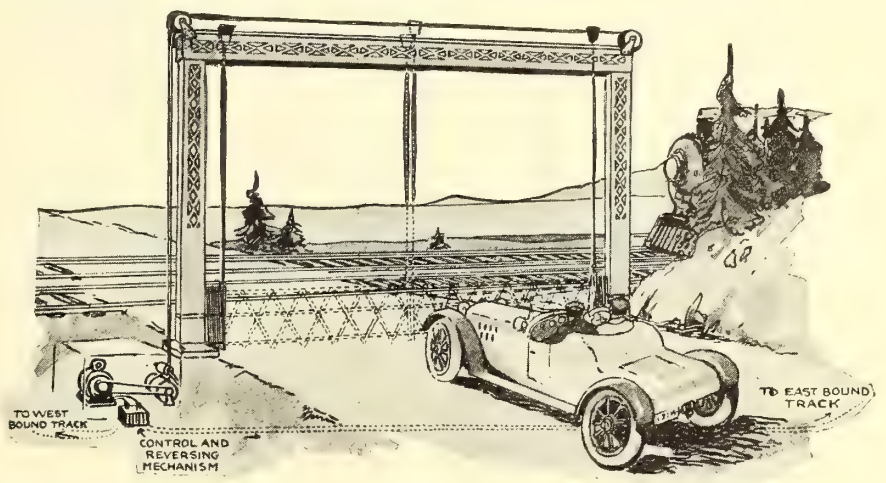
Therefore, the dictates of reason convince us that receiving $1,000 cash for an idea, as stated above, with an initial investment of $100 or less for a patent and the time necessary for perfecting it, should please the most particular, considering the fact that the $1,000 prize offered above is about 900 per cent profit on the investment involved. Do not waste your time submitting plans for products which cannot be manufactured as required by the manufacturer in question.

RAILROAD CROSSING SIGNAL.

"The automobile drove across the tracks back of one freight train and directly in front of another. The crossing signal and train could not be heard by the driver. The automobile was struck squarely." Only thirty-four simple words in this grim newspaper notice but volumes could be no more effective in recording the fatal result. How unnecessary this useless destruction of life and property when a simple device like that illustrated would prevent 100 per cent of it.

The bell signals now employed can be heard no more by the traveler than can the train whistle miles away. Road gates are effective, but a watchman to operate them cannot be stationed at every country crossing. Therefore an automatic watchman mechanically operated by the approaching train is greatly needed to prevent the growing number of gruesome accidents in daily evidence.

An electrical guard placed in the center of the road leading across the tracks, about fifteen feet from the crossing; a warning made similar to the folding telephone



Every Year Many People Lose Their Lives at Railroad Crossings, Due to Improper Signalling Devices, or, as Often Happens, Autoists and Others Drive Across Railroad Crossings When There Are No Gates to Stop Them, Especially If a Train Seems to Be at Quite a Distance. A Suggestion for a Simple, Automatic, Self-closing and Opening Crossing Gate Is Here Given, Which Could Be Connected Up So as to Be Operated Electrically Whenever a Train Approached from Either Direction. There Is No Reason Why, with Our Present Engineering Skill, That Such a Gate Could Not Be Perfected and Successfully Operated.

holder, red lights secured upon same, and electrically operated by a motor connected to the control arm that folds and unfolds the collapsible guard upon the approach and passing of the train are suggestions.

The commercial and life-saving value of this improvement cannot be overlooked. Every railroad would gladly adopt it upon demonstration of its perfection.

WOOD BORING BEETLE DESTROYER.

Out in California the telephone companies have considerable wire trouble caused by beetles eating the insulation which exposes the wire to the elements resulting in short circuits and the like. The following notice explains the difficulty:

When telephone girls in California find their wires are "shorted" a bug may be on or in the wire, for California has a wood-boring beetle that goes thru wood and also thru similar substances considerably harder than lead. The beetle has put hundreds of telephones out of commission by boring holes in the cables that carry the wires. Water enters the cables, making wire connections useless until the bored places are found and repaired. The problem of control of this active boring beetle is still unsolved, according to the bureau of entomology of the United States Department of Agriculture, and it will be difficult to find a practicable way.

Some chemical preparation mixed with the insulation or painted on it to poison these destructive pests appears to be the means desired to eradicate them. Undoubtedly telephone companies would pay a substantial price for a successful formula.

DOCTOR'S PATIENT RECORDER.

How many times have you waited hours to see your doctor and lost out by having some inconsiderate nabob rush in ahead of you, possibly thinking he was next, but more probably not caring a hang about you or your valuable time? This is a daily annoyance in nine-tenths of such places, and the inefficiency causing this condition suggests a much needed improvement of this system.

A practical electric recorder could easily be invented to keep proper tab on the patients to be treated, a small device in the form of a register that both designates the visible number in order and issues a duplicate number to the patient incoming. These numbered checks could be made of metal to be used over again, and the operation of the recorder would be practical in every way.

The patient pushes the button on the recorder *when he first calls,* thereby causing the machine to place a consecutive number in the glass indicator. At the same time a small metal check bearing a duplicate number comes out into the operator's hand. This check is retained by the patient and referred to as the doctor looks at the number in the recorder and calls out the next number in order. The patient holding the number announced then steps forward placing his check in the receiver provided in the doctor's office.

Using this device each person would be sure of keeping his place as originally received, and the efficiency obtained by the doctor in seeing his callers properly would more than warrant the cost necessary to install a system of this kind in his office, and of the 200,000 doctors in America, 100,000 would gladly buy an improvement like the one described.

The same scheme would find a use in our crowded barber shops.

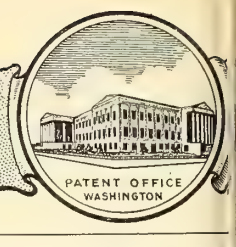
Copyright, 1920, by the Author.



Have You Waited Hours to See Your Doctor, and Finally Lost Out by Having Some Inconsiderate Nabob Rush in Ahead of You, Possibly Thinking He Was Next, But More Probably Not Caring a Hang About You or Your Valuable Time? Why Not Perfect an Electric Recorder to Keep the Doctor Posted as to Just Who Is Next? The Device Could Be Made to Indicate the Patients' Numbers in Order, Besides Issuing a Tally Check to Each Patient.



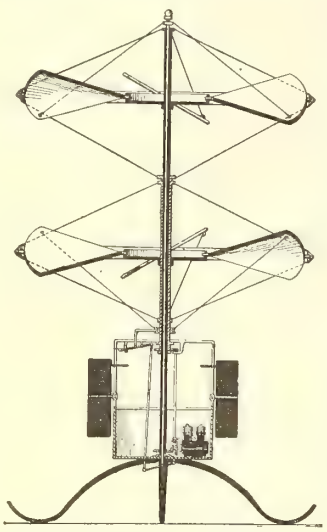
LATEST PATENTS



Flying Machine.

(1,345,159. Issued to James H. (Freeman.)

Here we have another of the now common helicopter types of flying machines which, however, has the added improvement in that it will act as a parachute in case of stoppage of the engine, thus enabling the occupant to make a safe landing. In order to prevent undue gyratory action on the part of the propellers they are so coupled that one will rotate in one direction and the other in the opposite direction. Four vertical vanes keep it end up and act as rudders to incline the machine from the vertical. The propellers are rather flexible and

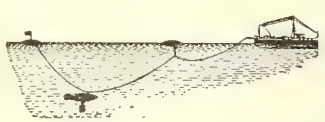


are arranged in such a manner that their pitch can be adjusted so as to increase or decrease the lifting effect, or they may be thrown entirely out of operation in which case the lifting propellers are used as a parachute for effecting a safe landing.

Submarine Destroying Apparatus.

(1,344,074. Issued to William E. Williams.)

We have here another device for the detection and destruction of submarines. It consists of a large number of submergible floats which are dragged by a steam trawler, each of which can be controlled individually by the operator on the parent ship and the submerged ves-

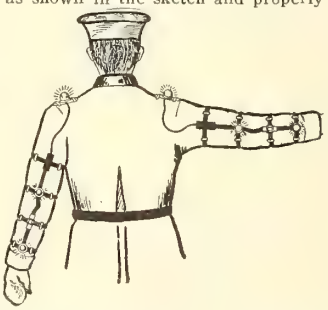


sels to which mines are attached may be separated from each other or directed closer to each other at the will of the operator. Each of these floats has within it a motor for actuating the rudder and carries microphonic telephonic transmitting diaframs adapted to receive sound waves from different directions. When a receiving device on the vessel announces that a stimulus has been received in one of the floats, the direction from whence it comes is readily determined, and the trawler is sent in quest of the enemy submarine. The mines can be exploded by contact, or simply by closing an electrical circuit when it is believed that the vicinity of the submarine has been reached.

Portable Signal System.

(1,346,531. Issued to Benjamin W. Davis.)

Several months ago we described in this journal and showed a photograph of a traffic policeman illuminated which forms the gist of this patent. Lamps are secured to straps as shown in the sketch and properly

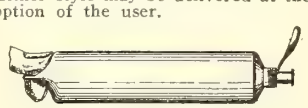


connected to batteries suspended from the waist of the user. A novel feature is an automatic switch which controls the lights. It consists of a small tube having metal ends half filled with mercury. When the arm is raised to a horizontal position, mercury flows across the two metal contacts, thus closing the circuit and lighting the lamps.

Collapsible Tube.

(1,346,897. Issued to Clifford G. King.)

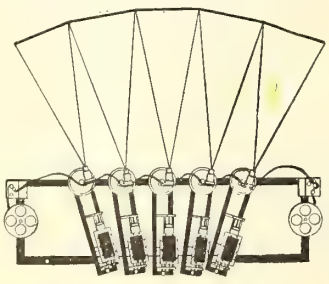
A new collapsible tube which promises to relegate all the present types to the scrap heap is here described and is used for dispensing shaving cream, tooth paste, etc. It has incorporated within it both forms of nozzles so that either a flat ribbon or a cylindrical shaped mass may be expelled. A cap on the end closes both openings. When the cap is removed, the cylindrical form of paste will be expelled upon pressure on the tube. When the cap is screwed into place again and a small slidable sleeve moved upward slightly, it opens a slit-shaped nozzle and a ribbon mass is expelled at right angles to the tube. Either style may be delivered at the option of the user.



Panoramic Apparatus.

(1,347,103. Issued to Thomas A. Killman.)

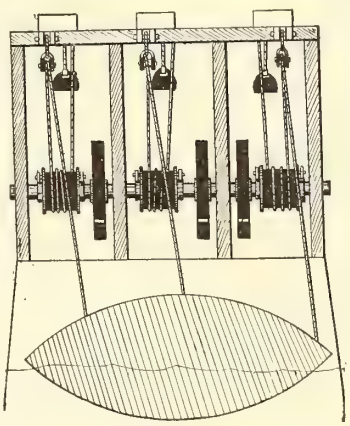
Rather a remarkable piece of apparatus is exemplified in this method of taking and projecting panoramic pictures, but its use seems quite limited as far as the ordinary playhouses are concerned. It consists of a series of projectors or cameras, all coupled to the same shaft, so that their shutters and speeds are in synchronism. Each of the cameras or projectors uses only a small part of the picture from the regular movie strip, so that if there are five projectors there will be five distinct sets of pictures on the same film, which will make the film look as if the five motion picture films were joined in parallel. Each of the five lenses take care of one of the five strips of pictures and upon projection a continuous panorama is viewed by the audience.



Wave Motor.

(1,346,399. Issued to William A. Crawford-Frost.)

Varied and numerous are the ideas on wave motors and the idea similar to the one here described was the subject of an article publisht some three years ago in this magazine. The inventor aims to construct two towers with truss work connecting them. From this truss work he suspends by means of ropes a large float about 100 feet long. These ropes encircle a drum where the action of the water upon the float causes it to rise and fall with each wave and consequently the ropes will cause the drum to revolve. A ratchet on the drum rotates a wheel and shaft, thus giving movement in one direction only. The shaft in turn is coupled

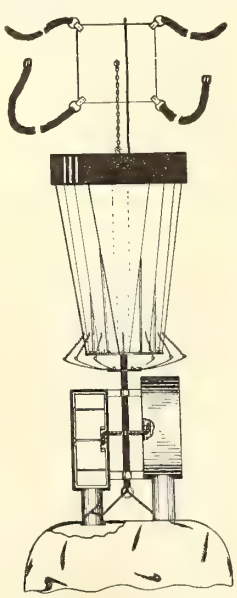


at the far end to a generator thru a system of gears, the function of which is to increase speed of rotation.

Parachute.

(No. 1,344,044. Issued to Andrew Kaminski.)

This invention relates to a form of parachute. It consists of three telescopic tubes, the lowermost section is fastened to the back of the

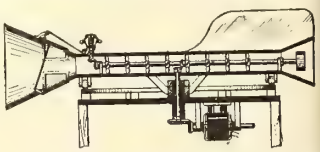


aviator with straps. The parachute proper is folded up. When the telescopic tube is extended, it releases a series of fan blades which immediately spread out like a spring umbrella and serve to stay the fall of the aviator. These blades are so arranged that they may be rotated by means of two powerful motors which are actuated by air or other gas under compression in an envelope above the motors. This aiso serves to stop the fall of the aviator because of the helicopter action of the fan blades.

Air Motor.

(No. 1,345,022. Issued to Dew R. Oliver.)

This is a rather novel invention for the utilization of wind to pro-

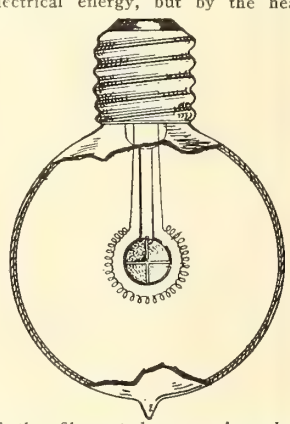


duce power and then to employ the power so produced to generate electric current or to utilize it in any other way desirable. It consists of a long tubular body which can swing in a horizontal plane so that it will always be nose-on into the wind. This tubular structure has a large funnel at both ends in order to allow for the concentration of the force of energy upon a plurality of propellers fixt upon a single shaft, and rotating as shown.

Illumination.

(1,346,172. Issued to Lucian W. Bugbee and Edgar D. Tillyer.)

The electric light bulb featured in this patent is radically different from those which we generally see in that it provides for a small body at the central position of the bulb. This body is not of itself conducting or coupled with any source of electrical energy, but by the heat

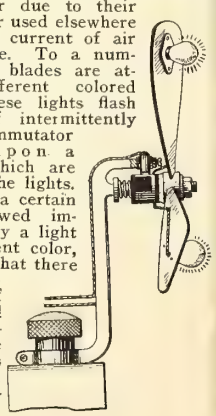


of the filament becomes incandescent and gives off a secondary light without directly using up current.

Display Device.

(1,344,084. Issued to James K. Hackett.)

A very novel feature is here described and relates to display devices adopted to be mounted upon moving vehicles and operated by a rush of air due to their movement or used elsewhere where such current of air is obtainable. To a number of fan blades are attached different colored lights. These lights flash on and off intermittently due to a commutator mounted upon a shaft to which are connected the lights. By having a certain light followed immediately by a light of a different color, it appears that there is a progression of lights and the appearance of the device is rendered very attractive.



Scientific Humor

"Pre-Matrimonial" Astronomy.—It was a beautiful moonlight night and they were taking a stroll down the beach.

SHE: "Does the moon affect the tide?"

HE: "No, dearest, only the un-tied."—*Roger E. Davis.*

So the Boss "Fired" Him.—"My tools went mad today."

"How come?"

"I left them near a fire and they lost their temper."—*Arthur Levy.*

U. S. A.—C. O. D.—When John left home for Europe, his father told him to send a short wireless message if ever he was in trouble. One day the message duly came "collect" and this is what it read:

Dad:

S.O.S. $ P.D.Q. R.S.V.P.

Son.

—*Kenneth Courtright.*



A High Flyer.—"If you are skilled in some particular pursuit, we shall be glad to let you follow it," said the deputy warden to a newly arrived prisoner.

"Thanks," said the prisoner, "I'm an aviator."—*Ellis King.*

Besides, Pneumonia Costs Less.—What's the difference between ammonia and pneumonia?"

"One comes in bottles, the other in chests."—*D. H. Bigelow.*

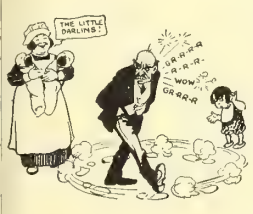
He'd Be "Fired" Too!—CHIEF ELECTRICAL ENGINEER, questioning Applicant: What would you do if lightning struck and exploded our apparatus?"

APPLICANT: "Go up with the report, sir."—*Joseph Baenoff.*

Does He "Collect" Privately Too?—My father," said the little boy, "is a numismatician."

"Why, Johnny," exclaimed the teacher, "a numismatician is a coin collector."

"Yes'm, that's what my father is; he's a conductor on an electric car."—*Samuel Martino.*



A Regular Cloudburst.—"So you have twins at your house, Johnnie?"

"Yes'm, two of 'em."

"What have you named them?"

"Thunder and Lightning. That's what pa said when they came to the house."—*A. Jones.*

Line's Busy!—In one of the little towns in Maine there is a single-track trolley line, which runs two cars in summer and one in winter. A passenger last summer, noticing that the car ran very slowly except at rare intervals, when it would spurt ahead for a minute or two, was greatly puzzled.

"What makes these sudden bursts of speed?" he asked the motorman.

"Oh," grinned the motorman, "that comes when the car at the other end of the line stops for passengers."—*J. Kent Smith.*

FIRST PRIZE $3.00



A Scientific Tell-Tail-Tale.—The farmers killed their cows and sent the tails to town for ox-tail soup. They found this quite expensive, so they just cut off the tails, letting the cows live. But they soon realized their mistake when the next year they wanted to sell the cattle; they had to sell them wholesale, because they couldn't *retail* them.—*Ruth Bonebrake.*

In "Polly"-Syllables?—Great Britain may be behind in aerial navigation, but in other respects she seems to be in the lead if we are to judge by the extract from a London paper reporting the experiments being made of crossing carrier pigeons with parrots in the hope of getting verbal messages thru the enemy's lines in time of war.—*J. Kent Smith.*

Too Much Music.—1ST MEDICAL STUDENT: "Are you going to that appendicitis lecture this afternoon?"

2ND STUDENT: "No; I'm tired of those *organ* recitals."—*Raymond Jones.*

ALL jokes accepted and publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

That Pinned Her Down.—"Mother, I just took a splinter out of my hand with a pin!"

"A pin! Don't you know that's dangerous?"

"Oh, no, Mother, I used a safety pin."—*Mrs. E. J. McEntee.*

Tried and Not Found Wanting.—(Sam, who covets the boss' white pants.) "Boss, ah jes' can't clean dem pants of your'n."

BOSS: "Have you tried gasolene?"

SAM: Yas, sah, it don't do no good!"

BOSS: "Well, try ammonia."

SAM: "I'se done tried 'em on, boss, and day fits me fine."—*J. Cecil Hulto.*

Why He Raised the Price of Milk.—"One of my cows swallowed my pocketbook," announced the chatty milkman.

"Any money in it?"

"Forty dollars."

"Well, I hope your milk will be a little richer," said the grouchy customer.—*E. Minch.*



This Joke Is On Us!—MRS. GLADSTON: "What is your idea of a practical scientific joke?"

MRS. SADSTONE: "The one which brings a dollar to my pocket."—*Mary Mattern.*

Same Here—Minus the Talk.—In China when the subscriber rings up exchange the operator may be expected to ask:

"What number does the honorable son of the moon and stars desire?"

"Hohi, two-four."

Silence. Then the exchange resumes.

"Will the honorable person graciously forgive the inadequacy of the insignificant service and permit this humbled slave of the wire to inform him that the never-to-be-sufficiently censured line is busy?"—*Edward Grimm, Jr.*

A Sad "Tale" of a "Swallow."—"I heard your dog committed suicide today."

"Yes, he put his tail in his mouth and that was the end of him."—*Cornelius Hogan.*



Perhaps the Sergeant Too.—It was Sunday, and Sergeant Jones was driving a bucking, one-cylinder Ford down the streets of the old home town.

"Ought to put Lizzie's name on the casualty list," called a fresh gob who witnesst the struggle.

"Whaddye mean?" hist the sergeant between bucks.

"Missing in action!"—*Elmo Hegman.*

Why Professors Go "Bugs."—A student in Zoölogy pinned together a grasshopper's head, a cricket's body and a butterfly's tail. To fool his professor, he asked: "What kind of a bug is this?"

PROF.: "Did it make a humming sound when you picked it up?"

STUDENT: "Yes."

PROF.: "Then it must be a humbug!"—*Walter H. Schulte.*

A Licensed "Driver."—BIGGS: "Our carpenter can drive nails like lightning."

JIGGS: "How's that?"

BIGGS: "Well, you know, lightning seldom strikes twice in one place."—*Joseph Baenoff.*

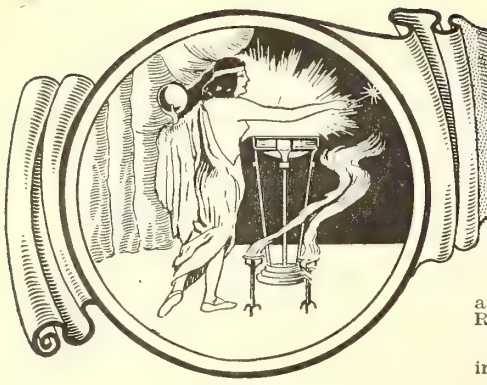


Perhaps He Was Cremated.—FIRST CROOK: "I hear Jerry got the electric chair."

SECOND CROOK: "Yeah, must have been a *grave* offense."—*D. H. Bigelow.*

"Science and Invention."—Byron Irwin was stopping overnight in a southern hotel and he asked the darky attendant to wake him up at 7 A.M.

"Say, boss," replied the darky, "I reckon you ain't familiar with these heah modern inventions. When you wants to be called all you have to do is to push the button at the end of de bed, then I comes up and calls you."—*Lawrence Degraff.*



THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will b answered here for the benefit of all, but only matter of sufficient interest will be publish Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else writte in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addrest to th department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerabl research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questior are answered.

REMOVING TATTOO MARKS.

(1065) R. Garnes, San Francisco, Calif., asks:

Q. 1. What will remove or obliterate tattoo marks from the arms, and give directions for use?

A. 1. Tattooing is the mechanical introduction of pigments under the skin, and a very well-known process. The pigments employed are carbon, cinnabar, carmine and indigo.

Most methods employed to remove these marks are by a reactive and a destructive inflammation which will result in the formation of a crust later cast off together with the tattooed markings. One method is to retattoo the marks with a solution of 30 parts of zinc chlorid and 40 parts of water. A mild inflammation will result; a crust forms and about a week later falls off, leaving a scar which gradually heals. Later, a repetition of this may be necessary. This may be done by the professional tattooer.

The second method is to tattoo again, making the punctures close together after the design has been drawn over with a concentrated solution of tannin. A stick of silver nitrate is then firmly drawn over the surface and after a period of several minutes, it is then wiped off. This is far more effective than the first and less scar forms. Two other substances, perhaps more efficient than either of the above, and applied in the same manner as the first, are caroid and glycerole of papoid.

COMMENT ON "ODDITIES OF SOUND" ARTICLE.

(1066) P. W. Calhoun, Madison, Fla., writes:

Q. 1. I notice in the article, "Oddities of Sound," publisht in your May issue, that the author states that the Woolworth Building could, theoretically, be shaken to pieces by a few violins. This is not the first time I have seen similar illustrations of the powers of vibration, but I believe the authors in each case overlook one very important item in their calculations, viz., *friction.*

To illustrate what I mean, let us take two violins, both tuned to a certain note of an organ. Let one violin be equipt with the best grade steel strings and the other with *copper* strings. Place them side by side and sound the organ, and what happens? The steel string begins to vibrate, reaches a certain intensity and remains there. No sound is heard from the copper strings unless it is very close to the organ. Is it vibrating? Examination with a magnifying glass would reveal that it is.

Where does the difference lie? Simply in that it takes a certain amount of power to vibrate each one, but much more power is required to vibrate the copper string on account of the friction of the softer metal; therefore the steel string vibrates much stronger, since each string receives the same energy from the organ pipe. But in each case you will notice that each string will not vibrate above a certain intensity, this intensity being the range at which the internal friction and air friction of the vibrating body exactly counterbalances the power available to vibrate it.

What has this to do with the destruction of the Woolworth Building with musical instruments?

Just this: The maximum amount of energy which could be produced by violins stacked all over the Woolworth edifice would be only a few paltry horsepower at best, and the amount of energy it would take to overcome the friction generated by such a building vibrating an almost inestimable amount would be quite a figure. Of course, the building would vibrate some, but, as in the case of the copper string, not enough to tell it.

The matter of soldiers marching across a bridge is a different matter, for two reasons. First, because it doesn't take anything like the energy to vibrate a bridge that it does to vibrate a building, because there isn't much friction in the vibration of a bridge, all motions being possible by simply springing the metal parts instead of having to drag bricks and timbers together. Second, the amount of power developed by several hundred men bobbing up and down together would be sufficient to vibrate almost anything. It is interesting to note, tho, that there is no military rule against marching in and out of buildings in cadence, which in itself proves that a building is much harder to vibrate than a bridge. However, if it were not for the friction of a bridge, it would be possible to adjust an alarm clock to the right speed, set it on the bridge, and down she would tumble in due time.

[Editor's Note:—We referred the interesting query from Mr. Calhoun to Prof. Dayton C. Miller, the well-known expert on the physics of sound and vibration, and author of the work, "The Science of Musical Sound." Professor Miller says:]

A. 1. Mr. Calhoun's comments are not altogether well taken, neither are his criticisms all wrong. Of course, the main supposition of the original article is based on assumed conditions, which are never actually present. It is easy to deny your conclusions by refusing to accept your premises.

A performer on the violin, or a thousand, are not going to cause the Woolworth Building to collapse. To argue this regarding the original article is useless. The author was illustrating a perfectly sound principle of resonance and of accumulated vibratory energy. The author's point in the article referred to was that if the energy were not absorbed or dissipated then, according to well-established principle, the body in resonance with a feeble source of energy might in time acquire a very large store of energy, even enough to be compared with that which would bend structural steel frame work; and under certain assumed conditions this might be dangerous to the stability of large structures.

As to the conditions by which the actu vibrations produced by a violin are dis persed in the Woolworth Building, the au thor presumably employed the violin in rather figurative sense; meaning that some independent source of suitable vibra tions were in operation the result might b important. Such a source might be an earth quake, for instance. Then accumulated v bratory energy would surely be dangerous.

Mr. Calhoun is not quite correct in his in terpretation of the difference between cop per and steel strings. If he were to tak strings of these materials of the same diam eter, same length, and tune them to the sam pitch exactly (the tensions would be nearl alike, since the densities of copper and stee differ but little) then, when they are place near the organ-pipe in unison, both string will be made to vibrate in practically th same amplitude. If he has tried the exper ment, I am inclined to think that the coppe string has been under less tension than th steel. The elastic property of a string mostly due to its tension. Mr. Calhoun idea of "friction" is not quite correct in it application to vibratory motion. Of cours elasticity is everything, and internal frictio or viscosity is important in the transmissio of certain kinds of vibrations thru bodie but it does not apply, as he suggests, t transverse vibrations of a string.

The differences between a bridge and th Woolworth Building is due to the differ ences in the ability to absorb and transm simple vibrations. It is much easier to s the bridge in vibration because it is acoust cally a much simpler type. Of course, it due to "friction," if by "friction" he mean absorption or dissipation, but it is not inter nal friction of the material, *viscosity.*

SPECIAL TIME SWITCH.

(1067) Earl Cochran, Poplar Bluff, Mo writes the Oracle:

Q. 1. Asking how he can construct switch for opening or closing a circuit whe a certain number of coulombs have past.

A. 1. There are several ways of openin or closing a circuit when the current from four-volt battery has delivered a desire quantity. The simplest is by way c a watt-hour meter which will automaticall make contact with one of the hands and metal piece opening or closing a relay. An other way is to have a long tube of glas balanced with plates at both ends and fille with silver salt. The current passes thr these plates. If a sensitive balance is no establisht and sufficiently weighted at th other end, it will be found that in a nitrat solution .001118 gram of silver will b deposited upon one plate for each cou lomb. When the plate therefore become heavier on one side it will automatically ti the balance and open or close the circui These plates could also be immersed in solution suspended from a delicate balanc and sufficient weight added to one scale pa to overcome any slight additional depos until the desired weight is reached.

Learn Electricity



In the Great Shops of COYNE IN 3½ MONTHS

Thousands of Electrical experts are needed to help rebuild the world. Come to Chicago to the great shops of Coyne and let us train you quickly by our sure, practical way backed by twenty-one years of success. Thousands of our graduates have become experts in less than four months. *You* can do the same. *Now* is your big opportunity. Come—no previous education necessary.

Earn $150 to $500 a Month

in the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position.

Electro Automotive Training Included

Our big new electrical course now includes a complete training on the electrical systems of automobiles: Lighting, starting, ignition and storage batteries. We have complete automobile chassis, motors on the block, thousands of dollars' worth of magnetos, lighting, starting and ignition systems. Every department has been enlarged.

Learn Drafting

Every electrical student is taught electrical drafting free. We also have special courses in all branches of drafting for those who want to specialize in this big paying splendid profession. We will train you EITHER HERE AT SCHOOL, OR AT YOUR HOME through our home study department. Expert draftsmen make from $60.00 to $200 a week. Check the coupon and send it now for special catalog.

Motion Picture Operating

We teach this attractive branch of the electrical profession in thoroughly equipped projection rooms; train you for Chief Operator, with salary from $40 to $75 a week, often for evening work only. Check and mail the coupon for special catalog.

Earn While You Learn

If you haven't enough money now don't wait to save it. Our employment man places students in spare time jobs to earn their living expenses or if they must earn all expenses he places them where they work half the time (generally right at electrical work) and go to school the other half. In this way they learn and at the same time earn and gain splendid experience.

Make Expenses in Chicago

Hundreds of our students have worked their way through, you can do the same. Make up your mind right now—send the coupon this very minute for our big free catalog and full information.

Send Today for Big Free Book

Write today, *now*, for the book. It tells what Coyne graduates have done. What you can do. Fill in the coupon, check the trade you are most interested in or send a postal card, do it *now*.

BENNETT W. COOKE, *President*

COYNE TRADE AND ENGINEERING SCHOOLS

Dept. 2-X 39-51 E. Illinois Street, Chicago, Ill.

COYNE SCHOOLS
Dept. 2-X
39-51 E. Illinois St.
Chicago, Ill.

Send me your big free book and particulars of the course I have checked off below.

[ ] Electricity
[ ] Drafting School Course
[ ] Drafting Home Course
[ ] Motion Picture Operating

Name.....

Address.....

MAIL COUPON FOR FREE BOOK NOW!

Army Goods Bargains!

Order NOW—Direct from this Ad. We deliver prepaid. Money-Back Guarantee.



SI-112—Army Breeches. Olive Drab cotton. Thoroughly repaired. A bargain for everyday work, outing, hunting, etc. Give size. Price delivered..... **95c**



SI-137—Olive Drab Blankets. Reclaimed by government methods. Practically like new. Genuine Wool. For camping, touring, etc. Price delivered..... **$5.75**

Brand New Olive Drab Blankets. Price delivered **$6.95**





SI-199—Boy Scouts Shelter Tents. Genuine Shelter or "pup" tents used by Yanks in France. Just the thing for hunters, campers, hiking trips. Waterproof. Complete with poles, etc. Price delivered..... **$3.95**

SI-231 — Canvas Leggins Used by U. S. Infantry. These leggins are second-hand, but are in splendid condition. Small rips or tears neatly repaired. Excellent for hunting, fishing, camping, touring, etc. Price delivered..... **57c**



SI-228—Military Axe. Made of highly tempered steel, keen cutting edge, genuine hickory handle, painted Olive Drab. For auto trip, hunting, camping, fishing. Received large supply from U. S. Quartermaster. Price delivered..... **$1.47**

SI-233—Spiral Leggins, reclaimed, O. D. Wool, first class condition. Price delivered.. **$2.15**

SI-229 — Leather Protector for above axe to be attached to belt. Price delivered..... **65c**



SI-200—Army Wool Shirt, Olive Drab, best quality wool shirting material. Thoroughly washed and repaired. New ones cost over $6.00 wholesale. Price delivered.. **$3.00**



SI-323—Army Aviator's Knitted Cap and Scarf combined. Pure English Olive Drab Worsted. Finest winter cap. Unfold it and you have a scarf. Used by all U. S. Aviators. Worth $5.00. Price delivered..... **$1.55**



SI - 165½ — Army Haversack. Extra strong Olive Drab canvas with harness to go over the shoulders. Used by doughboys in France. Fine for hunters, tourists, cross-country walkers, etc. Price delivered..... **95c**



SI-324—Aviator's Compass. Made of fine quality German silver. When closed the compass is automatically locked. Illuminating dial so you can see it at night. Used by all U. S. Aviators; fine for campers, tourists, cross-country walkers. Price delivered.. **$1.37**



SI-237 — Army Mess Kit. Made of Aluminum. Tight fitting cover. Combination frying pan and plate. Just the thing for Boy Scouts, campers and hunters, etc. Price delivered..... **85c**



SI-111—Army Coat, Olive Drab Cotton. Reclaimed and laundered. Fine for work, outing, etc. Saves good clothes. Sizes, 34 and up. Give size. Price delivered..... **95c**

FREE BOOK giving hundreds of other bargains, sent postpaid. Tents, Underwear, Overalls, Work Clothes, War Equipment direct from France—items of everyday use and historic interest all at remarkably low prices. SEND TODAY!

CARNIE-GOUDIE MFG. CO.
Dept. S. I. Kansas City, Mo.

What Makes A Magazine Cover

By CHARLES A. GROTZ

(*Continued from page 731*)

printing frame and electric lamp in operation making a print.

Figure 5 is a view of the operator in the act of laying the sensitive copper plate on the negative. You will notice that this printing frame is of a different construction than that used in printing on paper from a negative, but we have to contend with two non-flexible substances, namely a sheet of copper and a glass negative. Neither of them is optically flat, and it is necessary for us to get optical contact. We then must resort to some extreme pressure. The basis of this frame is heavy plate glass. After the negative and copper plate are in the frame a heavy rubber blanket is clampt down over them. This blanket has a rubber hose attach to the center which in turn is connected to a vacuum pump. This removes all of the air from between the negative and copper plate, giving a vacuum and an extreme suction, so much so, that a curve or wave in either the glass negative or the copper, is brought into optical contact with the neighboring surface.

ETCHING AND FINISHING THE PLATE.

The next step is in etching and finishing the plate, and here considerable skill is required. The printed copper plate is placed in an acid bath. This etches or dissolves the unprotected copper between the dots. After the plate is removed from the acid bath, the parts which have been protected by the enamel are in relief, and the plate could now be printed from, on a regular printing press, but the plates in this condition are far from perfect and require skillful re-etching in order to bring out the colors and detail perfectly.

Figure 6 shows a Finisher at work. He must now refine the etching by staging or painting in with a *resist* preparation, certain portions of the picture which he considers have had enough etching, and then giving to the unpainted portion a still further etch. He may find it necessary to fine etch the plate in several steps, holding back first the shadows, then the middle tints, etc. After he is satisfied with the etching, he cleans off all of the staging and rubs in a white powder. This sticks *between* the dots, or rather in the sunken parts and enables him to see the plate just as it will print. He then looks for needed toolwork, such as cutting in delicate high-lights, or taking out blemishes.

ROUTING OFF SURPLUS METAL ON CUTS.

The plates now pass to the routing room. Here the surplus metal is routed away by a machine which is practically a high speed cutter mounted on a universal jointed arm which can be guided by the operator to any position desired. This cuts or routs away the large open portions which would take too long to etch deep enough so that the ink rollers of the printing press and the paper on which same is to be printed will not come in contact with the bottom of the plate thereby causing a dirty impression.

Figure 7 shows the plates being routed.

After the plates are routed the burrs left by the routing tool must be carefully trimmed by an engraver, after which the plates

(*Continued on page 770*)

Akron Quality Tires

REDUCE TIRE COST 65%

GOODYEAR Tube FREE

5000 Mile Guarantee

Akron Quality Tires are made to meet the increasing demand for reconstructed tires which are indispensable to the maintenance of the auto industry. Their great economy is your personal advantage. To insure properly built and carefully selected goods always order **Akron Quality Tires.** Shipped direct from factory to you.

One tube given with each tire

30x3	$ 7.50	34x4	$11.85
30x3½	8.60	34x4½	13.55
32x3½ S.S. only	9.70	35x4½	13.90
31x4	10.90	36x4½	14.50
32x4	11.20	35x5	15.45
33x4	11.50	37x5	16.50



Reliner Free With Every Tire

State whether straight side or clincher desired. Send $2 deposit for each tire ordered, balance C. O. D. subject to examination. If you send full amount with order, deduct 5 per cent discount.

AKRON RUBBER CO.
Robey and Roosevelt
Dept. 600 CHICAGO, ILL.

TUBES FREE

In order to introduce our wonderful Everwear Double Fabric Reconstructed Tires, **guaranteed 6000 miles,** we give you, absolutely free, a new high grade standard make tube with every purchase of a tire. No more than four tires and four tubes to each customer. Order at once while stock is complete.



Satisfaction Guaranteed or Money Refunded

Prices Include Tire and Tube

Size	Tires	Size	Tires
30x3	7.25	34x4	$11.35
30x3½	8.35	33x4½	12.50
32x3½ s. s.	8.95	34x4½	13.00
31x4	10.20	35x4½	13.25
32x4	10.55	36x4½	13.75
33x4	11.00	35x5	14.50
		37x5	16.90

FREE Reliner With Each Tire

In ordering, be sure to state size wanted, also whether s. s. clincher, plain or non-skid. Send $2.00 deposit on each tire, balance C. O. D., subject to examination; 5% discount if you send the full amount with your order. Mail your order today and save money.

EVERWEAR TIRE & RUBBER CO.
Dept. 181 3935 Washington Blvd., Chicago
References: Madison & Kedzie State Bank

MAKE BIG PROFITS from HB Battery Charging

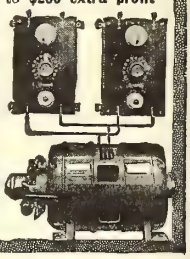
BIGGER PROFITS THIS WINTER

With winter at hand and cars being stored, HB battery charging can pay you $150 to $250 extra profit every month. Someone gets the business of charging those batteries—why not you? Start **now**—get a sturdy, dependable HB Charger with ample capacity to handle this profitable business.

THIS HB 16 BATTERY CHARGER Recharges 1 to 16 6-volt batteries or equivalent at once. Uses 2 or 3 phase city current—cheapest and best. Current cost 4c to 12c each—owner pays 75c to $1.50. Quick, clean, permanent profits easily made.

Small Payment Puts This Money-Maker in Your Garage or Shop Balance on easy monthly terms. Furnished complete with 2 8-battery capacity charging panels. No burnouts.

HOBART BROTHERS COMPANY
Box 1110 E TROY, OHIO
Successful Manufacturers Since 1893



Banner Storage Batteries

Mean less initial expense and real guaranteed service. It is essentially important to dealers as well as automobile owners to select a dependable battery. Our batteries are positively new and guaranteed in writing for 18 months, which means that you get that much service or we will repair same free of charge. We offer you economy and service. Compare our prices with others and be convinced of a saving of 50%.

6 volt, 9 plate 60 amps.	$18.00
6 volt, 11 plate 80 amps.	$22.00
6 volt, 13 plate 100 amps.	$26.00
12 volt, 7 plate	$30.00
12 volt, 9 plate	$35.00

Shipments made within three hours of the receipt of order. Deposit required to defray shipping expenses. 2% discount if remittance in full accompanies order.

Battery Supplies and Equipment. Write for Catalog. Discount to Dealers.

BANNER BATTERY CO., INC., 1219 So. Wabash Ave. CHICAGO, ILLINOIS

5 Master Keys

Have a set of the most wonderful keys in the world, which open hundreds of different locks and replace hundreds of different keys. Used by locksmiths, janitors, and detectives. Set and novel key chain sent for $1.00. Master Key Company, 42 Manhattan Bldg., Milwaukee, Wis.

CLIP THIS COUPON



Chicago Technical College
1145 Chicago "Tech" Bldg. Chicago, Illinois

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below.

- [ ] Architectural Drafting
- [ ] Machine Drafting
- [ ] Electrical Drafting
- [ ] Structural Drafting
- [ ] Sheet Metal Drafting
- [ ] Topographic Drafting
- [ ] Surveying
- [ ] Designing
- [ ] Contracting—Buildings
- [ ] Auto. Engineering
- [ ] Aero. Engineering
- [ ] Gas Engines
- [ ] Plan Reading—Buildings
- [ ] Estimating—Buildings
- [ ] Plan Reading—Machinery
- [ ] Plumbing—Estimating, Etc.
- [ ] Heating and Ventilating
- [ ] Steam Engineering

Name.....

Address.....

Post Office.....

College or Home Study. State which.....State.....

Free Lesson when inquiry is for Draftsmanship or Plan Reading.

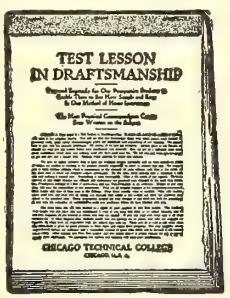
Learn Draftsmanship At Home

GET the facts about the Chicago "Tech" courses in Draftsmanship (or any of the other big paying professions listed on the coupon) which you can aster quickly by spare time study at home. Salaries paid raftsmen today are the highest in history because trained ıen are scarce. Not enough to go around and hundreds f big jobs waiting. Industries of all kinds—manufacırers, architects, railroads, electrical plants, etc.—need proficient men for their drafting departments. Experts in this profession earn $60 to $150 weekly.

No matter what you are doing, this is your big chance. We will send you without obligation or expense a Free Test Lesson (read details of this liberal offer below). See how well qualified you are before you spend a cent. Look into these opportunities today. Learn how a Chicago "Tech" course will make you the man chosen from among many. Clip that coupon—NOW!

Experts Teach You he Methods They Use

The Chicago "Tech" method trains you ıder experts who will equip you for an imortant position in the shortest practicable me. You learn exactly the methods which ıey themselves use in their own practical ork. They prepare you to rank with draftsıen of long experience. They give you the aining required in men who aim to hold nportant executive positions and draw high ılaries for their expert advice and service. Why plod along and be content to take rders from men who know the "Hows" and Whys" of a big job? You have it in you to *ive* orders, once your trained knowledge ives you the confidence to assume charge of ıe men who do the actual work. The trainıg in Draftsmanship which you get from hicago "Tech" experts fits you to step right ıt and earn a big salary. You do not need) resort to guess work. Nothing can halt ou—for you will KNOW your subject.



Send for FREE Test Lesson

Shows you how well qualified you are for draftsmanship. Other schools ask you to enroll and send money first. We send the free lesson first. Read it—practice the exercises—no obligation. Decide for youself whether you want to take the course or not.

FREE OUTFIT

With our home study course is included a complete set of high grade instruments, drawing board, T-square, etc. Same as leading draftsmen use. Credit given if you already have an outfit.

18 Practical Courses You Can Master Quickly

If you want to take up and master quickly any other technical study, the coupon above lists a number of professions that pay handsome salaries. If you can not come to the college, you will get the same course—the same thorough individual instruction by mail. No matter where you live, your lessons are directed and every exercise examined and corrected by experts. Every point is made clear. You progress as quickly as your work proves that you have mastered each lesson.

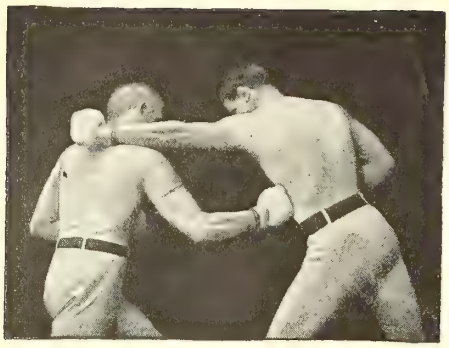
No matter which course you decide to take, you learn just what you need to know from practical men who familiarize you with the things that make you worth a large salary. With the practical knowledge gained from a Chicago "Tech" course, you will be the man wanted—the man who is pushed ahead, because you know why things should be done and how to do them. You can start at a good salary and win quick promotion.

)ecide Today—Then ACT

Now is the time to get the facts about any one of these Chicago "Tech" courses. Find it how hundreds of ambitious men have paved the way to high positions merely by using their are time to prepare for bigger work. Just put X in the square on the coupon opposite the urse you want to know about—sign and mail the coupon. This information costs you nothing so Act Today.

CLIP THE COUPON NOW

:hicago Technical College 1145 Chicago Tech Building CHICAGO, ILLINOIS



Can you play a man's part?

IF some one should make an insulting remark in the presence of your mother, sister or sweetheart, wouldn't you be ashamed if you could not take her part?

Or if you remonstrate with a man for striking a smaller man and the bully turns on you, can you hold your own?

Or suppose one of your pals says "Come on, put on the gloves and have some fun," can you do it and get any "fun" out of it?

To play a man's part whenever called upon you must know how to box and how to defend yourself against a violent attack. Here's how you can learn easily and quickly.

The Great New Course

Marshall Stillman's great new course in boxing and self defense is now ready. It contains the most complete lessons in boxing, wrestling, jiu jitsu, etc., ever prepared. It beats his old course that thousands of pupils thought wonderful and beats it a mile.

The lessons start with simple movements, such as the breast stroke in swimming, holding out your hand for a coin, etc., and step by step you are led into striking heavy blows, guarding, ducking, feinting, side-stepping etc., just as if you had a real opponent before you.

When you've mastered the fundamentals, you take up shadow boxing, in which you are taught such blows as the Bennie Leonard Triple, the Mike Donovan Double, etc.

Then follow lessons in the best Blows and Guards known to the ring. When you've finished you'll know what blows to use, when to use them, and how to guard against your opponent's blows.

To complete your training in self-defense, you're taught 15 jiu-jitsu and 8 holds in standing wrestling for use against violent attack—how to disarm an opponent with pistol, dagger or club, how to break a strangle hold, etc.

There's a set of daily exercises, inciuding the Colon Exercise (one of the best remedies for constipation) and Synthetic Breathing, a great lung developer and aid against nervousness. An article on Mass Boxing shows how to teach boxing to large numbers of men. Then there's a short criticism of all sports such as baseball, tennis, football, etc., and a history of 69 famous prize fighters with their pictures—and "inside" stories about them not generally known.

There are over 246 illustrations in the entire course.

SEND NO MONEY

We send the entire course (6 books) on approval. Keep it ten days, practise the lessons, and then return it or send $5 in complete payment.

Mail the coupon **now** to Marshall Stillman Association, Suite E-111, 461 Fourth Ave., New York.

FREE TRIAL COUPON

MARSHALL STILLMAN ASSOCIATION
Suite E-111, 461 Fourth Ave., New York

You may send me on approval your complete course in Boxing and Self Defense as described above. I have always been faithful in paying my obligations and I give you my pledge that you may feel safe in trusting me as agreed and that I will either return the course, or remit $5 (Canada $6, foreign countries $7) in 10 days.

Name.....

Address.....

PRACTICAL HINTS ON PLAYWRITING

By Agnes Platt

Designed to help the beginner in the difficult art of writing a really good play, and to clear away any obstacles which may beset the more advanced.

Price $1.50

Sent on 5 days' approval if you say so.

DODD, MEAD & COMPANY
441 Fourth Avenue, New York
(Established 1839)

What Makes a Magazine Cover

(*Continued from page 768*)

are ready for the *proving*. This is done on a regular power printing press much the same as the presses upon which the cover is finally to be printed, only of a smaller type.

Figure 8 shows a view of the proving department. Here the plates are printed in the rotation for which they have been made—usually yellow first, red second, and blue third. If a fourth impression is used, it is printed in black and is the last printing on the sheet. However this is not a set rule. The colors can be printed in any rotation and we will get practically the same result. But one thing is important, and that is the *register*. The respective colors must print each one *exactly* in its proper place.

Figure 9 shows an enlarged side view of a halftone printing plate. It will be noticed that the actual printing surface is all on a plane and the tones are produced by large and small dots.

This in a general way explains the process. Space does not permit us to go into the many little phases and detail.

The cover of this issue is a most interesting example of three color work. The large butterfly on a slightly dotted ground is an exact reproduction of the small one, but enlarged some 16 diameters. It has been made to show the action of the screen and how the colors are produced by superimposition. If examined at close range it looks like a crazy-patch quilt, but from a distance of fifteen or twenty feet, its colors blend and give a perfect picture of a butterfly with variegated wings. It is the best illustration of this type of color work that has yet been produced.

If the small butterfly is examined with a microscope, it will be found to be the same in all respects as the large one. Even the pale blue background is made up of the same proportion of little blue dots, widely spaced in the relative sense and regularly distributed.

Figures 10, 11 and 12 are "progressive" prints of the small insert, but printed in black only. They show the color formation and if these same plates were printed in yellow, red and blue, exactly in register, you would see the same little butterfly as is reproduced on this cover.

The picture was made direct from a *real* butterfly, no painting having been made. The name of this butterfly or rather moth—a valuable specimen—is *Urania Croesus*. It was kindly loaned to us thru the courtesy of Asst. Curator Dr. Frank E. Lutz, Entomological Dept. of the American Museum of Natural History of New York.

It was necessary for the Editor to spend two days at the museum where he inspected *over* 100,000 *butterflies and moths*, before the right one was found. There is practically no butterfly that has all the three colors yellow, red and blue, which we desired in order to illustrate the three color process. So we finally had to take *Urania Croesus*, not a butterfly at all, but a moth.

The Editor here wishes to express his appreciation to Dr. Lutz and his associates for their very kind assistance in locating the desired specimen.

ORANGE, N. J., PLANT DELIVERS PART OF RADIUM ORDER.

A radio-chemical company announced recently that one gram of radium valued at $120,000 had been brought from the radium-extracting plant at Orange, N. J., to New York. This is the first part of New York State's purchase of two and a quarter grams. It is to be used for research purposes.

FREE! *FORD SPARK PLU or TIRE COVE*

With every order of our STANDARD DEMONSTRATING TIRES

Fisk—Goodyear—Goodrich—Racine—E

These tires are in excellent condition a will give good mileage. Please speci straight side or clincher. Plain or N.S.

30x3	$6.25	32x4	$10
30x3½	7.25	33x4	11
32x3½	8.25	34x4	12
31x4	9.75	34x4½	14

New Inner Tubes—All sizes standard, $2.45

Send $2.00 deposit, balance C.O.D. for examinati

FULTON TIRE COMPANY
Dept. S. 1518 S. Michigan Ave. Chicago,



PHOTOS

Brand new original subject posed by the most beautifu models in the U. S. Our own work. Never offered before. Siz 7 x 10, mounted on 10 x 14 mats $1 each. 3 for $2. $5 per dozen Postcards, 15 for $1. 50 for $3 50 miniatures FREE **upon reques** with first order of $1 or more Miniature sheet only, 25c. N C.O.D. No stamps. No fre catalog.

L. GARVEY
20 S. Perkins Place Brockton, Mass

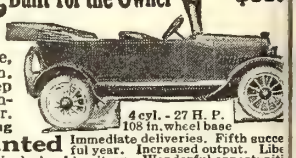
12 Months to Pay

Enjoy your 1921 "Ranger" at once. Earn money for the small monthly payments on **Our Easy Payment Plan.** Parents often advance first small payment to help their boys along. **FACTORY TO RIDER** wholesale prices. Three big model factories. **44 Styles,** colors and sizes in our famous Ranger line. **DELIVERED FREE ON 30 DAYS TRIAL.** Select bicycle and terms that suit—cash or easy payments—you take no risk. **TIRES** lamps, horns, wheels, parts and equipment, at half retail prices. **SEND NO MONEY**—Simply write today for big **FREE** Ranger Catalog and marvelous prices and terms. Special Offer to **Rider Agents.**



MEAD CYCLE COMPANY
Dept. B 107 CHICAGO

The Seneca MOTOR CAR **Built for the Owner** **$118**

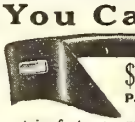


Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. **Comfortable E-Z riding** 4 cyl. - 27 H. P. 108 in. wheel base

Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Libe newspaper advertising in dealers' territory. Wonderful opportuniti **Write or Wire NOW.**

THE SENECA MOTORCAR CO., 51 Seneca Factory, FOSTORIA, OH

You Can Save $50.00



$8.46 and up **Parcels Post Paid**

By recovering your old auto top frame yourself. We make these recovers to fi all makes and models of cars. Any person that car drive a car can put it on We furnish instructions. Roof and quarters sewed together with rea curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. Guarantee Bond for 8000 Miles. (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.
901 Oak S.. Kansas City Mo.

Learn Autos and Tractor



Wonderful opportunities constantly offered trained men; we tr you thoroughly to start your o business or make good money motor expert, driver, shop fo man, etc.

5000 Graduates makir good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland,

ENINGER WILL SAV

BIG MONEY SAVINGS FOR YOU

$40



Used and rebuilt motorcycles, single and twins $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

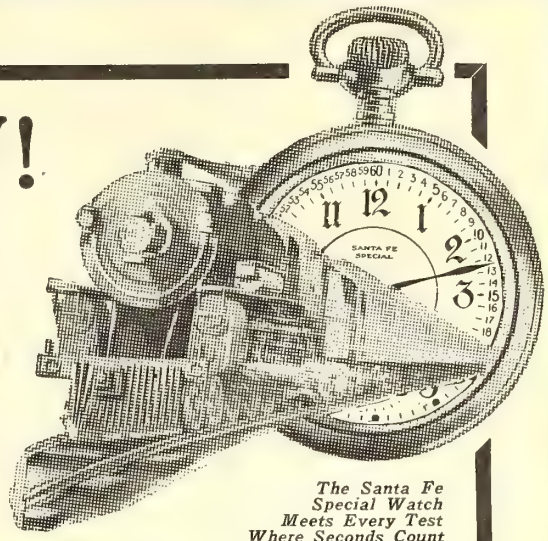
Send for catalog. **Deninger Cycle Co., Rochester, N.Y.**

YOU 25 TO 50 DOLLAR



OPPORTUNITY!

The Big Chance For You



The Santa Fe Special Watch Meets Every Test Where Seconds Count

to get started on the road to success may come any minute. So don't be careless about the **MINUTES** just because they pass quickly.

You must be **ON THE SPOT** at the **RIGHT TIME**—and the only way to be punctual is to have a **PERFECT WATCH.**

THE SANTA FE SPECIAL is such a perfect watch that we can guarantee it stronger than any other watch on the market. It is accurate, not only to the minute, but to the smallest fraction of a second. Read my wonderful offer below, and what I have to say about this marvelous time piece—then utilize this very minute by ordering a watch of which you will always be proud.

Always A Thomas

Pres. Santa Fe Watch Co.

The ILLINOIS Famous $ Santa Fe Special 21 JEWEL RAILROAD WATCH 3.50 A MONTH



The Standard Railroad watch that is GUARANTEED FOR A LIFETIME OF SATISFACTORY SERVICE. These Watches are NOW in service on practically every Railroad in the United States. "Santa Fe Special" watches are in every branch of the Army and Naval Service. Thousands of them are distributed all over the world. They are GUARANTEED ABSOLUTELY TO GIVE SATISFACTION. The wise man will act quickly if he wants a watch. Write today for the FREE watch book and make your selection quickly, before this offer expires.

Save ⅓ to ½ of Your Money Most Liberal Offer Ever Made

Our "Direct-to-You" low wholesale terms and **extra special distribution plan** is fully explained in the new Santa Fe Special booklet just off the press. The "Santa Fe Special Plan" means a **Big Saving** of money to you and you get the **best** watch value on the market today. Watch sent for you to see without one penny down.

New Case Designs

I want you to see the newest designs in cases used on these **("Santa Fe Special!")** Watches, so you will fully realize their beauty and up-to-dateness, as well as the value of the Bargain I am offering you. I want you to see the 3-color inlay work — think how distinctive your watch would be with your own name or monogram or some appropriate emblem engraved in the Case, just to suit your own ideas. You will also want to see the new French Art designs in engraved cases — all shown in MY NEW FREE WATCH BOOK, printed in beautiful colors.

Write today, it will be sent FREE

Santa Fe Watch Co.,

Dept. B80
Thomas Bldg.,
TOPEKA, KAN.
(Home of the Great Santa Fe Railway)

A Letter, Post Card or this Coupon will bring my new free Watch Book.

Santa Fe Watch Company, Dept. B80, Thomas Bldg., Topeka, Kansas.
Please send me your New Watch Book with the understanding that this request does not obligate me in any way.

Name .....

Address .....

State .....

Mail Coupon Today



Choose as Your Profession Electrical Engineering

Electricity offers a brilliant future to the young man who is about to choose his career. Never before has there been such wonderful opportunity in this great field. Big paying positions in electrical work the world over are open to trained men — men who possess specialized, practical knowledge. Come to the School of Engineering of Milwaukee — the largest and best equipped electrical school in America. Here you are trained in both theory and practice by a faculty of over 90 experts. You learn in large, finely equipped laboratories.

B. S. Degree in 3 Years

If you have 14 high school credits or equivalent, you can become an Electrical Engineer with a Bachelor of Science degree in 3 years. If you lack these credits they can be made up in our Institute of Electrotechnics in a short intensive course.

Earn While You Learn

By our special system you may earn your way while learning. Our Employment Department will secure you a position to which you may devote a part of each day, spending the remainder at the school. This plan both solves the students' financial problems and provides splendid experience at the same time. Low tuition fee and Fraternity House for all students who wish to secure board and room at cost.

Winter Term Begins January 2nd

Write for Catalog

Write today for our free, illustrated catalog. Read about this wonderful institution and the great opportunities that lie before you. Find out about our specialized method of training and the details of our "Earn While You Learn" plan.

SCHOOL OF ENGINEERING OF MILWAUKEE
Dept. 1198B—373 Broadway, Milwaukee, Wis.

School of Engineering of Milwaukee,
Dept. 1198B—373 Broadway, Milwaukee, Wis.

Please send me your free illustrated catalog on Electrical Engineering and give me the detail of your "Earn While You Learn" plan.

Name .....
Address .....
Town ..... State .....
Age ..... Education .....

WARNER'S "INFALLIBLE AUTOMATIC"



A CL.

15 QUICK SHOTS NO JAMS

"THE PISTOL That Shoots and Hits the Mark"

Before buying ask your dealer about the $18 Warner "Infallible." Get the best and save at least $5

Get a Warner "Infallible" Automatic and teach the women how to plug the bull's eye. Target shooting is intense, exciting sport. Excellent training for nerves and eyes. Teaches self-reliance, confidence and familiarity with weapons. **What a Shooter Says:** "Your 'Infallible' Automatic Pistol is all that you claim and more. I put seven shots in bull's eye one inch in diameter at distance of twenty-five feet with the pistol. The accuracy of this arm is unsurpassed by any regardless of price." C. S. Hoffman, 157 Oakwood Avenue, Orange, N. J.

FREE LESSON OFFER

An authority has prepared for us, a set of six lessons on the **Art of Pistol Markmanship.** These lessons are of marvelous value in the use and care of a **Warner "Infallible" Automatic.** Write today for illustrated circular and terms of **Free Lesson Offer.**

PRICE $18.00 WITH 2 MAGAZINES

KIRTLAND BROTHERS & CO., INC.
96 Chambers St. (Dept. E-E) New York

Phonograph Prize Contest

(*Continued from page* 740)

By placing a fan on the shaft in place of the buffing wheel those who have electric Victrolas might have a suitable fan for the warm nights when they wish to play their phonograph.

LESTER BENOIT.

HONORABLE MENTION.

Wire Winder.

The following kink of using an idle phonograph has saved me many toilsome hours of winding wire on spools after some experiment.

I constructed the following winder:

I first procured a steel plate 6" in dia., ½" thick, and drilled a hole in the center thru which the pin in the phonograph passes.

Then, taking another plate 1½" in. dia. and ¼" thick and drilling a 3-16" hole and slightly counterboring one side and riveting this to a 6" x 3-16" drill rod which had been previously threaded for 2 inches of its length, I procured a wing nut and washer to fit same. Then drilling and tapping the plates, I assembled the pieces into this winder, the weight of which is sufficient to keep it in place while revolving.

By placing a spool on the stand and put ting washer and nut into place a first-rate winder is the result.

WALTER C. PATZOLD.

HONORABLE MENTION.

Flying Toy Airplane.

A light paper toy airplane is mounted at the outer end of a wire arm offset about 18 inches from the vertical center line of phonograph disc. The lower end of this wire is clampt onto the center pin of the phonograph disc by a spring clamp similar to a spring clothespin.

As the disc rotates the little airplane will fly or whirl around in a three-foot circle and a light paper propeller mounted on the front of the airplane will be caused to spin rapidly by its passage thru the air. A small cloth flag mounted on top of the airplane will heighten the speed effect.

CARL S. BATES.

HONORABLE MENTION.

Metronome.

The following useful metronome has been constructed and used by me and my younger brothers for over a year and it has proved very successful.

A narrow, half-round strip of wood was glued across an old record of the "ten-cent" kind. A tube in the form of a right angle was soldered to the cover of a shoe paste box after the latter had a hole cut in it.

A hammer was made by gluing a hardwood stick into a hole in a hardwood ball.

The other end of this hammer was rounded so it would slide over the strip glued to the record. A light spring keeps the ball in contact with the back of the can and is fastened to the hammer arm just below the point where it is pivoted to the front of the can. If the cover does not fit tight enough it will have to be soldered in place.

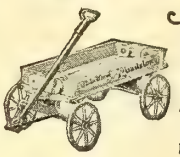
If the attachment is to be placed on a Victrola, then the goose neck must be revolved back to the rest position.

If necessary, a rest of wood with felt on the bottom can be used to hold the wood "needle" off the record, but not off the wood

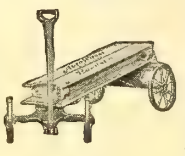
(*Continued on page* 809)



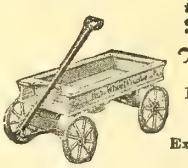
A New Sport for Auto-Wheel Clubs



AUTO-WHEEL SAILING. What fun you'll have with this new amusement. Attach a sail to your **Auto-Wheel Coaster or Auto-Wheel Convertible Roadster.** The roller-bearings are the same as used on automobile wheels. That's why the name **"Auto-Wheel"** means so much.



The **Auto-Wheel** carries 1000 lbs. The roller-bearings will not crack or chip as old-fashioned ball-bearings do.



The November *"Auto-Wheel Spokesman"* tells how to make a sail for your **Auto-Wheel** wagon. Send for it.

Organize an *Auto-Wheel* Club

FREE caps to members. Special Captain's cap. FREE **Auto-Wheel** Dime Bank. Just send names of three coaster dealers in your town, telling which ones sell the coaster wagon with the name **"Auto-Wheel"** on the sides.

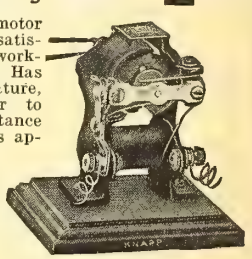
The Auto-Wheel Coaster Co., Inc.
Formerly
The Buffalo Sled Company
163 Schenck Street,
N. TONAWANDA, N.Y.
In Canada: Preston, Ont.
Export Office: 365 W. 23rd Street, New York City.

Auto-Wheel

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

LITTLE HUSTLER MOTOR

With New Starting Switch $2.00



A powerful little motor that gives perfect satisfaction. Excellent workmanship throughout. Has a three-pole armature, causing the motor to start without assistance when the current is applied.

Equipped with pulley for running mechanical toys, models or driving a fan at high rate of speed.

AT ALL LIVE DEALERS

Insist on your dealer showing you the **KNAPP** line—**KNAPP** goods are best. If your dealer cannot supply you, order direct. Send for FREE illustrated catalogue showing a complete line of Electrical Motors and Novelties.

KNAPP ELECTRIC & NOVELTY CO.
523 West 51st Street, N. Y. City



GET ON THE STAGE

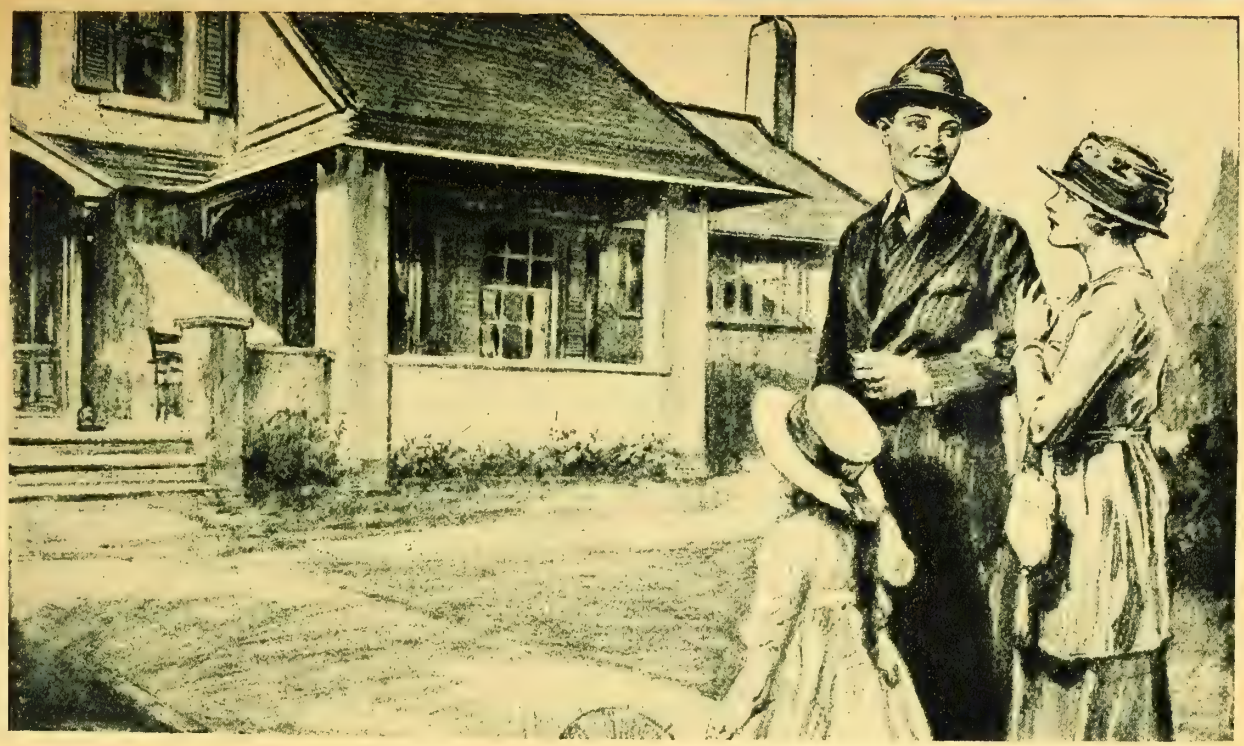
I Tell You How! Stage Work and Cabaret Entertaining successfully taught by mail. Your **BIG** opportunity. Travel, see the world as vaudeville actor or actress. My great Professional Course—only one of its kind—**COVERS ALL BRANCHES.** Develops **Personality, Confidence, Skill** and tells you **just how** to get on the Stage. Send 6c postage for illustrated booklet, **"All About Vaudeville."** State age and occupation. Write for this free Stage Book **today!**

FREDERIC LA DELLE Box 557-W LOS ANGELES, CALIF.

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.



"The Proudest Moment of Our Lives Had Come!"

"This was our own home! There were two glistening tears in Mary's eyes, yet a smile was on her lips. I knew what she was thinking.

"Five years before we had started out bravely together! The first month had taught us the old, old lesson that two cannot live as cheaply as one. I had left school in the grades to go to work and my all too thin pay envelope was a weekly reminder of my lack of training. In a year Betty came—three mouths to feed now. Meanwhile living costs were soaring. Only my salary and I were standing still.

"Then one night Mary came to me. 'Jim', she said, 'why don't you go to school again—right here at home? You can put in an hour or two after supper each night while I sew. Learn to do some one thing. You'll make good—I *know* you will.'

"Well we talked it over and that very night I wrote to Scranton. A few days later I had taken up a course in the work I was in. It was surprising how rapidly the mysteries of our business became clear to me—took on a new fascination. In a little while an opening came. I was ready for it and was promoted—with an increase. Then I was advanced again. There was money enough even to lay a little aside. So it went.

"And now the fondest dream of all has come true. We have a real home of our own with the little comforts and luxuries Mary had always longed for, a little place, as she says, that 'Betty can be proud to grow up in.'

"I look back now in pity at those first blind stumbling years. Each evening after supper the doors of opportunity had swung wide and I had passed them by. How grateful I am that Mary helped me to see that night the golden hours that lay within."

In city, town and country all over America there are men with happy families and prosperous homes because they let the International Correspondence Schools come to them in the hours after supper and prepare them for bigger work at better pay. More than two million men and women in the last 30 years have advanced themselves through spare time study with the I. C. S. Over one hundred thousand right now are turning their evenings to profit. Hundreds are starting every day.

You, too, can have the position you want in the work you like best. You can have a salary that will give your family the kind of a home, the comforts, the little luxuries you would like them to have. Yes, you can! No matter what your age, your occupation, or your means—you can do it!

All we ask is the chance to prove it. That's fair, isn't it? Then mark and mail this coupon. There's no obligation and not a penny of cost. But it may be the most important step you ever took in your life. Cut out and mail the coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6166-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electric Lighting and Railways
- ☐ Electric Wiring
- ☐ Telegraph Engineer
- ☐ Telephone Work
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Machine Shop Practice
- ☐ Toolmaker
- ☐ Gas Engine Operating
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREMAN OR ENGINEER
- ☐ STATIONARY ENGINEER
- ☐ Marine Engineer
- ☐ Ship Draftsman
- ☐ ARCHITECT
- ☐ Contractor and Builder
- ☐ Architectural Draftsman
- ☐ Concrete Builder
- ☐ Structural Engineer
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Textile Overseer or Supt.
- ☐ CHEMIST
- ☐ Mathematics
- ☐ SALESMANSHIP
- ☐ ADVERTISING
- ☐ Window Trimmer
- ☐ Show Card Writer
- ☐ Sign Painter
- ☐ Railroad Trainman
- ☐ ILLUSTRATING
- ☐ Cartooning
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Public Accountant
- ☐ TRAFFIC MANAGER
- ☐ Railway Accountant
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ Teacher
- ☐ Common School Subjects
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ AUTOMOBILE OPERATING
- ☐ Auto Repairing
- ☐ Navigation
- ☐ AGRICULTURE
- ☐ Poultry Raising
- ☐ Spanish
- ☐ French
- ☐ Italian

Name_____
Present Occupation_____
Street and No._____
City_____ State_____

Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

7-28-19

RADIO NEWS

REG. U.S. PAT. OFF.

"The 100% Wireless Magazine"

20 Cents
NOVEMBER
1920
Over 100 Illustrations
Edited by
H. GERNSBACK



FOR SALE AT ALL NEWS STANDS

ARTISTIC TWO COLO COVER

"THE 100% WIRELESS MAGAZINE"

Partial CONTENTS OF NOVEMBER ISSUE:

The Radio Compass on Board Merchant Vessel
By Arthur H. Lynch

Registering Radio Messages on Tape

A New Continuous-Wave Type Transmitter

Comparison of Modulation Methods in Radio Telephony
By A. S. Blatterman

The Radio Preacher
By C. A. Stanley

A 150 to 20,000 Meter Receiver
By D. R. Clemons

The Mystery of Dampt-Undampt Messages
By H. L. Moulton

What "Radio News" Is:

RADIO NEWS now in its second year holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO NEWS leads all other wireless magazines. The October issue had 64 pages; there were seventy-nine separate purely radio articles and 109 illustrations. *Over forty thousand copies were printed and circulated.*

Each issue of RADIO NEWS contains 74 pages (or more) and an artistic cover in two colors. The illustrations average 120 every month and there are from 60 to 80 up-to-date articles, some by our greatest radio scientists, in every issue.

THIRD $100.00 RADIO PRIZE CONTEST

A new radio contest. The third one offering $100.00 in prizes began in our May issue.

72 PAGES
120 ILLUSTRATIONS

20c The Copy
$2.00 A Year
Canada and Foreign $2.50 A Year

SEND 20c FOR SAMPLE COPY TODAY

EXPERIMENTER PUB. CO., 231 Fulton St., New York City

SPECIAL OFFER

Gentlemen:
Please enter my subscription for RADIO NEWS for the term of one year for which I enclose herewith $2.00. As a special offer you will also send me for 25c extra your great Wireless Course containing 160 pages, 350 illustrations size 6¾ x 10" with fine flexible cloth cover. I have written my name and address in margin below.



Free Proof that I Can Raise Your Pay

No matter how much your are earning now, I can show you how to increase it. I have even taken failures and shown them how to make $100—$200, and in one case as high as $2,000 weekly. I am willing to prove this entirely at my risk and expense.

LET'S have a little chat about getting ahead—you and I. My name is Pelton. Lots of people call me "The Man Who Makes Men Rich." I don't deny it. I've done it for thousands of people—lifted them up from poverty to riches.

I'm no genius—far from it. I'm just a plain, everyday, unassuming sort of man. I know what poverty is. I've looked black despair in the eye—had failure stalk me around and hoodoo everything I did. I've known the bitterest kind of want.

But today all is different. I have money and all of the things that money will buy. I am rich also in the things that money won't buy—health, happiness and friendship. Few people have more of the blessings of the world than I.

IT was a simple thing that jumped me up from poverty to riches. As I've said, I'm no genius. But I had the good fortune to know a genius. One day this man told me a "secret." It had to do with getting ahead and growing rich. He had used it himself with remarkable results. He said that every wealthy man knew this "secret"—that is why he was rich.

I used the "secret." It surely had a good test. At that time I was flat broke. Worse than that, for I was several thousand dollars in the hole. I had about given up hope when I put the "secret" to work.

At first I couldn't believe my sudden change in fortune. Money actually flowed in on me. I was thrilled with a new sense of power. Things I couldn't do before became as easy for me to do as opening a door. My business boomed and continued to leap ahead at a rate that startled me. Prosperity became my partner. Since that day I've never known what it is to want for money, friendship, happiness, health or any of the good things of life. That "secret" surely made me rich in every sense of the word.

MY sudden rise to riches naturally surprised others. One by one people came to me and asked me how I did it. I told them. And it worked for them as well as it did for me.

Some of the things this "secret" has done for people are astounding. I would hardly believe them if I hadn't seen them with my own eyes. Adding ten, twenty, thirty or forty dollars a week to a man's income is a mere nothing. That's merely playing at it. In one case I took a rank failure and in a few weeks had him earning as high as $2,000.00 a week. Listen to this:

A young man in the East had an article for which there was a nation-wide demand. For twelve years he "puttered around" with it, barely eking out a living. Today this young man is worth $200,000. He is building a $25,000 home—and paying cash for it. He has three automobiles. His children go to private schools. He goes hunting, fishing, traveling whenever the mood strikes him. His income is over a thousand dollars a week.

In a little town in New York lives a man who two years ago was pitied by all who knew him. From the time he was 14 he had worked and slaved—and at sixty he was looked upon as a failure. Without work—in debt to his charitable friends, with an invalid son to support, the outlook was pitchy black.

Then he learned the "secret." In two weeks he was in business for himself. In three months his plant was working night and day to fill orders. During 1916 the profits were $20,000. During 1917 the profits ran close to $40,000. And this genial 64-year-young man is enjoying pleasures and comforts he little dreamed would ever be his.

I COULD tell you thousands of similar instances. But there's no need to do this as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for you.

I don't claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I have failures—everyone has. But I do claim that I can help 90 out of every 100 people if they will let me.

The point of it all, my friend, is that you are using only about one-tenth of that wonderful brain of yours. That's why you haven't won greater success. Throw the unused nine-tenths of your brain into action and you'll be amazed at the almost instantaneous results.

The Will is the motive power of the brain. Without a highly trained, inflexible will, a man has about as much chance of attaining success in life as a railway engine has of crossing the continent without steam. The biggest ideas have no value without will-power to "put them over." Yet the will, altho heretofore entirely neglected, can be trained into wonderful power like the brain or memory and by the very same method—intelligent exercise and use.

If you held your arm in a sling for two years it would become powerless to lift a feather from lack of use. The same is true of the Will—it becomes useless from lack of practice. Because we don't use our Wills—because we continually bow to circumstances—we become unable to assert ourselves. What our wills need is practice.

Develop your will-power and money will flow in on you. Rich opportunities will open up for you. Driving energy you never dreamed you had will manifest itself. You will thrill with a new power—a power that nothing can resist. You'll have an influence over people that you never thought possible. Success—in whatever form you want it—will come as easy as failure came before. And those are only a few of the things the "secret" will do for you. The "secret" is fully explained in the wonderful book "Power of Will."

How You Can Prove This at My Expense

I KNOW you'll think that I've claimed a lot. Perhaps you think there must be a catch somewhere. But here is my offer. You can easily make thousands—you can't lose a penny.

Send no money—no, not one cent. Merely clip the coupon and mail it to me. By return mail you'll receive not a pamphlet, but the whole "secret" told in this wonderful book "POWER OF WILL."

Keep it five days. Look it over in your home. Apply some of its simple teachings. If it doesn't show you how you can increase your income many times over—just as it has for thousands of others—mail the book back. You will be out nothing.

But if you feel that "POWER OF WILL" will do for you what it has done for over four hundred thousand others—if you feel as they do that it's the next greatest book to the Bible—send me only $4.00 and you and I'll be square.

If you pass this offer by, I'll be out only the small profit on a $4.00 sale. But you—you may easily be out the difference between what you're making now and an income several times as great. So you see you've a lot—a whole lot—more to lose than I.

Mail the coupon or write a letter now—you may never read this offer again.

Pelton Publishing Company
30-T Wilcox Block **Meriden, Conn.**

Pelton Publishing Company
30-T Wilcox Block, Meriden, Conn.

You may send me "Power of Will" at your risk. I agree to remit $4.00 or remail the book to you in five days.

Name.....

Address.....

A Few Examples
Personal Experiences

Among over 400,000 users of "Power of Will" are such men as Judge Ben B. Lindsey; Supreme Court Justice Parker; Wu Ting Fang, Ex-U. S. Chinese Ambassador; Assistant Postmaster General Britt; Gov. McKelvie of Nebraska; General Manager Christeson of Wells-Fargo Express Co.; E. St. Elmo Lewis, former Vice-pres. Art Metal Construction Co.; Gov. Ferris of Michigan; E. T. Meredith, Secy. of Agriculture, and many others of equal prominence.

$300 Profit from One Day's Reading

"The result of one day's study netted me $300 in cash. I think it a great book and would not be without it for ten times the cost."—Col. A. W. Wilke, Roscoe, So. Dakota.

Worth $15,000 and More

"The book has been worth more than $15,000 to me."—Oscar B. Sheppard.

Would Be Worth $100,000

"If I only had it when I was 20 years old, I would be worth $100,000 today. It is worth a hundred times the price."—S. W. Taylor, the Santa Fe Ry., Milans, Texas.

Salary Jumped from $150 to $800

"Since I read Power of Will my salary has jumped from $150 to $800 a month."—J. F. Gibson, San Diego, Cal.

From $100 to $3,000 a Month

"One of our boys who read Power of Will before he came over here jumped from $100 a month to $3,000 the first month, and won a $250 prize for the best salesmanship in the state."—Private Leslie A. Still, A. E. F. France.



$6.00

No. 4889

Chemical Laboratory

We present herewith to our friends our **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform real chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

DESCRIPTION OF THE OUTFIT:

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The Instruction book is a real Chemistry Course for the Beginner. Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the Elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English System and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the 100 Experiments are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and Smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make Chemical Colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

Price $6.00. Shipping Weight 10 lbs. (Can be shipped by Express only.)
Immediate Shipment

The Boy's Electric Toys

"THE BOY'S ELECTRIC TOYS" contains enough material TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

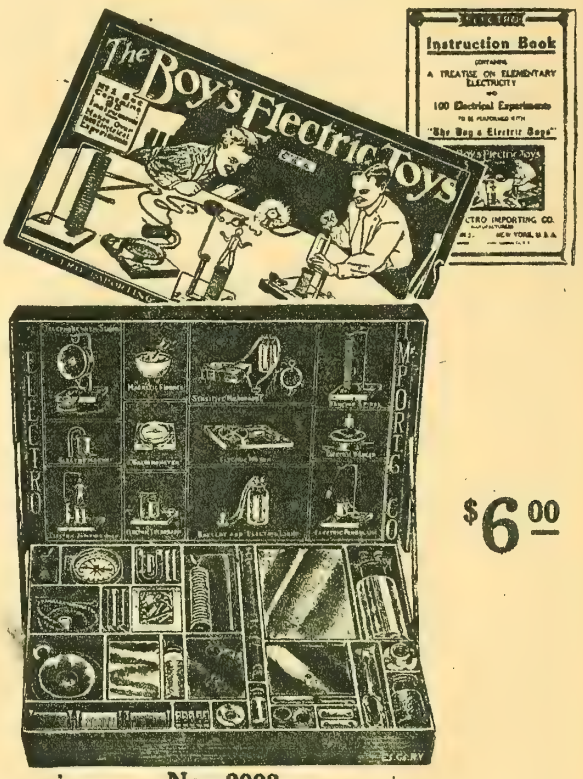
The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size over all of the outfit is 14 x 9 x 2¾. Shipping weight, 8 lbs.
No. 2002 "The Boy's Electric Toys," outfit as described.....$6.00

IMMEDIATE SHIPMENTS



$6.00

No. 2002

"The Livest Catalog in America"

IN this cyclopedia you will find all about radio. One of the greatest catalogs of its kind in print.

You will find in it dozens of wireless instruments of the famous E. I. Co. make.

Other things you will find listed in this catalog: Electrolytic Interrupters, Bulldog Spark Coils, Chemical Outfits, Code Practice Sets, Primary Batteries, Storage Batteries, Hydrometers, Volt and Ammeters, Batterymeters, Electrolytic Rectifiers, Rheostats, Tesla Coils, Microphones, Loud Talkers, Electro-magnets, X-ray Tubes, Telephones, Magnetos, Low Tension Transformers, Books, etc., etc. IN A WORD THE MOST COMPLETE CATALOG IN PRINT.

FREE with this wonderful cyclopedia —20 coupons for our 160 page Wireless Course in 20 lessons. 350 illustrations, 30 tables. Catalog explains how you can get this Course absolutely free.

The Electro Importing Co.,

231 Fulton Street **New York**

"Everything for the Experimenter"

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

I enclose herewith 10 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 22 as described.

NAME .....

ADDRESS .....

STATE..... S.&I. 11-20

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(Continued from page 739)

be lost in the glare of the sun, tho possibly at the time of the vernal and autumnal equinoxes when the sun is crossing the equator individual particles would be projected against the sun's disk.



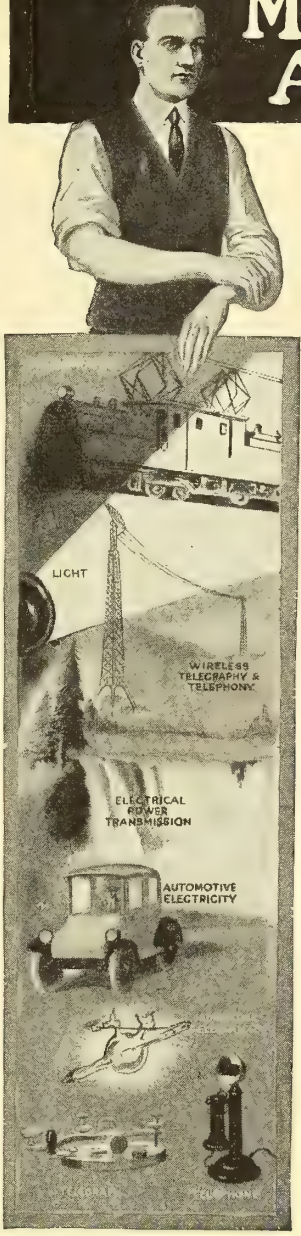
Diagram 1. Earth's Shadow Inclined 23½° to the Equatorial Plane. E, Earth; R, Hypothetical Ring of Meteorites in Plane of Equator 4,000 Miles From Surface; C, Critical Distance, Between 2.44 and 2.86 Radii (9,700 and 11,400 Miles), Within Which Range a Meteorite a Mile or More in Diameter Would Be Ruptured by Tidal Strains; S, Distance 8,000 Miles at Which a Satellite, 1 Mile in Diameter Would Be About as Visible as Mercury; P, Distance, 120,000 Miles, at Which a Ten-Mile Diameter Satellite Would Be Almost as Visible as Mars. If S¹ is a Meteorite, It Will Only Be Visible at Sunrise or Sunset and More Clearly by an Observer Near the Equator.

Just after sunset or just before sunrise within the tropics would be the only favorable time and place to look for a ring of meteoric particles encircling the earth in the equatorial plane. Were there such a ring consisting of many particles it would be visible only in the twilight hours extending along the celestial equator as an arch of faint light passing close to the zenith in the tropics and fading away toward the eastern and western horizons. In midlatitudes it would never attain a sufficiently high altitude above the horizon after sunset to be visible in the glow of twilight.

The zodiacal light, which is so conspicuous in a clear sky at night in the tropics as a faint haze of light extending along the ecliptic entirely across the heavens with a more luminous patch exactly opposite the sun called the "gegenschein," owes its origin to an extensive ring of meteoric particles revolving about the sun in the plane of the earth's orbit and extending far beyond the orbit of the earth. The faint hazy light is due to sunlight reflected from these countless minute particles of matter. The cause of the "gegenschein" or "counter-glow" is not so clear, but it must come from particles lying beyond the apex of the earth's shadow which falls between 844,000 and 873,000 miles from the earth's center. It may be due to a dense condensation of these particles about 930,000 miles beyond the earth where the field of the earth's attraction begins and where as a result these particles are whirled about under the rival attractive forces of the earth and sun.

In our latitudes the zodiacal light is much less conspicuous than it is in the

More Good Men ARE WANTED



Electrical Engineers Make Big Money
***"Roll up your sleeves"*--become an**

Electrical Engineer

You can qualify in a very short time

There has never been a time when the electrically trained man couldn't get a real man's sized job at a big salary. There have always been more such jobs than there were men to fill them. Today the demand is greater than ever. The wonderful possibilities of electricity are not half realized. New uses for electrical energy are being discovered every day.

Civilization Depends on Electricity

The Profession Needs More Good Men

The man who knows the fundamentals and knows that he knows them, gets the best positions. It's the trained man who gets ahead. He works with confidence, knows exactly what to do,—when and how to do it. There is no reason why you can't master this lucrative interesting profession quickly. The instruction we give you makes mastery easy.

Turn your idle hours into a profession to be proud of

Surely you have an hour or two a day that bring you in nothing—time that you waste. This time is worth money if you will use it right. You'll find our instruction interesting and easy to understand.

Where Technical terms are used they are explained and simplified

Now is the time to start—don't wait until a more convenient season. The sooner you start training the quicker you'll be classed as a regular Electrical Engineer with a big job and big pay. Send no money—use the coupon below—get our latest bulletin on this course—then decide.

American School of Correspondence
Dept. E-826
Drexel Avenue and 58th Street, Chicago, U. S. A.

WE HAVE TRAINED THOUSANDS OF OTHERS—WHY NOT YOU? START NOW—MAIL THIS COUPON TODAY

It pays to train right—to follow the teaching of men who know from practical experience.

What This Man *Has Done*
You Can Do

Pocatello, Idaho

Gentleman:
I have nothing but praise for your instruction courses * * * I am now manager of an automatic telephone company in this city. My success I attribute entirely to my Electrical Engineering Course with you, and take this opportunity of thanking you.

Yours very truly,
E. L. FARWELL

AMERICAN SCHOOL OF CORRESPONDENCE, Dept. E-826, Chicago, U. S. A.
I want job checked—tell me how to get it.

...Architect	$5,000 to $15,000	...Lawyer	$5,000 to $15,000
...Building Contractor	5,000 to 10,000	...Mechanical Eng'eer	4,000 to 10,000
...Automobile Engineer	4,000 to 10,000	...Shop Superitendent	3,000 to 7,000
...Automobile Repairman	2,500 to 4,000	...Employ't Manager	4,000 to 10,000
...Civil Engineer	5,000 to 15,000	...Steam Engineer	2,000 to 4,000
...Structural Engineer	4,000 to 10,000	...Foreman	2,000 to 4,000
...Business Manager	5,000 to 15,000	...Photoplay Writer	2,000 to 10,000
...Cer. Public Accountant	7,000 to 15,000	...Sanitary Engineer	2,000 to 5,000
...Accountant and Auditor	2,500 to 7,000	...Telephone Engineer	2,500 to 5,000
...Draftsman and Designer	2,500 to 4,000	...Telegraph Engineer	2,500 to 5,000
...Electrical Engineer	4,000 to 10,000	...H. School Graduate	In two years
...General Education	In one year	...Fire Insur. Expert	3,000 to 10,000

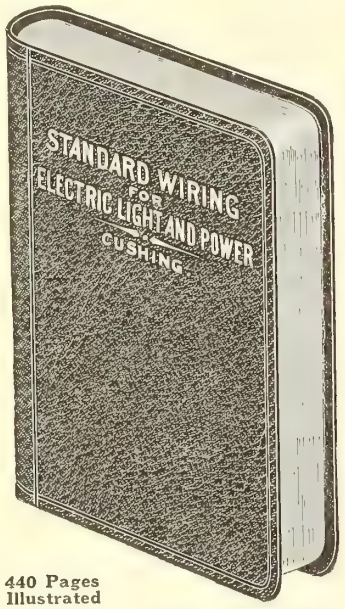
Name.....Address.....

LEARN WIRING

AND EARN

$75 a Week

This year's Edition will make you an Expert



440 Pages
Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. 250 Electrical Units and their Definitions and Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve your wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges.
Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.

8 West 40th Street New York

tropics where the ecliptic arches high across the heavens and it can rarely be traced in mid-latitudes more than 90° from the sun, its light fading away as the distance from the sun increases.

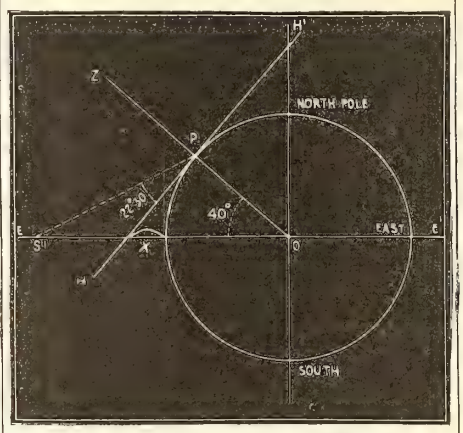


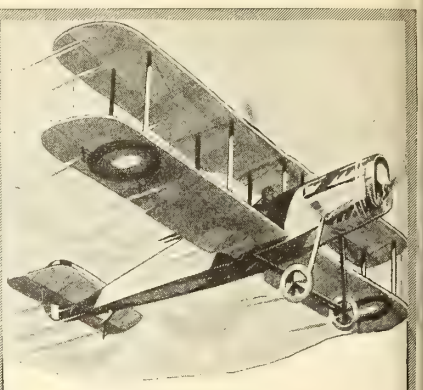
Diagram 2. Invisibility of an Object in Plane of the Equator to an Observer at High Latitudes. O—Center of the Earth. HH¹—The Plane of the Horizon for a Point P in 40° North Latitude. Z—The Zenith of the Point P. EE¹—The Plane of the Earth's Equator. S¹—An Object in the Plane of the Earth's Equator 4000 Miles from Its Surface. HPS¹—The Elevation or Altitude of the Object S¹ Above the Horizon (22½° for 40° N. Latitude). X=1222 Miles for 40° N. Latitude. An Object in the Plane of the Earth's Equator Within This Distance of the Surface Would Lie Below the Horizon HH¹ and Be Invisible.

A dense ring of meteoric particles surrounding the earth within four thousand miles of its surface would have the same hazy appearance as the zodiacal light, tho instead of lying along the ecliptic it would lie along the celestial equator. In mid-latitudes, just after sunset or just before sunrise, it would rise less than twenty degrees above the horizon and would be lost in the glow of twilight. In the tropics as we have said it might possibly be faintly visible at twilight as an arch of dim, hazy light across the zenith from east to west fading away toward the horizon. That the observation of no such phenomenon has ever been recorded in the tropics we may take as an indication that no dense ring of meteoric matter does exist within the critical limit for the earth. This does not preclude the possibility that many isolated meteoric fragments averaging one hundred feet in diameter or less may be revolving about the earth within four or five thousand miles of its surface or in fact anywhere within the field of its gravitational influence. The stony and iron meteorites that frequently fall to the earth's surface may be stray members of an extensive group encircling the earth, remnants possibly of a meteoric ring that has gradually been absorbed by the earth during the aeons that have elapsed since its birth.

We may feel certain, however, that no extensive ring of meteoric particles could exist undetected within the critical limit for the earth and no minute satellite *without* this limit as great as a single mile in diameter.



Fig. 1—1. Mars Viewed Thru Telescope. 2. An Object One Mile in Diameter and 400 Miles Distant, and 3. An Object 10 Miles in Diameter at 120,000 Miles Distance, All Viewed Thru Same Telescope.



Build and Fly a Model Aeroplane Just Like a Real One!

EVERY boy should build and fly one of these IDEAL models of real Aeroplanes. Building your own 'plane is great sport; it develops your mechanical ability and shows you how Aeroplanes are constructed. IDEAL Model Aeroplane Construction Outfits make building easy. They contain everything needed to build a Model Aeroplane that is an exact duplicate of a real machine; also Complete Plans and full instructions. IDEAL Model Aeroplanes are guaranteed to fly when correctly built. You can get Complete Construction Outfits for building models of any of these well-known Aeroplanes. Pick one you're going to build.

Curtiss JN4D-2 Training Plane, 3-ft. size	**$8.00**
DeHAVILLAND Battle Plane, 3-ft. size (shown above)	**8.50**
N C-4 Naval-Curtiss Seaplane, 4½-ft. size	**10.00**
Curtiss Military Tractor, 3-ft size	**7.50**
Bleriot Monoplane, 3-ft. size	**6.00**
Nieuport Monoplane, 3-ft. size	**7.00**
Taube Monoplane, 3-ft. size	**5.50**

West of Denver, Colorado, and in Canada—50c extra for each outfit.

These Construction Outfits are sold in sealed boxes by the Leading Toy, Sporting Goods and Department Stores. Ask for them at your store. If your store hasn't them, we will fill your order direct, postpaid, upon receipt of price above, and guarantee satisfaction or money back.

Plans for Model Aeroplanes

Complete Plans; which include Scale-Drawings and Building and Flying Instructions; for any one of the above Model Aeroplanes will be sent by mail, **Postpaid,** for **35 cents.**

These Plans show exactly what is required to build a Model Aeroplane and how to build it.

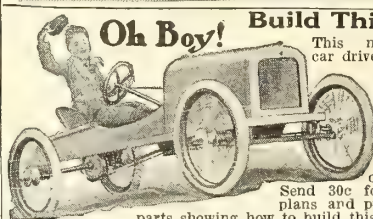
Send for This Aeroplane Book



Gives full descriptions, specifications and prices on all IDEAL Model Aeroplanes, IDEAL Racing Aeroplanes and IDEAL Flying Toys. Tells all about them and also lists hundreds of Model Aeroplane parts and fittings. It's a book every Amateur Aviator should have. Sent postpaid for **5 cents.**

Send for yours Today!

IDEAL AIRPLANE & SUPPLY COMPANY
Making Model Aeroplanes Since 1911
159-161 Wooster Street, Cor. West Houston St.
New York City



Build This Car

This nifty lit car driven by gas line mot can b built any bo Parts a furnish by us a are ve cheap Send 30c for build plans and price list parts showing how to build this lad's c

SYPHER MFG. CO., 156 Sypher Bldg., Toledo, O

MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE

Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.

The Universal Triangle



Combines the direct ruling protractor and all the angles of the 30 x 60 and 45 triangles without inverting or resetting. Under most handy control by a thumb-nut which secures the adjustment at any angle. Unequaled for utility. Get this inexpensive, efficiency tool instead of the three old, awkward ones and be up to the minute. Transparent. 7". $2 Postpaid.

EDWIN Z. LESH, Dayton, Ohio

BURGESS B² SERVICE

$186 IN 2 WEEKS

EARNED BY A BURGESS-TRAINED MAN

READ THIS LETTER

From the Chief Electrical Engineer of a Large Industrial Corporation

Dear Sir:
"One of your students, who has charge of half of the motors in our shop, received $186.05 for two weeks' pay a short while ago. To my recollection, this is the largest amount ever drawn by a man in this position and I must say it speaks well for you and the service you render."
(Name on request.)

ELECTRICITY

TAUGHT BY A PRACTICAL MAN

A Home Study Course



BEGINNERS GET ELECTRICAL JOBS

After Taking the Burgess Course a Short While

JUST A LITTLE OF YOUR SPARE TIME AT HOME BETWEEN YOU AND SUCCESS

I have been training ambitious men, both young and old, in practical electricity for a number of years by my Home Instruction Method, and would like to send you my catalog, which tells exactly what I do and **HOW I DO IT.** It also tells why, when and where my students succeed and **HOW THEY DO IT.** The catalog costs you nothing—it obligates you in no way whatever, but, for your own good send for it, as it contains things you should know.

WHY THE BURGESS COURSE AND SERVICE WERE STARTED

During my engineering experience I found that it was hard for an earnest young fellow to get into the electrical game right and it was hard for a man in the game to make the progress he desired. I looked into the reasons for this situation and found what was needed. To remedy this condition is the purpose of the Burgess Course and Service, and it is today filling a much needed want. Furthermore, our standing is built upon what we have actually done, not what we claim to do. I do not promise you $500.00 **PER MONTH,** or that you will be able to qualify as an **ELECTRICAL ENGINEER** in a few months. As a matter of fact, some of those I have taught are getting and earning more than $500.00 per month and there are **ELECTRICAL ENGINEERS TAKING MY COURSE** at the present time. However, what you get in the way of money, or whether you become a **WATER-BOY** or **ELECTRICAL ENGINEER** depends in a great measure on you. You will admit this if you think a minute. What I do say is, that if you will do your part by following my instruction and advice, I will help you get into the electrical business if you wish to get into it, and if you are in it, I will supply you with information and help which will push you along faster. Zillman McNamara of Densmore, Kansas, wrote me one day, "YOUR COURSE MAKES A MAN STAND ON BOTH FEET." He expresses in a very few words exactly what I aim to do. The Burgess Policy is truthfulness in advertising and to give an honest and satisfactory service. Therefore we offer no free inducements, but depend rather on telling just what Burgess Men are doing. This we find is one of our strongest endorsements.

INSTRUCTION

The instruction is no cut and dried book plan, but is actually prepared with a view of fitting the individual. In this way one who is slow has the same advantage as others. The course covers the various subjects from simple dry cells to hydro-electric operation, particular effort being made on the really practical things and the things men need in their everyday work, such as—**storage batteries, wiring calculations, automobile systems, farm lighting systems, motor applications, motor installing, motor testing and repairing, armature winding, transmission and power plants.**

COMPLETE ELECTRICAL OUTFIT

Including Apparatus, Tools and Material is supplied with the course without extra charge.

ELECTRICAL DRAFTING

Every A No. 1 Electrical man understands how to read drawings, and I find that the best way to teach him this is to teach him how to make them. Thus—the reason for my drafting course. This is a part of the regular work and certain drafting implements and materials are furnished students without any additional charge.

ELECTRICAL SLIDE RULE

As a thorough knowledge of the slide rule is so necessary in our business, I have written 30 lessons on this subject which are now included as part of the regular course in addition to the lessons on Electricity and Drafting. I am also supplying a Slide Rule and leather case to each student without charge.

FIFTY-FIFTY

It is odd, but true, that the most astonishing thing about my business is the way in which it is handled. I actually do handle the instruction work myself, and I see to it that A STUDENT GETS WHAT HE WANTS. HE PAYS ONLY FOR WHAT HE GETS. That is 50-50. Furthermore, every student enrolls with the understanding that if he should have to discontinue for any reason, his payments stop also. That is some more 50-50.

If you are one of the "LET'S GO" Type of fellows, send for my catalog and see the results my men are getting by studying at home, backed up by BURGESS SERVICE. Write your name and address plainly on coupon so there will not be any delay in the catalog getting to you.

YORKE BURGESS, Supt.
BURGESS ELECTRICAL SCHOOL
745 East 42nd Street **Chicago, Illinois**

YORKE BURGESS, SUPT.
Burgess Electrical School, 745 East 42nd Street, Chicago, Illinois.
DEAR SIR:—
Please send me your catalog "B," which explains your Home Instruction Course and the Burgess Service Method.

Name.....

Address.....

"ELECTRICAL HAND BOOK"

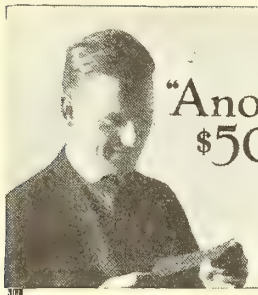
THE "Burgess Blue Book" contains drawings and diagrams of Electrical Machinery and Connections—Starting Boxes, Elevators, Controllers, Starters for Printing Press Motors, Street Car Controllers, Transformer Connections, Lighting Circuits.

The section on Calculations takes up Simple Electrical Mathematics, Wiring Tables, Alternating Current Calculations, etc. It also gives 200 formulas, with problems worked out, showing their application.

Price $1.00. If you decide not to keep it, your money will be returned

THE BURGESS COMPANY

YORKE BURGESS, President
Consulting Electrical Engineering
750 East 42nd Street **Chicago, Illinois**
Power Plants, R. R. Signals, Electric Railroads, Motor Troubles and Industrial Problems. Information Furnished on Electrical Subjects. Inventions and Patents Perfected.



"Another $50 Raise!"

"Why, that's the third increase I've had in a year! It just shows what special training will do for a man."

Every mail brings letters from some of the two million students of the International Correspondence Schools, telling of advancements and increased salaries won through spare time study.

How much longer are *you* going to wait before taking the step that is bound to bring you more money? Isn't it better to start *now* than to wait for years and then realize what the delay has cost you?

One hour after supper each night spent with the I. C. S. in the quiet of your own home will prepare you for the position you want in the work you like best.

Yes, it will! Put it up to us to prove it. Without cost, without obligation, just mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6167-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____



FREE
For 10 Days Wear

Send no money. Just ask us to send you either of these wonderful, dazzling, genuine Tifnite Gem rings to wear for 10 days. If you can tell it from a diamond, send it back.

No. 1. Solid gold mounting. Eight-claw design flat wide band. Almost a carat, guaranteed Tifnite gem.

No. 2. Solid gold Ladies' newest mounting. Has a guaranteed genuine Tifnite Gem, almost a carat.

No. 3. Solid gold six-prong tooth mounting. Guaranteed genuine Tifnite Gem, almost a carat in size.

In sending, send strip of paper fitting around second joint of finger. Pay only $4.50 upon arrival, then pay only $3.00 per month until the price $16.50 is paid for either one. Otherwise return the ring within ten days and we will refund any payment made. This offer is limited. Send while it holds good.

THE TIFNITE CO. Dept. 1053 Chicago, Ill.

AMERICAN TYPEWRITERS AND SEWING MACHINES IN THE DESERT.

Wander where you will among the oases of the Sahara desert, the click of American typewriters and the whir of American sewing machines are always with you.

The typewriters have followed the French railway that is creeping farther south into the heart of the desert every year, linking up the oases. Every station, no matter how lonely, has its machine—which, very likely, saw service with the American S. O. S.

As for sewing machines, every oasis town has its "sewing machine row," where the Arab operators sit elbow to elbow, cross-legged in the sand with their machines in front of them, gossiping and sewing all day long. Every Arab who can scrape together enough francs to buy a machine joins the local sewing circle.

Views of these oasis sewing machine rows are included in the film, "The Children of the Sahara," which the American Red Cross has taken in Algeria and Tunisia.

300 K.V.A. Transmitter at Bolinas, California

By ALLAN C. FORBES

(*Continued from page 757*)

the best working wave), the minimum input is 50 K.W., using main generating set, radiating 115 amperes; the maximum rated input 300 K.W., radiation 265 amperes. The radiation will vary, depending upon whether both the counterpoise and salt water "grounds" are used, whether the phase angle adjustment on the generators is in correct relation with the studs of the spark gap on discharge, etc. The effective height of the antenna is approximately 275 feet.

The station is provided with two "grounds." No. 1 is a salt-water ground, consisting of forty lengths of aerial wire buried in the ground and extending over the embankment into the ocean, and there fastened to zinc plates buried in the water. No. 2 ground consists of thirty-two lengths of aerial wire ploughed directly under, and extending the full length of the antenna.

The power-house consists of essentially two main rooms with two small storerooms and offices. The building is about 100x200 feet, and comprises the generator, condenser, storage battery and storeroom on the main floor, while upstairs are situated the switchboard gallery, jigger gallery and offices of the engineer in charge. In the generator room are located all the apparatus, with the exception of the switch keys, which are located in the jigger gallery. All apparatus is in duplicate, consisting of the two 300-K.W. motor generators, 2.75-K.W. direct-current generators (exciters), two air-compressors (to furnish air to the discharger), two exhauster motors that supply fresh air to the discharger rooms, two key-blowers supplying a blast of air to the switch keys located in the jigger gallery, two small signal motor generators for operating the switch keys, four 11,000/440-volt service transformers, five 2,000/13,000-volt radio transformers.

The condenser room is used exclusively for the condensers, which are enclosed in an iron railing for protection to the engineers. The storage-battery room contains a bank of 55 storage-battery cells; the total battery is rated at 125 volts, 20 amperes, normal discharge rate. This storage battery is used for furnishing an emergency lighting system for the power-house and to control the oil switches in case of failure of the electric company's power. The jigger gallery contains the oscillation transformer, high-frequency bus bars, choke coils, switch keys, reactance coils and loading inductance. The switchboard gallery contains a 17-panel switchboard with suitable instruments.



GLORIA SWANSON
Cecil B. DeMille Artcraft Player

WALLACE REID
Paramount Star

Hermo "Hair-Lustr"
(Keeps the Hair Dressed)

For Men, Women and Children

The hair will stay dressed after Hermo "HAIR-LUSTR" has been applied. No more mussy, untidy looking hair. Adds a charming sheen and luster, insuring the life and beauty of the hair. Dress it in any of the prevailing styles, and it will stay that way. Gives the hair that soft, glossy, well groomed appearance so becoming to the stars of the stage and screen. Guaranteed harmless, greaseless and stainless.

50c and $1 at Your Dealer

$1 size 3 times quantity of 50c size. If your dealer can't supply you we will send it prepaid upon receipt of price. Remember your money back if dissatisfied.

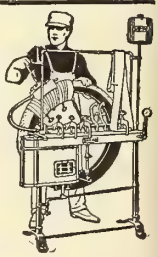
HERMO CO., 542 E. 63rd St., Dept. 1011, CHICAGO

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

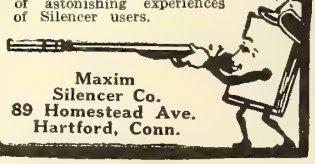
C. A. SHALER CO.
2210 Fourth St. Waupun, Wisconsin

Shoot Without Noise

Avoid disturbance, also flinching. Enjoy quiet shooting anywhere, any time. Use the new Model 1920

MAXIM SILENCER

Price, .22 cal., $7.00. Send 6c in stamps for catalog and BOOKLET of astonishing experiences of Silencer users.



Maxim Silencer Co.
89 Homestead Ave.
Hartford, Conn.

Model Electric Motor Boat



30 inches long. High power.
Built like a real boat—$15.00

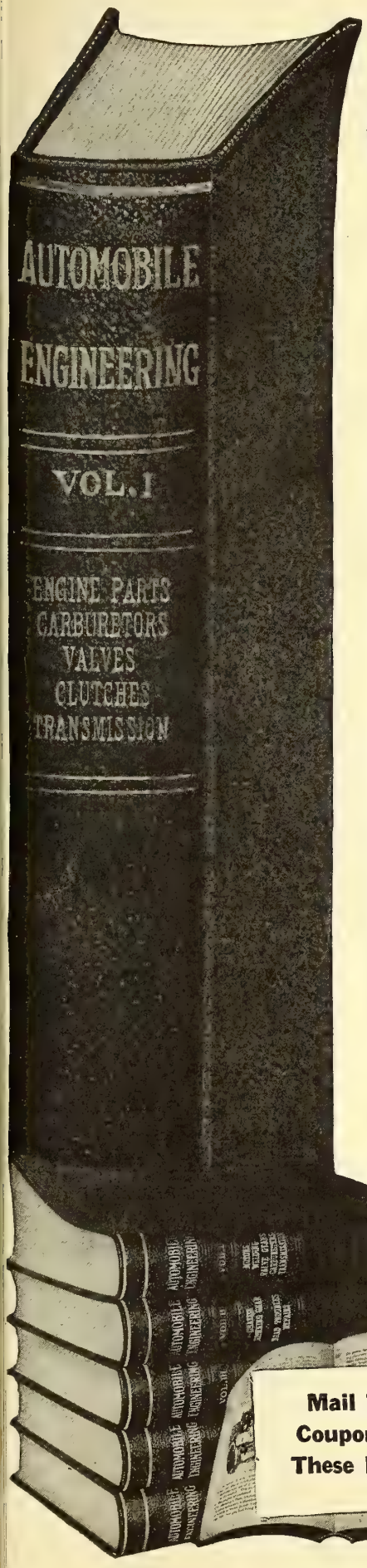
Send stamp for illustrated lists of working model boats, engines, etc.

BATHE MANUFACTURING COMPANY
Desk 2, 5214 Woodland Avenue, Philadelphia, Pa.

CLEAN SMOKING

One twist of mouth piece cleans this pipe of smooth-smoking Italian briar. Aluminum draining canal does the trick. $1 postpaid; cash or money order. THE S. & H. COMPANY. P. O. Box 254, Wilkes-Barre, Pa.





NAME	POSITION	SALARY
John	AUTOMOBILE ENGINEER	$125 A WEEK
	REPAIR MAN	$50 A WEEK
	CHAUFFEUR	$30 A WEEK

PUT YOUR NAME ON THIS PAY-ROLL

Men like you are wanted for big-pay positions in the fascinating field of automobile engineering. We have made it easy for you to fit yourself for one of these positions. You don't have to go to school. You don't have to serve an apprenticeship. Fifteen automobile engineers and specialists have compiled a spare time reading course that will equip you to be an automobile expert without taking any time from your present work.

AUTO BOOKS

6 Volumes Shipped Free

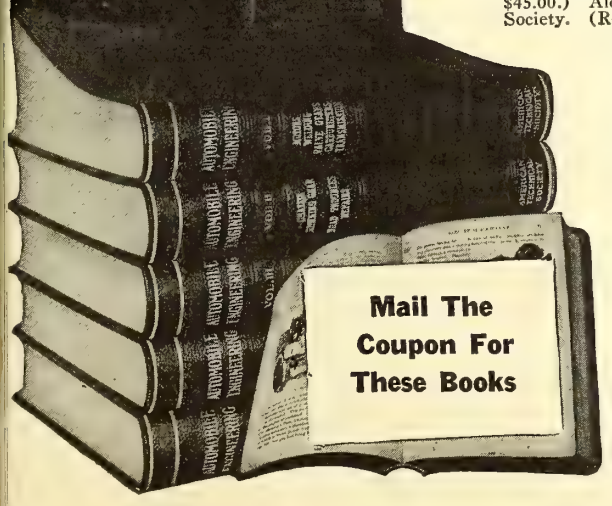
Now ready for you—an up-to-the-minute six-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Brimming over with advanced information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or owner or prospective owner of a motor car ought to know. Written in simple language that anybody can understand. Tastefully bound in American Morocco, flexible covers, gold stamped, 2,600 pages and 2,300 illustrations, tables and explanatory diagrams. A library that cost thousands of dollars to compile but that comes to you free for 7 days' examination.

PARTIAL LIST OF CONTENTS

- More than 100 blue prints of wiring diagrams
- Explosion Motors
- Motor Construction and Repair
- Carburetors and settings
- Valves, Cooling
- Lubrication
- Fly-wheels
- Clutch
- Transmission
- Final Drive
- Steering Frames
- Tires
- Vulcanizing
- Ignition
- Starting and Lighting Systems
- Shop Kinks
- Commercial Garage
- Design and Equipment
- Electrics
- Storage Batteries
- Care and Repair of Motorcycles
- Commercial Trucks
- Glossary

ONLY 10c A DAY

Not a cent to pay in advance. First you see the books in your own home or shop. Just mail coupon and pay express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books send only $2.80 in seven days and $3 a month until the special introductory price of $29.80 has been paid. (Regular Price $45.00.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.) This great bargain offer must soon be withdrawn.



SEND NO MONEY NOW

Don't take our word for it. See the books without cost. There is so much profit in this offer for you, that we urge you to waste not a moment in sending for the books. **Put the coupon in the mails today. Send no money—Just the coupon.**

American Technical Society, Dept. A258 Chicago, Ill.

Dept. A258
American Technical Society
Chicago, Illinois.

Please send me the 6-volume set, Automobile Engineering for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within 7 days and the balance at $3 a month until $29.80 has been paid. Then you send me a receipt showing that the $45.00 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after the seven days' trial I will return them at your expense.

Name.....

Address.....

Reference.....

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6168B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-28-19

Street and No._____

City_____ State_____

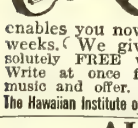


You can Ukulele!

You can easily play quaint, dreamy Hawaiian music or latest songs on the Ukulele. Prof. Harry J. Clarke's latest method enables you now to play the Ukulele in a few weeks. We give you a genuine Ukulele absolutely FREE with complete course of lessons. Write at once for FREE narrative of Hawaiian music and offer. No obligations! Send Now!

The Hawaiian Institute of Music, 1400 Broadway, Dept. 560M, New York

ALL MAKES



Underwoods, Monarchs, Remingtons, L. C. Smiths, Olivers, Royals, Coronas AT REDUCED PRICES. $20.00 Prices as low as....

Write for our Catalog No. 15

BERAN TYPEWRITER CO.
Dept. 21, 58 W. Washington Street, Chicago

Blind Now Read by Musical Sound

(*Continued from page* 744)

this means the light that falls on the printed matter forms five bright spots in line, forming what is called the "scala." Each spot is pulsating at a rate corresponding to the number of holes in the circle of perforations to which it belongs multiplied by the number of revolutions per second of the disc. There are 18 holes in the innermost circle, 24, 27, 30 and 36 in the other circles respectively, and if the disc makes 21⅓ revolutions per second, the second circle of holes will produce 512 pulsations of light per second—corresponding to the vibrations in the musical note C^1. The numbers of holes given above are in proportion to the vibrations in the notes G, C^1, D^1, E^1, G^1, (sol, do, re, mi, sol). A change in the speed of rotation of the disc of course alters the pitch of the notes, that is, the key in which the motifs are sounded, but the intervals remain unaltered.

The optical system used to produce the image of the holes has a variable minification, so that the length occupied by the scala of five spots may be adjusted to equal the height of the letters to be read, the range of adjustment covering the various sizes of type employed in ordinary printing. The optical system is so designed that the sharpness with which the five spots are focust upon the surface of the paper is little altered by a change in the minification, but more accurate focussing can be effected by movement of a small lens situated immediately below the selenium bridge. The spot of light corresponding to low G is caused to fall on the lowest points of such letters as j, p, y, etc., the high G^1 falling on the tops of capitals and of the high letters. The three intermediate spots cover the height of the short letters. This will be readily seen by reference to Fig. 5, which is an enlarged diagram showing the scala passing over the word "Type."

With an Optophone constructed in accordance with the above description, if all the spots of light fall on white paper—the space between two words, for example—all the notes will be sounded together in the telephone, producing a discord. If the scala passes over the letter V, the top note G^1 (high sol) will first be silenced, then E^1, D^1, C^1, D^1, E^1, G^1. Each letter will alter the succession of sounds in a different manner. This arrangement constitutes what is called the "white sounding" Optophone.

The present improved type of Optophone is modified so as to make it "black sounding." In this form white paper is represented by silence, and notes are sounded as the scala passes over the black letters. With this Optophone the letter V is represented by the motif G^1, E^1, D^1, C^1, D^1, E^1, G^1 (s m r d r m s).

The "black sounding" is obtained by providing a second selenium bridge which is called the "balancer"—illuminated by a small part of the intermitted light reflected aside before it reaches the paper—and connecting this bridge to the telephone and the battery in the manner shown in Fig. 6, so that the current traversing the balancer bridge (Se. No. 2) acts in the reverse direction in the telephone to that of the current thru the main selenium bridge (Se. No. 1). One battery is used and the two selenium bridges are connected one to each end of the battery, and both thru the telephone to a selected intermediate junction of the battery in the manner shown. The balancer thus tends to cause the telephone to sound all the notes continuously, and the main selenium bridge, that receives the light re-

(*Continued on page* 784)

No Batteries Needed

with this

FLASHLIGHT

Hand generated current gives brilliant light at no operating expense.

ELECTRO-AUTOMATE



Price
$7.20
Postpaid

These flashlights were manufactured to sell at $15.00. This is a special introductory offer and *only one hundred* will be sold at this figure.

Nothing to get out of order,—lasts a lifetime,—no parts to renew. *Order at once*—send money order, check or cash to

Elsaesser & Field
175 Fifth Ave. New York City

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

A few hours interesting work saves over half and gives you a machine to suit your ideas. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. Make fine profit building phonographs for your friends.

SAVE OVER HALF

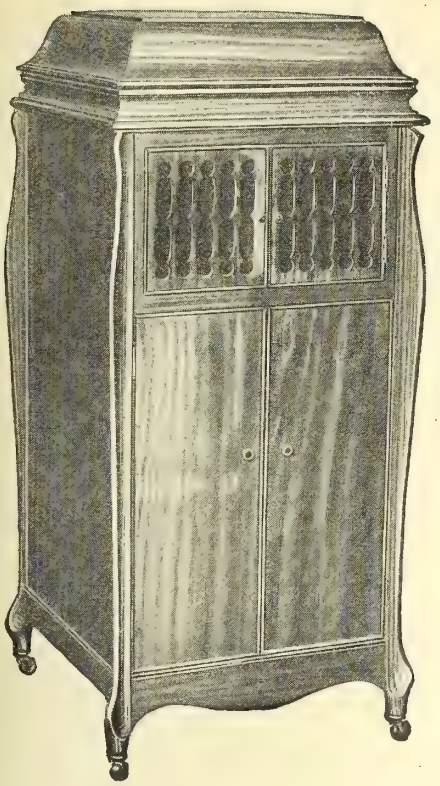


Write today for our Blue print offer. **FREE**

AGENTS wanted for Choraleon King Phonographs

Choraleon Phonograph Co.
1120 3rd St., Elkhart, Ind.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER **LONGMONT, COLO.**



You Can Build this Phonograph EASILY

Tremendous Saving in Cost

A FEW hours pleasant work—some simple tools found in any man's home—and

Our Simplified Plans

IT'S an easy and interesting job to build this fine, sweet-toned cabinet instrument by our system. We furnish blueprints, diagrams, motors, tone arms and all other metal parts together with knockdown cabinet and ready built horn all complete. You do the assembling and finishing at a saving of more than one-half the retail cost. You can't go wrong if you follow our instructions. There's a model and price for every taste and purse. Your choice of four beautiful models.

Everybody who has built a Makafone has found it much easier than he first thought. You will find it so too

Read What Satisfied Builders Say

"I have built my phonograph that I purchased from you and it is a dandy. I am well pleased. I had a neighbor in to look at it and he thinks it is nice. I think that he will buy one."—Crawford, East Peoria, Ill.
"I received everything O.K. and I have already built and enjoyed it for two weeks and I am very much pleased with it."—Bieschke, Chicago, Ill.
"I have the model No. 1 set up and in fine running condition and would not sell it unless I could get another one like it. It is equal to any I ever saw. I have finished it in natural wood and all that have seen it say that there is not a finer machine in any store in town."—Corbin, Vancouver, Wash.
"Have just finished the cabinet and believe me she sure does look swell. I can guarantee you several more orders very soon."—Armhein, Milwaukee, Wis.
"I am well pleased with the MAKAFONE I ordered from you some time ago and am now placing another order for a No. 4 machine."—Hysong, Covington, Ky.
"I received my MAKAFONE and have built it and find it a dandy. I will send an order for a No. 3 machine in the very near future."—Bank, Sanatobia, Miss.

Get Into the Phonograph Business for Yourself

No experience is necessary under our plan. Hundreds have gone into the business of building Makafones which they sell to their neighbors and friends at a clear profit of not less than $50.00.

"I received the outfit in good shape. Am perfectly satisfied that the machine plays well and it was sold right away. Please send more price lists and order blanks, as I want to order a No. 5 outfit right away."—Schettling, Kansas City, Mo.

Gentlemen:
I have the phonograph finished, ordered from you some time ago. The music reproduced on this instrument is better than any I have ever heard. This machine is now sold and I soon will be able to take advantage of your discount for ordering six outfits at a time. J. A. Devenny.

Many of these people have come from clerical or other non-mechanical vocations. *And they are all making good.* Why not you? We shall be glad to give you full particulars so send in this coupon today.

Modern Phonograph Supply Co.
365 Springer Bldg., 313 So. Clinton St., Chicago, Ill.

Fill Out This Coupon And Mail Today

MODERN PHONOGRAPH SUPPLY CO.
365 Springer Bldg., 313 S. Clinton St., Chicago, Ill.

Gentlemen:—Please send me full particulars of your "Build Your Own Phonograph" proposition, without obligation to me.

Name .....

Street Address.....

City or Town.....State.....

Try These "Pay Raisers"
At our Expense ~ Order On 5 Day Trial
DRAKE'S PRACTICAL MECHANICAL BOOKS FOR HOME STUDY

These books will perfect you in your trade—pave the way to the big position. We will send any book postpaid. If not entirely satisfied return the book and your money will be refunded in full.



Modern Electrical Construction
By Horstmann & Tousley. A perfect guide for the beginner. Valuable to the journeyman. Of special value to the inspector. Explains in detail how good electrical work is installed. 440 pages. 263 illustrations.
Leatherette Binding $1.75

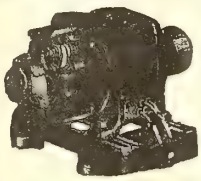
Easy Electrical Experiments and How to Make Them
By L. P. Dickinson. Equally valuable to the amateur or the practical electrician. Gives in plain language all the information you want about every kind of electrical apparatus. 220 pages, 110 illustrations. Cloth Binding.....$1.25

Telegraphy Self Taught
By Theodore A. Edison. Clearly and concisely written. Tells how to easily train the ear to receive messages by the audible alphabet system. 170 pages. Fully illustrated. Cloth Binding.....$1.25

Electricians' Operating and Testing Manual
By Horstmann & Tousley. A practical handbook for working electricians. Covers installation, operation, testing, maintenance and repairs of all electrical apparatus. 361 pages. Illustrated.
Leatherette Binding $1.75

Operators' Wireless Telegraph and Telephone Handbook
By V. H. Laughter. Describes in detail the construction of a wireless set, the winding of spark coils and the tuning of a wireless station. Written in non-technical language. 210 Pages. Cloth Binding.....$1.25

Order Direct Today On Our Money-Back Plan
Over a hundred pay-raising books for every trade are listed in our big illustrated catalog. Write for free copy.
FREDERICK J. DRAKE & COMPANY, 1009 Michigan Ave., Chicago, Ill.
Drake Books are for sale at all book-stores.



NEW MOTORS
FACTORY GUARANTEED
ALL SIZES
PROMPT DELIVERY

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

8 v. 10 amp.	$19.50
15 v., 10 amp.	$26.50
40 v. 6 amp.	$31.50
110 v, 2½ amp.	$31.50
110 v, 5 amp.	$52.50
40 v, 12 amp.	$52.50
110 v, 9½ amp.	$67.50
40 v, 25 amp.	$67.50
110v, 18amp.	$116.50
40v., 50amp.	$116.50
110v, 26amp.	$156.50
110v, 50amp.	$238.50
Moving Picture Arc Generator 60 v., 35 a.	$116.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., Complete with base and pulley.

½ H.P.	$46.50
1 H.P.	$66.50
2 H.P.	$86.50
3 H.P.	$98.50
5 H.P.	$116.50
1 H. P. Special Grinding and Buffing Motor	$106.50

Direct Current Motors
110 or 220 volts, D. C., shunt wound. 1750 R. P. M. With base pulley and starting box.

¼ H. P. Washing Machine Motor	$28.50
¼ H. P., 32 v. Washing Machine Motor	$28.50
½ H.P.	$58.50
1 H.P.	$82.50
2 H.P.	$124.50
3 H.P.	$142.50
5 H.P.	$218.50

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

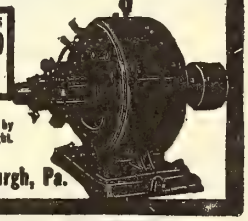
¼ H. P., 220 v. induction Washing Machine Motor	$28.50
¼ H. P., 110 v. grinding buffing motor	$28.50
½ H. P. induction, full load start	$46.50
½ H.P. repulsion induction For compressor service	$54.50
1 H. P repulsion induction, Special Garage Motor	$74.50
2 H. P. repulsion induction with sliding base	$126.50
3 H. P. repulsion induction with sliding base	$146.50
5 H. P. repulsion induction with sliding base	$188.50

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL 1/4 H.P. 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley



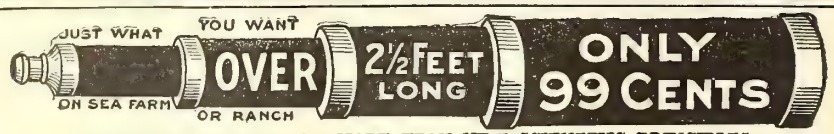
WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $26.50 Each! Reg. Val. $34.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER
CHAS. H. JOHNSTON, Box 12, West End, Pittsburgh, Pa.



ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.
Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. Guaranteed by the maker. Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.
EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.

Blind Now Read b Musical Sound

(*Continued from page 782*)

flected from the paper, annuls the effec the telephone in respect to any note v the spot of light corresponding to that falls on white paper. The division of total voltage of the battery can be va so that when the whole scala falls on w paper the telephone is silent, and notes sounded only as the scala moves over black letters, as previously described.

MECHANICAL CONSTRUCTION OF TH OPTOPHONE.

The book-rest consists of a metal fr standing on four feet and supportin curved glass plate on which the page t read is placed face downward. Means provided for clamping down the pag that it lies in close contact with the u surface of the glass.

The shaft carries an aluminum cas called the "tracer," on which are mou the electric lamp, the revolving disc its motor, the optical system and the se um bridges. The tracer can swing f one side of the book-rest to the other.

The lamp holder is carried at the lo end of the tracer. Above it there is rotating disc, thru the perforations which the light passes to the objective thru a small lens near the top of tracer, above which again there is ph the main selenium bridge (Se. No. Under the objective there is a conc convex lens, placed at an angle, which flects a portion of the intermittent ligh to the secondary selenium bridge (Se. 2), called the "balancer," situated in tracer a little above the disc and to the r of its axis. (See Fig. 3.)

When the tracer is swung over to right hand side (by means of a handle projecting out in front of the book- in Fig. 1) a spring situated on the behind the book-rest is bent down and t to throw the tracer over to the left. governor is provided which controls swinging of the tracer to the left. On top of the governor box (which is situ behind the left back corner of the h holder) there is a screw with a m head for controlling the speed of swin of the tracer—*i. e.*, the speed of pas along the line of printing.

An adjustable friction gear is provi for moving the tracer down the page a space at a time, or up the page one space at a time if desired for re-readir line.

READING SPEED 25 WORDS PER MIN AND HIGHER.

In the case of the letter V already ferred to, the connection of the charac istic tune or motif with the actual form the letter is readily recognized from succession of notes. It must not be s posed, however, that Optophone rea consists in analyzing the sound motifs as to identify the forms of the letters dicated. When the alphabet has l learned, the motif for each letter is re nized as a whole, and later in the read practice, the more extended motifs for lables and even words will become fami to his ear. A practiced Optophone rea will recognize words as readily as a t graph operator interprets a succession clicks on the Morse code. The great ra ity that has been attained by hundreds readers of Morse sounds encourages hope that equal or greater speed in Op phone reading will be attained with p tice. Already it has been found that v the latest type of Optophone a blind rea after some practice, has attained a sp of reading of 25 words per minute.

LEARN WIRELESS
AT HOME BY MAIL



Calls coming in steadily for National Radio Institute Graduates. Big Concerns in Need of Operators

Many attractive positions are now open in Commercial Land Radio Service, Merchant Marine, Radio Supply Factories, Lake and Ocean Steamship Lines, Telegraph Companies, and U. S. Shipping Board. We are continually receiving requests for more National Radio Institute Graduates than we can furnish.

Salaries Up to $3,500.00 a Year

Exceptional opportunity for ambitious men for promotion to the higher branches of Radio. You can learn Wireless the National Radio Institute way, quickly and easily, by mail right in your own home in your spare time. No previous experience or training is necessary. With our help you can quickly qualify for a First Grade Government License, and a good position. Our graduates are qualified as Senior Operators and start with a salary of $125 a month, besides Room, Board, and Laundry, which when totalled and added to salary, means more than $200 a month. One of our recent graduates is getting $6,000 a year.

U. S. Department of Commerce Recognizes N. R. I. Graduates

and allows them a credit of 5 points when taking examination for First Grade License. This school heads the printed list of reputable Wireless Schools recommended by the Dept. of Commerce.

Travel Without Expense

If you are eager to travel, anxious to visit foreign countries, and increase your knowledge of world affairs, Wireless offers you the chance of a lifetime. On shipboard you are rated as an officer, living and eating with the officers. However, you are not obliged to travel, if you secure a position at one of the land radio offices, which are steadily increasing in number.

Pay As You Learn

Our plans of payment place a wireless education within the reach of anyone who desires to learn. A small payment down, and the small payments made during the course, make it possible for you to earn the cost of your tuition while actually learning to be a wireless operator.

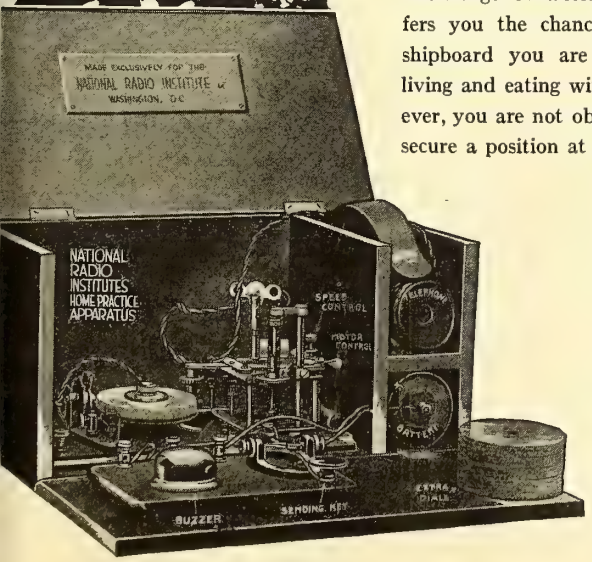
Instruments Furnished Free

In addition to all necessary text books and other equipment with which we supply you, we furnish FREE to every student, a Natrometer, which consists of an automatic transmitter and receiver. You receive the instrument after your enrollment; it becomes your personal property upon completion of our course.

The Natrometer automatically sends you messages in International Code, just as though they were coming to you through the air from a station a thousand miles away! The instrument is operated entirely without the use of aerials.

FREE—In addition to our complete course in Radio Telegraphy, every student is given our complete course in modern Radio Telephony. These combined courses enable our students to fill positions requiring a knowledge of both Radio Telegraphy and Telephony.

Send the following coupon today for our FREE BOOK containing all particulars.



National Radio Institute
Dept. 355 Washington, D. C.

Mail This Coupon Today

NATIONAL RADIO INSTITUTE,
Dept. 355, Washington, D. C.

Send me your FREE book, "Wireless the Opportunity of Today." Tell me about your Home Study Course in Wireless Telegraphy and Telephony—the free post-graduate course—and your Special Instrument offer.

Name .....

Address .....

City.....State .....



LEARN

Armature Winding

Motor and Generator Repair and maintenance

In 6 Months

in the fully equipped shops and laboratories of the School of Engineering of Milwaukee.

Prepare quickly and efficiently to fill the constantly growing demands for *trained* men in this remunerative profession. You can

Earn While You Learn

if you like. Actual practice under wage-earning conditions will train you most successfully.

Send now for bulletin and full particulars *FREE!* Clip the coupon today.

School of Engineering of Milwaukee
1198A—373 Broadway Milwaukee, Wis.

CLIP HERE

School of Engineering of Milwaukee,
1198A—373 Broadway, Milwaukee, Wis.
Gentlemen:
Please send me full information concerning your Armature Winding and Motor Generator Course.
Name .....
Address .....
Age..... Education.....

Play the Hawaiian Guitar

Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs, and other effects that make this instrument so delightful.



The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Your tuition fee includes a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 complete lessons and pieces of music.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK
I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc., etc.
NAME .....
ADDRESS .....
TOWN .....
STATE .....E.E.
Please write name and address Clearly.

Electrical men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical

Engineering enables graduates to secure good positions, and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma, complete

In One Year



Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops. Free catalog. 28th year opens Sept. 29, 1920
BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

When the "Sub S-5" Sank

(*Continued from page 729*)

hours thru Thursday evening and Friday morning, when a hole large enough to pass us thru was finally finished at 3 o'clock Friday morning. The most exhausted men were past thru first to the floating staging, and from there taken aboard the *Alanthus*.

"Next to my inexpressible admiration and praise for every officer and man in my crew and my pride in their courage and fortitude, my deepest feelings are of gratitude for the officers and crews of the *Alanthus* and the *General George Goethals*, who so heroically and tirelessly labored. Our rescue was an accomplisht fact. The rest of the story, I believe, has been told," he said in an interview with the New York *Times*.

SIGNAL BUOYS FOR SUBMARINES.

All of which makes fine reading indeed, but many of us were waiting to hear the details of the highly praised "signal buoy" so strongly featured in the first newspaper accounts of the disaster. But final accounts of the rescue of the crew failed to mention anything about the automatic signal buoy.

It is understood, however, on good authority, that the modern American subsea craft are fitted with such detachable signal buoys, which can be released from inside the craft in distress, the buoy floating to the surface of the water and being held directly over the sunken vessel by means of a self-retrieving cable, as clearly illustrated in the accompanying figures.

The signal buoy carries a telephone fitted in a water-tight box, the door of which can be readily opened by anyone coming to the rescue. The buoy also carries a tolling bell which can be heard for a distance of a mile, besides electric and acetylene lamp signals, and a rocket projector.

The signal buoy is designed to fit snugly into a recess in the hull of the submarine, so as not to spoil the smooth contour of the hull in cutting thru the water. When an electric release button is prest, the buoy is supposed to rise to the surface.

Why the "S-5" did not use or have such a signal buoy is not publicly known. If it had no such safeguard, it would seem about time that the Navy Department experts looked into the matter.

Super-Silkworms and Super-Silkworm Food

By RICHARD HOADLEY TINGLEY

(*Continued from page 719.*)

supply of raw materials. Our imports of raw silk in 1919 amounted to $329,338,872.

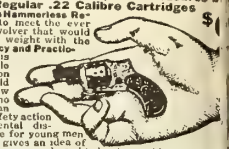
It is generally held that the United States can raise just as good mulberry and other trees upon which the silkworm feeds as any other country. Also, that we can raise the silkworm and the cocoon in competition with any nation. It has long been held as a demonstrated fact, however, that we fall down when it comes to reeling the silk in competition with Japan and China because of their cheap labor—and labor is a big element in reeling while in the other processes nature does most of the work.

It is the claim of Dr. Osigian that, with the application of his discoveries and inventions, the handicap of cheap Oriental labor competition will be more than overcome. It is his special mission in life to teach the American people how this can be done—how much of the 300 odd million dollars can be kept at home—and he has already made a good start at it.

"The Baby" Double Action Hammerless Revol

A Handsome and Most Effective Weapon. Measures 8 Inches Long. Takes Regular .22 Calibre Cartridges

The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability**. It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciate ammunition used is the standard 22-calibre cartridge obtainable anywhe operation of the charging mechanism is extremely rapid and absolutely six well aimed shots can be fired in as many seconds. The revolver w constructed, with finest nickel plated fluted barrel of cylinder, and it wei 45 ounces. **The price of the Baby Revolver is only $5.50 sent by mail, p.p.d. to any**



JOHNSON SMITH & CO., Dept. PM30, 3224 N. Halsted Street, CHI
AGENTS WANTED

Cut Your Own Hair WITH THIS 5



SAFETY HAIR CUTTER Can cut yo hair with th

velous invention. Cuts the hair any desired short or long. Does the job as nicely before yo mirror. You can cut the children's hair at home in Can be used as an ordinary razor to shave the face or finish around ten neck. Sharpened like any razor. **Saves its cost first time used. 3 for 15**
JOHNSON SMITH & CO., Dept. PM 30, 3224 N. Halsted Street, CHI

INVISIBLE INK

The most confidential messages can be written with this ink, for the writing **MAKES NO MARK.** Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and private memorandums away from prying eyes. Great fun for playing practical jokes. **Only 25c Bottle**



JOHNSON SMITH & CO., Dept. PM30, 3224 N. Halsted Street, CHIC

VANISHING I

Writing written with this rem ink vanishes entirely in a few weeks (sooner if desired), leaving the paper QUITE BLANK. **25c p.p.d.**

Dissolving Ink

Writing appears or disappears at will. Secret with each bottle. Very reasonable. **25c.**

MAGIC FLUTE

Wonderfully Sweet Toned and Musical



Post Paid **25c**

The Magic Flute, or Humanotone is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it, which when once acquired after a little practice, will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is as charming as it is surprising. **25c ppd.**
JOHNSON SMITH & CO., Dept. PM30, 3224 North Halsted Street, CHIC



Go Lu Ri

Qua and Des

A VERY striking and un mon ring. Silver finish, and crossbone design, with brilliant, flashing gems s long out of the eyes. Said by to bring Good Luck to the w hence its name, **Good Luck** Very unique ring that you will a pirate wearing. **ONLY 25 CE**
JOHNSON SMITH & CO., Dept. PM30, 3224 North Halsted Street, CHIC



LUMINOUS PAINT

Make Your Watches, Clocks, Et Visible by Night The very latest discovery i scientific world. Hitherto, "Really unobtainable except at an exorbitant price, we have succeeded in producing this remarkable LUMINOUS PAINT, which, appli the surface of any article, **emits rays of white light**, rendering it **perfectly v in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** simple to use. Anyone—you can do it. A little applied to the dial of watch or clock will enable you to tell the time by night. You can coat the Buttons of your clothing, parts of your electric lights, match boxes, and insume other articles; make your own Luminous Crucifixes, Luminous Rosaries. Small bottle, **price 25c** Larger sizes, **50c and $1** postpaid. Johnson Smith

Mystic Skeleton

A jointed figure of a skeleton in. in height, will dance to music and perform various gyrations and movements, while the operator may be some distance from it.



10c pd.

JOHNSON SMITH & CO., Dept. PM30, 3224 North Halsted Street, CHIC

Serpent's Eg

Box contains 12 eggs. When fit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most like manner. **Price per box, 15c**



All the Latest Surprising and Joke Novelt

"Chicken Inspector" Badge	15c	Luminous Skull	
Crying Kid in Bag	20c	Field Glasses	
Midget Bible (size of stamp)	15c	3 drawer Telescope	
Anarchist Bombs (Express only) 8 bombs for	$1.00	Invisible Ink (secret writing)	
Book on Boxing	35c	Vanishing Ink	
Thurston's wonderful Trk Cards	10c	Liar's License	
Box of Grave Dirt	75c	Fish Lure (catches fish)	
Conjurer's Casket of Magic Tricks	75c	Moving Picture Machines	75c
Watch Camera	$3.50		$3.00, $7,50 and $1
Films for Watch Camera	35c	Nail Klipper	
Exploding Cigarettes, box	50c	Exploding Matches (Express only) 8 bxs for	
Weather Gauge	$1.50	Stage Money, 50 bills	
Serbackroscope (see behind you)	25c	False Mustache	
Amateur Electrician Book	15c	Inkless Pen, writes with water	
Firecracker (Express only) 10 pkts for	$1.00	Exploding Fountain Pen	
		X-Ray Novelty	

JOHNSON SMITH & CO., Dept. PM30, 3224 North Halsted Street, CHIC

ENCYCLOPEDIA of Physical Culture 25



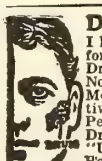
"Be Strong and Stay Strong"
By HENRY VICTOR

The most complete work, in concise ever published on physical culture. I plains all the phases of physical trai Here are some of its topics:

Diet — Constipation — Drinks — Out Life—Bathing—Clothing—Air Baths— —Breathing—In Case of Sickness—N Weight—Truth About Fat—How Not T Thin—Exercise.

The regular price of my book is but for a limited time I offer it for Send stamps or coin.

HENRY VICTOR
14-16 4th Ave. Dept. B New



DEAFNESS IS MISE

I know because I was Deaf and had Head N for over 30 years. My invisible Antiseptic Drums restored my hearing and stopped Noises, and will do it for you. They are Megaphones. Cannot be seen when worn. tive when Deafness is caused by Catarrh Perforated, Partially or Wholly Destroyed N Drums. Easy to put in, easy to take out. "Unseen Comforts." Inexpensive. Write Booklet and my sworn statement of how I ered my hearing.

A. O. LEONARD
Suite 369, 70 5th Avenue -- New York

SEX BOOKS

For Teachers, Students, Physicians, Nurses, J ists, Lawyers, Social Workers, Clergymen, Pries Professional and Advanced Adult Readers.

Send for Fr

THE MODERN BOOK SOCIETY
5 Hanson Place, Desk 58, Brooklyn, N. Y. C
"Books for Intelligent People"



FREE



Draftsman's Complete Outfit

Everything used by expert draftsmen given you absolutely free. Outfit includes "professional" complete set of drawing instruments with double set of compasses and dividers all in velvet lined case. Drawing board, T square, two triangles, protractor, universal curve, triangular standard scale, water-proof ink, pens, pencils and all accessories—furnished you free in this expert's complete outfit.

Bennett Wellington Cooke
President of the Coyne Trade & Engineering Schools. Leading Educator and Trainer of High Paid Men.

Easy to Learn at Home
from Largest School of Its Kind in the World

The Coyne Home Study course is directed personally by President Bennett Wellington Cooke. He guarantees to train you. Remember, the Coyne Trade and Engineering Schools is the largest institution of its kind in the world. Students come from all over the world to get Coyne training. Why, because of the Coyne Schools' long established, tremendous reputation for successful teaching by its great staff of experts. Coyne is not a "one man" school but a great educational institution, 21 years old, an acknowledged leader and originator. This school, under the direction of President Cooke, originated the "Learn by Doing" method now endorsed by educators everywhere. Coyne has graduated thousands of successful, prosperous men all over the world. You can't make a mistake if you write for the Coyne free book. Coyne students say every minute of the course was enjoyable. Some students took **good positions 3 months before their course was finished.**

Send for FREE Book

Mail this coupon for our interesting book, "Drafting the Foundation of Industry," sent you free. It explains all about the Coyne home study method and shows you how to become a draftsman in the quickest and easiest way. You want to know all about this great institution. Don't put it off. Send for this book now. It's absolutely free, no obligation. It contains the most valuable information you will ever get in your life. Send the coupon now.

COYNE
HOME STUDY DEPT.
TRADE & ENGINEERING SCHOOLS
Largest Institution of Its Kind in the World
39-51 East Illinois St., Dept. 1258, Chicago, Ill.

Draftsmen Make $225.00 to $500.00 a Month

There is a tremendous demand now for trained draftsmen. Employers are competing for men to fill positions. There will be no let up in this demand for many years to come. Now is the time to get started. Draftsmen get good pay from the very start and can work up to $500 a month *and more.* Draftsmen are needed everywhere. Once you are trained you can choose your own business and work in any part of the country you please. Don't be afraid you can't do it. Coyne training makes everything easy for you.

Coyne student L. T. Dubendorf writes: "Immediately after completing Coyne course I went to work for Armour & Company. Work was easy for me. Five months later I accepted a position in New York at a large increase in salary."

You Can Do As Well. Start Now
Write Today for Coyne Free Book

Coyne Trade and Engineering Schools
Department 1258, 39-51 East Illinois Street, Chicago, Illinois

Dear Sirs:—Please send me, absolutely free, without obligation, your book, "Drafting the Foundation of Industry," also full information about the Coyne Home Study Course in Drafting.

Name .....

Address .....

..... *State* .....



Earn Big Money

Pack your grip today and come to the Sweeney School of Auto-Tractor & Aviation Mechanics. Strike out for the big money and a world wide opportunity.

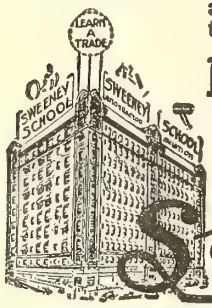
Expert Mechanics Wanted The machine expert is the boss of creation today, whether on the farm or in the city. If you are mechanically inclined learn to make and repair autos, tractors, trucks, gas engines, auto tires, etc., **in Eight Weeks by**

PICK YOUR JOB

Farm Mechs.	$125
Tire Men	150
Drivers	150
Repair Men	200
Taxi Drivers	175
Tractor Men	200
Garage Owner	400

The Sweeney System OF PRACTICAL EXPERIENCE

Learn as 35,000 other men have learned—**by tools, not books.** Learn power farming on my big Tractor farm—18 tractors. Learn to make a $30 tire from 45c worth of junk. Learn to fix any piece of machinery. You can't get this System anywhere else. Thousands of opportunities for experts trained in this **Million Dollar School—the greatest in the world.**

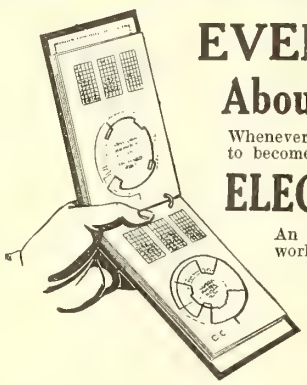


FREE Send today for my 72-page catalog, or simply say when you're coming and I will have classes arranged and your rooms ready. I guarantee railroad fare round trip if you find a single misrepresentation.

EMORY J. SWEENEY,
President



LEARN A TRADE—Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
844 SWEENEY BLDG. KANSAS CITY, MO



EVERYTHING You want to know About A. C. Motors and Repairing

Whenever any question arises regarding motors, or if you are anxious to become a specialist on electrical motor work, you need the

ELECTRICAL WORKERS FRIEND

An invaluable collection of diagrams and instructions for electrical workers, students, amateurs, etc.

This book contains 66 motor diagrams with complete instructions for rewinding and reconnecting A. C. Motors. Shows how to put each coil in the slots, giving all internal and external connections. For reconnecting they cover all practical changes showing which diagram to use for the change wanted. Bound in loose leaf form for handy reference. The only complete book of its kind on the market. So simple anyone can understand. It is helping thousands of other workers—it will help you too, as hundreds of testimonials prove.

SPECIAL PRICE, COMPLETE $3.50. Order today. If desired we will ship C.O.D. by Parcel Post.

YOU CAN EARN YOUR COPY FREE

We offer all owners of the Electrical Workers Friend a commission of 50c on every book they help us sell. All you have to do is show your book and recommend it. You can earn the full price of one of these books in a few days. Write immediately for full particulars—this offer is limited.

SMITH & SMITH PUB. CO. 1524 Lowrie St., N. S. Dept. B, Pittsburgh, Pa.

SUCCESS OPPORTUNITY **UTTMARK'S NAUTICAL ACADEMY RADIO SCHOOL**

8 State St., New York, N.Y.
Phone Bowling Green 8079

Complete instruction in radio operating in all branches for Merchant Marine, Ocean Steamships, Telegram Service. Special course in Vacuum Tubes and Radio Telegraphy. Preparing for Government Examinations.

Elementary and Advanced Classes
Day and Evening Classes

Write for Circular.

Insure your copy reaching you promptly each month. Subscribe to SCIENCE AND INVENTION—$3.00 a Year.



SENT TO YOU FREE TO WEAR 10 DAYS

Just send your name for a beautiful Rosebrite ring. Wear this wonderful new sparkling stone ten days at our risk. All the dazzling fire and brilliance of a genuine diamond. Mounted in solid gold ring, men's or women's style.

Send No Money! Simply write today, stating style wanted and finger size. (Send strip of paper just long enough to meet over second joint of ring finger). Do not send a penny. When ring arrives deposit only $4.75 with postman. Wear it 10 days. **We guarantee to refund your deposit if you can tell this marvelous gem from a genuine diamond.** If you keep it send $3.00 a month for four months. Write today before this amazing, cut-price offer is withdrawn.

Rosebrite Diamond Co., 30 North Dearborn Street Dept. 5811 CHICAGO, ILL.

How to Become A Master of English

is a valuable FREE booklet which *proves* that the Kleiser Mail Course in Practical English and Mental Efficiency will teach you to *Write Stories that Sell—Literature that will Compel Attention;* it will show you how to *Enlarge Your Stock of Words—Use the Right Word in the Right Place — Prepare Sermons, Addresses, Advertisements, Letters, etc.*

BOOTH TARKINGTON
Distinguished Novelist:
"Your Course is almost painfully needed by many professional writers and speakers. A student who intelligently follows your Course will know what he is talking about when he talks or when he writes."

Famous Writers, Business and Professional Men, Speakers, and others are sending enthusiastic letters telling how the Course has enlarged their mental capacity, increased their incomes. It will do the same for YOU. Send TO-DAY for the FREE booklet to

FUNK & WAGNALLS COMPANY
Dept. 429 New York, N. Y.

Why We Remember Things

By WILLIAM M. BUTTERFIELD

(*Continued from page* 734)

a foundation for and influence all of th ideas that may come to us later as a resul of memory. Every moment of wakefu consciousness increases this spontaneou supply. Every voluntary movement of th body is prompted and controlled by thi store of knowledge, which is provided pri marily for such purpose.

No one without sensation, we see, ca have a knowledge of things, and withou memory knowledge would be useless; henc we know how to feed ourselves with wha is wholesome, agreeable food, solely by ini tial sense impressions that have been in delibly registered in our mind, and whicl memory recalls, as a guide or incentive We protect and care for our bodies in th way common to us simply on account o memory. It is quite different with animal who have an instinct, a sort of mechanica mind—similar to that of man, provided un questionably for purpose of protecting thei bodies and securing food necessary to thei existence.

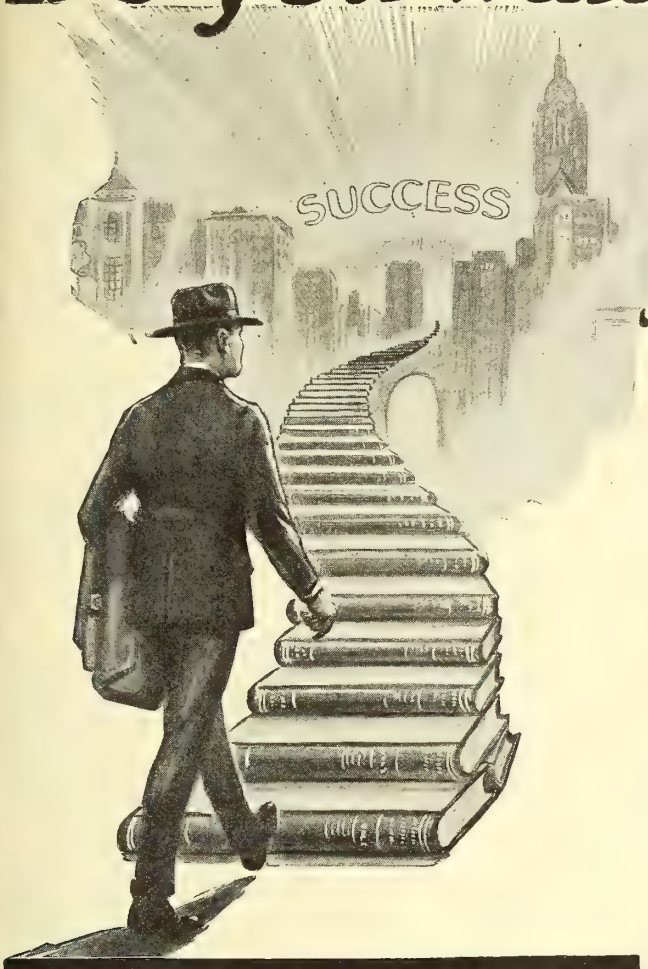
The operations of memory, complicate as they are, and recalled by trivial, seem ingly unconnected things such as an odor sound or sight of an object, are all of them definable. For, the process of recalling a event or fact is a voluntary brain response This response is created by one or mor sense impressions, received in the norma way, forming a new product by combining the recent and the stored-away impressions This produces a vision, or something akin to it, in the mind. Such sensations we cal mental pictures. The mind, thus stored with mental impressions, varies greatly in different individuals, not so much on account of the difference in physical attributes, but because some people are more interested in or give more attention to certain affairs, and in this way acquire special impressions. Hence we have the musical mind, philosophical mind, mechanical mind, and so on.

It is said that as the body decays the mind decays also; this may or may not be true, according to the nature of the wasting process. Certainly there is second childhood when the minds of the old are keen in recalling anew events that had been crowded out and forgotten during the period of their declining years. This faculty, many believe, is due to the fact that the power of the brain to receive and store impressions is never destroyed.

To aid the mind in its conception of common events, one must have a lively, keen interest in common events, else the mind will have little or no understanding of them. This, of course, is true of every variety of mental impression. When a person says "I have no knowledge" of a thing, we may assume that they have never seen or given attention to this particular object. We may conclude, in a like way, if they have acquired a knowledge of the object, but never again see it, or any thing that reminds them of it, the knowledge they once had may become dead or forgotten. Thus one may have had, at some time, a very clear knowledge of an event, object or fact. Yet because one no longer takes an interest in its source, or in things that may recall it, one may loose, temporarily or forever, all of this knowledge. We can see, if we look at it in this way, that "loss of memory" is not necessarily an indication of physical or mental decay, but rather caused by a cessation of the interest necessary to recall or renew it.

Do you want more money and SUCCESS

Then start on the right path of "KNOW HOW"



Mere bluff and luck may land fair jobs, but,—they won't hold them. Big business men today want associates who **know why** a thing should be done and **how** to do it. It's the trained man—the knowing man who climbs way up on the ladder of Success and stays there. You want to Succeed—you want the bigger income which Success brings. You can have it.

There is a fine job waiting for you to fill it

Give a few moments of your time each day to useful reading. Study any one of the several libraries which we present for your guidance. Learn in a few short months what it has taken other men, successful men, years to learn. Do it in your spare time, the time you waste now.

These books will make it easy to win

Every one of them is written in plain, easy-to-master English. Technical terms, where used, are explained and simplified. Thousands of charts, diagrams and illustrations make the facts as plain as day. Fifty cents a week will make any one of these libraries yours, and bear this in mind—

You may have any Library for Seven Days' Free Examination

You can decide for yourself just how much good the books will do you. Send us the coupon, we'll send the library you want, express collect. Use it for seven whole days, show it to your friends—put it to every possible test. Then if you can't get along without it, send us the small first payment of $2.80 and balance $3.00 a month. If you decide not to keep the books, send them back to us, charges collect within the week.

Send No Money—Just the Coupon

AMERICAN TECHNICAL SOCIETY, Dept. X-258 Chicago, U.S.A.

Pay Raising Books

At Greatly Reduced Prices

Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $37.50 .....Now **$24.80**

Civil Engineering, 9 volumes, 3900 pages, 3000 pictures. Was $67.50..... Now **$39.80**

Electrical Engineering. 8 vol,, 3000 pages, 2600 pictures. Was $60.00 .....Now **$34.80**

Automobile Engineering, 6 vol., 2600 pages, 2000 pictures. Was $45.00 ....Now **$29.80**

Machine Shop Practice, 6 vol., 2300 pages, 2500 pictures. Was $45.00 .....Now **$29.80**

Steam and Gas Engineering, 7 vols., 3300 pages, 2500 pictures. Was $52.50 .....Now **$29.80**

Law and Practice (with reading course) 13 vol., 6000 pages, illustrated. Was $90.00.....Now **$49.80**

Fire Prevention and Insurance, 4 vols., 1500 pages, 600 pictures. Was $30.00 .....Now **$19.80**

Telephony and Telegraphy, 4 vols., 1728 pages, 2000 pictures. Was $30.00 .....Now **$19.80**

Sanitation, Heating and Ventilating, 4 vols., 1454 pages, 1400 pictures. Was $30.00 .....Now **$18.80**

Accountancy and Business Management, 7 vols., 2700 pages, 800 pictures. Was $52.50.... .. ...Now **$29.80**

Drawing, 4 vols., 1578 pages, 1000 pictures, blueprints, etc. Was $30.00..Now **$19.80**

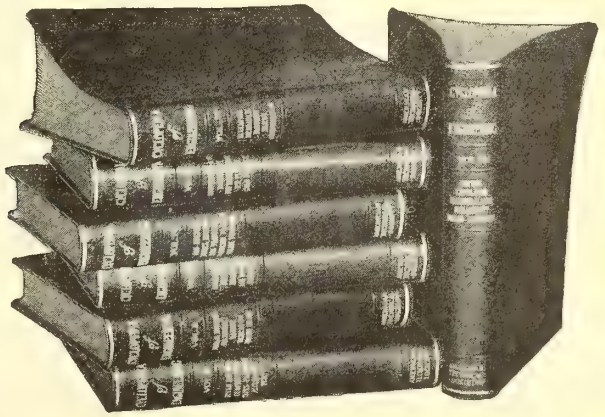
AMERICAN TECHNICAL SOCIETY, Dept. X258 Chicago, U. S. A.

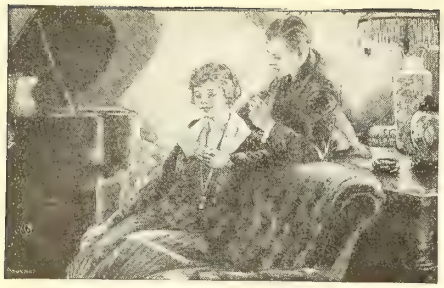
Please send me set of..... for 7 days' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send the $2.80 within 7 days and $3.00 each month until I have paid the special price of $ ..... If I decide not to keep the books, I will return them by express at your expense.

Name.....

Address.....

Reference.....





"$5,000 Working for Us!"

"I bought another good bond today and tonight Helen and I were figuring up our investments. All told we now have $5,000 saved and invested where it will add $300 to our income every year!

"I used to scrape along in routine work and spend what little I earned. Then one day my employer gave me some advice. He said success depends on two things. First, learn to do some one thing well. Second, save and invest something out of what you earn each month.

'I decided then and there to get some special training. I wrote to Scranton and found I could get just the course I wanted and study at home evenings. So I started, and it wasn't long before the manager gave me more important work—and more money. I kept on studying with three increases the first year. And each pay day I put something aside. So it has been ever since. As I advanced at the office and my salary grew, my savings grew faster and I put them into good securities.

"Helen was happy as a lark tonight when I told her we had five thousand dollars in safe, sound investments working for us! And this is only the beginning. At our present rate of saving, in a few years more we'll have an independent income for life!"

Success is within easy reach for *you* if you'll just follow the simple rules that have made all men successful who have practiced them. First decide what *your* work is, learn everything about it that you can. The easy, convenient way to do that is to let the International Correspondence Schools help you.

More than two million men and women have taken the up road with I. C. S. help. More than 130,000 are now turning their spare time to profit. Isn't it about time for *you* to find out what the I. C. S. can do for you? Then mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6169-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

REBUILT ELECTRIC MOTORS



General Electric
Westinghouse
Crocker-Wheeler
Emerson
Century
Wagner
etc.

All Motors Guaranteed For One Year

Motors bought, exchanged and repaired
ELECTRICAL SUPPLIES
Wholesale Prices
Sockets, wire, tape, loom, fuses, switches, cut outs, etc.
New illustrated catalogue free. Satisfaction guaranteed or money refunded.
HYRE ELECTRIC CO.
631 S. Dearborn St. Chicago, Ill.

Learn to Dance!



You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful Peak System of Mail Instruction.
New Diagram Method. Easily learned; no music needed; thousands taught successfully.
Write for Special Terms. Send *today* for FREE information and surprisingly low offer.
WILLIAM CHANDLER PEAK, M. B.
Room 238, 621 Crescent Place—Chicago, Ill.

What Your Hands Reveal

By Dr. W. De KERLOR

(*Continued from page 737*)

The prejudiced objectors who maintain that: the lines of the hand are formed by prehensile movements which the hand affects during its period of toil," seem to lack first hand information, on this subject. Experimentation proves the contrary to be true. If the lines were the product of hand contractions while using a hammer, pike, shovel, razor, pen, or whatever else, for a whole life time, *these lines should be found to be approximately the same in each of the particular trades.* But that is not the case. As there are no two characters precisely alike, nor two lives identical in unfoldment, there are no two hands precisely the same. Shapes of hands and line formations may fall into general types and classifications; but just as in the finger-printing system of identification, there are not half a dozen hands alike in a hundred millions.

The hand of a peddler, except for its callousness, often may look just like a millionaire's, tho it is not a millionaire's hand. He may possess all the character attributes of a millionaire; but his graven palm, however, will be minus the "signs" of *predetermination.* True, any peddler in these democratic days, may become a millionaire, a chance he did not have in the days of "slavery." Many peddlers have become millionaires, since, the Gould and Co., for instance. But so did many a butcher, a meat packer, a 'bus driver. While many another man born in the humblest of circumstances became a shining light in the world of statesmanship or empire building: Lincoln, Disraeli, Napoleon. Willpower, no doubt was the "dynamic" force which enabled them to reach their goal, and keep there . . . . for how long however?

WHAT THE LINES REVEAL.

A look into the structure of their palms and thumbs would have revealed widely different configurations. There is the hand of Failure, and there is the hand of Success. No matter what one will undertake will turn into "an apple of Sodom"; his knack is to start everything at the wrong psychological time. Whereas in the case of the other "every thing he touches" will turn right . . . until it does not. It is not disputed that character may be the stepping stone to achievement, tho many a Man of character never "gets there." It cannot be denied that both Character and Predetermination are inseparably linked together, in the Mysterious scheme of Life's Evolution, whether national or individual. And both these factors are to be found graven in the very hollow of your palms.

Why Nature "placed signs in the hands of Men, that each man may know his work" (Job, chapter 37 v 7.) is a Mystery, which for some time to come will remain an unsealed secret of the Creator.

Science, which cannot *explain* electricity, is dumb before the simpler phenomenon of —lines in the hands. Yet, the experimenter-electrician can apply electrical power to practical usage; and so can the Hand-Psychologist trace, according to his individual ability, past, present conditions, and in a measure some future possibilities.

(*Continued on page 792*)



The Electric Safety Razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."
A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."
No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.
Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

VIBRATING ELECTRIC RAZOR CO.
Dept. 122, Council Bluffs, Iowa



Are You Flat Chested? Are Your Lungs Weak? Do You Lack Vitality? Is Your Carriage Faulty?

If any of these conditions fit your case you urgently need my book.

CORRECT BREATHING and CHEST EXPANSION

Each one of these conditions can and should be remedied. My book will teach you how. Send for it now before you forget. **25c coin**
PROF. ANTHONY BARKER, D. C.
127 W. 42nd St., 3563 Barker Bldg., New York

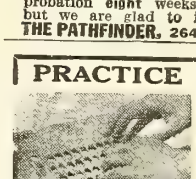
What a Dime Will bring You From the Nation's Capital

The little matter of **10 cts.** will bring you the Pathfinder **eight** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for all the Nation; an independent home paper that prints all the news of the world and tells the truth; now in its 28th year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, strongly, briefly—here it is. Send 10c to show that you might like such a paper, and we will send the Pathfinder on probation **eight** weeks. The 10c does not repay us, but we are glad to invest in new friends. Address:

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, 264 Langdon Sta., Washington, D. C.

PRACTICE TYPEWRITER, $1



You haven't one of the $100 market typewriters, but you would like to learn the regulation typewriter keyboard. In fact you want something that will familiarize you with the fingering of a regular machine at a nominal price. Well this little prize has a "STANDARD KEYBOARD" You get the regular fingering without the usual tiresome labor of a heavy machine. For typists just beginning it is invaluable. Send $1 and it is yours.
MAINE SUPPLY COMPANY
609 CONGRESS STREET PORTLAND, MAINE



"Lighting Fixtures"
Ready to Hang
(Direct from Manufacturers)
Completely wired, including glassware. New designs.
Send for catalogue No. 18
ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

Book on Law Free



Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.
Write Today—now while we are making a special reduced price offer.
American Correspondence School of Law
7448 Manhattan Bldg. Chicago, Illinois

Camels ring true!

They'll give you new notions about how delightful a cigarette can be



YOU get to smoking Camels because you appreciate their fine, refreshing flavor! And, you like them better all the time because they never tire your taste!

Camels quality makes Camels so appetizing, so continuously delightful. And, Camels expert blend of choice Turkish and choice Domestic tobaccos gives them that wonderful mildness and mellow body.

You have only to compare Camels with any cigarette in the world at any price to know *personally* that Camels are a revelation!

And. Camels never leave any unpleasant cigaretty aftertaste or unpleasant cigaretty odor!

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes for 20 cents.

R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

Camel
CIGARETTES



HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competion is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

American School of Correspondence
Dept. H-825 Chicago, U. S. A.

American School of Correspondence,
Dept. H-826, Chicago, Ill.

I want job checked — tell me how to get it.

.....Architect $5,000 to $15,000	.....Lawyer $5,000 to $15,000
.....Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Photoplay Writer $2,000 to $10,000
.....Certified Public Accountant $7,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telephone Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....Telegraph Engineer $2,500 to $5,000
.....Electrical Engineer $4,000 to $10,000	.....High School Graduate In two years
.....General Education In one year	.....Fire Insurance Expert $3,000 to $10,000

Name.....

Address.....

What Your Hands Reveal

(*Continued from page* 790)

Yes! there is a Fate line . . . . and a line of Fame, too.

The "Society favorite," and her sister the "door-step cleaner" bear the stamp of their ups and downs upon their Fate lines. Fifty thousand pairs of hands over which I have pondered, and thousands of handprints I have collected, classified and analyzed have made the conviction firm as to a law of "Individual predetermination" being reflected in two small lines: the Fate and the Fame lines. They run: one from the base of the hand to the base of the second finger, while the other runs from the center of the hand toward the base of the third finger. Why? I can't tell. But it is so, nevertheless.

I have examined the hands of Statesmen, Princes and Dukes, newly-weds, Monte Carlo gamblers, Stock Exchange "plungers," kitchen maids, murderers and lunatics. Of all these one pair of hands stands out most prominently in my recollections. They are those of a young person whose lines *changed completely* from 1906 to 1912.

A REMARKABLE CASE.

This case, and to me the most valuable from the scientific point of view, is that of the hands (herewith reproduced) of Miss M. W. After a series of extraordinary events, and misfortunes, including sunstroke, she had to be interned in an Asylum, as a hopeless case. That was in 1906. At the time handprints were taken which showed the head line bearing all the signs of profound melancholia: drooping at a sharp and deep angle, reaching almost the base of the palm.

By patient and careful training a specialist in mental diseases brought her back thru the judicial use of the power of suggestion. But it took no less than five years. In 1911 she left the Asylum and was advised by the writer to take up a course of nursing in one of the largest hospitals in London. Not only did she pass all her "exams" in a brilliant fashion in the record time of ten months, but she also won honors besides. She had never been capable of earning a cent before that time; but to-day she supports a whole family on the income she derives from nursing the sick.

On the handprint which was taken late in 1912, the head line, which recorded the ailment, changed its course entirely. From slanting downward it became straight and even grew much longer. The smaller lines have also grown accordingly, becoming firmer, straighter, more direct, while the whole aspect of the hand appeared decidedly healthier. Thus while the mind was ill, the lines of her hands exprest its conditions. As her Mind felt, every cell of her organism reflected its thoughts and impulses, which became registered as it were, upon the outer surface of the organism. And when the Will became stronger and normal once more, when "Mind ruled over Matter," creating harmony within it, the whole body responded. The lines in the Hand changed. It was a remarkable phenomenon, and almost unbelievable were it not for the facts.

Yet, nearly two thousand years ago the scribe from the Orient was caused to write: "And he causeth all, both small and great, rich and poor, free and bond, to receive a mark in their right hand, and on there forehead." Revelations, chapter xiii, 16.

Truly we must admit that the ways of Nature are both subtle and mysterious—notwithstanding the advancement of Science.



Voice Thrower 10c

Learn to throw your voice into a TRUNK, under the bed, out in the hall or anywhere. Lots of FUN fooling the Teacher, Janitor, Policeman, Parents, Neighbors, or Friends.

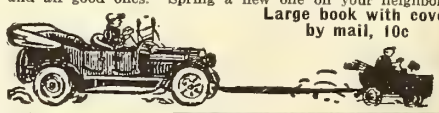
THE VENTRILO

is a little instrument that fits into the mouth out of sight. **BOYS** or **GIRLS** can use it in conjunction with the above for imitating birds and animals. Never fails. A 32-page book on Ventriloquism sent with the Ventrilo for 10 cents.

NEW FORD JOKE BOOK 1920

All the latest jokes on the Ford auto. Hundreds of them, and all good ones. Spring a new one on your neighbors.

Large book with cover by mail, 10c





ROGEN X-RAY

Price 12 cents

HERE, BOYS, is just what you want. With this instrument you can apparently see the bones in your fingers. Think of the fun you can have with it. Sample by mail, **TWELVE CENTS.**



SKULL RING

Here is a handsome, up-to-date Ring, representing a Skull and Cross-bones. Has stones in the eyes and looks something frightful. Women won't like it, but for men or boys it is a great novelty. **Sample, by mail, 15c.**



Gee! What a Wad!

This is STAGE MONEY

Looks like the GENUINE STUFF. Some Green backs and some Yellow backs. Create a BIG sensation among your friends. The girls will all be after you when they see the wad. BIG roll of 15 pieces by mail, **10 cents.**



ENCHANTED BARREL

The Most Wonderful Pocket Trick Made

CHANGE A CENT INTO A DIME

Ask your friend to drop a dime in the barrel. When he takes it out, Behold! It is a CENT. You make 9 cents every time you fool them. **Never fails.** They cannot get on to it. Sample barrel, with directions, only.... **12c**



Hindoo Flower Pot Trick

You have all heard of the great Hindoo trick (making a plant grow out of a flower pot right in front of an audience). This trick has puzzled the whole world for years until an old Hindoo fakir gave it away. We send the whole outfit by mail with full instructions for **15 cents.**

BIG VALUE for 10 Cts.



6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Baseball Book, giving rules for games; 1 Toy Maker Book; Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 5 Puzzles; 12 Games; 30 Verses for Autograph Albums. **All the above by mail for 10c.**

Trumpet in Handkerchief



The Trumpet in the Handkerchief has come to torment us. It is a startler. A small metal trumpet is ingeniously concealed in a handkerchief. On meeting your friends, after chatting awhile, you take out this handkerchief and blow your nose. It's like a sudden clap of thunder! The ladies scream, and your male friends will think they heard the whistle of a steam engine. You can blame the hideous noise to your having a very bad cold, and keep the fun up as long as you like. **Price 10c, 3 for 25 cents, by mail.**

ALLEN OUTLAWS



A new illustrated book in 42 chapters. Tells the provocation that led up to the most daring gun fight on record, where they shoot the Judge sheriff, States attorney, 3 Jurors, and 8 others in the Hillsville Court Room. All crimes have a woman back of it, and BOYS, this one is worth reading. Large bound book in plain wrapper for **TEN Cents.**

Any of the above Mailed with Catalog

ROYAL NOVELTY COMPANY
419 East Ave. South Norwalk, Conn.

Dr. Pringle Discusses Life

By JOHN DeQUER

(Continued from page 726)

aporizing and, we must believe, their ultiate electrizing and etherizing points. Of ourse, matter ceases to exist the moment s atoms are resolved into their component lectrons.

"Now speaking of the descending scale, e know that certain gases liquefy at a omparatively high temperature, while thers resist liquefaction to a degree far elow the greatest terrestrial cold. They an only be rendered fluid by suitably deised and powerful apparatus. But to say, hat because we have not succeeded in solidiying certain gases, it is therefore impossible, would be evident folly. One might as ell have argued twenty years ago, as many id, that the aeroplane was impossible beause Professor Langley's device fell into ie Potomac. All that was needed to make angley's machine fly was a light, and, at ie same time, powerful, engine. And all iat is needed to solidify liquid air is a deice of suitable construction. There may, owever, be atoms of the Argon and Krypn type which can be neither liquefied nor olidified, because their structure is such ey have no combining power. There may so be atoms which cannot be reduced bew the liquid state, which only proves that ey must have a certain valency before ey can function as solids or liquids. It n be mathematically demonstrated, from perimentally verified data, that if we reice temperature far enough we will come a point of absolute zero, or what may be rmed, the perfect absence of heat. At is point all molecular motion, and hence l corresponding phenomena, must stop. In e year 1812 the philosopher Davy gave s the clue to this conclusion, when he ointed out that the laws governing heat id motion were the same. Since then it as been demonstrated that absolute cold ould be attained at two hundred and eventy-five degrees below zero Centigrade. /e can hardly imagine what would happen , in our experiments, we could reach this egree of cold."

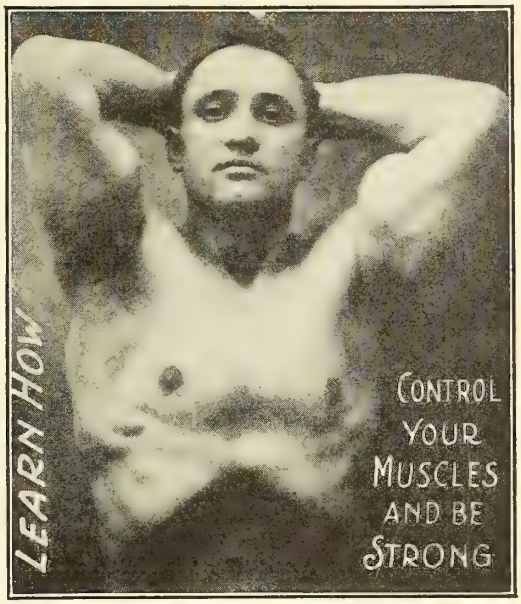
He leaned forward in his chair and looked me fixedly. "Now can you imagine what is would mean, this cessation of all such otion, if it could happen to a planet?" he sked, as if eager to impress me with the ill weight of his statement.

I replied that I had not the faintest idea cept that which I had gathered from his atement, that at that point all phenomena ould cease, and consequently such a planet ould instantaneously pass into ether.

"I think it was Professor Michelson who id that if we could shoot a bullet at the eed of light, it would itself be turned into ght, imparting life instead of death. It is well-known fact that bodies reduce in ass in proportion to the rate of their moon. This is but another way of saying at matter comes into, and goes out of, extence within a circumscribed range of that bratory activity we call heat, below and ove which there can be no material extence.

"Only a few years ago we looked upon e atoms as the ultimate units of matter— indivisible entities. Now we know that e were mistaken. We realize that matter a condition produced by forces which at at time were entirely beyond our knowlge. Matter may now be defined as the anifestation of cosmic force, which offers sistance to our senses in the form of lids, liquids, and gases.

Listen to the Voice of Experience



Antoné Matysek, the muscular phenomenon, the man who is offering to place you on the energetic strong man map. When you find your place on this map, you will always be full of pep, ambition and joy. You will be a real man!

Be a Pride to your Sex. Become a Matyseker—that means—an Efficient, Strong Man

ADMIRATION always follows the robust, graceful, and alert man. Pity trails behind the weakling because his failing strength is not sufficient to carry him over the obstacles that obstruct every man's path to progress. Do you belong to the REAL MAN set—the dominant class of successful people; or are you among the sickly, flat-chested, weak-legged, and nervous—the insignificant class, that, instead of living, just merely exist and manage to breathe? NO MATTER what your position, environment, physical and mental development now is, you are being given a wonderful chance to get more satisfaction out of yourself, by this

Amazing Opportunity for Greater Strength!

Prof. Matysek, the man who, years ago, having resolved to become healthy, strong, and highly developed, has experimented and trained himself until he is ranked among the strongest men in the world. He, in order to accomplish this, has been SECRETLY PRACTICING ON HIS "BODY-BEAUTIFUL" MAKER. It is

Matysek's Muscle Control Course, the Surest and Quickest "Muscle Bulging Out" Stimulant. A System of Exercises That Produces Really Athletic Men with Graceful Outlines Full of Strong Personality.

These Muscle Control exercises aid me in performing the many herculean feats **that hold all the so-called strong men DEAF from accepting my open challenge to the world's best.** Yes, my Physical Culture Friend, these exercises are the CHIEF SECRET of why I am growing despite my age, day after day, stronger and better developed, as well. Do you blame me for offering to acquaint you with such progress making exercises that will bring forth the maximum results you are after and NOW are within your easy reach?

MATYSEK'S MUSCLE CONTROL COURSE CONSISTS OF

Two handsomely finished charts containing twenty-one beautifully produced pictures of myself, many of decidedly larger size than the above specimen, showing every detail as to how to perform the movements with absolute correctness. The instructions are "straight from the shoulder" such as only an expert who went thru the mill himself could ever possibly produce. The following is but a part of what is embraced in the course:

How To—quickly make respond the inactive bowels.
How To—easily correct the rounded shoulders.
How To—in no time expel the bothering gas out of the stomach.
How To—promptly chase away the staleness of the body.
How To—strengthen the nerves and internal organs.
How To—control every muscle of your body—make them roll like the waves.
How To—store up energy for feats of strength.

Other subjects of the course: Complete relaxation and contraction—Effective breathing—The best way to arouse your inactive nerves—Creation of better blood circulation—Easiest way to increase your chest circumference—The famous shoulder blade control—How to thicken the shoulders—How to learn the art of making your shoulders supple from only three days' practice—Development and control of the neck muscles—Spreading of the back—Depression of the abdominal muscles and wall—Control of the Pectoralis (chest muscles) the biceps, triceps, thighs, calf and all other muscles—How to train the abdominal regions to be immune from rupture—How to master correct posture—Simple yet positive cure for insomnia—How to pose for good pictures—Advantages of perfect co-ordination of muscles and mind thru concentration which brings success and all the good things that go with it, and many other vital pointers you need every day too numerous to mention.

Let My Muscle Control Exercises Mold Muscle on You Quickly and Solidly!

Only ten minutes a day, in the privacy of your own room, solves any case. From my own experience, as well as the very large number of pupils that I have successfully aided, I know that in less than five days your muscles must respond, and bulge out to a most surprising extent. If you are already training on some good "system" these Muscle Control Exercises will force your progress to be 100% faster! If, however, you do not exercise, then for your own sake and happiness, start building yourself up into a real man. Do not merely drag on—make your life worth living.

It is My Sincere Wish to Assist Every Reader of "Science & Invention" to Get Really Strong

For this reason, this Muscle Control Course is being offered you for a limited time at such a trifling price that YOU CAN WELL AFFORD IT. Costs but $2.00. I GUARANTEE QUICK RESULTS AND ABSOLUTE SATISFACTION OR MONEY BACK. MY HONEST REPUTATION PROVES THAT I AM NO QUACK. COME THEN, MY FRIEND, WHEN I AM REACHING OUT TO HELP YOU! I will place you on the real road; I will show you the main secret that helped me to get what I longed for, and now certainly possess. In addition to this Muscle Control Course, you have the privilege to ask any questions pertaining to your physical training; to these I will gladly reply, giving you personal attention. This favor alone is worth the $2.00 I ask. Matysek's Muscle Control will do wonders for you. You will be the envy of your friends. Learn how to get the most out of yourself. It is easy. GET STARTED RIGHT NOW! Simply tear off the coupon below, mail with but $2.00, and leave the rest to me.

Prof. Matysek — 523 North Charles Street, Dept. 400 — Baltimore, Md.

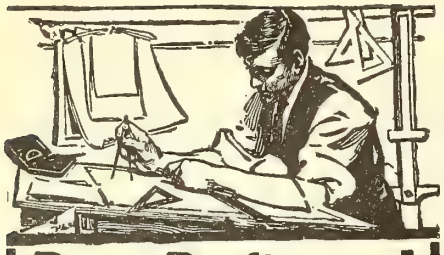
Detach and mail NOW while it is on your mind

PROF. MATYSEK MUSCLE CONTROL DEPARTMENT
523 North Charles Street, Dept. 400, BALTIMORE, MD.

I want bulging muscles and yet I want them to have fine outlines. I desire to increase my strength, my internal activity, my energy. I want to be more than I am now and I want to achieve my "chief aim" in a short and efficient manner. For these reasons send me your wonderful Muscle Control Course, illustrated with 21 high-grade pictures of yourself. If I am not completely satisfied my money will be promptly refunded.

Write name and address plainly.....

City.....State.....S. & I. Nov.



Be a Draftsman!

Make $40 to $100 a WEEK

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $40 to $100 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 6½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

75c a Week Only $3 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership given free with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-258, Chicago, U. S. A.



AMERICAN TECHNICAL SOCIETY
Dept. D-258
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $3.00 a month until $19.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....



BURN LESS COAL

With an improved, all-cast pipeless furnace you can cut your coal bills in two. This efficient, basement installed heating plant heats and ventilates the entire home. It burns any grade of coal more economically than a stove. It needs no expensive piping or other equipment. Anyone can install it in a day. They are described at our wholesale prices in our Handy Man Book. Send for it.

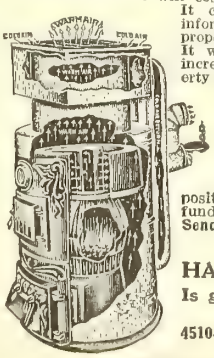


Do Your Own Plumbing and Heating by the Cut-to-Fit Method.

By our new plan anyone can install a complete plumbing or heating plant in his own home. Send us a rough sketch with measurements. Our Engineers will draw your plans, furnish information and see that the supplies you order come CUT-TO-FIT your needs. No waste of time, labor or unused material. Only a few simple tools necessary. **Send for**

The Handy Man Book

It will show you how. It will tell you just what to order and what it will cost at our wholesale prices. It contains plans and useful information for every builder, property owner or contractor. It will convince you. It will increase the value of your property 50%. You can do the work yourself.



We have spared no effort or expense in the preparation of this valuable book. To keep from sending it broadcast to uninterested persons we request a temporary deposit of 25c which will be refunded with your first order. **Send for it Today.**

The Service of
HARDIN-LAVIN CO.
Is guaranteed by 40 years' business at
4510-20P Cottage Grove Avenue
CHICAGO

"We have followed matter into absolute zero where we believe it must cease to exist. We have also followed it upward to where it vanishes beyond the range of our sense, which fills the entire expanse of the of the great abyss from which rises all phenomena, and into which all phenomena descends. Into this abyss we cannot go, but we may learn something of what it contains by observing that which comes from it. And that to which the abyss gives birth leads us irresistibly to the conclusion that all phenomena, whether radiant, gaseous, liquid or solid, arise from that substance which, for want of a better name, we call the ether. We must take it for granted that such an essence exists, or phenomena are entirely unexplainable in the present state of our knowledge." Once more he paused while he chewed the butt of his cigar. "Yes," he continued, leaning back in his chair and resting his feet upon his desk, "we will have to think of the ether as a non-particulate, all pervading essence, which fills the entire expanse of the universe, and that it fills this immensity at different densities, thereby giving rise to the phenomena of motion from higher to lower potential. Such motion is only limited by the resistance it encounters, and etherial resistance has thus far not been discovered, except where the ether whirls into vortices, called electrons.

"Electrons are believed to be of two kinds, called positive and negative, but this is by no means certain; in fact, I believe, the theory will ultimately be discarded. We do know, however, that when electrons are once formed and suitable conditions arise, they have the power of aggregating themselves into atoms, or it may be that, due to the fact that they are resistant to the ether, they are prest into atoms of different volume and design which, when the range of vibration is further reduced, tend to form gases, liquids, and solids, such as gold, silver, lead, copper, carbon, zinc, bismuth nitrogen, argon, and so forth. Electrons when not symmetrized into atoms, but moving freely among them, give rise to the phenomena we call electrical or electromagnetic.

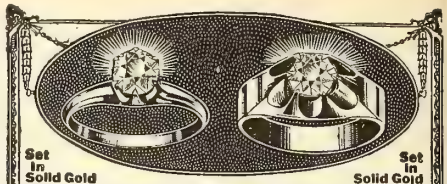
"Electro-magnetism does more than turn motors and lift iron. As early as 1867 James Clerk Maxwell, a celebrated English mathematician, proved that solar light was an electro-magnetic phenomena, and twenty years later Heinrich Hertz, a German physicist, verified Maxwell's contention experimentally. It is now well known that magnetism, electricity, light and heat, are inter-convertible. At base everything is etherial.

"Matter then, may be re-defined as an aggregate of interlocking electrons, and electricity as electrons in a state of freedom, moving among, and acting upon, matter. An atom to which an additional electron has attached itself, becomes an ion, and according to Faraday, gives rise to the phenomena of electrolysis.

"Thus we can no longer say that we do not know what electricity is, altho our knowledge is still far from perfect. We know that it manifests itself to us as swarms of electrons penetrating the inter-atomic and inter-molecular spaces of matter. We know that certain substances resist them more than others, probably due to the nature of their atomic structure, or their molecular combination.

"Why have I said all this? It is simply to prepare the way for a re-definition of electricity. We shall call it proto-matter and consider it as a sort of half-way point on the way from ether to the concrete."

Here I interrupted the Doctor to ask what place in his scheme he accorded to magnetism, and he answered: "Magnetism may be called proto-electricity, or ether in motion. It may be that the magnetic field accompanying electric currents is simply a



Set in Solid Gold — Set in Solid Gold

Send Your Name and We'll Send You a Lachnite

DON'T send a penny. Just send your name and say: "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will send it prepaid right to your home. When it comes merely deposit $4.75 with the postman and then wear the ring for 10 full days. If you, or if any of your friends can tell it from a diamond, send it back. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.

Write Today Send your name now. Tell us which of the solid gold rings illustrated above you wish (ladies' or men's). Be sure to send finger size.

Harold Lachman Co., 204 S. Peoria St., Dept. 1258 Chicago

MEMORIZE CONTINENTAL CODE ALMOST INSTANTLY

This method THE short cut to success

Get Wise. Ask for latest reports from Successful, Satisfied, Gratified, Grateful Users, Maine to California — Texas to Canada. Free on request or

COMPLETE CHART

and full instructions 50 CENTS

C. K. DODGE
Box 300 Mamaroneck, N. Y.

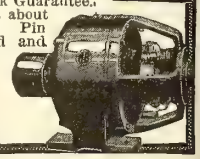
PROFITS for YOU { Charging Batteries / Making Electric Lights

With the HB Lighting and Battery Charging Set you can make your own electric lights for as low as 2c per KW, and make a profit from $100 to $150 per month on battery charging. Anyone can easily operate without experience. Sturdy, dependable, economical to operate from line-shaft or your engine.



Small Payments Put This Money-Maker in Your Shop

Balance on easy terms. Profits pay for outfit. Absolute Money-Back Guarantee. Ask our Service Department about proper size for your needs. Pin this ad to your letterhead and write TODAY for information.



HOBART BROTHERS COMPANY
Box 118E Troy, Ohio
Successful Manufacturers Since 1893

LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries. Thousands needed today. We give you personal and thorough training—practical, technical courses three months to two years, under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. **Not a trade school.** Enroll anytime. Do not judge us by size of ad but write for free illustrated catalogue.

FINLAY ENGINEERING COLLEGE
Greatest of its kind
1001 Indiana Avenue Kansas City, Mo.

Chicago Painting School

The only school in the U. S. teaching by actual application.

Sign Painting, Show Card Writing, Paperhanging, Marbling-Graining Decorating, Auto Painting. Short Term—Low Cost—Catalogue FREE.

CHICAGO PAINTING SCHOOL
156 W. Austin Ave. Chicago, Ill.

READ LOCOMA



—an interesting, instructive MAGAZINE, on personal subjects, such as Love, Marriage, Divorce, Eugenics, Birth Control, Sex Hygiene, etc. For Men and Women only. 15 cents a copy, $1.50 a year, 8 months' special trial 50c.

100 E.E. & M. Bldg., Farmington, Mich.

"BOW LEGS and KNOCK-KNEES" UNSIGHTLY

Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.

PERFECT SALES CO.
140 N. Mayfield Ave., Dept. 50, Chicago, Ill.



disturbance in the ether due to the passage of electrons thru the conductor, something analogous to the wake behind a boat. As early as 1822, the Danish philosopher Oersted discovered that wherever an electric current flowed in a closed circuit, a magnetic field developed at right angles to the direction of charge. Forty years later, Faraday discovered the complementary fact that whenever a wire was moved rapidly in a magnetic field an electric current was set up in it. Magnetism and electricity are inter-related phenomena, but that is not saying they are identical. The statement 'magnetism is electricity in rotation,' as found in certain text books, will never do, nor will anything like it do. Magnetism is electricity in much the same way that ice is water. To change ice into water we must apply heat and to turn magnetism into electricity we must apply motion; and as I have already said, the laws underlying heat and motion are the same. It is the cutting of the magnetic lines of force which sets the ether whirling, thereby forming the electrons.

"Faraday made his first electrical machine by placing his discs east and west so as to cut the lines of force in the magnetic field of the earth, but he soon discovered that electro-magnets were even more efficient than the terrestrial product.

"Notwithstanding Einstein and the other physicists who tend to ignore it, we must consider that the ether is a fact in nature; that it is the matrix of all phenomena. Its motion is magnetism, its eddies are electrons which, when grouped together, possibly by the pressure of the circumambient ether, forms the atoms of the eighty to ninety elements known to science. We must not forget that atoms differ according to their weight, which in turn is due to the number of electrons concentrated in them. The difference between hydrogen, which is the lightest, and radium, which is probably the heaviest element is not one of substance but of number. The electrons in all the elements are the same, but their numbers differ, and it is this which gives rise to their different characteristics. The temperature needed to liquefy or solidify elements depends upon the volume and structure of the particular atom under consideration.

"I tell you all this, simply to re-inforce my definition of matter as an ethereal manifestation dependent on temperature. Temperature is due to atomic or molecular oscillations within the masses of matter regardless of their state. It is a measure of the inter-molecular activity taking place in any given mass of matter. Temperature is the result of work done. It makes no difference whether due to a blow of a hammer, to the friction of bodies moving in contact, or to chemical reactions splitting up molecules and forming new combinations, as when lime is slaked, or to the movement of electrons thru an imperfect conductor, as in an electric heater. Whatever increases the oscillatory activity of the atoms in any mass must of necessity increase its temperature. The fact that all bodies expand under the influence of heat is an evidence that when heat is applied their molecules or atoms are forced apart, giving rise to the phenomena of expansion.

"Heat then may be defined as a rate of atomic or molecular vibration consequent upon the application to, or liberation of, energy. Heat is a mode of motion and temperature a measure of that motion.

"But our foundation for considering the phenomena of life is not yet laid. The saying of certain Indians, that the sun is their father and the earth their mother, is really more than a figure of speech. The earth may be considered as a mammoth conductor of electricity, being constantly

LEARN DRAFTING

At Home—In Spare Time
as you would in actual practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed, by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher, especially qualifies him to give you the training you need to become a successful Draftsman.









Draftsmen Get $35 to $100 a Week

Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field paying as high as $50,000 a year.

Become a Specialist

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.

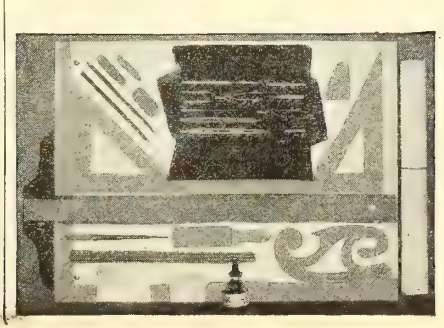
Draftsmen are needed in greater numbers, and receive better salaries than ever before.

How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions now open. Here is what "Columbia" training is doing for some of our graduates: Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.

This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



Big Concerns Employ "Columbia" Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them.

Send This Coupon Today

Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write today to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1201, 14th & T Sts., N. W., Washington, D. C.

COLUMBIA SCHOOL OF DRAFTING,
Dept. 1201 14th and T Sts., N. W.,
Washington, D. C.

Without obligation to me, please send me FREE your illustrated book of particulars, testimonials from students, rates and liberal terms.

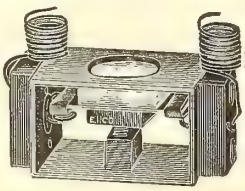
Name .....

Age .....Address .....

City..... State.....

Selenium Cells

IMPORTED CELLS

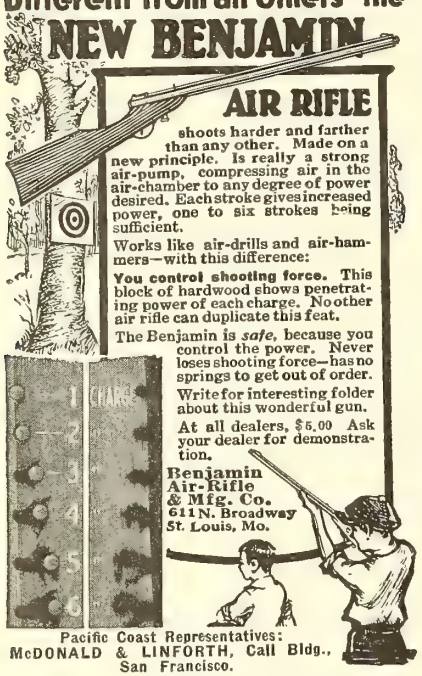
$10.00 EACH  $10.00 EACH

We have received a small shipment of very sensitive *imported* cells, of the same make as imported by us before the war. Very wide range of Resistance. Order at once.

We have also a domestic grade of Selenium Cells, selling at $6.00 each.

THE ELECTRO IMPORTING CO.
233 FULTON STREET
NEW YORK

Different from all others—the NEW BENJAMIN AIR RIFLE



shoots harder and farther than any other. Made on a new principle. Is really a strong air-pump, compressing air in the air-chamber to any degree of power desired. Each stroke gives increased power, one to six strokes being sufficient.

Works like air-drills and air-hammers—with this difference:

You control shooting force. This block of hardwood shows penetrating power of each charge. No other air rifle can duplicate this feat.

The Benjamin is *safe*, because you control the power. Never loses shooting force—has no springs to get out of order.

Write for interesting folder about this wonderful gun.

At all dealers, $5.00 Ask your dealer for demonstration.

Benjamin Air-Rifle & Mfg. Co.
611 N. Broadway
St. Louis, Mo.

Pacific Coast Representatives:
McDONALD & LINFORTH, Call Bldg., San Francisco.



Do You Want to Know

HOW TO DEVELOP

Vitality, Energy, Endurance, Nerve Strength, Muscular Strength, Perfect Physique?

My FREE BOOKS, "The Whys of Exercise" and "The First and Last Law of Physical Culture," tell you, if you are weak or underdeveloped, how to grow strong; if strong, how to grow stronger. They explain how to develop the lungs and muscles, a strong heart and vigorous digestion—in short, how to improve health and strength internally as well as externally. SEND TODAY — NOW — for these FREE BOOKS. Enclose 6c in stamps to cover postage.

PROF. H. W. TITUS
56-58 Cooper Sq. Dept. 600 New York City

RADIO CLUB PINS

Special folder of designs and prices in addition to regular School pin catalog free on request. Be sure to see these new numbers which will put new life in your club.

IOWA CITY HIGH SCHOOL RADIO CLUB

METAL ARTS CO.
Dept. 12 Rochester, N. Y.

energized by the sun, which subjects it to a continuous bombardment of electrons, causing a magnetic field to flow from the equator to the poles. It is my belief that this magnetic field of the earth makes life phenomena possible.

"Major General George O. Squire's discovery that the electro-magnetic waves set up by our radio stations can be reproduced again from living trees thousands of miles away, proves to me that the protoplasm of trees is resistant to electro-magnetic disturbances. Now, if the protoplasm of the trees is affected by movement in the earth's magnetism, is it too much to conceive that the fast circulating and electricity conducting blood of living animals may be an efficient transformer of terrestrial magnetism into vital energy? I say it is."

I looked at him curiously—I could not help it. I had always considered life as a purely physical and chemical phenomena, so that to hear him say that this apparently insignificant force which draws the compass needle to the north, was in fact the fulcrum of our existence, appeared to me, to say the least, rather startling.

But Dr. Pringle divined my attitude. "I know you consider my hypothesis a little wild. I suppose that you, like many other young fellows have been fed up on the eighty-point monism of the last century. I realize that biology and radio-activity have not yet coalesced. Medicine is not a science but a tradition. It is hardly right to call it an art. Life must be studied in the living, instead of, as is too often the case, in the dead. Professor Loeb, in his "Mechanistic Conception" I believe, was playing on the edge of a great discovery, especially when he experimented on the heliotropism, that is, light sensitiveness, of the lower organisms. He proved that sunlight had a powerful influence upon the development and conduct of these organisms. Light, as we have known since the days of Maxwell, is a form of electro-magnetic energy. Now it is my opinion that living things may be defined as mechanical organisms for transforming the solar radiations and the magnetic energy of the earth's field into the kinetic energy found in living things. The probable difference between plants and animals may be that one thrives on radiant, and the other on magnetic, energy.

"Plant life can be explained by solar energy, and so could animal life, if it were not for the fact that many species will survive the long nights of the arctic, and persist for ages in the depths of caves where the sunlight cannot penetrate. We know that we can insulate any living thing from light, but we cannot insulate against magnetism. It appears to me as an unavoidable conclusion, that the earth's magnetism is the ever available source of animal power. Animals receive their strength by a process not different from that which obtains in our dynamos. The circulation of the blood, which is a conductor, in the magnetic field of the earth, gives rise to electric currents which, functioning thru the various organs, gives rise to the phenomena of digestion, assimilation, secretion, locomotion, reproduction and sensation, in a way not essentially different to that by which an electric dynamo produces heat, light, sound, power and electrolysis. I may be wrong, but I cannot help believing that the nine fundamental characteristics of protoplasm can all be explained by the known *laws of electricity*.

"Remember that the smallest granule of protoplasm shows unceasing movement within it, and also remember that the substance is an electrical conductor. Again, remember that it lies in the magnetic field of the earth and, keeping these facts in mind, do not forget Faraday's law, that wherever a conductor moves in a magnetic

Be a Finger Print Detective



Earn Big Pay

Get into this fascinating new profession. Big salaries, rewards and fees are paid in this work. Finger Print experts needed by governments, corporations, police departments, and other institutions. Learn in spare time at home to fill one of these big jobs or go into business for yourself as a Finger Print Detective.

Book FREE Write quick for big, fully illustrated Finger Print Book. Tells all about this wonderfully interesting work and how you can easily qualify. Right now we are making an amazing special offer of a **FREE COURSE** in Secret Service.

UNIVERSITY OF APPLIED SCIENCE
Dept. 1798, 1920 Sunnyside Ave., Chicago, Ill.

RICHARDSON'S POLYPHASE SLIDE RULE



has the regular A, B, C, and D Scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case with 100 page Instruction Book $2.00.

An ideal Slide Rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10. each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO. **NILES, MICH.**



AGENTS: $6 PER DAY AND UP

Selling concentrated, non-acoholic food flavors. Always fresh. Put up in collapsible tubes. Ten times the strength of bottled flavors. Guaranteed under U. S. pure food laws. All flavors. Sells in every home. Used every day. Not sold in stores. Big repeater. 100% profit.

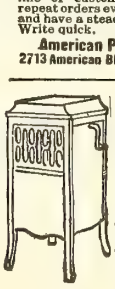
Men or Women

can make big money. Haut sold over $300 in one month. You will find this a big, easy seller and a sure repeater. Must satisfy customers or money back. Write for territory and sample outfit. Get a big line of customers. Get repeat orders every month and have a steady income. Write quick.

American Products Co.
2713 American Bldg., Cincinnati, O.



ACT QUICK WRITE TO-DAY



Cleartone Phonographs

$4.00 to $200.00 Retail

Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84-page catalogue, the only one of its kind in America, illustrating 3 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B East 12th Street, N. Y.

Learn Watch Repairing

Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates.

Ask for our Free Book. It explains our system and terms.



THE DeSELMS WATCH SCHOOL
720 Perry St., ATTICA, IND.

field, an electric current is set up in it. I sometimes fancy that life has its origin in Brownian movements, set up in suitably ionized chemical compounds which, by some chance, were set into the necessary movement of living matter. This, when acted upon by the electro-magnetic waves of solar light, gave rise to the first protoplasm. It may be that this only happened once in the earth's history, away back in the childhood of the world, and again, it may have happened thousands of times; may be happening to-day. It makes no difference. A self dividing granule of protoplasm once started in the paleozoic seas was powerful enough to become the 'Eva,' that is, the mother of all living."

He spoke with a quiet dignity and a wonderful depth of expression which gave one the feeling that this man was very sure of his ground. Rising from his chair, he said "Let us go into the laboratory. I can explain matters better where I have my tools." He led the way down a flight of stairs and into a large basement underneath the building which housed at once his office and his home. The south side of his room, between the ground and main floor, was composed of a series of windows as were the east and west walls, only to a lesser degree, —the house standing on a side hill which sloped to the south. In one corner of the room stood a large glass aquarium and before the windows in the east walls were a great array of potted plants. Before the southern windows stood a series of bench-like tables loaded with experimental apparatus. In the middle of the room was another table beside which stood a large rack filled with, what appeared to me to be, an entangled mass of electrical devices.

He walked over to the table which stood near the south-west corner. Upon it stood a microscope among an array of bottles, retorts, condensers and burettes, as well as several little electric motors with appliances for centrifugation. He picked up a glass and filled it with water from a hydrant situated over a basin built into the table. Next, he took from a box a small quantity of grayish powder which he dropt into the water, stirring it with a glass rod. This made the water slightly turbid. Then he placed a drop of this liquid on a glass slide and put it under the lens of his microscope. Adjusting the instrument to his sight he said "Look at this."

I looked and, to my surprise, saw literally swarms of tiny particles dance madly to and fro. I asked him how long this movement would last if left undisturbed and he answered that if the fluid would not evaporate the movement would go on forever.

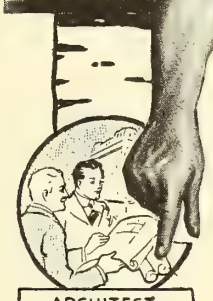
"It is the Brownian movement," he explained. "It was first seen in 1827 by an English botanist named Robert Brown. It is a purely mechanical movement, possibly typical of the molecular movement going on in the masses of matter."

He broke a small twig from a potted plant and made a very minute cross section of its stem. This he mounted on a slide and, after treating it with some kind of a stain, he again focussed the instrument. "Now, look at this," said he. "Notice how it differs from the mere random action of the Brownian movement."

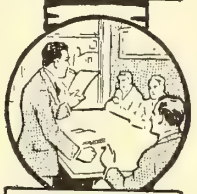
I looked again. There was no doubt the movement here was different from that which I had seen in the drop of turbid liquid. Within the cross-section of the glass there were numerous small globules and in these, tiny granules seemed to follow one another like links in a chain. They moved in circular motion, myriads of them in each little sphere. The cross-section of the plant remained one of a highly complicated machine in motion. The Doctor explained that this movement was the rotary action of granules within the protoplasmic cells. "This

"I'm A Man- I Want Man's Pay!"




ARCHITECT $5000 TO $15,000


ACCOUNTANT $7,000 TO $15,000


BUSINESS MANAGER $ 5,000 TO $15,000


ELECTRICAL ENGINEER $4,000 TO $10,000


CIVIL ENGINEER $5,000 TO $15,000


AUTOMOBILE ENGINEER $4000 TO $10,000

That is what Albert Foster wrote us eighteen months ago, and he goes on: "I'm tired of being bossed for $25 a week. I want a He-Man job with real pay. I want to get into the $100 a week class. Tell me how to do it." We showed him how. Today he has a He-Man job and He-Man pay. We tell of his experience because it's typical.

WHAT ARE YOU? A man who is up and doing, getting real money, or are you simply marking time on $25 or $30 a week? $100 jobs don't go begging. If you want one you've got to go after it. Are you satisfied with your present condition in life? If you are, we have nothing to offer you, but if you want one of these real jobs with big pay, then we can help you and help you in a hurry.

A REAL MAN with a real man's pay is what you want to be, and we will show you how. Without loss to you of a single working hour, we will show you a sure way to success and big pay. A large number of men in each of the positions listed are enjoying their salaries because of our help —we want to help you.

Make a check on the coupon against the job you want and we will help you get it. Write or print your name on the coupon and send it in today. You will be under no obligation.

American School of Correspondence
Dept. G 826 **Chicago, U. S. A.**

AMERICAN SCHOOL of CORRESPONDENCE

Dept. G-826 Chicago, Ill.
Explain how I can qualify for position checked:

___Architect $5,000 to $15,000	___Accountant and Auditor $2,500 to $7,000	___Steam Engineer $2,000 to $4,000
___Building Contractor $5,000 to $10,000	___Draftsman and Designer $2,500 to $4,000	___Foreman $2,000 to $4,000
___Automobile Engineer $4,000 to $10,000	___Electrical Engineer $4,000 to $10,000	___Photoplay Writer $2,000 to $10,000
___Automobile Repairman $2,500 to $4,000	___General Education In one year	___Sanitary Engineer $2,000 to $5,000
___Civil Engineer $5,000 to $15,000	___Lawyer $5,000 to $15,000	___Telephone Engineer $2,500 to $5,000
___Structural Engineer $4,000 to $10,000	___Mechanical Engineer $4,000 to $10,000	___Telegraph Engineer $2,500 to $5,000
___Business Manager $5,000 to $15,000	___Shop Superintendent $3,000 to $7,000	___High School Graduate in two years
___Certified Public Accountant $7,000 to $15,000	___Employment Manager $4,000 to $10,000	___Fire Insurance Expert $3,000 to $10,000

Name _____

Address _____

Be a Movie King



OH BOY! SOME SPORT
Surprise the Bunch—Have a Barrel O' Fun
Own a Genuine Moving Picture Machine

Here's what you've always wanted—a genuine MOVING PICTURE MACHINE—a machine that uses STANDARD FILM—like the Big theatres show—at a price you can easily afford to pay. This is the BIG opportunity—don't MISS it. Read every word, then act quick. Three swell models to select from. Each the best of its kind. All REAL moving picture machines—not toys or magic lanterns, but REAL Movie Machines, that show the pictures on the screen. The Films are supplied to us by the leading film companies in America, and the subjects include all the LEADING actors and actresses that you see and admire in all the big theatres. The "fellers" and girls and the grown-ups, too, will sit spellbound, or roar with laughter at the wonderful, lifelike, real movies you can show them.

Three-Reel Cinematograph

Here is an astonishing bargain. Our latest Model Cinematograph is a whirlwind value. At the price it has everything beat you ever heard of. Here is a genuine Moving Picture Machine, made entirely of metal, solidly constructed, and put together by expert workmen, that you can buy at a price that will simply astound you. It comes equipped with a SAFETY CARBIDE Gas Generator, and can be used to show moving pictures anywhere. The mechanism is so simple it can be operated by anyone. The greatest value in a Genuine Moving Picture Machine ever offered at the price. Think of it! A genuine Moving Picture Machine, using STANDARD FILMS, shipped by express, charges collect, with 3 REELS FREE, for ONLY $3.00; or shipped by parcel post to any address in the world prepaid for $3.25.



$3.00



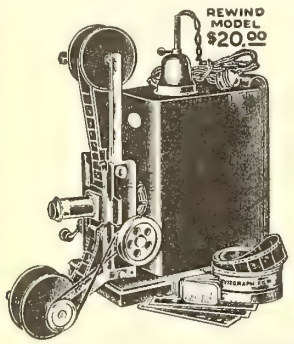
New Model Movie Machine
Your Choice of Gas or Electric Light

This is a beautiful, high-class Moving Picture Machine. Made of sheet iron with wood base. Finished in black or battleship grey with handsome red stripe trimmings. Solid and substantial construction. Size 12x7½x5½ in. Uses STANDARD FILM same as the big machines. TWO TYPES—Electric and Gas. The electric machine is equipped with plug and cord complete, ready to attach to any electric light socket. Gas machine has its own generator and makes its own light. The gas machine can be used anywhere and will be sent unless electric type machine is specially ordered. Sent securely packed in special shipping case with full instructions, film, supply of show tickets, etc., for $7.50, by express, or $8.00 if sent by prepaid parcel post.



Keystone Moviegraph
Moving Picture and Magic Lantern Combined

A regular beauty, all complete, ready for you to use the minute it arrives. Hang up a sheet, put on a reel, turn the crank, and you're off. That's all there is to it. Made of metal throughout, with heavy base casting. Finely adjusted mechanism, easily operated. Electric model only; simply screw in plug to your electric light socket and you are all ready for an exhibit. Equipped to show slides as well as Real Moving Pictures—just like the big machines. 12x9½x6 in. Comes with 3 EXTRA LONG STANDARD SIZED FILMS, 3 FINE LANTERN SLIDES, and admission tickets—all FREE. A machine you will be proud of. You can have endless fun and amusement, and MAKE MONEY with it. Sent by express, with full instructions and extra long cord and plug, securely packed, for $12.00; or by parcel post, to any address in the world, for 75c extra.



No. 2 Rewind Model
Largest and Most Powerful Model

This is the No. 2 Rewind Model, with equipment for unwinding and rewinding 100 to 200 feet of film. The size of the machine is 6¾ x 14 x 19 inches. It is constructed on a wooden base 6¾ x 11½ inches, which will not scratch the furniture. Electric model only, it operates from any electric lighting circuit. All you have to do is to screw in plug to any electric light socket. It has a regulator so that different sized lamps may be used—electric socket, plug and six feet electric lamp wire cord, and nickelled reflector. Also shows magic lantern slides. With this machine we furnish a can of 100 feet of film, three American-made Lantern Slides—subjects of which are Wilson, Pershing, Aeroplanes, Boy Scouts, Charlie Chaplin, Jiggs, Comics, etc., 100 Theatre Tickets, guarantee and full directions. **PRICE $20.00**, shipped by Express, or by prepaid parcel post to any address in the world for $1.00 extra.

Extra Films

EXTRA FILMS. For all our Machines. Big variety of subjects, including leading and best known movie actors and actresses. Standard size. **Short Reels, Price** 15 cents each. **Extra Long** (5 feet), **Price** 3 for $1.00. **Special 100-feet reels** $2.50 each. CHARLIE CHAPLIN FILMS, 25c each; 5-foot lengths, 60c each. All postpaid.

LANTERN SLIDES for Keystone Moviegraph, American made, 6 for 75 cents.

"U-MAK-EM" SLIDES. A special slide for use with the $12.00 and $20.00 machine or any other machine with Lantern Slide equipment, for showing on the screen announcements such as "Please Remove Your Hat," "No Smoking," "Intermission," "Goodnight," sporting results and even advertisements, etc. Can be used repeatedly. **PRICE** 3 for 50 cents postpaid.

JOHNSON SMITH & CO., Dept. P.M.30 3224 N. HALSTED ST., CHICAGO

OUR GRADUATES
NOW WITH

Independent Wireless Telegraph Co.
Ship Owners Radio Service
Radio Corporation of America
International Radio Telegraph Co.
U. S. Army Transport Service
American Hawaiian Line
United Fruit Co. (Tropical Radio Co.)
Panama R. R. S. S. Co.
Cutting & Washington (Mfg. Co.)
U. S. Shipping Board
AND NUMEROUS OTHERS

The Radio Operator aboard American vessels is paid One Hundred and Twenty-five Dollars ($125.00) per month. Aside from this, he is also furnished food and quarters. He is an officer of the ship and consequently enjoys the privileges that go with such a position.

Call or Write for Booklet

Y.M.C.A. RADIO SCHOOL
152 East 86th Street, New York City

"Best Radio School in the East"

Dependable Radio Apparatus

A new Tuner and a new Short Wave Set have joined the DEPENDABLE FAMILY

Catalogue Mailed for 10 Cents in Stamps

DORON BROTHERS ELECTRICAL COMPANY
Hamilton, Ohio

movement will go on as long as the essential conditions persist, and I believe that if it were possible to insulate this phenomena from magnetism that then the motion we just now observed would cease, just as effectively as if it were broken up by some powerful acid. But I must not let you forget that what happens in the uni-cell, or in the single granule of protoplasm, also happens in the commonwealth of cells we are pleased to call organized beings."

He walked across the room to his aquarium, and presently returned with a large, living frog. Holding the web of the creature's foot, he showed me its blood corpuscles trailing after one another in perfect chains through its capillary structures. "Like the granules," said he, "it looks as if they might be a sort of secondary generator,—these blood cells. They are cutting magnetism, making electrons—that's the business of living. Life is the process of generating that particular series of electrical phenomena which enables an organism to survive."

Returning his frog to the aquarium, he walked over to the table in the center of the room and took, from the rack that stood at the other end of it, a wire coil, which he connected with an ordinary one hundred and ten volt direct current circuit. "Now, this is the primary," said he, dropping into it a bar of iron, thereby showing me the power of the electro-magnet formed by the circulation of the current in the coil. Next he cut off the current and withdrew the iron; it had attained a permanent magnetism. He proved this by picking up with it a variety of iron objects about the table. Next he took a spool of insulated wire, wound on a wooden block and dropt it into the coil. Turning on a primary alternating current circuit, he demonstrated the induced current by lighting an electric lamp from the terminal ends of the spool. "Now," he continued, "do you see how this secondary, cutting the lines of force generated by the primary, evolves this induced current. Without motion, that is, without the expenditure of energy, we cannot produce electricity." Picking up the iron bar which he had just magnetized, he said "this is a magnet, not unlike that wire coil when it is excited, but when I place this magnet within the coil it will not give rise to an electric current except just at the instant that I drop it in." He disconnected the coil from the mains, and reconnecting its terminals with the wires of a galvanometer, he bade me watch the needle. There was no doubt that when he dropt the magnet thru the coil the needle of the galvanometer was deflected. But when the magnet had come to rest there was no further motion visible.

He seated himself upon a stool and fingered the instruments that laid upon the table. "Motion is necessary to form electrons and when once they are formed we can make them perform miracles by simply varying their volume, pressure and frequency."

He now proceeded to show me how, by means of electricity, he could separate compounds, produce spectacular sights in vacuum tubes, make magnets with which to bend streams of electrons from their courses and affect objects apparently at a distance; and he remarked casually that some day he would devise an instrument that would reveal man's unspoken thought.

Returning to his subject, he said, "We were talking of the protoplasmic granule and of the fact that it apparently had within it the physical requirements for generating electric currents. It is significant that these granules or cells combine and organize to form the higher organisms—that they develope a circulatory mechanism carrying a fluid, the conducting power of which is capable of cutting the lines of force in the

magnetic field of the earth, with the result that they give rise to experimentally demonstrable electric phenomena. Dr. Brown Sequard, years ago, proved that the muscles of human beings carried distinct and relatively powerful currents. A noted German physician has defined health as being the electro-positive condition of the cells constituting our bodies. I have proved to my own satisfaction that all animals are electro-positive, differing only in degree according to their biologic requirements. For instance, in certain fishes special electrical organs are developt to such a degree as to constitute an effective weapon of defence."

Leaving the stool upon which he had been seated, he walked over to the northern wall and showed me a chart depicting the venous and arterial structure of man. Pointing to the apparently entangled network of red and blue lines, he said "Man's blood circulates—that has been known for three hundred years. The earth has a magnetic field—that has been known for six hundred years. An armature rotating in a magnetic field cuts the lines of force, producing electric energy—that has been known for seventy-five years. But so far as I am aware, no one ever seriously tried to connect these different branches of knowledge in an effort to solve the phenomena of existence. If a man were a tree rooted in the earth, and fed by the rain and the breeze thru the medium of sunlight, he would not need the circulatory mechanism. But it is man's lot that he must chase, work and compete for everything he needs. He therefore needs an effective dynamo by which to evolve the required energy.

"It follows that man is sick or well, strong or weak, in proportion that he is a good or bad transformer of magnetism into that form of electrical energy we call life. I may be wrong, but to my mind there can be no other conclusion when I consider life in the light of modern chemistry and physics.

"To any person who gives the matter serious thought, it is evident that food alone does not account for the energy expended by a normal human being. We often notice small eaters who are tireless workers, while the phlegmatic nature of the gormand is proverbial. The amount of heat generated; the amount of energy expended by people who eat and exercise normally; to say nothing of those who fast for days and weeks or those who perform monstrous feats of strength and endurance, cannot be accounted for on the theory of combustion. I feel myself forced to the conclusion that animals are transformers; instruments of a wonderful complexity for the production of all reactions essential to their growth and survival.

"Take for instance the composition of human milk, or the milk of any other animal for that matter, and in it you will find all the essential elements for the growth and development of the offspring so arranged that the electro-positive and electro-negative elements will, when acted upon by electric currents in the various fluids of the body, tend to combine into compounds essential to the structures of the various organs. Electrolysis will yet explain many of the present mysteries anent digestion, nutrition and metabolism. Everything in nature sug——"

An angry voice from the head of the stairs shouted "Doctor, Doctor, are you ever coming to eat? Dinner has been waiting for half an hour. There are three patients in the office. When will you ever attend to business?"

The Doctor shrugged his shoulders. "Science, business, and domesticity are hard to mix," said he, as he showed me out of the basement door.

LEARN WIRELESS AT HOME

The Demand for Wireless Operators Far Exceeds the Supply

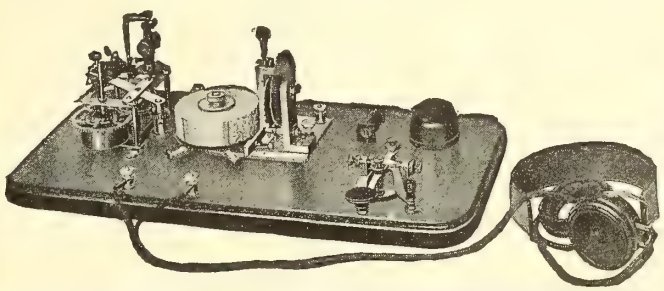
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, Chief Radio Inspector, Bureau of Navigation, N. Y. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way, will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free,* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do,* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* **This set is not loaned, but *given* to all students completing the Course.**

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph,* place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—*but do it today.*

NEW YORK WIRELESS INSTITUTE
Dept. 12, 258 Broadway
New York City

New York Wireless Institute
Dept. 12, 258 B'way, N. Y. City

Send me free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your *Free Instrument Offer.*

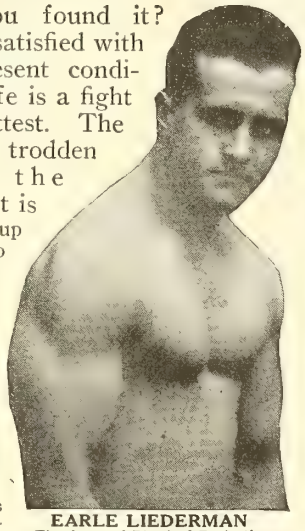
Name .....

Address .....

City or Town.....State.....

The Road to Strength

Have you found it? Are you satisfied with your present condition? Life is a fight of the fittest. The weak are trodden down by the strong. It is therefore up to you to prepare yourself and build up that body of yours for the fight. Enter the conflict and be a success. No one cares for the failure.



EARLE LIEDERMAN
The Acme of Physical Perfection

Be a Man of Strength and Power

What I have already done for thousands of others I can do for you. I will broaden your shoulders, deepen your chest (increasing your lung power), enlarge your arms and strengthen every muscle of your body. I will fill you with vim and pep so that you will be admired for your perfect physique and dominance of strength.

Send for MY NEW BOOK

"Muscular Development"

It tells the secret. Handsomely illustrated with 25 full page photographs of myself and some of the world's best athletes whom I have trained. This valuable book and my special offer will be sent on receipt of 10c, stamps or coin, to cover cost of wrapping and mailing. Don't delay! Send for it now, while it is on your mind.

EARLE E. LIEDERMAN

Dept. 210 305 Broadway New York



Here's the new **"Big City" Style Book—the only Book of its kind in America**—showing large assortment of actual Cloth Samples and all the latest styles in Men's Made-to-Measure Clothes together with a complete assortment of Shirts, Ties, Hats, Shoes, Collars, Sox, Sweaters, Jerseys, etc.,etc. This Book shows you how to get everything you wear **direct from the manufacturer at inside wholesale prices.** If you want to **dress well** and **save money,** get a copy of this Book—**TODAY.** Yours **FREE** for the asking. Address Dep't. B65

WRIGHT & COMPANY
Congress, Throop & Harrison- CHICAGO

FREE



$20

TENOR BANJO Ukulele, Hawaiian Guitar, Violin, Mandolin, Guitar, Cornet or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.

SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 41 , CHICAGO, ILL.

Electrical Machinist

By H. WINFIELD SECOR

(*Continued from page* 754)

of the magnet will vary as well as the dimensions and winding of the magnet coil. In some cases a small outfit of this kind will serve its purpose, while for other conditions a much larger one will be needed perhaps. A simple way of designing the magnet is to obtain a field coil from an old motor. If you can obtain one of the two shunt field coils from a bi-polar 220-volt D.C. motor, then this coil will be satisfactory to operate on 110 volts D.C. Once you have the coil, you can then design the iron frame, which can be constructed from wrought iron or soft machine steel stock in one piece or more and bolted together with machine screws if the central core and the outer annular pole member are constructed separately.

The usual way to build a magnet of this type is to construct a wooden pattern and have the whole iron frame cast in the foundry. Cast iron will do, but for a given size of coil the magnetic pull or attraction will be about double if the magnet frame can be cast of steel. Therefore, it is strongly suggested that the frame, if it cannot be cast in a steel foundry, be made in the machine shop by turning out a groove in a piece of flat machine steel stock, probably 2½ inches thick and about 7 to 8 inches in diameter. The coil in this case could measure about 2 inches deep and about 1 inch thick—having an outside diameter of from 5 to 6 inches. It is a simple matter to calculate this coil for a given voltage, allowing 1,000 mils cross-sectional area per ampere of current so that it will not overheat.

Magnetism is proving a great ally, indeed, to the machinist, and other uses of the electro-magnet are shown at Figs. F and G. It is often difficult to support an electric lamp in the desired position near the machine work, but with the model shown at F, provided with a magnetic base, this difficulty is at once obviated.

The magnet at the base of the lamp is excited by the magnetizing coil, about 1½ inches in diameter and 2 inches long, wound with a fine gage of insulated magnet wire, which can be connected in series with the lamp. About No. 26 or No. 28 B. & S. gage enameled or other insulated magnet wire will be found useful, all depending upon the candle-power or wattage of the lamp used. The coil is placed on an iron core about ¾ inch diameter, the magnetic flux passing thru an iron ring at the base of the core and returning thru the outside annular iron pipe which acts as the second pole of the magnet. The magnetic flux passes thru the iron against which the lamp is placed and returned, to the central pole in the manner readily apparent, thus securing a firm grip on the frame.

The lamp is protected when not in use (as when carried in a tool bag, etc.) by a rotating metal or fiber sleeve having one or two slots cut into it, in the manner illustrated, and which method has been described in detail in a patent issued to the writer several years ago, both for single and double lamp test units.

Frequently it occurs that a broken drill, tap, or some other tool drops in the bottom of a deep hole in a machine and cannot be readily extricated. By using a piece of tool steel rod (any other steel will do) and magnetizing this rod by means of a magnet coil placed on the upper end of it, the iron or steel part in the bottom of the hole can often be removed without further trouble.



Be an ELECTRICAL SIGNAL ENGINEER

FREE BOOK TELLS HOW

Big positions open now for Signal Engineers. You can qualify for this fascinating, highly-paid work in your spare time at home. Railroads everywhere need men who understand Signal Engineering and electrical safety devices.

$2500 to $5000 a Year

Earn a big salary right from the start—enjoy quick success and swift promotion. We train you in every branch of this great profession, including a complete course in

Practical Electricity

Write today for handsome FREE Book on Signal Engineering and details of our amazing Free Signal Engineers' Outfit. Address

DEPARTMENT OF SIGNALING, DEPT. 1798, 1924 Sunnyside Avenue, Chicago, Ill.

"EARN WHILE YOU LEARN"



If you are earning less than **$100.00 PER WEEK** and like to draw—you should study

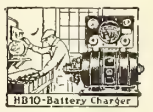
Commercial Art

Leading Art Managers—the men who know — recommend us and employ our students. We will guarantee to make you successful—Learn at home in your spare time—or in our resident school—Day or evening. Many of our students earn money by the sale of their drawings while learning. Write for FREE illustrated catalogue.

COMMERCIAL ART SCHOOL
708, 116 So. Michigan Avenue, Chicago, Ill.

BIG PROFITS for You in HB BATTERY CHARGING

Profits of $100 to $300 a month are easy—hundreds of letters from HB users prove it. Cost 4c to 12c per battery—customer pays 75c to $2.00. There is a sturdy, reliable, economical HB Charger to fit any size battery business.



Mark a cross (X) on the outfit suited to your needs. Then tear out this ad and mail TODAY for complete information. Small cash payment—balance easy monthly terms. *Get busy.*

HOBART BROTHERS COMPANY
Box 117E Troy, Ohio

Don't Wear a Truss



We Guarantee Your Comfort

with every Brooks' Appliance. New discovery. Wonderful. No obnoxious springs or pads. Automatic Air Cushions. **Binds and draws the broken parts together as you would a broken limb.** No salves. No plasters. No lies. Durable, cheap. Sent on trial to prove it. Full information and booklet free.

C. E. BROOKS
203D State St. Marshall, Mich.

$2 Now!



"Hear Me All Right?"

"Yes, couldn't be better—I hear every word and even whisper now, clearly, distinctly and without the slightest effort since I bought the

"THERAPHONE"

This marvelously powerful Receiver Earpiece is Tuned to the Ear. It means action, progress, accuracy, satisfaction and is a blessing to both office and home. Prevents mistakes, conserves energy, saves time and money. Put one on your phone today and be convinced. $2 delivered. Satisfaction guaranteed.

EVOLUTION PHONE CO., Inc., Dept. 11, 48 Greenwich Ave., New York

Learn the Sign-Show Card Business



Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.

EARN $25. TO $75. WEEKLY

You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.

DETROIT SCHOOL OF LETTERING, 531 D.S.L. Bldg., Detroit, Mich.

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

IMPORTANT NOTE TO CORRESPONDENTS

We receive from thirty to fifty letters requesting advice on patents every month. Due to lack of space, even tho condensing this department into the smallest type, we can only publish from eight to ten letters, with their answers, monthly. Obviously we are falling back further and further, and it looks as tho we will never be able to publish all the requests.

For this reason we would urge correspondents to avail themselves of our special service, as outlined above. In that case an immediate answer will be assured.

EDITOR.

SCRAPER.

(419) G. Brennan, New York City, writes:

I would like to have your advice as to the patentability of the following idea and if it would have a good market.

I am an electrician and I have considerable trouble with the scrapers which we use in taking up floors. The trouble is it is very difficult to withdraw the scraper from two tight pieces of flooring as one cannot get a grip.

The enclosed drawing shows a device in which the scraper would be clampt by four screws. This device would save considerable time and labor and would be easier to work with.

A. A very good idea and economically sound. Our correspondent should not have any trouble in securing a patent on this idea.

TEMPERATURE DEVICE.

(420) Marvin Wilson, Nashville, Tenn., has the following to say:

I inclose herein a diagram of an invention and wish to know whether you think I could obtain a patent on such a device.

The object of it is to ring a bell in case the temperature of a place became too high or too low by the use of platinum points protruding thru the tube so that when the mercury in the thermometer rises high enough to complete the circuit, the bell will ring.

Would like also to know if it is necessary to have a model in order to obtain a patent.

A. There is nothing new contained in this idea. It is quite old and well-known. Many such devices are on the market now which ring the bell either at minimum or maximum temperature as desired for various work. We do not think it would pay to either make a model or apply for a patent on it.

AUTO DEVICE.

(421) Richard S. Gregory, Fulton, Ky., advises:

I am enclosing sketches of a device which I have invented and wish your advice as to its practicability. As you know, doubtless, when a Ford is running in high speed or pulling in low gear, the headlights are very bright, and when at low speed they are very dim, almost useless. My device is intended to keep them at the same brilliancy at all speeds.

The device is a rheostat attached to the steering column and throttle lever and electrically connected in series with the headlights. The rheostat lever is fastened to the throttle lever so that when the speed of the engine is increased the resistance of the lighting circuit is increased, thus absorbing the excess voltage caused by the high speed of the engine and maintaining the lights at their usual and best strength. Because the voltage of the magneto at low engine speed is insufficient for good lights, a step-up transformer of the proper size is placed in the circuit.

It seems to me there ought to be a good future for a device that would correct this great flaw in the Ford's lighting system.

A. This indeed is a good idea, and we are sorry that we have not the room available to show the constructional features of this device. If it can be marketed at a low cost, there is no reason why there should not be a large demand by Ford users for this device. We think there is a demand for it, and we believe a patent can be obtained on the constructional features. As a precautionary measure, however, we would advise our correspondent to seek the advice of a patent attorney.

DETECTOR.

(422) Diran Heghin, Wilmot, S. D., writes as follows:

I would like your opinion of the practicability of obtaining a patent on the following galena detector.

On an insulating base two columns are erected and a crosspiece is secured across their upper ends. On one column a brass or copper strip is fastened which projects about half way across the space between the columns. On this is placed the crystal cup.

On the opposite post another strip is mounted on the end of which is the catwhisker which makes the contact with the crystal. The pressure is controlled by a thumbscrew mounted in the crosspiece. This detector is very suitable for portable work as it will not jar out.

A. There is nothing fundamentally new shown in this detector. The double spring arrangement, we are quite sure, instead of keeping the adjustment of the detector would jar out on the slightest vibration. Another objection we find is that no good adjustment can be readily made on the detector as submitted.

USING PATENTED DEVICES.

(423) Sidney C. Holman, New Orleans, La., seeks the following information:

I have read many of your valuable magazines since the year 1914 and have enjoyed them to a high degree.

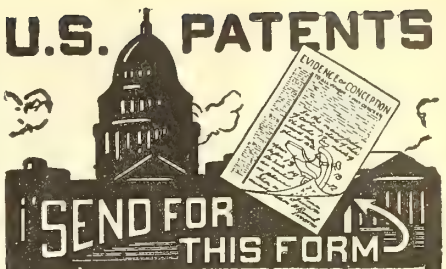
I have a question regarding the usage of an already patented article to be used as an accessory and method of obtaining same.

(1) I have an original idea of a new type of "Water Heater" and I would like to know if I can use an already patented burner as a source of heat (kerosene burner)?

(2) The burner would then become an accessory to the improved heater, would it not?

The burner has nothing to do with the original usage of the heater. Any burner may be used

U.S. PATENTS



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St. San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... *Address*.....

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—**"Inventions and Trade Marks, Their Protection and Exploitation"** and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. **A postal will do—it is free.**

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

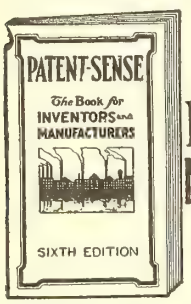
Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c



"The Book for Inventors and Manufacturers"

SIXTH EDITION.

By return mail FREE. Write LACEY & LACEY Dept K. Washington, D.C.

PATENTS C. L. PARKER Formerly Member Examining Corps, U. S. Patent Office. PATENT LAWYER McGill Bldg. Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The **Scientific American** should be read by all inventors.

MUNN & CO., 618 Woolworth Bldg., N. Y.

Tower Bldg, Chicago, Ill. 625 F St, Washington, D.C. Hobart Bldg., 582 Market St., San Francisco, Cal.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, **HOW TO GET YOUR PATENT.** Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.

Dept. 172 Washington, D. C.

WILLIAM C. LINTON

Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.

OFFICES

364 University St. Montreal, Canada

919 F St., N. W. Washington, D. C.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

as the originality lies in the construction of the coil and its unique application to a now widely marketed commodity.

A. The patent laws are very specific in a case as explained by you. If you wish to use a device that has already been patented by someone else, the only way to do so is to obtain permission from the patentee. You may have to, at his request, buy his patent outright, or pay him a royalty, and then you will be in a position to use his patent. Of course, that does not hold good in every case; as for instance in your case you can perhaps *buy* the device in the open market and thus use it in connection with your device without infringement.

Let us give an example. The present electric bulbs are all covered by patents. You will find no trouble to buy these in the open market and use these patented bulbs in connection with any device you see fit to use it as long as in so doing you do not actually infringe upon the patent of the electric bulb. If you would constructionally *change* the electric lamp bulb and then re-market this bulb, you would then infringe on the patentee's rights. For instance, it was found some years ago that you cannot take an electric light bulb, open it up and make certain changes in it, and re-market this new product without infringing on the original patent.

FARADIC DEVICE.

(424) Frank Heydon, Ponca, Nebr., says:

I inclose a diagram of an apparatus for the application of Faradic current directly from an alternating or direct current house-light socket.

As is shown by the diagram the contrivance consists merely of resistance coils with sliding contact in circuit with the person to whom current is being applied. A lamp bulb is in series for protection of fuses, while another bulb is in parallel and acts merely as an indication of the amount of current flowing thru the resistance. What do you think of the originality of this arrangement?

A. Your idea is not very practical. We think it is dangerous to operate such a device as shown by you direct from the 110-volt alternating current merely by using resistances. The danger is that someone might be hurt seriously by using such an appliance, having only a lamp in series with the device. We do not think it would give the user enough protection. Nothing short of some sort of a transformer arrangement, such as a Tesla coil, in our opinion would do the work right, and such devices are of course well-known and covered by patents.

AERIAL.

(425) Harold Beach, Winthrop, Mass., has submitted a plan of an aerial to us whereby instead of bunching the four wires near the lead-in together he brings each wire separately to a switch which enables him to cut in any section of the aerial, either all the wires or any combination of them. He asks our advice on the patentability and practicability of the aerial.

A. There is nothing new contained in this idea. It has been described as far back as 1908 in "Modern Electrics" and later in back issues of the ELECTRICAL EXPERIMENTER and other radio papers.

TROLLEY WHEEL.

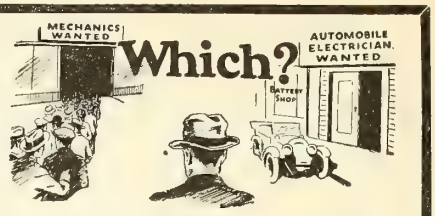
(426) Maurice Goldberg, St. Paul, Minn., submits a design of trolley wheel of which the principle consists of a ball and socket joint beneath the trolley wheel. The idea is that the trolley wheel will then be able to swing in any direction easily and freely, and will thus keep readily on the trolley. In explanation he says:

I notice in your valuable magazine that inventors of any degree should leave the trolley wheel alone in their experiments. However, I am enclosing a diagram of a trolley wheel which would work on a ball and socket principle, the design to be altered at will. I think that this wheel would keep on the trolley wire. Please tell me what you think about it, and if it is patentable.

A. We have not changed our opinion. We would strenuously advise inventors to leave trolley wheels severely alone. There are altogether too many patents on trolley wheels today, and the hard-headed trolley engineers insist in sticking to the old fashioned wheel because they have found from experience that the present wheels in the long run are the best. Any attachment to a trolley wheel is not looked upon with favor by the traction companies. Thus, a ball and socket joint would not be a good thing to have in the winter when it would easily be put out of order by sleet or ice formation.

COLORADO MINES PRODUCE BULK OF WORLD'S RADIUM.

Colorado being the chief producer of radium in the world, and the only producer while the war was in progress, it is of interest to note that the total supply of radium in the world to-day is estimated to be four ounces—an amount hardly sufficient to fill the cup from which you drink your morning coffee. The total annual production of the metal thruout the world is now about one ounce, and comes chiefly from the carnotite ores of Colorado. The present value of this annual output, which can be held in a tablespoon, is in the neighborhood of $3,000,000, or $93,750 per gram.



Should the time come when you have to be looking for work, do you want to be competing with a crowd of mechanics for an **ordinary job** or do you want to be able to take a **position** as head of an automotive electrical shop? The only difference lies in your training—in your preparation now.

Learn AUTOMOBILE ELECTRICITY at THE ONLY SCHOOL

Devoted Entirely to Teaching This New, Profitable and fast growing branch of the

AUTOMOBILE INDUSTRY

A wonderful opportunity to prepare for good positions or a business of your own.

Only 20 Men to a Class 8 Weeks' Course

New Class Every 2 Weeks

Write for Catalog and Date of Next Class Open

C. J. Buckwalter, Pres.

AMBU ENGINEERING INSTITUTE

901-1601 S. Michigan Ave. Chicago

PATENTS

Write for free INVENTOR'S RECORD form for establishing the date of your Invention, and INVENTOR'S BULLETIN Confidential Service

WM. H. MULLIGAN, PATENT LAWYER
110 Woodward Bldg. Washington, D. C.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287. TALBERT BLDG., Washington, D.C.

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?

Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.

1926 Broadway, New York

PATENTS & TRADE-MARKS

—FREE BOOKLET ON REQUEST—

MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES —

WARNER I. CUBBERLEY—PATENT ATTORNEY
22 NATIONAL UNION BUILDING
WASHINGTON D.C.

SAVE 25% to 60%

on slightly used **GRAFLEX-KODAKS**



Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. **All goods sold on 10 days' Free Trial.** Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.

CENTRAL CAMERA CO., Dept. 1111 124 S. Wabash, Chicago

BE AN EXPERT

Penman

Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. Complete outline FREE. Write C. J. Ozment, Dept. 44, St. Louis, Mo.

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. **Only finest approval sheets, 50 to 60%. Agents Wanted.** Big 72-p. Lists **Free. We Buy Stamps.** Estab. 25 yrs. **Hussman Stamp Co., Dept. 118, St. Louis, Mo.** **10c.**

Coney's New Topsy-Turvy Wheel

By I. KUTTNER

(*Continued from page* 745)

going to have at least one ride on this great revolving wheel and see how it feels to be rolled up into the higher atmosphere to a height of what appears to be several hundred feet, from which advantageous point you should have a most bewildering panorama of the Island, as well as Greater New York, spread out before you—the tens of thousands of electric lights blinking and winking like millions of fire-flies in the night.

As you gradually draw closer you perceive that around the outer perifery of the wheel there are a series of fixt cabs or coaches carrying passengers, which simply swing on their pivots as the wheel rotates around, but every few seconds several of the cars in different parts of the wheel suddenly take a big dip and you almost lose your breath watching them.

Finally you arrive at the base of the huge revolving star wheel, and, asking one of the attendants as to the height attained, you are startled to find that it rises for 150 feet from the ground.

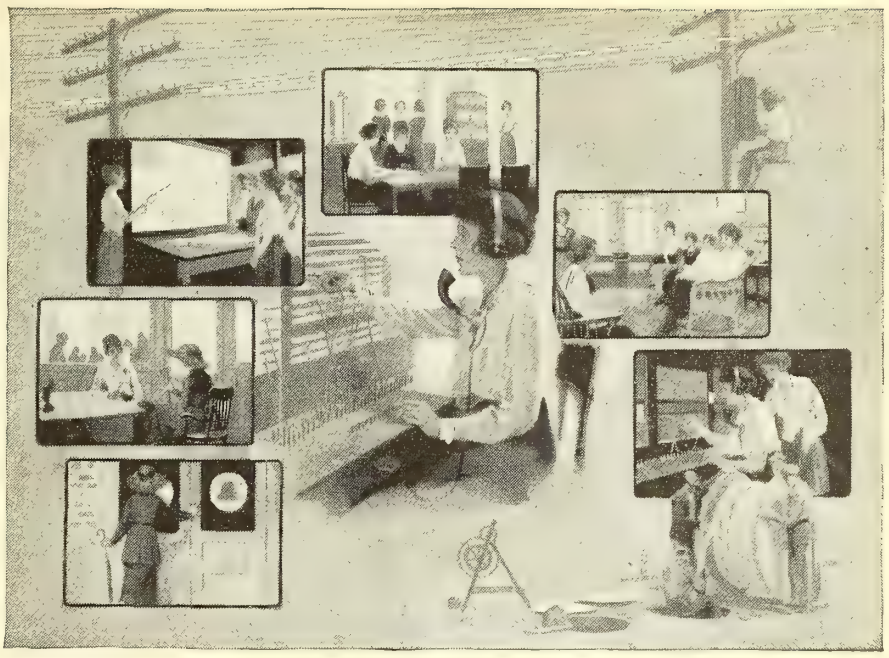
So you pay your fare and enter one of the "Dip-the-Dip" cars (these cars being loaded one at a time); you are securely strapt into your seat in one of the "dip cars" with your companion and two other passengers. Somewhere the man in charge of the wheel has pushed an electric button and the great circular steel structure commences to revolve. You ascend slowly—rise ten feet, then another ten feet, and the position of your car has hardly changed. You ascend ten feet higher and your car is ready to make its first dip—it commences to slide a little bit and—before you know it—you have reached a forty-foot level. Whzzz-zzzzz-zz-sss! With a rush of wind and a catch of your breath, down you go in a startling yet withal pleasant and graceful glide toward the center of the wheel, making a dip of about forty feet.

Your "dip car" now hangs on the inner circle and you keep on moving around as the wheel turns and ascend to a height of 120 feet from the ground. (The non-dip cars reach a total height of 150 feet from the ground.)

Shortly you find your car in position for making a second "dip." Here's a real thrill that you have probably never enjoyed before—at least not at this great height! For now your car dips from the inner to the outer circle, and, if anything, the car travels faster on this "dip" than on the previous one.

At the moment of writing, the structure rapidly nears completion. The mammoth wheel is built of structural steel thruout. It measures 130 feet in diameter and weighs 150,000 pounds. The eight massive steel supporting columns rise 73 feet from the ground and rest upon two reinforced concrete foundations of huge size. The wheel itself is supported by two sets of vertical steel columns on an axle measuring 20 inches in diameter and 20 feet in length. The structure will have a foundation of 240,000 pounds in weight, and is said to be the largest of its kind in the world. The total height is 150 feet above the ground.

The wheel is driven by an electric motor rated at 40 horsepower, thru a series of reducing gears. This motor rotates on its center bearing the great circular structure by means of a gear fastened to the steel frame of the wheel, 80 feet in diameter. The entire operation of the wheel is designed to be controlled by one man, including the propelling as well as the loading and unloading of the passengers.



Training For Service

What science and engineering have done to develop the mechanical efficiency of the telephone, specialized training has done in the development of workers.

Plant engineers, linemen, directory clerks, toll operators, equipment installers, electrolysis engineers, trouble hunters, line repairmen, test table operators, chief operators, contract agents, building engineers, line installers, exchange repairmen, plant inspectors, trouble operators, fundamental plan engineers, draftsmen, estimate clerks, exchange operators, cable testmen, equipment inspectors, wire chiefs, traffic engineers, galvanometer men, cable splicers, facilities engineers, surveyors, information operators, switchboard installers, accountants, testmen, supervisors, station repairmen, equipment engineers, directory operators, statisticians, appraisal engineers, routing operators and scores of other skilled employees are specially trained for the exacting work of providing telephone service.

Throughout all work of telephone construction and operation there is a ceaseless endeavor at mastery of service that makes for improvements beneficial to the public.

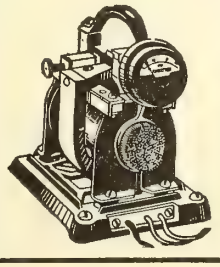
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

And all directed toward Better Service

BATTERY CHARGED AT HOME FOR 10c WITH THE F-F BATTERY BOOSTER

IT PAYS BIG



or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current.

Bantam type 6-6 amp. 6 v. battery..	$15	**Bantam** type 12-5 amp. 12 v. battery.	$20
Type 16-8 amp. 6 v. battery.....	24	Type 112-6 amp. 12 v. battery.....	24
Type 166-12 amp. 6 v. battery.....	32	Type 1612-7 amp. 12 v. battery.....	32
Type 1626-12 or 7 amperes in combination for both 6 and 12 volt batteries.....			48

Shipping weight complete with **Ammeter** and **Battery Clips.** 11 to 15 pounds.

The higher charging rates are best for the larger batteries or where time is limited.

Battery is not removed or disconnected from car.

Include postage and insurance with remittance for parcel post shipment.

Also other F-F charging apparatus that operate on Farm Lighting Plants and Direct Current.

Battery Stations Use the F-F Rotary Rectifier for Group Charging.

SEND FOR BULLETIN NO. 12

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

Listen TO ME!



Be A CERTIFICATED ELECTRICIAN

THIS IS YOUR CHANCE OF A LIFE TIME

I am Chief Engineer of the great Chicago Engineering Works. I am in close official touch with the electrical world. I know how badly we need trained electricians who can take charge of important work as experts. Right now there is such a need for executive electricians that I am making a special effort to help meet the demand. I am publishing this special announcement to secure a certain number of ambitious men whom I will personally train by mail for the wonderful opportunities that are open.

I WILL MAKE YOU a Trained Electrician

I don't care how young or old you are, just as long as you can read and write and have a spark of ambition. I don't care where you live or what you do. I don't care if you don't know a blessed thing about electricity. Just give me a little of your spare time for a short period and I'll show you the quick way to success in electricity. You can qualify to earn $65 to $175 a week with opportunities for greater earnings.

I Train You By Mail!

Your spare time will do. No interference with your regular duties. I understand just what you must know and I have devised a wonderful way of instructing by mail. I positively guarantee your satisfaction.

FREE Wonderful Electrical Outfit

Absolutely free. Not a penny cost to you now or later. To those who enroll now I will give a wonderful set of Electrical Equipment with my compliments. Write me at once. I have only a limited number of sets to be given free. Drop me a post card or letter.

Write! You will have to act quick to get in on this opportunity. Write me today for full particulars. Drop me a post card. *Write Now.*

CHIEF ENGINEER COOKE
Chicago Engineering Works
Dept. 520x
1918 Sunnyside Ave. Chicago, Illinois

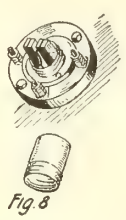
Home Electrics

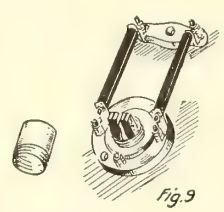
By G. L. HOADLEY, M. E.

(*Continued from page 743*)

which guards against both power currents and lightning. The proper location for the lightning arrester is just outside of the building under a protected porch where the arrester is not exposed to rain and is not likely to become damp. If such conditions are impractical then place the arrester inside the building, preferably on a dry basement wall at the point where the line wires enter. If this practise is followed there is very little danger of fire, of grounding or of personal injury. Figs. 10-A and B show the method of wiring a two party set and arrester, on both the *grounded* (one-wire and ground) and full metallic or two-wire systems.

Ground Wire:—In connecting the ground rod, Fig. 10, to the lightning arrester, use single-braided, rubber-covered copper wire and run it straight, with just as few bends as possible. Use porcelain tubes, g, Fig. 14, if the ground wire must pass through the building wall to the arrester and keep the ground wire from touching the house at any point by the use of porcelain knobs, f, as shown. Avoid at all costs spiral coils, knobs or sharp bends in the ground wire, and *never enclose it in an iron pipe!*


Fig. 8


Fig. 9

Figs. 8 and 9 (above) Show Two Types of Carbon Block Arresters for Telephone Circuits

Ground Rod:—A ½-inch galvanized iron rod driven 6 feet into permanently damp earth makes an excellent ground connection for the arrester. Solder the ground rod at the top to the end of the ground wire and make certain that the earth near the rod remains moist thruout the dry season of the year. In towns where water pipes are available attach the ground wire to a water pipe by a ground clamp or thoroly clean the water pipe and tin it with resin flux solder and then wrap the ground wire tightly around it and solder the wire firmly to the pipe. Steam or hot water pipes must not be used for a protector ground. Gas pipes may be used if connection is made back of the meter towards the street mains.

Inside Wiring:—No. 19 B.&S. gage twisted pair copper wire with an outer insulation of cotton braid and an inner rubber covering should be used for connecting the telephone set with the protector. No. 18 B.&S. gage wire is large enough for ordinary runs for other telephone inside wiring. The method of fastening the wire to the wood is important. Probably the best all around method is to use zinc coated, insulated, saddle staples as shown in Fig. 11. They are as cheap in the long run and have the advantage that both wires can be safely held under one staple, thereby saving time. They are square on top also, making them easy to drive and secure the wire well at the corners. In stringing a long straight run, one of these saddled staples at the end can be used to advantage to hold the slack until intermediate staples are placed. Care should be used to obtain the right length of staple for any given conditions. Table 1 following is a good guide.

YOU Can Do YOUR Own SOLDERING and All Metal Repairing With

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR



95c PER TUBE
TORCH $1.25

A PASTE THAT TURNS INTO METAL WHEN HEATED
A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.
SOLDERALL CO., Dept. E,
129 Sussex Ave., Newark, N. J.
COMBINATION SET Tube and Torch Complete $1.50
Dealers Send for Quantity Prices.
Look for Trade Mark "SOLDERALL"
Beware of Imitations with similar names

Learn Autos & Tractors **Earn** $100 to $400 Per Month

Qualify right away for a good paying job and bright future in the Auto and Tractor field. At our great school, under expert instruction, you can learn to operate, adjust and repair all makes of Autos, Tractors, Trucks and Gas Engines, including complete automotive electricity. Low tuition now. Work with actual tools. Write at once for particulars.



FREE A fine kit of 29 tools given to everyone who enrolls now. Send for free book. Get full information.
MILWAUKEE MOTOR SCHOOL, Dept. 1168
555 Downer Ave., Milwaukee, Wisconsin

GET BIG BUSH OFFER

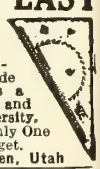
We do not deal through distributors but County Agents only. GET OUR BIG MONEY CATALOG TODAY. Don't wait! Learn how you, in your spare time can make Big Money, introducing Bush Cars in your County. The cars with Money-Back guarantee. Bush light four and De Luxe six. Don't wait. Write today!



Big Money-Making Offer for County Agents Only

BUSH MOTOR CO., Chicago, Illinois, Deptp. 15 Bush Temple

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only One Dollar Postpaid. Order today before you forget.
Dept. J, L. J. LEISHMAN CO., Ogden, Utah



$4 AND $5 WILL BUY
a month
A Standard, Guaranteed
TYPEWRITER
With Every Modern Writing Convenience
WRITE TODAY FOR ILLUSTRATED CIRCULAR
Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

WHY DON'T YOU WRITE THE WORDS FOR A SONG
WE'LL HELP YOU ALONG
By composing the music Free and publishing same. Send poems to-day.
D. N. LENOX CO., 271 W. 125th St., N. Y.



PIGEONS PAY
They build their own nests and work for you 11 months in the year. A few good pair of pigeons now will bring you a good sized, profitable squab farm next season.
Write today for circular.
PIGEON SUPPLY HOUSE, P.O. Box 251, Hanover, Pa.

TELEGRAPHY
(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.
DODGE'S INSTITUTE A Street, Valparaiso, Ind.

Be an Artist
Comics, Cartoons, Commercial, Newspaper and Magazine Illustrating, Pastel Crayon Portraits and Fashions. By Mail or Local Classes. Write for terms and List of successful students.
Associated Art Studios, 111 Flatiron Bldg. New York

TABLE I. See also Fig. II.

o.	Width inside of saddle W	Length L	Kind of Wood
.....	3/32 in.	19/32 in	Hard Wood
.....	3/32 "	13/16 "	General Use
.....	3/16 "	11/16 "	Hard Wood
.....	3/16 "	13/16 "	General Use
.....	3/16 "	15/16 "	Soft Wood

Appearance:—In inside wiring for telephones the completed job should always present a neat appearance. To this end conceal the wires wherever possible. Where concealment is impractical run the twisted pair along the door- or window-casing against the plaster, under the picture moulding or in the groove at the top of the baseboard. In attics or in basements avoid damp or wet locations and either select a seldom frequented place for the wires where they will not be likely to get injured by a person doing ordinary work in the room, or else protect them by boards or an inverted trough. In crossing water pipes, gas pipes, etc., run the wires above the pipes and protect by wrapping two layers of friction tape around the wires, letting it extend out 1 inch beyond each side of the pipe. When splices are required it is better to solder the joints, using only resin flux solder.

Connecting Telephone to Line:—Bare wire used as "drops" should be the same size as the line wire and should be deadended as illustrated in Fig. 12, with their ends left long enough for easy connection to the line wires on the pole as shown in Fig. 13 and to the "leading-in" wires on the house as shown in Fig. 14. If the wires run on the outside of the house down to the basement before entering the building, they should be insulated from it by porcelain knobs or else carried on telephone insulators.

Entrance Holes:—Bore two separate holes thru the building wall sloping upward from without as near as possible to the location of the lightning arrester. Insert porcelain tubes in these openings and install the "leading-in" wires as shown at Fig. 14. These "leading-in" wires should consist of braided, rubber-covered copper wire. A drip loop "c", Fig. 14, should be made in each wire to prevent water from following along down the wire into the building.

The Belin System of Telephotography

(*Continued from page* 717)

Exact reproduction of the mechanical variations of the arm resting on or touching the sheet on the sending cylinder.

At the receiving station, perhaps hundreds of miles distant, there is on the receiving instrument a cylinder rotating in exact synchronism with the sending cylinder. On this is mounted a sheet of photographic sensitized paper. The varying current from the line acts upon a mirror, somewhat as the current affects the mirror in the reflecting mirror type of galvanometer. The motions of the mirror correspond in extent to the strength of the current impulses. The light reflected from the mirror is brought or focust by lenses to the form of a spot or small disc on the drum, or rather on the paper coating it. The actinic effect of the spot on the paper varies with the motion of the mirror so that a photograph of the relief object on the distant sending cylinder is eventually reproduced on the paper affixt to the receiving cylinder.

Exact details of the apparatus are not as yet available. The sequence of operation is fourfold. The specially prepared object or reproduction acts mechanically on an electric resistance, so as to cause the pro-

(*Continued on page* 812)



"Some confab you had with the foreman. What was he telling you?"

"Only what I knew already. I was using my Vernier Depth Gage, and when he saw the Starrett mark on it, he started in telling me about Starrett Tools. How, when he was on the bench, he always used 'em, when he was doing real close work.

"It was nothing new to me. The first foreman I ever had—back when I was an apprentice—used to tell me the same thing. He'd been using them since the 80's. When I started to get a kit together, I bought Starrett Tools. Couldn't do without 'em. Simply have to have a Starrett for high-grade work."

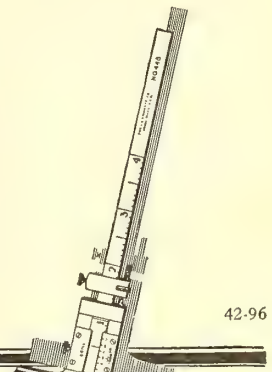
"Sure. I never buy anything else either. And I always tell the kids in the shop to get Starrett Tools. Then they're certain to have a kit they can depend on."

When you want a tool of the greatest accuracy, buy one with the Starrett trade mark. Write for Catalog No. 21 "LE". Sent free on request.

THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

42-96



Starrett Tools

Does *ALL* Your Gasoline Explode?

OR DOES part of it just clog up the cylinders in the form of carbon—*through an inefficient spark?*

Put an Alsop-All-Spark Intensifier on your car. Old, cracked, oil-soaked plugs will now give a hot, fat spark that explodes *every particle* of the gas. You will find unexpected power in your car and your carbon troubles will be gone forever. Government tests prove that an All-Spark actually will eliminate carbon,—besides getting 100% power out of your engine.

You can try an All-Spark with no risk. It is fully guaranteed and your money will be refunded in full at any time if you are not thoroughly satisfied. Incidentally, the saving in gasoline and new spark plugs alone will soon pay the cost of an All-Spark Intensifier.

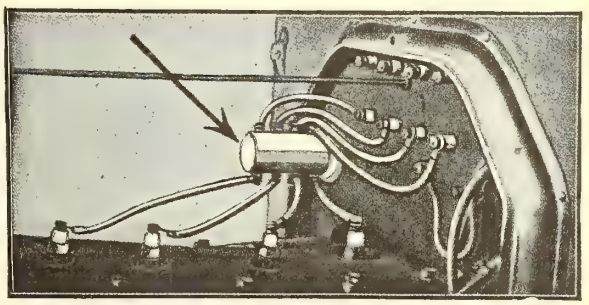
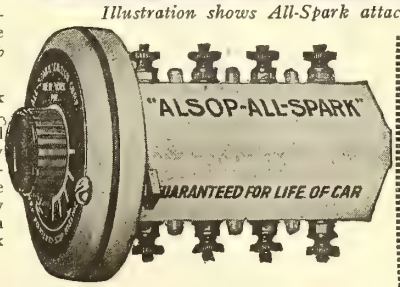


Illustration shows All-Spark attached to a Ford



ALL-SPARK IGNITION COMPANY, Inc.
13-X Water Street, New York, N. Y.

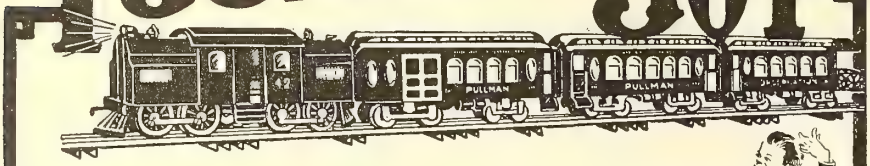
ALL-SPARK IGNITION COMPANY,
13-X Water Street,
New York, N. Y.

Gentlemen:

☐ Enclosed please find remittance for $7.50 for which please send me one Alsop-All-Spark Intensifier for a four cylinder engine together with full instructions for installing it in ten minutes.

Name.....
Address.....
City.....
State.....

"I JUMPED FOR JOY"



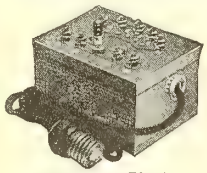
That's the Happy Message of a Lucky Boy

after he had been given a Lionel Train by his parents. It will be the *big joy time* of your youth when you open that nice box with its beautiful label and find inside—wrapped in soft tissue paper to keep it from being marred—a splendid Lionel Electric Train with a "Multivolt" Transformer.



Hooray!

Oh! Boy—Imagine it! A complete railroad system with electric lighted trains, powerful quick-acting electric motors, stations, tunnels, bridges, semaphores—good for years of daily fun. Send quick for



Your Power Plant
Lionel Multivolt Transformer

Runs your trains on house current at less cost than batteries. Get one with your train.

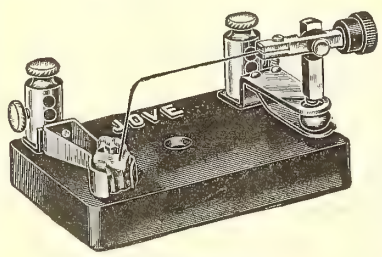
FREE—BIG CATALOG in COLORS

Then Get Your Train From Your Dealer

Catalog shows trains, stations, tunnels, bridges, 'n' ev'rything in actual colors. Free—send for it, pick out your train, then take Dad down to your dealers and show him the dandy railroad system you want for Christmas. If your dealer hasn't Lionel Trains write us his name and address and we'll see that you're supplied.

THE LIONEL CORPORATION
50-X, East 21st St. New York City

LIONEL ELECTRIC TOY TRAINS
& Multivolt Transformers



(GHEGAN PATENT)

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

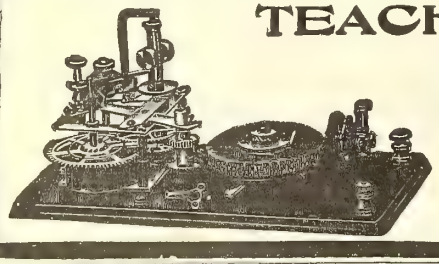
Send stamp for new edition 42E Catalog.

J. H. BUNNELL & CO., 32 Park Place, New York

"THERE'S MONEY IN IT"

AT HOME **LEARN TELEGRAPHY** AT HOME
MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter, **THE OMNIGRAPH.** Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
26 L Cortlandt St. New York

10¢ OR 25¢ **Anti-Kamnia**

AK FOR HEADACHE, NEURALGIA, INFLUENZA AND ALL PAIN

Ask For A-K Tabs **TABLETS**

"Applied Chemistry"

By CHARLES S. WOLFE

(*Continued from page* 748)

The words died on his lips, as a terrif crack, followed by the thunderous roar c falling rock, brought them terror-stricke to their feet. A shower of small debr rained over them, and then they were e veloped in a cloud of whirling dust.

Even before the thickest dust had settle Benson's voice came thru the haze. "Ever damned time I get it," he was saying con plainingly, "and I never knew it to fail."

As the dust settled, the party gazed abou them, and to their great relief found a apparently unhurt.

"A fall!" called Archer, grey-faced. "Di it catch any of you?"

"I'm all right," came from the palli Small. "How about the rest of you?"

"It caught us all," said Benson, quietly.

Following his gaze, the others saw.

Entombed!

God! The horror of it! Square acros their pathway lay tons of rock. They wer sealed up, alive, in their grave.

Brown, full realization breaking on hin began to sob. It was not fear, it was hys teria.

Benson, veteran in peril, spoke sharply "Here, old-timer, none of that. Take standing up. The mourners aren't assemble yet."

Archer was gazing stupidly at the barrie "I thought that wall was safe," he mut tered. "I looked it over carefully, and thought it was safe.'

Benson turned to him kindly. "No blam coming to you, Archer," he said, "you'r caught just as tight as the rest of us Come on, everybody. Let's get out of this.

Rallied by his cool, fighting spirit, the moved to the examination of the obstacle.

Half an hour later, dejected, they sat i the cavern, surrounded by their wealth staring down on them in cold mockery, an faced their fate in gloomy silence.

All but Benson. That gallant soul re fused to be cowed by the odds against him "Now then, men," he addrest his despair ing comrades energetically, "let's have pow wow. We are not greasers; we ar Americanos. Digest that fact. You al know the American motto. 'Over, under around, or thru.' One of those ways simpl must work. I've no particular objection t dying, but I strongly object to going lik this. Archer, you are the mine expert What are our chances of working out o this fix."

Archer raised a dull face to the speaker "All the fat chances of a celluloid cat chas ing an asbestos rat thru Hell," he said flatly. "It is hopeless to attempt to dig thru that fall. We would be dead long befor we made an impression on it. If we ha explosives, we might, at a risk of buryin ourselves deeper, try to blow our way out But about the one thing we haven't got i those packs is dynamite. Who would hav thought we'd need it in sampling?"

"For the time, I'll take your word fo it," rejoined Benson. "That scheme is dea before we start. Now how about over?"

Archer shook his head. "No," he re plied, "nor under, nor around. Here w stay."

He arose abruptly, went over to his ap paratus, and began mixing solutions pre paratory to assaying the sample that Groi had secured.

Small regarded him with dull curiosity "Now what do you suppose that will get hin now?" he asked, tonelessly.

"It will keep him from going crazy fo a while, anyway," Benson said. "All of yo get busy. Brown, on with that meal. Bu for God's sake, man, stretch it."

Without comment Brown set about the task assigned him. Small knelt at the packs, and methodically laid in a row five gas masks. "When the air gets bad," he said, significantly, and Benson nodded.

Professor Groin moved over to Archer, and began work on the array of bottles. "Mrs. Groin wasn't so unbearable at that," he remarked, to no one in particular, and in spite of himself Benson grinned.

And so the hours wore on. For some remarkable reason the air remained good, a symptom that greatly encouraged the indefatigable Benson as he roamed around their cage, tiger-like, seeking a method of escape.

Eventually Archer came from his improvised laboratory. "Gentlemen," he said, "I have completed the assay. This is without doubt the richest mine in the world."

The irrepressible Americanism in Brown came welling to the surface, as it is wont to in terrible moments in every member of our remarkable race. "Swap you my fifth for six good sticks of dynamite, Archer," he said.

"Are you thru with these chemicals, Archer?" queried Groin.

"All thru," Archer returned. "Pack them if you wish."

"If you don't mind," Groin said, apologetically, "I'd like to potter with them. I'm not happy, you know, unless I'm in the laboratory, working."

"As you wish," Archer replied, indifferently and relapsed into inactivity and silence.

As the time wore on Small fell asleep. Brown followed him into restless slumber a little later. And finally Archer gave over his gloomy meditations and sought relief in sleep.

Groin fust on over his beakers and flasks. Benson, resting, turned over in his mind avenues of escape, reluctantly abandoning each as impractical.

He was startled by a touch on the arm. Looking up, he found Groin beside him.

"Come with me to the fall, Benson," said the little professor, and, mystified, Benson rose and followed him.

Groin gazed meditatively at the barring rock. "Do you know anything about the placing of explosives, Benson," Groin asked. "I mean so that you get the most out of their released energy without unnecessarily risking further disaster."

Benson laughed shortly. "I do that," he replied. "I've done a bit of sapping in my time. Why?"

"I was in hopes that you knew," Groin replied, relieved. "Unfortunately, I know nothing of the art. If you are sure there is no other way out, I propose to blast this stuff out of the way."

"With what?" demanded Benson. "We have no explosives."

"With magnesium powder," replied Groin. "We have that."

Benson started. "How much of it have we?" he asked.

"I have been able to make about six ounces," Groin said, triumphantly.

Benson stared stupidly. "Groin, are you daft?" he demanded. "Do you realize what effect six ounces of flashlight powder would have on that heap?"

"If you will place my stuff for me, I will try, nevertheless." The little professor spoke so firmly and confidently that he imprest Benson in spite of himself.

"Oh, I'll place it, all right," he said. "We have everything to gain and nothing to lose. When do we begin?"

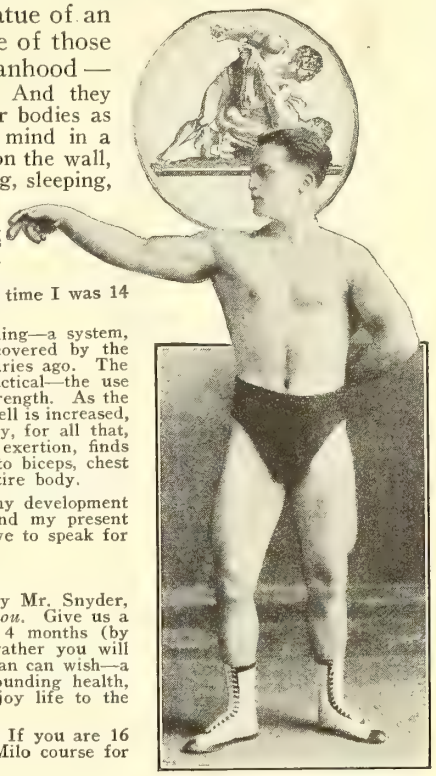
"You are sure there is no way over, under, or around?" Groin demanded. "Nothing with less risk?"

"There is not." Benson was emphatic.

"All right," Groin's jaws closed with a snap, "then we'll go thru. Wake the others up and tell them to put on their masks. Get them as far back into the tunnel as possible. You and I alone will face the immediate danger."

Born 2500 Years Too Late

By ROBERT SNYDER, Jr.—*A Milo Pupil*



DID you ever stand before a statue of an athlete of ancient Greece—one of those physical marvels of perfect manhood—and think—"Those were the days?" And they *were* the days—when men trained their bodies as well as their minds—when "A sound mind in a healthy body" wasn't a motto to paint on the wall, but an every day rule for making eating, sleeping, work or play, a pleasure.

I used to think, looking at those *men* of old time Greece—"Have I been born 2500 years too late? Or can I, too, become a *man* in every sense of the word?"

I resolved that I *could* and *would*. At the time I was 14 years old and weighed 116 pounds.

I heard of the Milo System of body building—a system, by the way, founded on the principles discovered by the Greek Athlete Milo, more than twenty centuries ago. The system is simplicity itself and perfectly practical—the use of a bar bell of a weight to suit the pupil's strength. As the pupil becomes stronger the weight of the bar bell is increased, so that little by little—but remarkably quickly, for all that, the pupil, without danger of strain or over exertion, finds himself tremendously developed, not only as to biceps, chest and shoulders, but evenly throughout his entire body.

I wish I had space to give the history of my development in strength and *health*, month by month, and my present measurements. However, my picture will have to speak for itself.

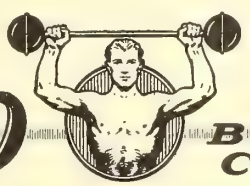
RESULTS GUARANTEED

The Milo System, which developed not only Mr. Snyder, but hundreds of others can do as much for *you*. Give us a few cents and a few minutes per day for 4 months (by correspondence) and we will give you (or rather you will give yourself) the greatest gift for which a man can wish—a body in which he can take a just pride, bounding health, vitality and energy—and the capacity to enjoy life to the very uttermost.

This is not a *promise*. It is a *guarantee*. If you are 16 or 35 years old or older there is a special Milo course for *you*. Write for booklet today.

Physical Culture Specialists and World's largest manufacturers of Bar Bells, Dumb Bells and Kettle Bells. Publishers of "Strength."

THE MILO BAR BELL CO.
Dept. 10
Diamond and 3rd Streets
Philadelphia



MILO BODY BUILDING COURSES



Free Trial

YOU may have any instrument with complete musical outfit, for a week's free trial at home. No obligation. Return it at our expense after trial if you wish.

Outfit includes velvet lined case, self instructor, music and all accessories at factory cost. A tremendous saving.

Convenient Monthly Payments

A few cents a day will pay for instrument and outfit. Wurlitzer instruments are known all over the world for artistic quality.

Send Coupon for Beautiful New Catalog

Every instrument known illustrated with price, easy terms and free trial blank. Catalog absolutely free. Write today.

The Rudolph Wurlitzer Co., Dept. 1258
117 E. 4th St., Cincinnati, O.—329 S. Wabash Ave., Chicago

Send me your new catalog illustrated in color with full details of Wurlitzer Complete Outfits and free trial and easy payment offer.

Name .....

Address .....

.....
(State instrument you are specially interested in.)

Reg. U.S. Pat. Off.
WURLITZER
200 YEARS OF MUSICAL INSTRUMENT MAKING
Cincinnati Chicago



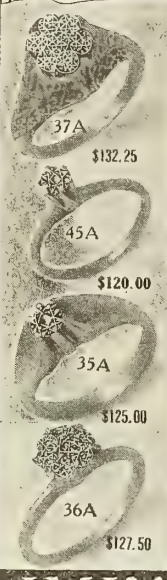
INSYDE TYRES
Inner Armor for auto tires. Prevent blowouts and punctures. Double tire mileage. Easily applied to any tire between casing and tube. Details free. Agents wanted. Liberal profits. Amer. Accessories Co. Dept. X-10 Cincinnati, O

DOLLARS IN HARES
We supply guaranteed high grade stock and buy back all you raise at $7.00 to $18.50 and up a pair, and pay express charges. Big Profits. Use back yard, barn, cellar, attic. Contract and Illustrated Catalog Free.
STANDARD FOOD & FUR ASSOCIATION
409Z Broadway - New York



Buy Your Xmas Gifts Now

Only a few cents a day



No Money Down

JUST send your name and address for our 128 page Christmas book of bargains in diamonds, watches and jewelry. Millions of dollars worth of jewelry from which to choose your Xmas gifts. Your selection sent on your simple request, *without a penny down.* If you don't think it is the biggest bargain you have ever seen, send it back at our expense. If you keep it you can pay at the rate of *only a few cents a day.*

8% Yearly Dividends

You are guaranteed an 8% yearly increase in value on all diamond exchanges. Also 6 per cent bonus privilege.

Write Today for Xmas Catalog

Send your name and address *now.* No obligation. Beautiful Xmas catalog comes free by return mail. Explains all about the Lyon Charge Account Plan. See this great collection of jewelry bargains now. *Send your name today to Dept.* 38-I

J·M·LYON & CO

1 Maiden Lane, New York N.Y.

Learn in Spare Time to be a CIVIL ENGINEER



Earn $1500 to $5000 Yearly

Here's your big chance to become a full-fledged Civil Engineer! With this set of books you can fit yourself to make big money, in the greatest outdoor profession on earth! Offer fully explained in coupon. Good only within boundaries of the U. S. and Canada.

Great Books Shipped FREE

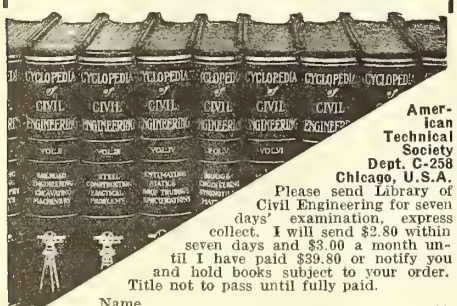
A Dime a Day if you keep them after 7 days' FREE TRIAL.

Nine big flexible-bound volumes; 3900 pages, 5½x8½ inches; 3000 plates, maps, diagrams, etc. Written by world's greatest civil engineers. Books tell you ALL ABOUT surveying; highway construction; railway engineering; earth work; specifications; estimating contracts; bridge engineering; masonry; reinforced concrete; water supply; sewers and drains; water power equipment; irrigation engineering—etc., etc. Written in simple language—every point made plain.

CONSULTING SERVICE FREE

A $12 Consulting Membership solves your difficult problems for a whole year. FREE with the set of books.

SEND NO MONEY—JUST THE COUPON!



American Technical Society
Dept. C-258
Chicago, U.S.A.

Please send Library of Civil Engineering for seven days' examination, express collect. I will send $2.80 within seven days and $3.00 a month until I have paid $39.80 or notify you and hold books subject to your order. Title not to pass until fully paid.

Name.....

Address.....

Reference.....



WANTED—Railway Mail Clerks

$135 to $190 Month

HUNDREDS NEEDED AT ONCE

MEN—BOYS Over 17

COUPON

Franklin Institute
Dept. D 181, Rochester, N.Y.

Kindly send me, by return mail, free information, telling how I can quickly get into the U. S. Government service as Railway Mail Clerk ($1600 to $2300 a year), or as City Mail Carrier or Postoffice Clerk ($1400 to $1800 a year).

Name.....

Address.....

If not interested, hand to a friend.

Benson held out his hand. "Groin, you may be little, and your idea may not be worth anything, but your spirit is all right. I'd sooner have you with me in a pinch than lots of bigger chaps that I've met. You die on your pins and fighting. Let's get going."

Groin wrung the hand of the big soldier of fortune, swung on his heel, and went to his flasks. Benson awoke the mystified three, got them into their masks, and back into a place he deemed reasonably safe from the effects of any explosion.

Then he turned to look up the professor. He found Groin already at the barrier, holding carefully in his hand a bulky object wrapt in strips of bagging.

He ran a speculative eye over the mass of rock, made a rapid estimate of the size of the object in Groin's hands, knelt, and with his bare hands scooped a hole. Rising, he turned to the professor. "Try her there," he said briefly.

Groin dropt to his knees before the little hole. *"Out with the lights,"* he snapt, and silently Benson obeyed.

He could hear Groin fumbling in the darkness. Then came the scrape as the professor arose. The single flickering beam *from his now carefully shaded electric torch* revealed him moving slowly away from the spot, methodically laying a train of bagging strips along the cavern floor. "Bagging soaked in nitrate," he explained shortly. "The fuse."

Without comment Benson followed him. They prostrated themselves behind an outjutting ledge. Groin produced a box of matches. "Ready?" he queried.

"Right," replied the other, and silently they donned their masks.

The wavering flare of a match, the feeble blaze of burning rags. A train of glowing sparks writhed along the floor toward the barrier. A hesitating instant. Then a blinding flash, accompanied by a terrific roar. Their little world rocked.

As the last patter of falling shale died away, Benson staggered to his feet, flashed his torch, and stumbled toward the obstruction.

A glance told him of the work of destruction. Much of the moved mass had gone to dust. What had been immovable boulders lay scattered about as crushed stone. Much of the strangling wall was gone.

He cast an anxious eye on the walls and ceiling. They had not escaped damage. It was a terrible risk.

Rapid thought. The risk was great, but the stake was life itself. Better death beneath the crumbling mass than lingering torture with exactly the same finale.

He found the professor at his side hugging a second bundle. Quickly he selected his point of attack. In silence the preparations were made, the retreat accomplisht.

Another hissing flame-snake, again the blinding flash and crashing roar! Anew he staggered forward to investigate. His heart leapt in exultation. One more, just one more, dear God, and if the walls held they would be able to crawl thru. . . .

With throbbing pulse he once more picked the site for the saving thunder, picked it carefully, for he scarce dared risk more than another of those terrific detonations with the goal almost won.

Once more the earth shook under that terrific impact, and as he made his way down the cavern the feeble beam revealed the yawning tunnel darkness where the giant mass had been. *They had gone thru!*

Quickly the party was assembled, the packs gotten together, and still masked they fled stumblingly toward freedom.

Blinded by the bright, blessed sunlight at the breast of the slope, they halted. Masks were torn off, packs thrown down, and panting they fell on the mossy dirt piles at the tunnel's mouth.

Benson let out a roar of exultation. "Thru, praise God," he bellowed. "Groin, shake, you are the man of the hour."

The little professor blinked up from

No Seals-No Secrets —But Service

Inspection of the interior of any Radi apparatus bearing the mark:

GREBE RADIO

reveals design and workmanship fully in keepin with its outward appearance.

GREBE RADIO apparatus is licensed under th original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional Each instrument must give satisfactory service Our interest in the purchaser does not terminat with the sale.

Ask your dealer to show you our line of super grade apparatus. If he doesn't carry it, writ us—mentioning his name—for catalogue.

A. H. GREBE & CO., Inc.,

70 Van Wyck Blvd., Richmond Hill, N.Y

Order Your Scientific and Technical Books *Now.*

They are difficult to obtain and prices are constantly increasing. We will quote present price on any book of this nature and the price will hold unless the publisher should increase his price in the interim.

Write for our 96-page catalogue—the most complete scientific and practical catalogue now issued. In addition, our 1920-1921 list will be sent you as soon as ready, and the prices in this list will hold good in possibly 80 per cent of cases; but you will be notified of any change before filling order.

There will be no obligation in requesting catalogue for we want you to know our Book Department. Write today. You'll find it valuable for suggesting books you need.

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Room 655, Woolworth Bldg., New York City

Packard



Back up that wireless outfit of yours with the Packard Transformer.

It is absolutely the most powerful transformer built for amateur purposes under the government regulations.

Distances covered by present owners of the Packard put it in a class by itself.

Exceptionally high voltage (13,200) gives the kick necessary to send from 450 to 900 miles.

We will be glad to send you any information on these transformers you may desire.

The Packard Electric Company Warren, Ohio

Wireless Transformer

BOOKKEEPING & SHORTHAND

Make Money! Bookkeepers and Shorthand Writers Earn Large Salaries

Succeed in Business! Bookkeeping and shorthand are stepping stones to conspicuous success. We will make you an expert shorthand writer or bookkeeper by mail. This is your big opportunity.

CHICAGO EXTENSION UNIVERSITY
Dept. S 128 N. LaSalle St. Chicago

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 772 Bogue Bldg., Indianapolis

re he lay. "Must sleep," he mumbled. rry—exhausted."

Sleep you shall, old ace," roared Ben- "and I'll guard your precious old car- while you do. But what under Heaven, , did you do to that flashlight powder? ver saw anything like it."

roin made an effort to answer intelli- ly. Relaxation and reaction struggled ompel slumber. "Wasn't the powder," nuttered, brokenly, "was—bottles. Flash- der—only—detonator."

uzzled, Benson scratched his head, le Archer started, startled.

What was it, then?" persisted Benson, king Groin's shoulder. "What was the losive?"

or a second the little professor's eyes ned. "Hydrogen—" it was only a mum- now. "Hydrogen—and chlorine—they bine in the presence—sunlight—explo- violence. Had no sunlight—used —"

he voice trailed off into nothingness. slept.

Phonograph Prize Contest

(*Continued from page 772*)

ps. The tube must be made exactly like sound box neck so that it will fit snugly the tone arm without turning or wab- g.

o have a *waltz* time, *which cannot be duced by the bought metronome,* make ecord with three strips glued to it, but n one strip higher than the other two, as to produce a louder "tick" at the per time.

SAMUEL J. GOLDWIN.

HONORABLE MENTION.

Dryer.

hotographic films as well as light clothes be dried by placing a hook in plate at tom and tying to top rail.

ll articles to be dried must be small well wrung out, so they will not drip. phonograph can be covered with a cloth protection.

ERIC LEAF.

HONORABLE MENTION.

Razor Blade Sharpener.

his device which has been presented sists of a simple mechanism readily at- nable to any phonograph. A rubber d wheel can be moved in place so as to tact with the rim of the turntable of the tograph. Two roller-stroppers are sed to revolve in opposite directions by rs while the razor blade, mounted on a ker arm contacts from one to the other er.

esult: Jazz music and sharp blades in minute.

JULIUS FUCHS.

HONORABLE MENTION.

Power for Toys.

wooden board 7/8" x 4" x 20" cut as wn in illustration is used. A rubber m a circular eraser is fastened as wn. This rubber runs on the turntable. e shaft is wedged into the hole of the ser, while a few washers keep the shaft easy running order. At the end of the ft a thread spool is tightly wedged. is latter thus becomes a fine pulley to weights, run models, etc.

H. M. DECKER.

1920 ATLAS WITH MAPS of NEW EUROPE FREE

To the readers of Science & Invention who take advantage of this offer now made in connection with

Webster's New International

THE ONLY GRAND PRIZE

(Highest Award) given to **dictionaries at the Panama-Pacific International Exposition** was granted to **Webster's New International** and the **Merriam Series** for **superiority of educational merit.**

WORDS OF RECENT INTEREST

Anzac, ace, barrage, Bertha, blighty, Boche, Bolsheviki, camouflage, Lewis gun, Liberty bond, Sammy, soviet, tank, war bride. These are but a few of the thousands of late words—all clearly defined in this great work.



"To have this work in the home is like sending the whole family to college."

"The Supreme Authority" **The Merriam Webster**

A Complete Reference Library in Dictionary Form—with nearly 3,000 pages and type matter equivalent to a **15-Volume Encyclopedia,** all in a **single volume,** in Rich, Full Red Leather, or Library Buckram Bindings, can now be secured on the following remarkably easy terms:

THE ENTIRE WORK (WITH COMPLETE 1920 ATLAS)

DELIVERED for $1.00

and easy monthly payments thereafter (in the U. S. and Canada)

ON SUPERIOR INDIA PAPER

Reduced About One-Half In Thickness and Weight

INDIA-PAPER EDITION

Printed on **thin, opaque, strong,** superior India paper. This edition is only about **one-half** the thickness and weight of the regular edition. Size 12⅜ in. x 9¾ in. x 2¾ in. **Weight** 8⅜ lbs.

REGULAR PAPER EDITION

Printed on strong book paper of the highest quality. Size 12⅜ in. x 9¾ in. x 5¼ in. Weight 15¼ lbs. **Both editions are printed from the same plates and indexed.**

Over 400,000 Vocabulary Terms, and in addition **12,000 Biographical Names,** nearly **30,000 Geographical Subjects,** besides thousands of other references. Nearly **3,000 pages. Over 6,000 illustrations.**

The only dictionary with the New Divided Page, characterized as "A Stroke of Genius."

To those who mail this coupon at once

G. & C. MERRIAM CO.

Home Office Dept. S Springfield, Mass.

(Publishers of Genuine Webster Dictionaries for over 75 years)

Please send me free of all obligation or expense a copy of "Dictionary Wrinkles" containing an amusing "Test in Pronunciation" (with key) entitled "The Americanization of Carver;" also "125 Interesting Questions" with reference to their answers and striking "Facsimile Color-Plate" of the new bindings. Please include specimen pages of India and Regular paper with terms of your Science & Invention free Atlas offer on Webster's New International Dictionary.

Name .....

Address .....

The ATLAS is the 1920 "New Reference Atlas of the World," containing 148 pages, with 96 pages of maps beautifully printed in colors with areas and populations of all countries, including changes brought about by the Great War, Parcel-Post Guide, etc., all handsomely bound in red cloth, size 9⅝ x 12½.

You Can Make Big Money

During Your Spare Time

BUILDING PHONOGRAPHS

First of All Build Your Own High Grade Phonograph and Save About $200

GET OUR READY-MADE PARTS, PUT IT TOGETHER IN A FEW EVENINGS AND CONVINCE yourself how easy it is. If you want to add $200 to your monthly income this is your opportunity. We want you to build phonographs for others and not only for yourself. Get in the phonograph business. The business that makes men independent and wealthy.

With Our Help

Your opportunities in this great and growing business are unlimited. No special training and previous experience is necessary. Thousands of men, whom we have started in business have found the road to quick fortune. We help you. We show you exactly what to do and how to do it. We furnish everything complete.

Our Simple Plans

Make it easy and intensely interesting work to put together these beautiful, sweet clear-toned instruments. We furnish you everything complete—motor, tone-arm, cabinet pieces, all metal parts, and simplified instructions. You assemble and finish your own phonograph and save more than half of the retail cost.

Beautiful Catalog Free Tells all about our plan and shows the big opportunities awaiting you in the phonograph business. No canvassing—no capital needed. Remember—we are an old reliable house and will stand back of you in every way. Write for our beautifully illustrated catalog today. We will gladly send it by return mail absolutely free.

Chicago-National Phonograph Mfg. Co.

655-657 N. May St., Dept. 113 Chicago, Ill.



SAVE!! Over Half

GREEN AUTOMATIC MACHINE



ADD TO YOUR INCOME WITH LITTLE EFFORT **$5 to $10** A DAY MADE EASY WITH

New Improved Green Automatic Machine

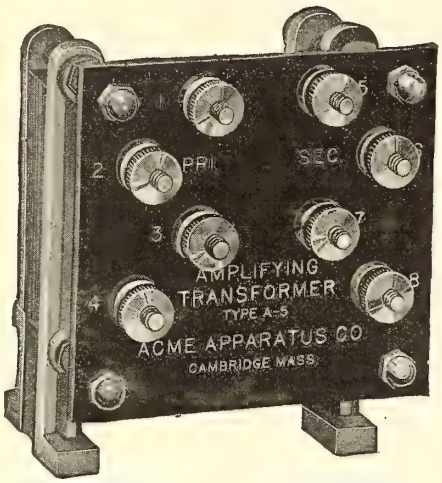
Sharpens, Hones and Strops all kinds of safety razor blades, in one operation, from four to six blades per minute. For both Quality and Quantity, this machine is in a class by itself. There is nothing like it on the market. Let us send you our free booklet explaining everything including the **"AMERICAN" Key Cutter**—cuts square, angular or round slots.

"AMERICAN" Key Cutter



AMERICAN SHARPENING MACHINE CO. (Inc.) Dept. S. J. 184 W. Washington St. CHICAGO

ACME APPARATUS



RADIO TRANSFORMERS

AMPLIFYING TRANSFORMERS

MODULATION TRANSFORMERS

C. W. POWER TRANSFORMERS

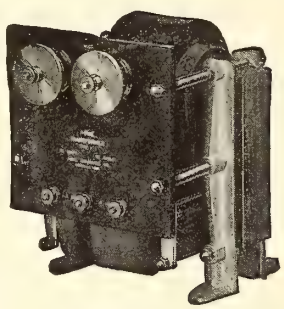
FILAMENT HEATING TRANSFORMERS

TELEPHONE TRANSFORMERS

SPECIAL TRANSFORMERS

CONDENSERS AMPLIFIERS
DETECTORS
1½ HENRY CHOKE COILS

Send for a Copy of Our Manual of Wireless Telegraphy, W12





To secure satisfactory results in radio communication, absolute perfection in material and workmanship, both electrically and mechanically, is essential. These conditions obtain in all the material we offer for sale. We have on the press a manual and catalog covering practically the entire field. It will be ready for distribution within the next few weeks. We make a charge of 25 cents for it, give a coupon receipt, which coupon receipt is good for 25 cents on a future order.

It will contain 200 pages, size 6 x 9 in. profusely illustrated, printed on high grade paper with cover in two colors.

RADIO EXPERTS AT ALL OF OUR STORES

MANHATTAN ELECTRICAL SUPPLY CO., Inc.

17 Park Place **110 W. 42nd St.** **127 W. 125th St.**
NEW YORK

CHICAGO, 110 S. Wells Street ST. LOUIS, 1106 Pine Street
SAN FRANCISCO OFFICE, 604 Mission Street

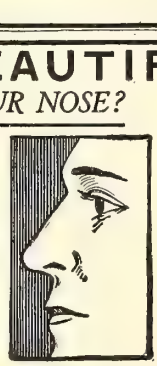
YOU HAVE A BEAUTIFUL FACE

BUT YOUR NOSE?





BEFORE



AFTER



IN THIS DAY AND AGE attention to your appearance is an absolute necessity if you expect to make the most out of life. Not only should you wish to appear as attractive as possible, for your own self-satisfaction, which is alone well worth your efforts, but you will find the world in general judging you greatly, if not wholly, by your *"looks,"* therefore it pays to "look your best" at all times. **Permit no one to see you looking otherwise; it will injure your welfare!** Upon the impression you constantly make rests the failure or success of your life. Which is to be your ultimate destiny? My new *Nose-Shaper*, "TRADOS" (Model 24) corrects now ill-shaped noses without operation, quickly, safely and permanently. Is pleasant and does not interfere with one's daily occupation, being worn at night.

Write today for free booklet, which tells you how to correct ill-shaped noses without cost if not satisfactory

M. TRILETY, Face Specialist **1401 Ackerman Bldg., Binghamton, N. Y.**

Simplest Long Wave Receiver

By ELLIOTT A. WHITE

(*Continued from page* 759)

CONNECTIONS OF RECEIVING SET.

The manner of connection and operation on this set are as follows. It will be seen that the inductance coil L and the tuning condenser C1 form a *closed oscillating circuit*, with the grid and filament across it, the antenna being an open capacity across the tuning condenser, and in parallel with it. The antenna capacity is thus added to the capacity of the condenser. With a wave meter, the set may be permanently calibrated for a given antenna, and the results marked on the condenser scale if the latter is extended with a card dial. It is also easily calibrated by noting the settings for stations of known wavelength heard. The tickler coil T, gives a feedback of proper polarity to maintain oscillations in the circuit L C1 and has adjustable coupling with the coil L. To pick up stations, the tickler coupling is first increased to the point where oscillations begin, as is determined by the familiar faint "frying" sound, or the click which results either from changing the tickler coupling to start or stop oscillations, or the click which results from touching with the finger any point connected to the grid such as the antenna binding post, the grid side of Condenser C1, or the top of the coil L. The inductance switch should then be set on some tap of the coil L, and the condenser C1 rotated till a musical whistle in the phones, varying in pitch as the condenser knob is turned, indicates the presence of a signal. If no station is heard on that tap, another may be tried. The condenser should then be carefully moved to determine the point of maximum signal strength, being sure to get the sending wave and not the compensating wave, as both waves can be heard in the arc stations.

Annapolis, NSS, is particularly troublesome to separate the waves; but New Brunswick, NFF, and Sayville, NDD, give no trouble in this respect. The Arlington arc, NAA (6,000 meters), is characterized like that of Great Lakes, by a clear bubbling sound. When the station has been picked up and tuned in, the next step is to increase the loudness of signal by decreasing the tickler coupling, that is, moving the tickler coil T farther away, or more at right angles to, the inductance coil L. With the arrangement described (Fig. 3), this means pulling the tickler coil out of the center of the other coil. It will be found that as the coupling is decreased the signal gradually becomes louder, until the point is reached where the oscillations "break," or stop. This adjustment is quite critical, and the whole matter of signal strength depends on doing it properly. The coupling must usually be changed as the condenser pointer is moved over the scale, if the coupling is anywhere near the critical point. While hunting for stations the coupling should therefore be kept rather close. The simplicity of tuning, as here detailed, should be contrasted with the many confusing adjustments present in the old type of set in order to realize the advantage which results from increased simplicity of circuits.

As was remarked, one advantage of this set is that it can be used with equal flexibility on either an open or a loop antenna. The open antenna will usually give louder signals, but is likely to bring in more static and interference from power lines, and so forth. A switch may be used to connect in either kind of antenna, and the one used which at the time seems preferable. During heavy summer static the loop is probably better, but, several authors to the contrary there seems no possible objection to the

MURDOCK No. 55



2000 OHM SET.....$4.50
3000 OHM SET..... 5.50

That these Murdock No. 55 Sets have earned a nation-wide reputation for value, is due, not so much to the fact that they are, without question, the best low priced receivers obtainable anywhere, as it is to the recognized fact that they closely approximate in operation the sensitive performance of the most expensive sets.

The customary assurance of "Satisfaction or Money Back" affords the opportunity of proving the exceptional value of these 'phones at no risk to you.

Other instruments — MURDOCK MADE—of recognized merit at equally reasonable prices are illustrated in Bulletin 19B, a copy of which will be mailed on request.

WM. J. MURDOCK CO.
55 Carter St.
CHELSEA (BOSTON 50) MASS.
509 Mission St. San Francisco, Calif.

NEW DIAL INDICATOR



Fits standard ¼" Shaft. Made of same quality as our smaller dial. Black composition. White filled engraving. Bevelled edge.

3" Dial.....$0.75. With Knob.....$1.30 Postpaid
3⅞" Dial..... 1.00. With Knob..... 1.70 Postpaid
Moorhead Electron Relay New Style....$6.00
Moorhead V.T. Amplifier..... 7.00
Moorehead Extra Hard V.T..... 7.50
Shipping weight 1 pound. Guaranteed. Licensed under Fleming and De Forest Patents.

Our new Catalog now ready, send 10c for it.

For sale at all RADISCO Agencies and by

A. H. CORWIN & CO.
4 West Park St., Dept.E-1, Newark, N. J.

use of this direct-connected set for long waves on a straight open antenna. During the past summer the author has had no trouble on the open antenna except during thunderstorms, altho in this part of the country the summer has proved rather favorable for radio. Again, when the amateurs start transmission, trouble may be experienced on the open antenna from QRM.

The following table gives some sample settings for tuning on one particular loop antenna; of course the settings will differ in other stations.

Station		Wave Length	Inductance Tap	Condenser Setting	
Annapolis	NSS	17,000	1" (175 mhy)	74	degrees
			7/8"	96	
			¾"	140	
			5/8"	165	
New Brunswick	NFF	13,600	1"	42	and 53
			7/8"	46	70
			¾"	82	103
			5/8"	117	144
			½"	149	168
Arlington	NAA (arc)	6,000	½"	0	(antenna only)
			¼"	60	
			1/16"	159	(calling)
	NAA (spark)	2,500	5/16"	8	
			¼"	10	
			3/16"	12	
			⅛"	13	
			1/16"	20	
			0 (antenna)	22	

From this table it will be seen that any tap up to 5/16" brought in 2,500 meters, so that the first tap might be placed at ¼", for the minimum wave length of 2,500 meters. For the maximum wave length, it may be seen that for the longest wave station, NSS, on 17,000 meters, any tap from ⅝" to the end of the coil (1") was suitable; and for NFF on 13,600 meters, any tap from ½" to the end of the coil. Moreover, any tap from ⅝" to 1" gave both NSS and NFF by merely turning the condenser. This shows that for this particular antenna only ¾ of the coil needed to be used, or even less, and that one tap at ¾" covered the upper range of wave lengths. If then one tap were put in at ½" or half the coil, for intermediate wave lengths, all wave lengths from 2,500 to 20,000 meters would be covered by the three taps of ¼", ½" and ¾" respectively. This would mean that the inductance switch would need only three or four points, to cover the whole range specified, and that this switch would hardly, if ever, have to be toucht, the tuning being all done by the single 43-plate condenser, and the loudness of signals brought out by pulling out the tickler to the critical point. It is surprising how simple such a set can be made. Settings for the open antenna are not given here, for the readings are similar and the conclusions the same.

(*Conclusion.*)

NEW RADIO LICENSE RULES AT NEW YORK.

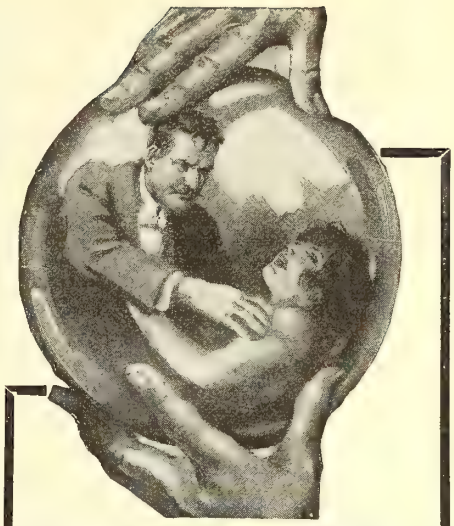
Applicants examined in the New York office for commercial radio operator's licenses will be tested in their transmitting ability in sending Continental Code.

Applicants for commercial first grade operator's licenses will be required to send 100 satisfactory code characters in succession in a five-minute test at a 20-word-per-minute speed.

Applicants for Commercial Second Grade Operator's license will be required to send 60 satisfactory code characters in succession in a five minute test at 12 words per minute speed.

The transmissions by the applicant will be received by the examiner and will also be graphically recorded on a tape recorder as a check against transmissions in case of doubt.

Radio schools training men who expect to take these examinations are requested to prepare their students for this transmitting test and include a test therein before they give the student the usual letter certifying that they have satisfactorily past the course, and for which the applicant is allowed a 10% experience mark in this office. The transmitting test given the applicants will include characters, numbers and signals of all kinds used in the usual transmission.



The Fortune Teller

"I see a man—a dark man. He is talking earnestly to a young girl. She is trying to avoid him. He seizes her by both arms. They struggle. He has his hand at her throat. She falls. He strikes her. He goes—I cannot see where he goes. It is dark—dark—"

What happens then — how this medium knew—that is the perplexing mystery solved only by the marvelous genius of

CRAIG KENNEDY
The American Sherlock Holmes
ARTHUR B. REEVE
The American Conan Doyle

He is the detective genius of our age. He has taken science — science that stands for this age—and allied it to the mystery and romance of detective fiction. Even to the smallest detail, every bit of the plot is worked out scientifically. For nearly ten years, America has been watching his Craig Kennedy —marveling at the strange, new, startling things that detective hero would unfold.



FREE—POE
10 Volumes

To those who send the coupon promptly, we will give FREE a set of Edgar Allan Poe's works in 10 volumes.

When the police of New York failed to solve one of the most fearful murder mysteries of the time, Edgar Allan Poe—far off in Paris—found the solution. The story is in these volumes.

In England and France, Edgar Allan Poe is held to be the greatest writer that America has produced. To them he is the great American classic.

This is a wonderful combination. Here are two of the greatest writers of mystery and scientific detective stories. You can get the Reeve at a remarkably low price and the Poe FREE for a short time only. Sign and mail the coupon now.

HARPER & BROTHERS
(Established 1817)

Cut out this coupon & mail it today

Sc. Inv. 11-20

HARPER & BROTHERS, 250 Franklin Square, New York

Send me, all charges prepaid, set of Arthur B. Reeve—in 12 volumes. Also send me, absolutely free, the set of Edgar Allan Poe—in 10 volumes. If the books are not satisfactory I will return both sets within 10 days at your expense. Otherwise I will send you $3.50 within 5 days and $3 a month for 12 months.

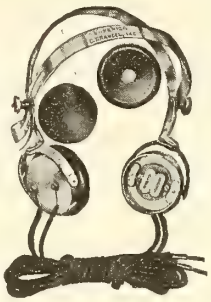
Name .....

Address .....

Occupation .....

OUR TRADE MARK

is a sign that you can buy any Radio Apparatus of proven merit manufactured in the United States from us.



RECEIVERS

BRANDES Superior, as illustrated $7.00

MURDOCK 2.000 ohm, $4.50; 3.000 ohm, $5.50



BALDWIN
Type C, $16.50; E, $20.00; F, $21.00

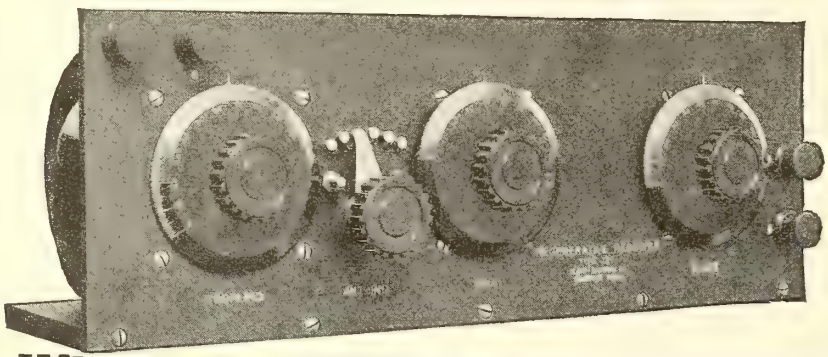
SWITCH POINTS, as illustrated:
Brass, ¼" x ¼"—3/16 thread, .05c each
Nickel . . . . . .06c each

BINDING POSTS

Hard Rubber . . . . . .20c each
Hard Rubber, Metal Bushing 12c
Brass or Nickel . . . . . .08 to 20c

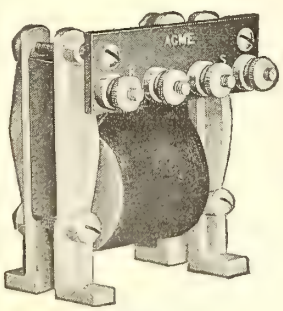
AMERICAN ELECTRO TECHNICAL APPLIANCE CO.
DEPT. E, 235 FULTON STREET, NEW YORK

TYPE Z. R. F. REGENERATIVE RECEIVER



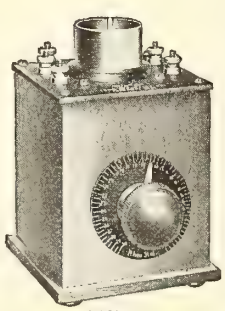
WE invite your comparison with any set of similar type for performance or quality. Range 175 to 600 meters.
Price complete, $38.00. Variometer, only $6.50
Our Radio Products have been established in their leadership for thirteen years, are carried in stock by discriminating dealers and are manufactured at 139 Main St., Cambridge, Mass., by
CLAPP-EASTHAM COMPANY
Catalogs mailed for 6c stamps

HAVE YOU SEEN THESE?



Ask your dealer to show them to you
Ask us to send you our bulletins

ACME APPARATUS COMPANY
28 WINDSOR STREET,
CAMBRIDGE 39, MASS.
Transformer and Radio Engineers and Manufacturers



ACME
AMPLIFYING TRANSFORMER } $5.00

ACME
AMPLIFIER $13.00
DETECTOR 10.00

DEALERS: *Deliveries are inversely proportional to demand. ORDER NOW!*

BE A BANKER
Prepare by mail in spare time for this attractive profession, in which there are great opportunities. Send at once for free book, "How to Become a Banker"
EDGAR G. ALCORN, *President*
American School of Banking, 114 McLene Bldg., Columbus, O.

Learn to Write
I TEACH BY MAIL
WRITE FOR MY FREE BOOK
"How to Become a Good Penman"
and beautiful specimens. Your name elegantly written on a card if you enclose stamp. Write for it today. **F. W. TAMBLYN, 424 Meyer Bldg., Kansas City, Mo.**

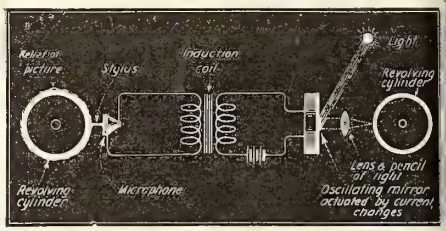
The Belin System of Telephotography

(*Continued from page* 805)

duction of a varying or irregular undulatory current. These are the first two steps—the first mechanical, the second electrical. Then the current, as the third step, also an electrical one, causes the mirror to oscillate. The fourth step may be taken as optical; this step is the focussing of light reflected from the mirror upon the sensitized paper. It is at this stage that one of the most characteristic features of the process appears. The work is being done with very feeble currents, of what may be crudely termed microphonic intensities. So all the work that is given them to do is to cause a small and exceedingly light mirror to oscillate, and it is its imponderable beam of light which, acting on the sensitized paper, brings us to the last step—the final photographic one. The final step is the one of greatest delicacy, for it is fair to say that the sensitiveness of the photographic surface is an example of one of the highest degree of that quality attained by man outside of vacuum tube reactions and the like, where the investigation or processes approach pretty close to the molecule or even to the electron.

Thus there is a regular succession of processes of gradually increasing delicacy beginning with mechanical action and ending with the photographic effect. The last is the most delicate of the progressive operations, the first is the least sensitive.

We give in addition to the illustrations of the apparatus, both sending and receiving, some interesting examples of the work of the system. The photographs (unretouched) of the representatives of the French and American armies, General Mangin and Pershing, were transmitted in a few minutes, perhaps the principal delay being the time required for the development of the photographic image.



Method by Which Pictures Are Transmitted and Received by the Belin System.

Autographic writing is transmitted with still greater ease, as there are no gradations to be taken care of, and the sudden change from black to white represent the simplest phases of the subject. Yet our illustrations show that the infinitesimal gradations of the photographic likeness are given with great clearness in the reproduction.

The applications of the invention are evident. There are many occasions when the transmission of an autograph message would be most desirable, if only for social or similar motives. It would not constitute, as things are now, a legal signature.

The general disposition of parts is given in the diagram, which, taken with the text above, makes the principle clear. The cylinder with its picture or writing in relief, is shown with the microphone on which the arm acts mechanically. The line with induction coil and battery and other requirements, transmits the vibration from the microphone to the distant receiver-like device, whose diafram carries a mirror. This reflects the light thru a system of lenses to the sensitized paper on the receiving cylinder.

"USE THE TUBE THE NAVY USES"

On its remarkable trans-Atlantic flight the U. S. Navy flying boat NC-4 used A-P VT Amplifier-Oscillators. So efficiently did these A-P tubes serve on this flight, and so much did they contribute to the success of this great achievement, that voluntarily the Bureau of Engineering of the U. S. Navy wrote our Laboratories a letter of appreciation.

THIS is the LETTER

THIS is the TUBE

A-P tubes manufactured under the De Forest Audion and Fleming patents. Other patents applied for and pending.

N S R 5s
ADDRESS BUREAU OF STEAM ENGINEERING, NAVY DEPARTMENT
AND REFER TO NO

ENCLOSURES
CE—1062

NAVY DEPARTMENT,
BUREAU OF STEAM ENGINEERING
WASHINGTON, D. C.

July 5, 1919.

Moorehead Laboratories,
San Francisco, Cal.

Gentlemen:

While on the Trans-Atlantic Flight the Moorehead tubes gave such excellent service, that I feel it my duty to personally tell you of their performance and send you one of the tubes used and a portion of the lead fish that held down the antenna to which the receiving equipment was connected.

During the trip your tubes made it possible to receive signals from the Norfolk Radio station while the N C 3 was on the water near the Azores, a distance of 2300 miles. But the longest record of reception of radio signals in any type of plane while in flight was far surpassed when signals were received from a ship 1800 miles away. This enviable record is even more distinguished from an aviation point of view in that your tubes required but half the power used by other types of tubes, thus saving many valuable pounds in weight of storage batteries.

Thanking you for the valuable part that you have taken in the first Trans-Atlantic Flight and with best wishes for your continued success, I am,

Very respectfully,

Robert A Lavender

Radio Officer N C Seaplane Division 1.
Trans-Atlantic Flight.



THE A-P VT.
AMPLIFIER-OSCILLATOR
equipped with the SHAW standard four-prong base.

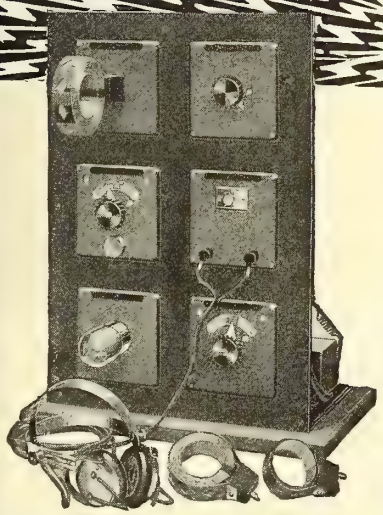
AMATEURS—"Use the Tube the Navy Uses" — the A-P VT Amplifier-Oscillator—price $6. Order from your dealer. Descriptive pamphlet free upon request.

ATLANTIC RADIO SUPPLIES CO.
Kirk Place Newark, New Jersey

PACIFIC RADIO SUPPLIES CO.
338 Mission St. San Francisco, Cal.

Distributors for Moorhead Laboratories

DE FOREST



DeForest Audion-Unit Radio Receiving Station (6 Panel). "Honey-Comb" Tuning Coils, Tuning and Grid Condenser, Audion Detector, Head Telephones, "B" Battery, Aerial and Ground Connections, and all other needed supplies. A very efficient set of wide range.

Complete $76.15

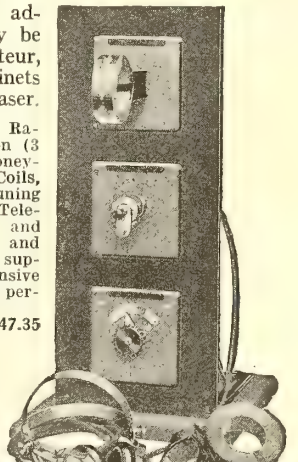
Complete Unit-System Receiving Sets for Amateurs

THESE complete Radio Receiving Stations offer the most satisfactory method of securing reliable, efficient, and scientific apparatus of absolutely dependable quality. They include everything required to set up and operate a Receiving Station that will operate satisfactorily and allow for expansion as the owner desires; including Aerial and Ground Connections, Panels, Base and Back Boards, Unit Panels, all screws, wiring, insulators, etc.

Both Sets are part of the famous DeForest Unit-System and additional panels to increase the range and selectivity of the sets may be added at any time. For the beginner, or even the experienced Amateur, these sets are the most logical system: They do away with costly cabinets and more costly factory assembly, thus saving money for the purchaser. They are also more instructive as by wiring the panels the Amateur secures practical information.

Send for Catalogue

DeForest Radio Apparatus should be on every Amateur's Christmas list. Send for our latest catalogue giving full, detailed descriptions of DeForest Receiving Apparatus. Sent postpaid for 10 cents.



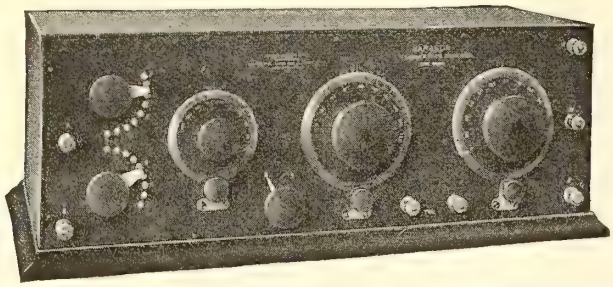
DeForest Simplified Radio Receiving Station (3 Panel). Has "Honey-Comb" Tuning Coils, Crystal Detector, Tuning Condenser, Head Telephones, Aerial and Ground Connections and all other required supplies. An inexpensive set of wonderful performance.
Complete $47.35

DE FOREST RADIO TELEPHONE AND TELEGRAPH COMPANY
Inventors and Manufacturers of Amateur and Commercial Radio Apparatus
1401 SEDGWICK AVENUE NEW YORK CITY
Sole Western Distributors Lee DeForest, Inc., 451 3rd St., San Francisco, Cal.

DE FOREST

Amplification 100 Times

Do you want to receive signals of marvelous strength; to hold those that gradually fade out, and to bring in stations that you have never heard before? You do not need a big aerial to get them,—use



The New Paragon RA-TEN

Licensed Under Armstrong and Marconi Patents

Greatest Improvement in Modern Radio

Do you remember the super service of the old original Paragon RA-SIX amplifying short wave receiver? This new set surpasses it in every respect.

And the Original RA-Six Was the Only One of Its Kind.

150% improvement over the old original Paragon, away ahead of all other receivers and excels the most serviceable set on the market today.

Here are the 150% Pointers

A Wave Length range of 150 to 1000 meters.
24% more sensitive and selective than the RA-SIX.
Coupling has scale of 180° instead of 90°, giving wider range of coupling.
Cabinet of quartered oak, overall size 20⅝ x 8 x 7½"; white filled engraving, bakelite panel, knobs and dials.
Controls on all adjustments fitted with Vernier attachments, permitting of very fine tuning and control.
And the price $85.00.

Remember the old Paragon? This one beats it and all others by miles. Our special bulletin tells you how. Send for it—it's free.

Our word of honor to you is our guarantee. Let us prove it.

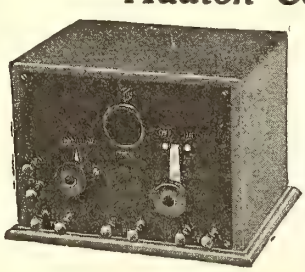
CONTINENTAL RADIO AND ELECTRIC CORP.

Sole Distributors of the New Paragon RA-TEN

J. DI BLASI, Secretary — J. STANTLEY, Treasurer

DEPT. A.1 — 6 WARREN STREET — NEW YORK

Audion Control Unit only $13.75



The K. & G. Wireless Supply Co., in its efforts to place technically correct and reliable wireless apparatus well within the price reach of critical amateurs, announces its new Audion Control Unit, Type A1. This new unit is absolutely reliable and can be used with every known circuit. It is designed and built for exacting service. It combines the very latest ideas in design with the best of material and workmanship. The cabinet, 8½x6¼x6½, has a highly polished mahogany finish and with its well mounted panel will add much to the attractiveness of your station. The unit contains these instruments: vacuum tube socket (for standard 4-prong tube) filament rheostat (10 ohms), grid condenser, grid leak, and filament switch. Panel has binding posts, suitably marked in white, for secondary, tickler, phones, and filament battery. Whole back of cabinet swings open on hinges and thus permits easy insertion of tube and batteries and complete inspection of the interior. Efficiency guaranteed, or money refunded.

Price $13.75, without tube or batteries. If your dealer can't supply you, order direct. Dealers: Write for proposition.

K. & G. WIRELESS SUPPLY CO.

Dept. 15A, 152 Chambers Street — New York

DOUBLE ANNOUNCEMENT

Central Radio Company

CENTRAL RADIO COMPANY is the largest radio supply house in the central states. A complete stock of all leading makes assures prompt shipments. **Exclusive central states agent for A. H. Grebe & Co.** Every radio man in the Mississippi Valley should write at once for a copy of our latest bulletin and special information, which will be mailed free upon request.

Central Radio School

CENTRAL RADIO SCHOOL is the best radio school in the central west. Modern, complete equipment. Special licensed radio station. Experienced instructors trained to teach. Low rates and expenses. **Both radio-telegraph and radiophone courses.** Day and evening classes. Our school only nine miles from Kansas City. Enroll any time. New classes formed first Monday of each month. Catalogue free.

NOTE:—We are successors to Independence Radio Institute, advertised in August and September Issues.

CENTRAL RADIO BUILDING, INDEPENDENCE, MO.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page* 750)

To make hydrogen connect the furn with a copper boiler as shown in figur and the accompanying cut. In the sil combustion tube place a layer of iron ings. Turn on the current and bring tube to a good red heat, at the same ti heating the water to the boiling tempe ture. As the steam passes over the red l iron it will be decomposed forming ir oxid in the tube and liberating large volun of hydrogen, which may be collected o water in the usual way.

Making Water Gas: If pieces of charc are substituted for the iron filings, wa gas consisting of a mixture of hydrog and carbon monoxid may be obtained a collected in the same way.

An Astonishing Demonstration: Usi the furnace and tube alone bring the sili combustion tube to a good red heat a then seizing it with the tongs quickly plun it into a tall jar of ice water. There w be a great seething and bubbling but t tube will not break. The co-efficient expansion for silica is so small that t tube is subjected to very slight strain a no fracturing results.

The Crucible Electric Furnace: For host of laboratory purposes, a crucible fu nace is an ideal luxury. These furnac are made to run continuously on 110-v circuits, either direct or alternating, a will generate temperatures of 1,200 degre Centigrade. In such a furnace you c make fusions, alloys, quicklime, coke a charcoal, glass, reductions of metallic oxi and bring about many other chemical rea tions.

Making Brass: Into a fire-clay crucibl of suitable size to fit the receptacle of yo furnace, weigh 70 grams of copper and ha at hand 30 grams of zinc. Place t crucible in the furnace and connecting t latter to a 110-volt circuit obtain the hig est temperature possible. When the co per has melted into a clear lake of liqu metal, which it will do at 1,084 degre Centigrade, add the zinc. The zinc w melt and quickly dissolve in the molten co per. When the zinc and copper have mixe thoroly, seize the crucible with tongs a plunge it into a pail of cold water. T brass will quickly solidify and may knocked from the crucible.

Other alloys may be made in a simil way.

Making Quicklime: In the crucible the furnace place lumps of marble, or lim stone, and heat to white heat for abo twenty or thirty minutes. Allow the quick lime to cool in the furnace and then pla a lump of it on a watch glass or in a po celain dish. From a wash bottle play small jet of cold water over the lime. Im mediately steam will appear and the har lump of lime swelling in size will crumbl to a powder. Enough heat will be generate to ignite the head of a match.

This process is called *slaking* and is th same action that takes place in the prepara tion of mortar.

The Oxy-acetylene Torch: While th use of the oxy-acetylene torch is outsid the province of amateur work, it is of ver great commercial importance and gives tem peratures very close to those of the electri arc. With it iron may be cut and welde with the greatest facility. In San Fran cisco is a skating rink containing 10 mile of brine pipes and 10,000 welds, all of whic were made by the oxy-acetylene process In cutting steel girders and old armor plat the oxy-acetylene torch has reduced th time and cost to a small fraction of wha they were in the days of more primitiv methods.

OVER HALF A MILLION TONS BY MOTOR.

The American Red Cross has about 900 motor vehicles of all kinds operating in France, Rumania, Poland, Western and Southern Russia, Constantinople, Vienna and other places doing relief work.

Within six months the Red Cross has moved over half a million tons of supplies by motor to and from trains and steamships.

A train of thirteen cars—ten of which were trucks, recently left with 134 cases of spare parts, 75 barrels of oil and 10 barrels of grease for the Polish Commission.



The ACE RAZOR

$1.00 POSTPAID ANYWHERE

Combined straight and safety razor in one, detachable guard (not shown in cut) permits of use either as straight or safety. Neatly finished, black enamelled long handle, detachable blades of finest selected steel, good for 4 months' use. Instantly cleaned.

The old-fashioned clean shave and the new-fashioned safety shave in one. Send for yours today, postpaid, anywhere. Money refunded after 10 days if not satisfactory.

Raymond Farrell Co., Dept. 22, 3256 Third Avenue, New York

Faintest Signals Readable



"Superior" 2000 Ohms, $7

BRANDES

MATCHED TONE
Wireless
Receivers

With Brandes Matched Tone Receivers

The one thing that makes "Brandes" receivers better than, and different from all others, is the "matched tone" feature. The tones of both receivers are perfectly matched; like two fine violins tuned in exact unison: two human voices pitched in the same tone. This makes the faintest signals clear, sharp and readable; carrying through the longest distances.

Light in Weight
Comfortable, Durable

Brandes Receiver shells are made of hard-drawn aluminum, combining strength with extreme lightness. The use of high-grade steel in the magnets requires less metal for full magnetic power. Brandes Receivers are so easily adjustable that they may be worn continually for hours with comfort. They are hand-made throughout, by wireless receiver specialists; and so well made that they'll last indefinitely, giving accurate service all the time.

Trial Offer

Buy a Brandes Receiver; try it for 10 days; if it fails to do all we claim for it, return it and money will be refunded.

Send 5c for Catalog E

C. BRANDES, Inc. ***Wireless Receiver Specialists***
Room 814, 32 Union Square, New York

Positively Your Last Opportunity

to purchase the Original Tubular, Vacuum Detector, Amplifier, Oscillator so well known as the double-filament, double-life, hand-made

AUDIOTRON

In Constant Service Since 1915

AUDIOTRONS, recognized as the most sensitive detectors ever produced, are now free and clear of all patent difficulties. By agreements entered into with Radio Corporation of America, AUDIOTRONS are manufactured under the following patents: Nov. 7, 1905; Jan. 15, 1907; Feb. 18, 1908. Licensed only for amateur or experimental uses in Radio communication. Any other use will be an infringement of the above patents.

$6.00
Each. No increase in price

AUDIOTRONS are no longer limited to audio frequency and can now be used as detectors and oscillators as well as amplifiers.

See your dealer at once, or order direct. Be sure to benefit by this last opportunity to secure a *hand-made, supersensitive, double-filament AudioTron Detector, Amplifier, Oscillator.* Insist on the name *AudioTron* on every tube you purchase. Fully guaranteed.

Dealers and Amateurs!

Send at once for advance information on the NEW

AUDIOTRON
DETECTOR

AMPLITRON
AMPLIFIER

OSCILTRON
OSCILLATOR

mounted on the standard four-prong base. These NEW TUBES will be ready for delivery about October tenth. A valuable bulletin on these new fully licensed tubes is now being prepared. See your dealer today. If he cannot supply this Free Bulletin, send us his name and address and we will mail you an advance copy of Bulletin No. P170.

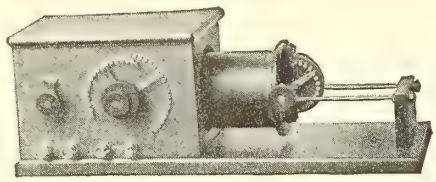
DEALERS, JOBBERS—If you are not on our mailing list, write us immediately.

AUDIOTRON MANUFACTURING COMPANY

(Successors to The AUDIOTRON Sales Co.)

Dept. S, 35 Montgomery Street **San Francisco, Calif.**

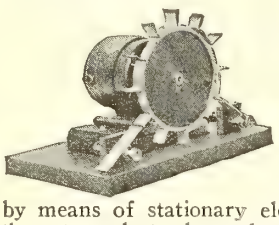
"SIGNAL" RADIO APPARATUS



"Signal" Navy Receiving
Transformer No. R21—$21.00

We have been manufacturing the Navy Type Transformer for a number of years and thru development are able to offer an instrument that is well-nigh perfection and which has made it one of the most popular that we make.

The Panel and Secondary switch is of Grade "M" Formica. Woodwork is hand rubbed, mahogany finish. Metal parts are highly nickel plated and polished.



"Signal" Rotary Spark Gap
No. R8—1 KW.—$24.00

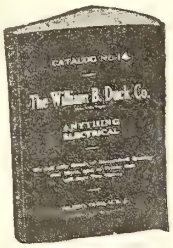
On our R8 Rotary Spark Gap we use a universal motor of about 1/12 H.P. and of very high speed. We use Formica for mounting blocks and rotary discs. Note the flat blade rotary electrodes which by proper quenching keep them well below room temperature. The quickness of break is made adjustable by means of stationary electrodes which may be moved towards or away from the rotary electrodes and which may also be pivoted upon their mounting.

Secure "Signal" Apparatus from your dealer or if he cannot supply you write our nearest distributor, giving your dealer's name

SIGNAL ELECTRIC MFG. CO.
MENOMINEE, MICH.

DEALERS—For prices and discounts write any of the following distributors:

P. M. Dreyfuss Co., 150 Chambers St., New York, N. Y.
Newman Stern Co., 1874 6th St., Cleveland, Ohio
A. W. Marshall Co., 141 Jefferson Ave., Detroit, Mich.
C. H. Wallis & Co., 1433 Syndicate Trust Bldg., St. Louis, Mo.
Signal Electric Mfg. Co., 33 S. Clinton St., Chicago, Ill.
G. C. Kowfeldt & Co., Minneapolis, Minn.
Globe Commercial Co., 618 Mission St., San Francisco, Calif.
Brian & Powers, 304 Canal Bank Bldg., New Orleans, La.
R. E. T. Pringle Co., 95 King St. E., Toronto, Ont.
R. E. T. Pringle Co., 401 New Birks Bldg., Montreal, Que.



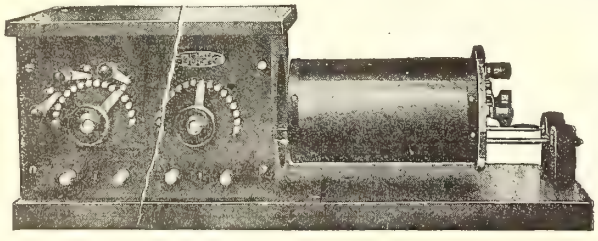
DUCK'S

New Big 200-Page No. 14 Wireless Catalog and 100 Page Electrical Catalog

The wireless catalog mailed for 12c and the electrical catalog for 6c, either in stamps or coin, which amount you are privileged to deduct on your first order of $1.00. Catalog positively not sent otherwise.

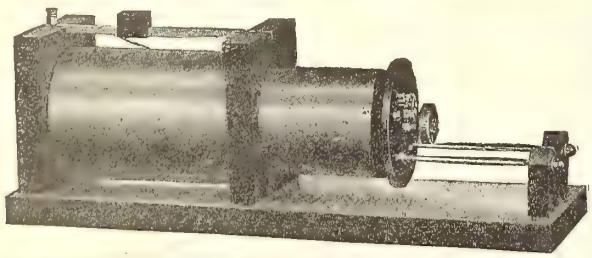
This edition of our wireless catalog is the most complete and elaborate we have ever put out. It embraces everything in wireless worth while. As an encyclopedia of information it is invaluable. It is printed on excellent paper and with a beautiful cover. Your amateur friend will tell you that there never has been any wireless catalog to take the place of Duck's, and above all that you can absolutely rely on the quality of every instrument listed in this catalog. In a word it is all worth while catalogs in one.

Audio Tron bulbs prepaid $6.00
We discontinued selling Audio Tron bulbs and accessories for a short time but we have again resumed their sale and also panel sets, and can guarantee immediate delivery.



NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER

A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $27.50.



OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

The secondary on our new type Arlington is divided into three sections with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type, permitting a looser coupling. It is a beautifully finished instrument.

Price only $15.00

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio

How to Become a Professional Radio Man

By PIERRE H. BOUCHERON

(*Continued from page 761*)

If the home student is not very speedy in receiving and yet is unable to attend a school or have a friend send to him at regular intervals so that he can gradually acquire speed, he may resort to the use of a mechanical sending machine, several practical models of which are on the market today.* One of these instruments employs a disk having its edges slotted out with dots and dashes and spaces so that when the disk is made to revolve by clockwork the slotted edges cause a contact maker to reproduce actual messages by means of a local buzzer and telephone circuit. In the other case, specially prepared phonograph disks when placed in a regular talking machine reproduce actual messages. These last have been so perfected that even static and interference are inserted here and there in various parts of the records in order to duplicate, as near as possible, actual operating conditions.

These mechanical sending devices are mentioned here for your information, but it must not be inferred that they will teach you radio receiving with the same effectiveness that a personal instructor would. As mentioned before, they are only to be resorted to when other methods are impossible.

If you are a fairly good receiver and can copy a message on paper without too many breaks, it is suggested that you learn the art of copying directly upon the "mill," which is telegraphers' slang for a typewriter. This is a very effective and business-like way of receiving messages and is one which will come in good stead when you become a practical operator.

HOW LONG WILL IT TAKE?

The time necessary to prepare yourself to the point where you are ready to take the government examination for a license depends entirely on the following conditions:

1. Your previous knowledge of either radio or wire telegraphy.
2. The degree of enthusiasm, the adaptability and the consistency you display in your studies and code practise.
3. The extent of your education.
4. The amount of time you have to devote to study, which is to be based on whether you are taking a day or night course at a resident school or learning at home.
5. Your income while learning, whether you are receiving instruction at a school, or at home by means of textbooks.

LICENSE GRADES AND THEIR REQUIREMENTS.

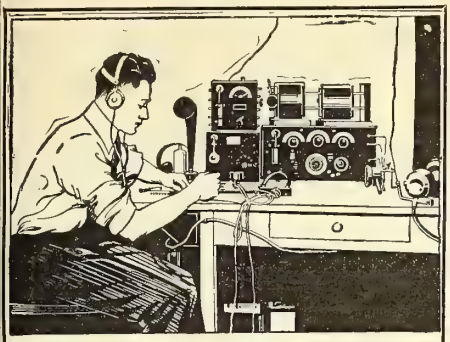
The United States Government issues a number of licenses covering certain purposes for which they may be required. There are eight grades of these, as follows:

1. Commercial Extra First Grade.*
2. " First Grade.
3. " Second Grade.
4. " Cargo Grade.
5. " Temporary Permit.
6. Experiment and Instruction Grade.
7. Amateur First Grade.
8. " Second Grade.

*A regularly licensed operator must have 18 months' actual experience before eligible to take the examination for this rather rare document.

In the present instance we are concerned with but one grade, that of *Commercial First.* This is the one which is insisted upon by all radio companies and there are very few instances where a company will employ any other operator but one holding at least

*The Omnigraph. The Victor Radio Practise Records.



Study Evenings and Learn Radio

You can secure first grade commercial license in a few months and position paying $125 a month and expenses. Individual attention given each student. Moderate rates.

Ask for Booklet A

Y. M. C. A. RADIO SCHOOL

Marcy Avenue Near Broadway
Brooklyn, N. Y.
Telephone Williamsburg 3800

"IN THE GOOD OLD SUMMER TIME"

A ACE E

did not get that C-W set fixed Get busy *now* so you will be in for the coming season. We have or finished instruments. Only the best get our list before buying.

DEALERS, if you are going to be ready for the Holiday rush, let's have your orders. e going to publish our dealers list, get name in. Our apparatus is licensed r Armstrong Patent No. 1,113,149.

emember—"You may pay more but you buy better."

PRECISION EQUIPMENT CO.

ept. E, 2437 Gilbert Avenue
Cincinnati, Ohio

RADIO XMAS

this holiday season a radio one, our apparatus now before the de- exhausts the supply on hand. We fil mail orders promptly—and post- o.

	Each
"B" Batteries	$1.25
Detector	17.00
Amplifier	25.00
mplifier	65.00
Dials	1.30
CO Coils 70c to	4.85

nore complete list of instruments send 10c log, cost will be deducted from first $1.00

RADISCO AGENTS
pen Evenings until 9.30 P. M.
ELLY & PHILLIPS
latbush Avenue, Brooklyn, N. Y.

R OWN MACHINE FOR TELEGRAPHING PICTURES



never offered before lue print and complete ions for most marvelous ion of the age. Machines nd inexpensively made rial and simple articles the hands of every ex- Will transmit pictures, ings and handwriting. e transmitted on set of ines. Only $2. Send

. LEISHMAN CO.
Ogden, Utah

a Commercial First Grade License. It behooves you, therefore, to strive for this "ticket."

The necessity for an operator holding a license is required by international law which was decided upon several years ago, when certain regulations were drafted and from which we glean the important fact that "the service of the station on shipboard shall be carried on by a telegraph operator holding a certificate issued by the government to which the ship is subject."

Concerning the matter of licenses, there is at the present moment of writing a movement on foot to change the present system of grading operators, as it is felt that the method of today is not as effective as it might be. In this connection the United Radio Telegraphers' Association is co-operating with the United States Shipping Board, as well as with the Secretary of the Department of Commerce, to bring about a mutually agreeable system of issuing radio licenses based primarily upon ability and length of service, taking into consideration the grading of vessels ranging from large passenger to small cargo tramps, and the licenses which will be held valid on each type. These tentative changes, however, need not worry prospective operators; they need only concern themselves with the important task of training themselves as it is being recognized, more and more, that the important post of ship operator should be filled solely by competent men.

COMMERCIAL FIRST GRADE.

The general requirements for this license should be carefully noted and diligent study of them practised. Briefly these are:

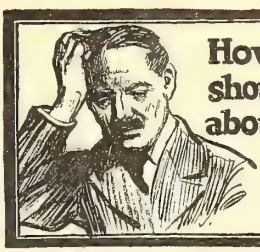
(a) The adjustment, operation, and care of the apparatus, including correction of faults and change from one wavelength to another.
(b) Transmitting and receiving by ear at a speed of not less than twenty words a minute in Continental Morse (five letters to the word).
(c) Use and care of storage battery or other auxiliary power apparatus.
(d) Knowledge of the international regulations in force applying to radio communication.
(e) Knowledge of the requirements of the acts of Congress to regulate radio communication (secs. 3, 4, 5, 6 and 7 of the act of Aug. 13, 1912).
(f) The commercial extra first grade and the commercial first-grade licenses qualify holders for employment at any ship or land station of any class.

CITIES WHERE EXAMINATIONS ARE HELD.

Commercial radio operators' licenses, as well as amateur licenses, of all grades, may be secured upon due examination by applying to any of the following named cities, where are situated representatives of the Department of Commerce:

Radio Inspector, Customs House, Boston, Mass.
Radio Inspector, Customs House, New York City, N. Y.
Radio Inspector, Customs House, Baltimore, Md.
Radio Inspector, Department of Commerce Bldg., Washington, D. C.
Radio Inspector, Customs House, Savannah, Ga.
Radio Inspector, Customs House, Charleston, S. C.
Radio Inspector, Citizens Bank Bldg., Norfolk, Va.
Radio Inspector, Customs House, New Orleans, La.
Radio Inspector, Customs House, San Francisco, Cal.
Radio Inspector, Customs House, Seattle, Wash.
Radio Inspector, Customs House, Chicago, Ill.
Radio Inspector, Customs House, Cleveland, Ohio.

As may be seen, this covers all the radio inspectors in their offices, and elsewhere by special arrangement. Additional opportunities for taking the examination are also offered to applicants as may be deemed necessary. These special dates and places may be readily ascertained by writing to the Commissioner of Navigation, Washington, D. C., or to the nearest radio inspector. In this manner prospective applicants who are



How much should I know about business law?

THIS question is being asked by an ever-increasing number of men and women who realize that a better understanding of business law means an addition to their income. One needs specialized knowledge today to be thoroughly successful—whether for one's self or for his employer. You are badly handicapped unless you KNOW JUST HOW TO HANDLE YOURSELF at every turn.

Are you in—or going into—business—entering a partnership—building a house—buying or selling property—employing agents—suing or being sued—in doubt on any legal point?

Ever-increasing opportunities are ahead of the man who keeps himself abreast of the times. During the period of industrial and social readjustment through which we are passing, every man and woman is facing constantly changing conditions. The courts have made new and very definite rulings concerning business relations between employer and employee, and between buyer and seller, and those who remain in ignorance of the fundamental laws on which these rulings are based are in constant danger of committing mistakes which may result in great loss.

Know the Law and Be Safe

While it would be impossible and impracticable for the average man or woman to consult a lawyer concerning the hundreds of questions which are constantly arising in one's daily affairs, the Virginia School of Business Law has compiled a course which makes it possible for every one to gain a complete and thorough knowledge of law as applied to the everyday problems of the individual.

This course, which is divided into ten treatises and which covers Corporations, Partnerships, Contracts, Sales, Agency, Real Estate, Wills, Bills, Notes and Checks, Bankruptcy, etc., has been prepared by the Hon. George Bosman, of the Virginia Bar, a specialist in business law, to meet the needs of the average man and woman. ** It is not cluttered with legal phraseology and does not waste time in lengthy discussions of theories, but in plain, concise language it fully covers all questions. ** A few moments a day, devoted to the study of this course or reference to it when you find it necessary, will put you in possession of facts which may save much litigation and thousands of dollars. ** The COUPONS ACCOMPANYING THE COURSE will save you many an attorney's fee.

10 Coupons for 10 Questions

With each subscription to this course there will be sent 10 LEGAL-ADVICE COUPONS, each one entitling the holder to a legal opinion on any subject and to the same sort of impartial advice which he might expect if he walked into an attorney's office and paid him his fee. These coupons are good for two (2) years and may be used by the subscriber as desired. The service he will receive in exchange for any one of these coupons may alone be worth the entire cost of the course.

A Service of Great Value

A short cut to the exact information you want. No useless instruction or verbiage. No wasted effort. A Practical, Accurate, Complete Guide to Everyday Business Affairs. Prompt advice and guidance in all troublous matters. Dependable counsel on any 10 Questions of Law which may cause you anxiety within the next two years. A direct guide to the correct settlement and handling of any mooted legal question. A sure means of forging ahead by being better informed than your competitor.

Pin $10 to this coupon below and mail it to us today. Your check will do. The complete set of 10 Lessons will come to you by return mail, along with 10 Legal-Advice Coupons, each one of which will entitle you to an authoritative opinion on a single subject. ** If, after five days' examination, you would rather have your money, ship the 10 Lessons and 10 Coupons back to us and we will make full refund—gladly and without question.

Just send in the coupon below (omitting the $10.00 payment if you like) and we will, without cost or obligation to you, send you a full, detailed description of the course and the service we offer.

Virginia School of Business Law
353 New Kirn Building, Portsmouth, Virginia

VIRGINIA SCHOOL OF BUSINESS LAW
353 New Kirn Building, Portsmouth, Virginia.

Enclosed find $10. Send me your complete course of 10 Lessons in Business Law along with 10 Coupons, each one of which will entitle me to an authoritative opinion on some legal point or question of my choosing; these coupons to be used within two years. Should I decide, after 5 days' examination, to return course and coupons you agree to at once refund my $10 payment.

Name _____

Address _____

_____

Date S.I. Nov. 1920

Theory and Operation of Vacuum Tubes in Radio Science and Engineering

arranged in a complete and comprehensive course of instruction. Every amateur operator, commercial operator, engineer or manufacturer should study this course. Instruction—Lectures—Laboratory Work. Under the personal supervision of an expert who has made a special study for years of the vacuum tube.

Write for Booklet.

Y.M.C.A. RADIO SCHOOL

152 East 86th Street
NEW YORK, N. Y.

"The Best Radio School in the East"

If desired, arrangements can be made for students to enjoy the privileges of our gymnasium—swimming pool—dormitory—employment bureau.

RADIO APPARATUS

Distributors of Reliable Radio Apparatus for Experimenters in Every Branch of the Radio Field.

"Pittsco" the Sign of service

PITTSCO

All we ask is a trial!

HONEYCOMB COILS

Litzendraht Wire. (While they last.)

LL- 75	330- 1030 Meters	$1.60
LL- 250	1300- 4000 Meters	2.30
LL- 300	1550- 4800 Meters	2.50
LL- 600	4000-12000 Meters	3.00
LL- 750	5000-15000 Meters	3.20
LL-1000	6200-21000 Meters	3.50

Note: These are genuine DeForest Litz coils.

TELEPHONES (Pair)

No. 55 Murdock 2000 Ohms	$4.50
No. 55 Murdock 3000 Ohms	5.50
Brandes Superior 2000 Ohms	7.00
Baldwins's Type C Navy standard	16.50
Baldwins's Type E Super-sensitive	18.50

B. BATTERIES

No. 7623 Standard 22.5 V. Small	$1.35
No. 7625 Standard 22.5 V. Large	2.40
No. 7650 Standard 22.5 V. Large Variable	3.25

Send 6 cents in stamps for new catalog.

F. D. PITTS CO., Inc.
12 Park Sq., Dept. D, Boston, Mass., U. S. A.

The WIRELESS EQUIPMENT COMPANY, Inc.

Furnishes all kinds of reliable radio apparatus at lowest prices. Send for latest bulletin No. 150C on new apparatus.

188-190 Greenwich St. New York

New 1920 RED HEAD PHONES



$12.50

We announce the new model of the famous Red Head Radio Receivers, greatly improved, 3200 ohms, $12.50 the pair. Write for Bulletin F6 for information on these supersensitive receivers.

THE NEWMAN-STERN CO.
Dept. E.E. Cleveland, Ohio
Distributors for DeForest, Murdock, Signal, Bunnell and other famous lines.

situated in remote sections far from any of the above-named places are often given the opportunity to take the examination thru the courtesy of traveling radio inspectors.

WHAT TO STUDY.

To attempt to detail within this article the exact matter which you should study in order to pass the examination is, of course, impossible. You are supposed to be familiar with all-around radio conditions before you can qualify. Do not think that it is a case of "boning up" on a lot of stock questions so as to be able to answer them by rote or memory system. If you expect to pass the examination you must have a good knowledge of the technical side of radio, involving theory and practise. You will probably be asked to draw complete circuit diagrams of a ship's modern transmitter and receiver; in fact, be prepared for it. The questions will also cover the advantages and disadvantages of various radio appliances, the complete method of procedure in tuning a transmitter with a wave meter; faults and repairs of the power circuit. Receiving systems with their attendant practical operation are also covered in detail. The modern storage battery is given considerable attention. This involves the Edison as well as the lead cell. You will need be quite familiar with the manner of caring for these cells and the proper method of charging and discharging.

Motors, generators and motor-generators are very important items of the examination.

In addition to the above it is also necessary that you familiarize yourself with radio laws and regulations, which takes in not only those of the United States but also those which have been adopted by the International Radio Telegraphy Convention.

In order to secure a very good knowledge of all of the above-mentioned subjects, I can do no better than refer you to the following volumes which should be secured and carefully digested:

> The Radio Communication Laws of the United States and the International Radio Telegraphy Convention, Edition Aug. 15, 1919, and which can be secured by writing to the Government Printing Office, Washington, D. C., for the sum of 15 cents. This volume is almost indispensable to the would-be radio man.

In addition to the above book the prospect is referred to:

(a) Practical Wireless Telegraphy, Wireless Press, New York, N. Y.
(b) The How and Why of Radio Apparatus, Experimenter Publishing Co., New York, N. Y.
(c) The Principles Underlying Radio Communication, Government Printing Office, Washington, D. C.

Outside of the first mentioned government book it is not, of course, necessary for you to secure all of those mentioned in the second list, one of them will do. Incidentally you are cautioned against resorting to book knowledge alone. If you are one of the unfortunates who cannot attend a school, it would be well for you to secure a certain amount of practical instruction in the care and maintenance of a ship's radio station before attempting to take the examination. For even if you do manage to obtain a license solely on book knowledge, you may find yourself up against it when confronted with some real trouble or breakdown when on board ship at sea.

RADIO ENGINEERING.

Ship radio operators are often given the opportunity to become operators at land or coastal radio stations which are situated, as every one knows, at many important points along the Atlantic and Pacific coasts. If the operator has the necessary education, it is often from these posts that some are called

GENUINE ASPIRIN

Name "Bayer" means genuine

Say "Bayer"—Insist!

BAYER

Say "Bayer" when buying Aspirin. Then you are sure of getting true "Bayer Tablets of Aspirin"—genuine Aspirin proved safe by millions and prescribed by physicians for over twenty years. Accept only an unbroken "Bayer package" which contains proper directions. Handy tin boxes of 12 tablets cost few cents. Druggists also sell larger "Bayer packages."

BAYER-TABLETS of ASPIRIN

Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid

In Tablet Form Only



Easy to take

NUXATED IRON

For Red Blood Strength and Endurance

DO NOT ACCEPT SUBSTITUTES

'FIBRE-LITE" LIMBS

Easy Payments—Do Nature's Work. **AGENTS WANTED** who wear leg. Good Pay. FREE Fibre Sample.

Describe Stump to

WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.

"They WORK while you sleep"

Cascarets

Best Laxative for Men, Women and Children.
10, 25, 50c—drugstores.

to fill minor vacancies in the engineering, construction and inspection staffs of the large radio companies.

Concerning radio engineering, it is certainly to one's advantage if he happens to be a graduate E.E., for then radio engineering will prove a very interesting as well as comparatively easy study.

To others who are less fortunate and who have not had the opportunity of technical instruction, it may be said that before they are able to take up radio engineering in earnest, they must be well versed in general science, such as physics and chemistry. A considerable number of colleges and universities are now equipt with radio laboratories and thus are able to offer a radio engineering course to those who may qualify. A few of these are: Columbia University, and the College of the City of New York, N. Y.; Yale University, at New Haven, Conn.; Harvard University, at Cambridge, Mass.; and the Massachusetts Institute of Technology, Boston, Mass. There are, of course, other schools in the Middle West as well as on the Pacific coast. Radio engineering is really a specialized division of electrical engineering and at present there is no college in this country which confers an R.E. diploma, altho there are, of course, a considerable number of expert radio men who are privileged by knowledge and experience to use R.E. after their names.

THE END

The Audion In a New Rôle

(*Continued from page* 758)

and for other reasons such as the unsymmetrical wave form of the current, as that produced by kick-coil apparatus, etc. With the apparatus employed as shown in the present diagrams, Figs. 3, 4, 5 and 6, a wide range of adaptability is had, and several forms of current readily available, including the direct high frequency discharge, as well as the effluve or brush discharge.

Referring to Fig. 3, we find a high powered audion rated at from 100 up to several hundred watts, having the usual grid, plate and incandescent filament. There are three inductances—these are numbered six, seven and ten. High voltage energy is transferred from inductance 7, to inductance 10 by electro-magnetic induction, the degree of the current in the applicatory circuits being registered by a hot wire ammeter A. This circuit, containing the electrodes 12 and 14, also has a variable condenser or capacity 11. The plate 5 of the audion is connected thru a driving inductance 7, to a high voltage direct current generator 8, which is shunted by a fixt capacity or condenser 9.

The oscillating vacuum tube cricuit shown at Fig. 3, is adjusted so as to generate and sustain high frequency currents, the inductance itself serving to inductively couple the coils 6 and 10, the result of which is the transfer of high frequency energy to the circuit comprising the inductance 10 and its associated parts. At Fig. 4, a single or unipolar discharge is obtained by grounding the apparatus, as indicated; while Fig. 5 shows how high frequency currents are induced in the patient's body directly due to the eddy current effect produced by the magnetic field created around the inductance at 7, by the constant high frequency currents surging therein. The circuits are adjusted to resonance at a frequency substantially above that frequency which can be detected by the nervous system of the body.

The circuit shown at Fig. 6 is one intended for producing Oudin unipolar currents by connecting the secondary 10 with the primary coil 7, the inductance members being the same as those numbered in diagram, Fig.

e Copper Aerial Wire
GAUGE—2 ft. for One Cent
GAUGE—80c for 100 ft. Roll
Postage Must Accompany Order
Send 15c for our big illustrated Catalogue showing scores of bargains in radio apparatus. This may be deducted from your first order of $1.50 or over. High printing costs make free distribution impossible.
ECTRICAL SPECIALTY COMPANY
E, 48-50 S. Front St., Columbus, Ohio
E, 20 N. 9th St., Philadelphia, Pa.

LEARN WIRELESS
OLDEST, LARGEST and BEST
PED school of its kind in New England.
nds of satisfied graduates all over the
Splendid opportunities now in the Mer-
larine. Day and Evening classes. Start any
y. Illustrated Prospectus for the asking.
EASTERN RADIO INSTITUTE
Boylston St. Boston, Mass.

ONDERFUL WIRELESS
EGRAPH
Two Instruments & 2 Codes, with which you can Telegraph from house to house without wires. 10 CTS.
ERSAL CO., DEPT. K Stamford, Conn.

rnold Loose Couplers
Combination Loose Coupler Parts and accessories.
Send 3c stamp for literature which is sure to interest you.
ARNOLD 2082 Lexington Av. N.Y. Established 1910

Wrestling Book FREE
Be an expert wrestler. Learn at home by mail. Wonderful lessons prepared by world's champions Farmer Burns and Frank Gotch. Free book tells you how. Secret holds, blocks and tricks revealed. Don't delay. Be strong, healthy. Handle big men with ease. Write for free book. State age. Farmer Burns, 1258 Ramge Bldg., Omaha, Neb.

I CAN HELP YOU-
IF I CAN PUT INTO YOUR HANDS THIS BOOK ON
STRONGFORTISM

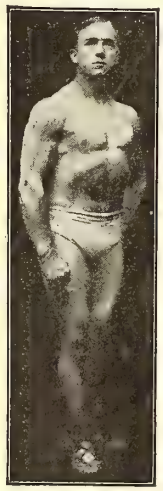
IS YOUR WIFE PROUD OF YOU?

DOES she look upon you in admiration as her ideal physically and mentally? Does she compare you with other men and see in you the noblest of them all? Or does she see in you a frail, hesitating, discouraged individual for whom she is sorry—a weakling she has to jolly and coax and prod to go to work and make a man of himself? Are you languid, tired out, disinclined to go out into the world and make a fight for a place for yourself and family? Are you afraid to go into social circles where both sexes mingle and enjoy themselves? Or are you a croaker and a grouchy, grumpy clod whom nobody wants around?

ARE YOU TO BLAME?

You may not be wholly to blame for being dumpy, grouchy, disheartened if you feel all off when you rise in the morning and feel languid and sluggish all day; but you should be blamed if you permit such a condition of the body and mind to ruin your whole life and the lives of those about you without making an effort to throw off the monsters—disease and ill-health—when I stand ready to help you in a way that no other man in the world can help you—when I offer to place within your grasp a system of self-cure, of rehabilitation, upbuilding and strengthening, that is leading the way in making better men, happier men out of thousands who had counted themselves failures.
You only are to blame if you refuse to listen to the advice of the man who first made of himself the most perfect specimen of manhood in the world and who now extends his hand to you and offers to point the way to health, strength, happiness and hopefulness.

STRONGFORTISM
Works Wonders In Men



STRONGFORT
The Perfect Man

It is years ahead of any health-building course. It makes men new. It awakens slumbering ambition. It puts pep into the languid fellow. It sends a new thrill of energy through the body—fills it with the desire to do, to achieve. It rids the system of disease without the use of drugs or medicine, clears the mind of despondency—makes the world look brighter and life more worth living for.

I GUARANTEE IMMEDIATE RESULTS

I guarantee to improve you physically and mentally, if you will follow my directions. It makes no difference where you live, what your present condition is or what has brought you to it. You can follow out my course without interfering in any way with your present occupation in the privacy of your own bedchamber if you like.

MY BOOK IS FREE

Send for my FREE BOOK, "Promotion and Conservation of Health, Strength, and Mental Energy."
Send for It TODAY—Right NOW.
There's no charge for it; I ask you only to inclose three 2c stamps to pay for packing and postage. Fill out the coupon and send it in TODAY. You'll hear from me by return mail with a message that will be a revelation.

LIONEL STRONGFORT
PHYSICAL AND HEALTH SPECIALIST
Dept. 97 Newark, N. J.

FREE CONSULTATION COUPON
Absolutely Confidential

Mr. Lionel Strongfort, Dept. 97, Newark, N. J.,
Personal—Please send me your book "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY," for postage of which I enclose a 10c piece (one dime).
Send me special information on subjects marked X below, without in any way obligating me.

..Colds	..Short Wind	..Despondency
..Catarrh	..Flat Feet	..Skin Disorders
..Hay Fever	..Stomach Disorders	..Impotency
..Asthma	..Constipation	..Great Strength
..Obesity	..Biliousness	..Falling Hair
..Headache	..Torpid Liver	..Weak Eyes
..Thinness	..Indigestion	..Pimples
..Rupture	..Nervousness	..Blackheads
..Lumbago	..Poor Memory	..Round Shoulder
..Neuritis	..Rheumatism	..Lung Troubles
..Neuralgia	..Gastritis	..Female Disorders
..Flat Chest	..Heart Weakness	..Weak Back
..Deformity (Describe)	..Poor Circulation	..Muscular Development
..Insomnia	..Increased Height	..Advanced Course
..Vital Depletion	..Successful Marriage	..Healthy Children
..Youthful Errors	..Easy Childbirth	..Manhood Restored

Mention other subjects not listed above.....
.....
Name .....
Age..... Occupation.....
Street .....
City..... State.....

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section ten cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the January issue must reach us not later than November 22.

The Circulation of Science and Invention is over 150,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York, N. Y.

Auto Accessories.

Fords start easy in cold weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene, using our 1920 carburetors. Increased power styles for all motors; can attach them yourself. Big profits to agents; money back guarantee; 30 days' trial. Air Friction Carburetor Co., 270 Madison St., Dayton, Ohio.

Tire Agents. Exclusive representatives to use and sell the new Mellinger Extra-Ply Tires. (No seconds.) Guarantee Bond 8,000 miles. Wholesale prices. Sample sections furnished. Mellinger Tire Co., 980 Oak, Kansas City, Mo.

Auto Motor Supplies—Buick, Michigan, Stoddard-Dayton, Cadillac-Overland, E. M. F. Continental and Buda Motors, all types, $50 each and up. Special high-tension, 2 and 4 cylinder magnetos $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Battery Charging Profits $100 to $250 clear monthly with HB equipment. Your lighting current or engine operates. No expense to you. Easy payment plan lets outfit earn own way. Satisfaction guaranteed. Write Hoberts, Troy, Ohio.

Battery charger for garage or service station. Terms if desired. HB Company, Troy, Ohio.

Blueprints. Automobile Armatures. See ad under "Electrical". Charles Chittenden.

Aeronautics.

Interested in Aeronautics: Send for our wonderful new shoot the shoot aeroplane glider. Guaranteed to fly. Mailed postpaid $1.00. Illustrated leaflet of Broadfield top aeroplanes sent free. Do they fly? Oh-Boy. Address Broadfield Flyer, Box 24, Hempstead, N. Y.

Wanted, to buy Monoplane. W. C. Deckard, Box 1, Eminence, Mo.

Automobiles.

Classy—speedster body, will fit any car. Construction simple, cheap. Blueprints 50c. Wendling Design Co., 11800 Ablewhite Ave., Cleveland, Ohio.

American Made Toys.

An Opportunity for Home Workers on small scale and manufacturers on large scale to make American Metal Toys. Army, navy, machine guns, cannons, warships, Indians, cowboys, wild animals, whistles, bird-whistles, religious designs and other toys and novelties. Greatest chance for industrious people to have an independent business. Enormous demand for cheap toys offers unlimited field and great future all over United States and foreign countries. Experience or tools not necessary. Hundreds and more made complete per hour. Casting forms, complete outfit from $3 up. We buy these goods, paying fixed prices. Attractive prices offered for painted goods. A strictly business proposition. No one need apply unless he means business. Booklet and information furnished free. We have no sales agents and we warn against worthless and cheap imitations. Toy Soldier Manufacturing Co., 32 Union Square, New York.

Motorcycles—Bicycles.

$25.00 up, guaranteed rebuilt motorcycles, Henderson, Excelsior, Indian, Harley-Davidson. Bicycles $5.00 up. Tires and accessories at wholesale. Illustrated Bulletin A free. Ash Motor Corporation, 162 N. Clinton Ave., Rochester, N. Y.

Motor Engines and Dynamos.

Small motors and generators; ¼ hp. AC $26.50; ½ hp., $38.50; ¾ hp. AC $67.50. Battery charging sets; charging lighting and moving picture arc generators; motors for all phases of current. Prompt delivery; wholesale prices. Write for late catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Motors, 2, 5 and 10 hp. Special prices. Write me. William Hobart, Troy, Ohio.

Motors, generators, battery chargers, prompt deliveries. Easy terms. Write Hobartsons, Troy, Ohio.

Machinery, Tools and Supplies.

Automatic Air Compressor, also Motor Buffer. Terms if desired. Hobartsons, Troy, Ohio.

Salesmen Wanted.

Salesman—Side or Main line, to sell low priced 6,000-mile guaranteed automobile tires, 30 x 3½ non-skid sells for $13.95; other sizes in proportion. Good money-making proposition for live wires. Master Tire Co., 1414 So. Michigan, Chicago.

Salesmen—City or traveling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment services rendered members. National Salesmen's Training Association, Dept. 158-S Chicago, Ill.

SWAP BULLETIN

"The National Exchange Medium"

DETROIT, U. S. A.

Sept. 13, 1920.

Experimenter Pub. Co.,
233 Fulton St.,
New York City.

Enclosed find $1.44 in payment of statement rendered.

For your information we wish to state that for the amount expended SCIENCE & INVENTION has pulled us *more replies in proportion to cost* than any other medium we use, and we use a large number. We have been with you now nearly a year.

Cordially,

C. A. Bubb, (Publisher)

Help Wanted.

Men, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 760, Chicago.

Detectives earn big money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write. American Detective System, 1968 Broadway, N. Y.

Firemen, Brakemen, Baggagemen, $140-$200; colored porters by railroads everywhere. Experience unnecessary. 897 Ry. Bureau, East St. Louis, Ill.

Stop daily grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 48, Marion, Indiana.

Hundreds Railway Mail Clerks wanted by Government. Men, women over 17; $135-$200 month. Permanent. List positions free. Write immediately. Franklin Institute, Dept. D-25, Rochester, N. Y.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Secret Service Men Earn Big Money. Travel; easily learned. Write for our copyrighted booklet. Johnson's Detective School, 232 Sheldon Ave., Grand Rapids, Mich., Desk A.

We want to hear from a man, or lady, who would like to learn chemistry while continuing present work. Unusual opportunity. Write immediately. International Buyers' Association, Box 296-Black, Topeka, Kansas.

Be a Mirror Expert. $3-10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Get a Business College Course at Home. Prepare to earn $100 to $200 month. Graduates placed in good positions. Details free. Brown's Home Study School, 310-R, Peoria, Ill.

Detectives and Investigators are in demand. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. American School of Criminology, Dept. E, Detroit, Mich.

Boys, Men—Become automobile experts; $45 week. Learn while earning. Write Franklin Institute, Dept. D-806, Rochester, N. Y.

Agents Wanted.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Agents—$40-$100 week; free samples; gold sign letters; anyone can put on store windows; big demand; liberal offer to general agents. Metallic Letter Co., 433-Z, N. Clark, Chicago.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Agents: Sell our accident and sickness policies in your spare time. Pay $5,000 death. $25 weekly benefit. Premium $10 yearly. Permanent income from renewals. Easy seller. Liberal commissions. Insurance Co., Dept. N-2, Newark, N. J.

Agents make big money because sales may be made in every home. Our modern aids to home sanitation have an appeal that cannot be resisted. A brush, mop or duster for every need. Liberal commissions and good territory. North Ridge Brush Company, 127 Clark St., Freeport, Ill.

$6000.00 a year is your profit from 4 sales a day. Davidson sold 96 one week. No experience needed. The Aladdin light is a sensation wherever introduced. 5 times as bright as electric. Won Gold Medal. Farmers have the money, they need this light and 9 out of 10 will buy. Also big opportunity in small towns and suburbs. Excellent spare time and evening seller. No capital required. Sample on free trial. Write for agency proposition while territory still open. Mantle Lamp Company, 507 Aladdin Bldg., Chicago.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Man to distribute samples, circulars, for "Foot Ointment," mail or hand; splendid opportunity. Write us today. Address The Elder Co., 290 Parkdale, Buffalo, New York.

Men, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 759, Chicago.

Insyde Tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts; quickly applied; cost little; demand tremendous; profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, Ohio.

Business Opportunities.

Men, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 761, Chicago.

Shawnee, Oklahoma. Center of a great farming country. Write for free agricultural booklet. Board of Commerce, Shawnee, Oklahoma.

Breed Canaries. Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $2,000 necessary. Will allow expenses to Baltimore as explained. Address, Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

New discovery! Establish a good, steady, profitable business of your own. Whole or spare time. No canvassing or mail order proposition. Everything necessary furnished. Write immediately. Ferber Company, 296-C Broadway, New York.

3,384 Moneymaking Plans. Formulas. Trade Secrets. "Encyclopedia Business Opportunities." 3 volumes $1. Ideal Book Shop, 5501-EV North Robey, Chicago.

"Money-Talks." The Business magazine published for progressive people. Send for sample copy. P. O., Box 236-B, Newark, New Jersey.

If Interested in Profitable Money-making plan send dime. Zoff, 20 Linden, Flushing, L. I.

Business Opportunities.

(*Continued on next page*)

Volume VIII.
Whole No. 92

Science and Invention

H. GERNSBACK – EDITOR
H.W. SECOR – ASSOCIATE EDITOR

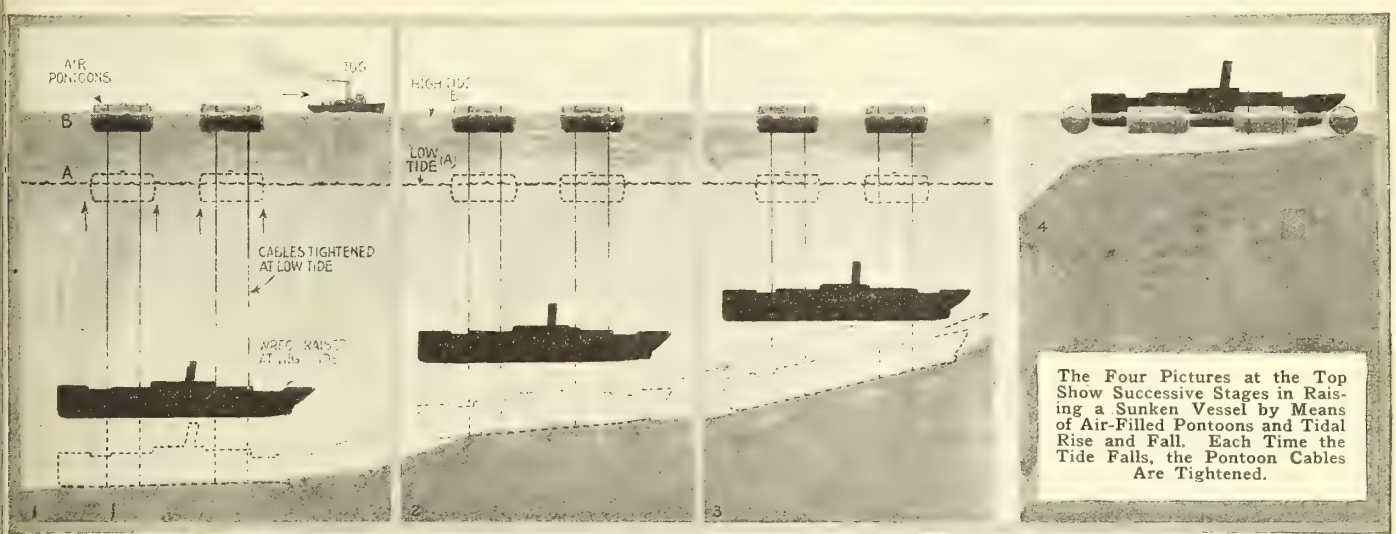
DECEMBER
1920
No. 8

DEC 9 - 1920

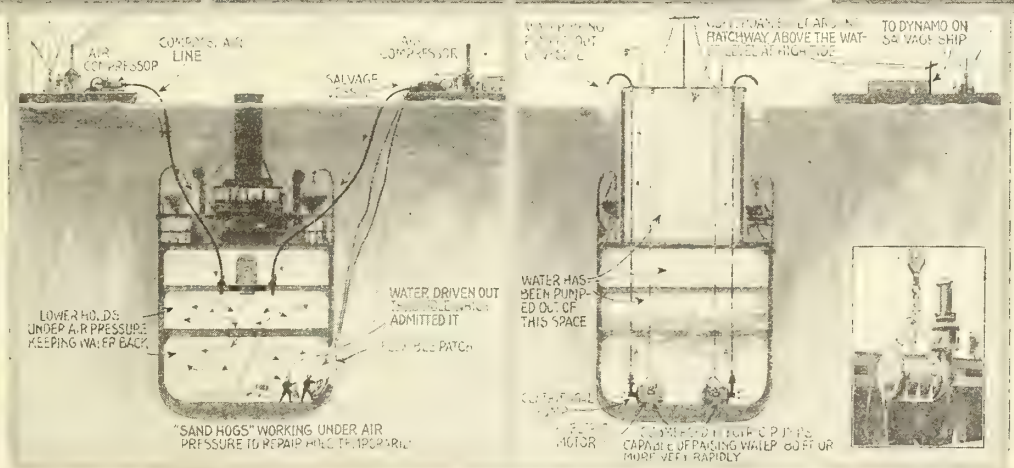
Floating Sunken Ships

How Submerged Electric Pumps, Comprest Air and Huge Pontoons are Raising Sunken Ships

NOT only were hundreds of ships sunk by torpedo attacks and shell fire during the progress of the World War, but there are many other wrecks which have lain on the bottom of the sea for years, some of which contain considerable wealth in the form of bullion and coin.



The Four Pictures at the Top Show Successive Stages in Raising a Sunken Vessel by Means of Air-Filled Pontoons and Tidal Rise and Fall. Each Time the Tide Falls, the Pontoon Cables Are Tightened.



The Scheme for Salvaging Ships by Means of Comprest Air Shown at the Right, Has Been Successfully Carried Out. The Comprest Air Is Shot Down into the Ship's Hold, Which Has Been Made Air-Tight by Divers, Driving the Water Out Thru the Opening Which Previously Admitted It. A Flexible Patch Is First Lowered Over the Rent from the Outside, as Shown. The Rent Is Then Repaired by Men Working Under Air Pressure.

In the Successfully Tried Scheme Shown at the Left, Coffer Dams Are Built Directly Over the Large Hatchways in the Ship's Deck. Powerful Submergible Electric Pumps Are Lowered Down into the Hold of the Vessel and the Water Is Pumped Out from the Coffer Dams and the Lower Hold, and the Ship's Buoyancy Finally Reestablished, Causing the Ship to Rise. Any Rents Are First Covered with Patches or Otherwise Taken Care Of.

Salvage experts, the world over, have become awakened to the fact that a fortune awaits those who will conceive successful schemes for salvaging the hundreds of vessels which were sunk in various European waters, not to mention many dozens of ships which were sunk off the American coast from time to time, either by accident or otherwise.

The accompanying illustration shows three very interesting and practical inventions which have been successfully applied in a number of instances for the salvaging of sunken ships. These include three striking and logical applications of the "laws of Nature," plus mechanics, comprest air and electricity.

Floating Ships by Comprest Air.

One of the most spectacular and surprising methods of floating submerged ship hulls, particularly to the layman, is that involving the use of comprest air to render buoyant all or the major portion of the vessel's hull.

One of the accompanying illustrations shows how comprest air applied from powerful compressors, driven by steam or gasoline engines carried by the salvage craft, is shot down thru tubes of steel and rubber into the bowels of the sunken ship—the deck hatches and other openings having been previously closed and tightened down thoroly by divers.

The first sunken wreck to be raised by this method of comprest air, was the *S. S. Royal George*. By the aid of divers and experts in this class of work, the decks were suitably strengthened and all hatchways and other openings closed. Suitable air locks were installed as shown in the illustration to enable the *sand hogs* (that is, men who are accustomed to working in a comprest air atmosphere), to gain entrance to the lower holds of the vessel.

In many cases, including the present one, the outside rents are covered as accurately as possible with large flexible blankets braced by steel and wooden beams, known as patches. The comprest air when shot down into the lower hold compartments of

(*Continued on page 929.*)

Einstein Theory and the Fourth Dimension

By H. GERNSBACK
Member American Physical Society

VOLUMES have been written during the past few months about the now famous Einstein theory of relativity and the fourth dimension. As for the latter, this is not a new subject, having long appealed to the delvers into the occult and to adherents of spiritism, as well as those who reason solely by metaphysics.

Thus, for a long time students of the fourth dimension had an entirely different conception from what physicists think it today. In their earlier fourth dimensional world, for instance, it was thought possible that you could turn an orange inside out without breaking its skin. Or you could remove a patient's appendix without making an incision in him. In other words, among many other similar absurdities, they thought that in the fourth dimensional state every three dimensional body could be turned inside out the same as you turn a glove or a sock inside out without in the least damaging it.

Since Einstein has appeared on the stage, however, this trend of thought has disappeared, and our present conception of the fourth dimensional world—if indeed it exists—is totally different from the old concept. We will, however, come back to this later.

In order to become better acquainted with the Einstein theory, let us first cite the fundamental experiment upon which his researches are based.

About Relativity

The velocity of light which is about 186,000 miles per second is unaffected by the movement of its source. Let us first make this plain by an analogy.

If a man in a train going sixty miles an hour throws a ball in the same direction as the train, and at the same speed, the velocity of the ball in relation to the earth is 120 miles an hour. Suppose this ball was thrown from the engine towards the rear. Then the velocity of the ball in relation to the earth would be zero, and if the ball was thrown from the rear platform, it would drop vertically to the ground. This is a simple example of *relativity;* this expression means that *the movement of the ball is relative to the train, as well as relative to the earth.*

Now consider a ray of light. Here an entirely different phenomenon takes place. It makes no difference whatsoever if we have a searchlight mounted on the locomotive of a moving train throwing the light backward, or if we have the searchlight on the last car of the train throwing the light forward with the train. *The speed of the light is absolutely unaffected by such motion.* Not only is this true for the light placed on a moving object, but it is also true for an observer stationed on the ground. Strange as it seems, the speed of the light ray either coming toward him or moving away from him is not at all affected by the speed of the train which carries the searchlight. This statement may be readily proved by the regularity of the apparent motion of several moons of some of our planets, as, for instance, the moons of Jupiter. At one part of their orbit these little moons are moving away from us, while at the opposite part of the orbit they are moving toward us. Yet they appear absolutely regular in their motion, proving that light coming from their surface takes the same time to reach the observer on earth whether the little moon advances or recedes from us.

If this were not so, the motion of the satellite would be irregular at all times. It might even happen that it would seem to move backward. This brings us to the famous Michelson-Morley experiment. This was originally based on the fact that light has the same velocity irrespective whether its source moved or was fixt.

To elucidate: Light for a long time has been thought to be merely a wave motion in the ether. This ether is supposed to surround us, filling the most minute interstices of all matter and, therefore, it must permeate the earth as well. Thus the earth is supposed to be entirely merged into this ether. Consequently, either of two things must happen, which we put in the form of questions. First, as the earth is speeding in its orbit around the sun, does it pass thru the ether without disturbing it as, for instance, a fine wire-mesh sieve passes thru water? And, if so, does it produce a sort of vortex or disturbance in the ether as it rushes thru it? Second, does the earth push thru the ether as a train pushes thru the atmosphere, leaving behind it a sort of ether whirl and partial vacuum, just as the train leaves behind it a whirling eddy of air and partial vacuum?

THERE are few subjects so difficult to explain in simple language as the Einstein theory and the fourth dimension. The present article, which covers the more important phases of the Einstein theory, aims to instruct the reader in a popular way and in plain English devoid of all technicalities. We believe little difficulty will be found even by the average school-boy in understanding the subject. In an article of this kind, it is of course not possible to cover all of the various phases without going into mathematics, and for that reason such phases have been covered by means of analogies as much as possible. It should be noted that the views expressed by the author are those held by most physicists today. But as there is very little known on such subjects as, for instance, light, gravitation and space, it is quite likely that our present-day views will be modified from time to time. This is the first time that the Einstein theory and the fourth dimension have been explained in a strictly popular, non-technical manner, and we hope our readers will appreciate the present effort.

The Michelson-Morley Experiment

This question the Michelson-Morley experiment was supposed to solve. A light ray being a wave motion in the ether, it was naturally thought that a ray of light going in the direction of the earth should naturally move a trifle faster than a ray of light shot against the motion of the earth or at right angles to it. Then if there was a sort of *ether-drift* produced by either of the reasons mentioned above, accurate instruments would be enabled to detect the slight difference in speed. The famous Michelson-Morley experiment was originally based upon the fact that light has the same velocity, irrespective of the movement of its source. A ray of light was sent out to a mirror occupying a plane parallel to the motion of the earth, so as to go out and be reflected back to the observer. A second ray was sent out at right angles to this one in the direction of the terrestrial motion, also to be received by a mirror and reflected back. The plane of the first mirror was arranged by measurement, at the same distance from the observer as that of the mirror for the other ray of light.

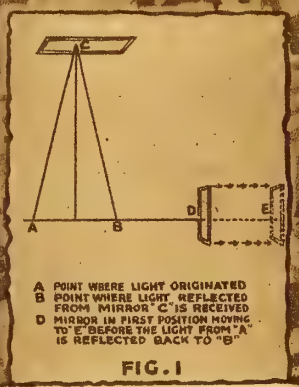
The diagram, Fig. 1, shows the path pursued by the two rays. One path is an isosceles triangle, whose base is the space moved over by the observer during the passage of light from its source to the mirror and back to him. At right angles thereto, is the path of the second ray, which has to catch up with the mirror moving away from its source, and is reflected back again to the observer. The effect of all this, is that the rays will pass over paths of different lengths, and it was anticipated that they would reach the observer at different periods of time, one ahead of the other. This is what was anticipated as the result of the experiment which was intended to be a very convincing demonstration of the fact that the earth was moving thru space. But when the experiments were tried, nothing of the sort occurred, so that apparently *the longer path was traversed by the light in exactly the same time as was the shorter one.* So scientists were called upon to explain what other causes there might be to produce this paradox. This led to the so-called Lorentz-Fitzgerald contraction theory. These scientists came to the conclusion that as there is no measurable difference in the speed of light in the above experiments, this could only be accounted for by having the earth shrink just sufficiently to account for the difference. In other words, as the earth moves forward in its path, due to its tremendous speed, viz., 65,533 miles per hour, it shrinks just a sufficient amount (about three inches) to account for the missing difference. In plain English, if we take a body and move it at a tremendous speed forward, *it shrinks in the direction of its axis* for a small amount, this amount increasing as the speed of the object is increased.

The Speed of Light

Now it must be made plain right here that in order to shrink at all, these speeds must be quite tremendous, and as far as we human beings are concerned, our everyday lives will probably never be affected. In its axial rotation the earth revolves at a speed of 1,039 miles an hour. Low as this speed is compared to 65,533 miles per hour of the earth's speed in its orbit around the sun, such speeds are never encountered on earth, as far as large bodies are concerned. Even our fastest projectiles, moving faster than anything known on earth, fall far short of this speed. But it has been maintained that a projectile shot from a cannon shrinks or rather contracts for a small fraction of an inch, which can be calculated. It should be understood right here that this shrinkage or contraction has nothing whatsoever to do with the air resistance. As is well known the earth moves in a perfect vacuum; yet modern scientists

(*Continued on page* 890)

EINSTEIN THEORY AND FOURTH DIMENSION



A POINT WHERE LIGHT ORIGINATED
B POINT WHERE LIGHT REFLECTED FROM MIRROR "C" IS RECEIVED
D MIRROR IN FIRST POSITION MOVING TO "E" BEFORE THE LIGHT FROM "A" IS REFLECTED BACK TO "B"

FIG. 1

The Michelson-Morley Experiment. Was Based on the Fact That the Velocity of Light is Unaffected by the Motion of the Source Whence it Emanates. The Result of the Experiment Was Negative.

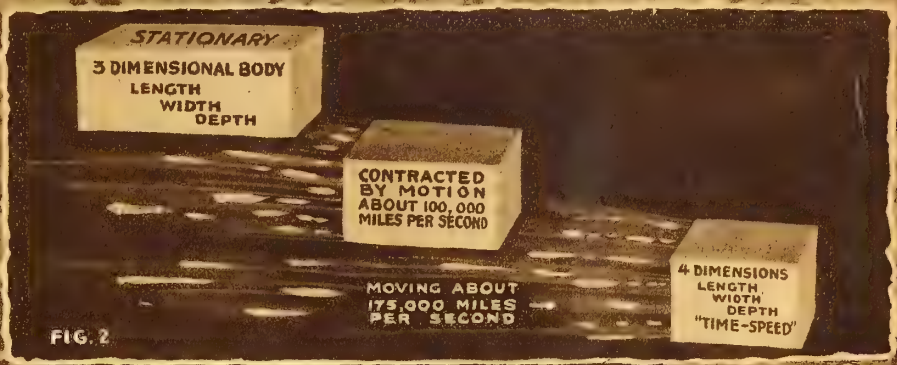


FIG. 2

A Modern View of the Fourth Dimension. It Asserts That If We Project a Three Dimensional Body Into Space at Tremendous Speeds, Such a Body is Reduced in Length, In the Direction of Its Axis of Motion, According to the Lorentz-Fitzgerald Contraction Theory. It Would, However, be Impossible to Measure Such a Contraction Because Our Measuring Instruments Would Contract in the Same Ratio as Shown in Fig. 3.

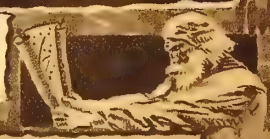




FIG. 3

An analogy of the Lorentz-Fitzgerald contraction theory. The man with his measuring sticks shrinks or is lengthened by the curved mirrors. It is impossible for him to know the REAL length of the stick by looking into the curved mirrors.

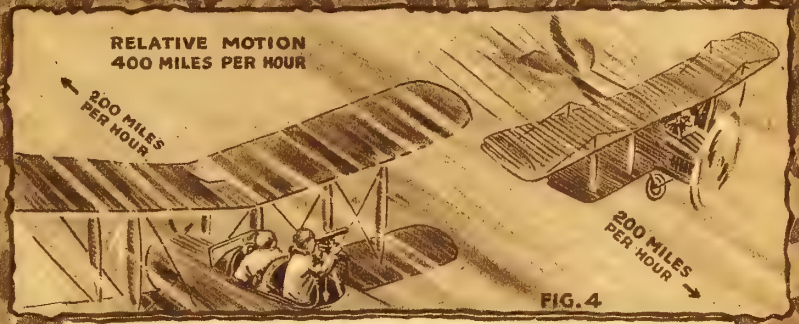


FIG. 4

A Study in Relativity. The two Airplanes Going at 200 Miles Per Hour in Different Directions Give Us 400 Miles of Relative Motion. This is Relativity. According to Einstein, It is Impossible for Either of the Two Aviators to Tell at What Absolute Speed the Opposite Airplane is Moving, No Matter What Instruments He Uses.



FIG. 5

If You Take a Train From New York to Chicago, You Believe That You Are Going West. You Do Nothing of the Sort. You are Going East Many Times Faster Than You Go West, Because the Earth Revolves From West to East Carrying the Train "Backward." If Your Train Ran West Along the Equator at 60 Miles an Hour, It Would be Carried East 979 Miles an Hour As the Velocity Due to the Earth's Axial Rotation is 1039 Miles an Hour at the Equator.

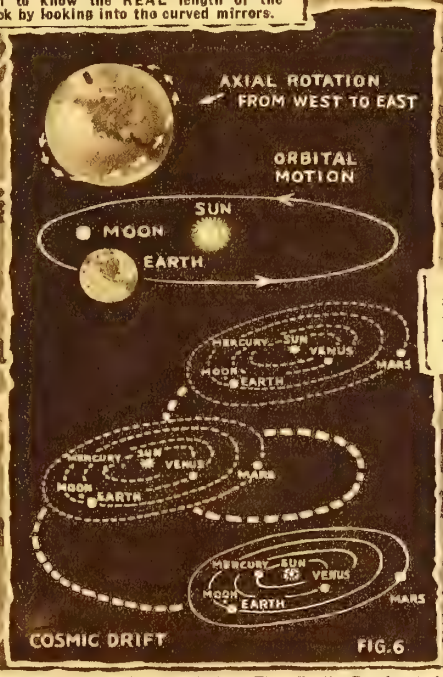


FIG. 6

A Further Study In Relativity. The Earth Revolves at 1039 Miles an Hour Equatorial Velocity in its Axial Rotation. At the Same Time It Speeds, Around the Sun Due to its Orbital Motion at the Rate of Over 65,000 Miles an Hour. This is Not All. The Entire Planetary System Moves In a Sort of Huge Spiral, Termed Cosmic Drift, as Shown.

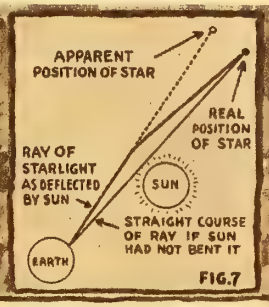


FIG. 7

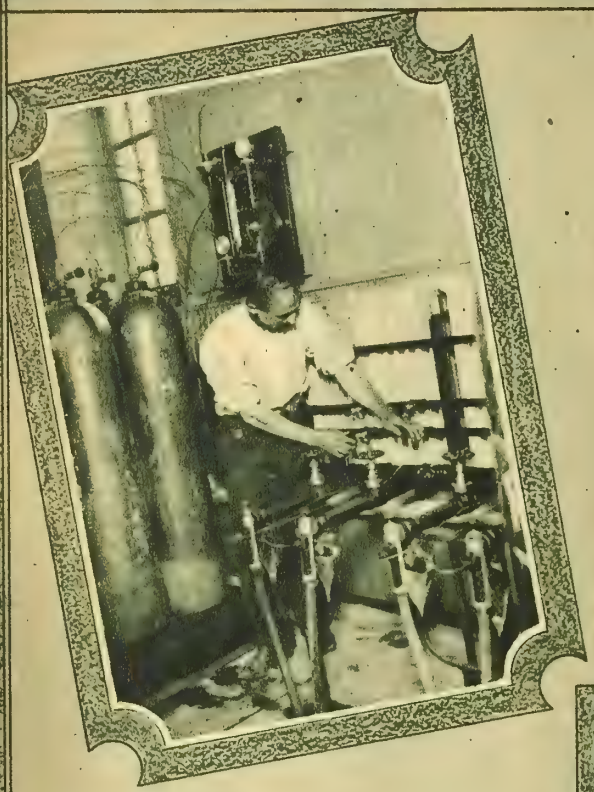
How the Einstein Theory Was Confirmed. Light (Which Now is Thought to Have Substance) Coming From a Distant Star is Deflected by the Sun Due to its Gravitational Field.



FIG. 8

Sunlight Exerts a Pressure of Over a Hundred Tons Upon the Surface of the Earth. This is Now Thought to be the Chief Reason Why the Tail of a Comet Always Points Away from the Sun.

SCIENCE



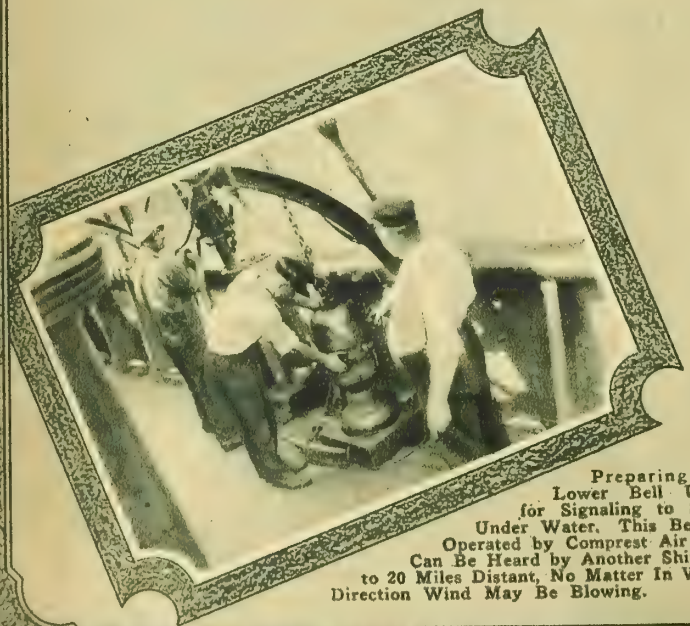
Applying Chlorine Gas at the Kensico Reservoir for Sterilizing the Water Supplied to New York City. The Gas is Received in Liquid Form Comprest in Cylinders. The Croton Supply is Treated Similarly and Smaller Plants in the Catskills and Croton Watersheds Treat the Streams Before Entering the Reservoirs.—(Copyright by Keystone.)



A Novel Motor-cycle Combination, Consisting of a Canoe Attached to a Motor-cycle in Place of the Usual Side-car. It Provides Ample Accommodation for Three People and is Easily Detached on Reaching the River.—(Copyright by Keystone.)



The Paddle Row Boat Worked by Pushing Lever Backward and Forward. No More Losing Your Oars. This Latest Invention Recalling the Canoe Paddle is Very Simple to Work With the Two Arms, Which Also Work Individually. They are Used as Pushers by the Lever in the Seat Not Only Making the Boat Go, But Serving as Good Exercise for the Back and Arms.—© Kadel & Herbert.

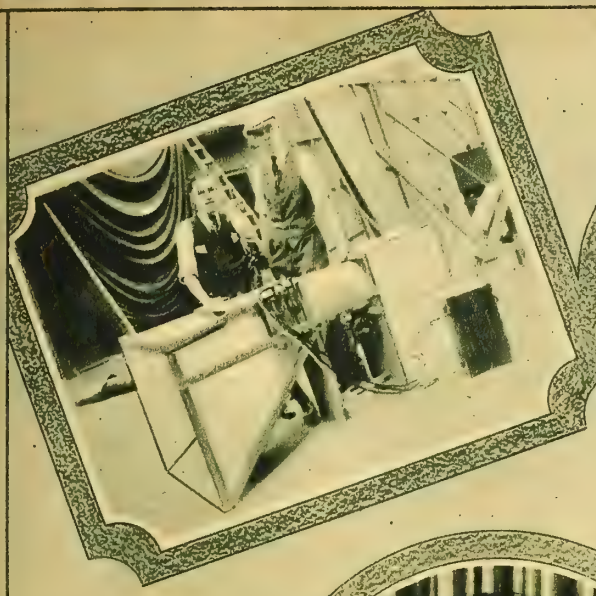


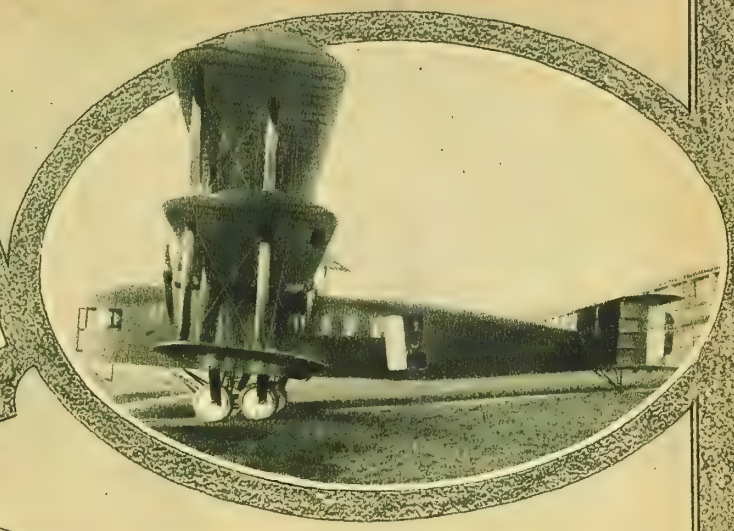
Preparing to Lower Bell Used for Signaling to Ship Under Water. This Bell is Operated by Comprest Air and Can Be Heard by Another Ship 15 to 20 Miles Distant, No Matter In What Direction Wind May Be Blowing.



Invents Electric Hand Saw. Charles M. Geiger, of Chicago, Operating His Recently Invented Electric Hand Saw. The Saw, Operated by a Small Electric Motor, Will Facilitate the Arduous Labor of Sawing by Hand.

IN PICTURES





Above:—The Giant "Bristol Pullman" Airplane Built in England. It is Designed to Carry Pilot, Engineer and 14 Passengers. It is Powered With Four 410 Horse-Power Engines and Attains a Speed of 125 Miles Per Hour.

Inventors Doom the Movie Bug—the Little Pest that Flies Around the Bright Lights, and Has Spoiled Many Feet of Film. The Invention is a Bug-catching Machine, Consisting of a Wide Box, a Carbon Arc, 2000 Candle-power Lamps, a Funnel, a Suction Fan and a Large Net. The Bugs are Attracted by the Light, the Carbon Arcs Burn Them and the Suction Fan Draws them into the Net. In a Recent Test the Machine Netted Nearly 10 Pounds of Bugs in Less Than That Many Minutes. By Number the Total Haul Was Estimated in Excess of 12,000.



At Left:—Prof. Albert Einstein Who Has Decided to Leave Berlin Because of the Attacks Made Upon Him by Berlin Scientists. His Theories Were Not Criticised—But His Personality and the Fact that He is a Jew. Einstein Has Been Offered Several Chairs in Both European and American Colleges.—(Copyright by Keystone.)

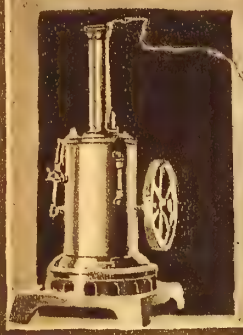
Below:—Milady Exercises in a New Fashion. After a Long and Dusty Drive, Anyone's Hair Would Need a Brushing, and This Physical Vitalizer, Which is Easily Attached to a Machine, Brushes the Hair to Perfection, and Even Massages the Hands and Face.—(Copyright by Keystone.)





Teaching Birds How to Sing Sweetly. Do You Know That Your Canary Bird Can Take Singing Lessons? They Have Special Music As Well As a Device Which Consists of Two Large Tanks Fitting Inside of Each Other Filled With Water, Which With Whistles of Various Notes Makes Music Such As Your Bird Sings Today.—© Kadel & Herbert.

SCIENTIFIC XMAS TOYS



Toy Electric Steam Engine With Vertical Cylinder. The Boiler is Nickel Plated and Equipt With a Safety Valve, Whistle, Gage Glass, Driving Pulley and Flywheel. It Will Drive Toys and Operate a Miniature Shop



This Toy Airplane is Equipt With a Real Electric Motor and Diminutive Battery. It is Built Exactly Like a Flying Monoplane in Principle Except That Its Power is Electric.



A Pretty Nursery Gift is This Small Lamp Shade of Two Layers of Silk, Between Which is the Child's Own Silhouette, and That of the Pet Puppy.



By Pressing a Bulb Held in the Hand, These Small Pool Balls Are Shot at Each Other. The Table Has the Usual Pockets and Everything.



Here is a New Folding Table for the Child Who Likes to Draw. It is Fitted With a Pantograph and a Blackboard, so That the Child May Trace Any Small-sized Picture.

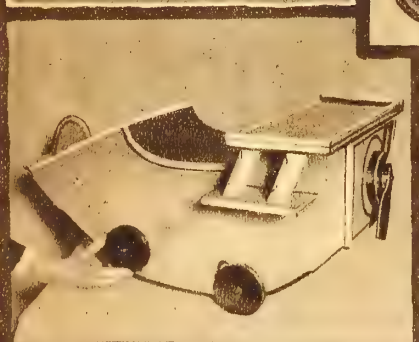




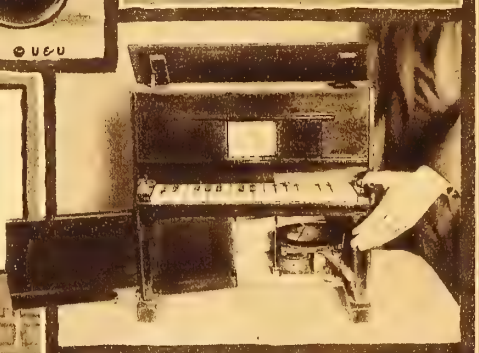


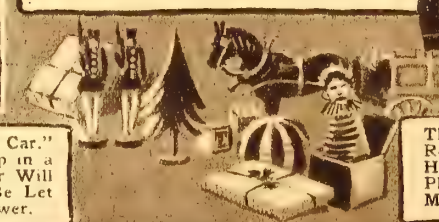
This Tallyho Has a Crank in the Front, Which Winds Up the Motor and Makes it Run Along the Ground. But the Crank Also Does Something Else. It Winds a Phonograph Inside the Tallyho and Plays a Tune as it Goes Along the Floor.

A Small Flat Music Box Underneath the Chair Plays a Tune When It Is Sat Upon. A Novelty Filled With Surprise for the Youngsters. It is Wound With a Key Under the Chair.



A "Vest Pocket Auto" Weighing Scarcely 200 Pounds and Costing About $200 Was Introduced to New York Recently by no Less a Distinguished Personage Than the Comely Miss Shown. She Caused Quite a Sensation When She Hit Busy Fifth Avenue. The Car Is Electrically Run and Makes 10 Miles Per Hour on One Charge.





A Combination Version of the "Kiddie Car." For the Baby the Wheels Can Be Put Up in a Groove Out of the Way, So That the Car Will Rock. For the Older Child They May Be Let Down and the Car Operated by Foot Power.

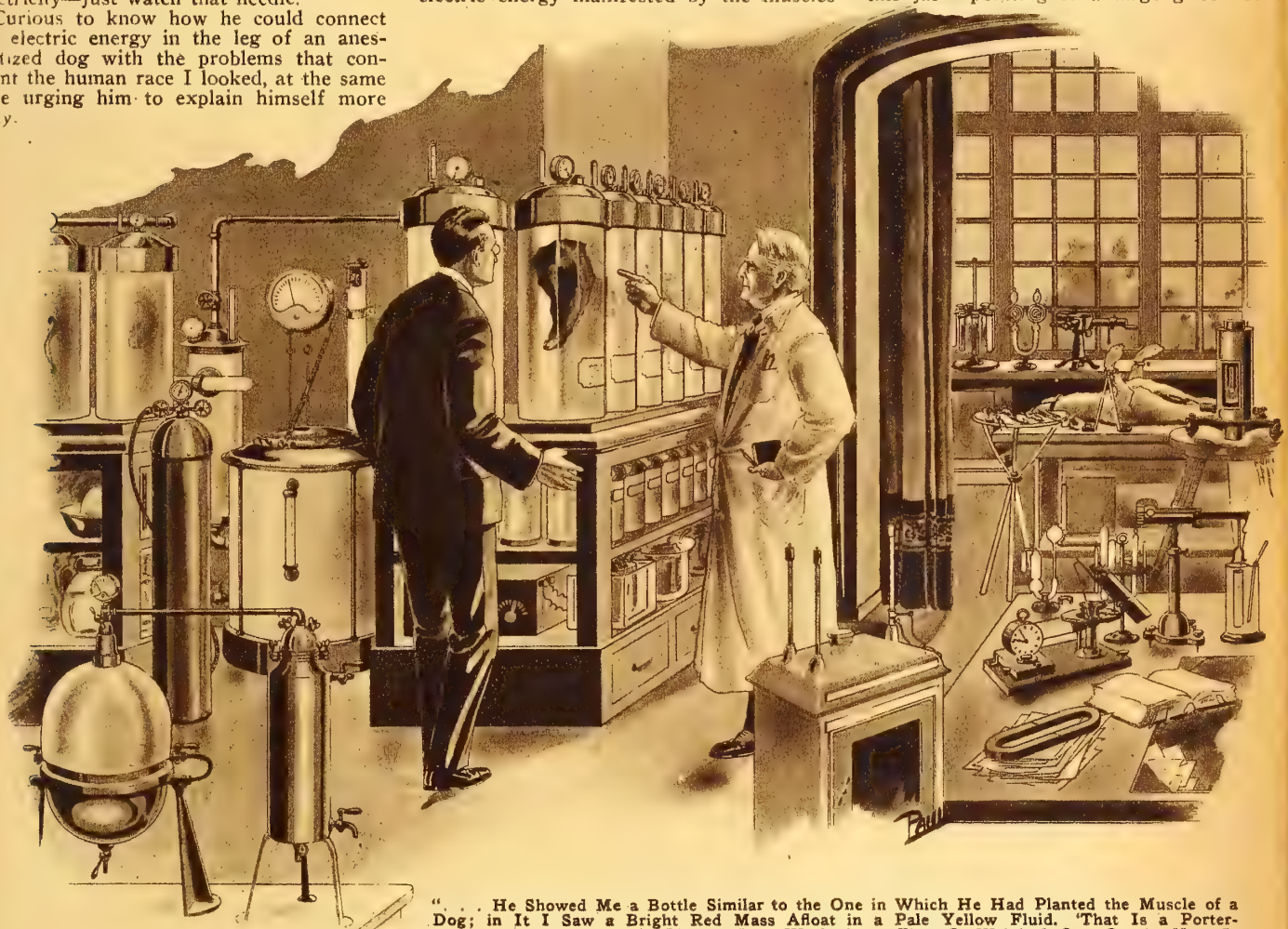
This Toy Piano Has a Player Roll Which Revolves in Realistic Fashion. Its Music, However, Comes From Beneath, Where a Phonograph is Concealed. The Toy Piano May Also Be Played By Itself.

A Prophet of Science

By JOHN DEQUER

"IN science must be found the solution for every problem which confronts the human race," remarked Dr. Pringle, as he watched the needle of a very sensitive galvanometer on his laboratory table with one slit-like blue eye, and with the other the ham string of a chloroformed dog with which he was experimenting. Then, as if suddenly changing the subject, he continued, "All life is accompanied by manifestations of electricity—just watch that needle."

Curious to know how he could connect the electric energy in the leg of an anesthetized dog with the problems that confront the human race I looked, at the same time urging him to explain himself more fully.



". . . He Showed Me a Bottle Similar to the One in Which He Had Planted the Muscle of a Dog; in It I Saw a Bright Red Mass Afloat in a Pale Yellow Fluid. 'That Is a Porterhouse,' He Explained. 'I Planted It a Week Ago. Then It Weighed One Ounce, Now It Weighs Three and One-Half Pounds and Is Pure Meat; and What Is More Important to Me, It Grows Unassociated With a Highly Sensitive Organism. . . '"

"Just watch these experiments," said he, "and see if they will not prove to you that there are no unrelated facts in the universe. The needle in the galvanometer, as you know, shows that this muscle is liberating electricity. I recognize that this, in itself is a rather uninteresting, and I might say unimportant, detail of my research work. But so was the kite-flying experiment an apparently unimportant part of Franklin's life work; yet it was that kite-flying above everything else which gave him a place among the immortals."

As he spoke, he kept on testing the muscles of the comatose canine with his electrodes, and jotting down the variations of the needle in his note book. After a few minutes of this work, he said, "Now we will kill our dog and see if this energy ceases with death, altho I can tell you right now that it does not."

I know that my looks betrayed my surprise, and Dr. Pringle noticed it. Those narrow eyes of his noticed far more than one would expect from their size, and his active brain interpreted what they saw with startling speed and accuracy. "You wonder how I can maintain that life is always accompanied by electrical phenomena, if muscles continue to liberate this energy after the animal is dead, or when they have been removed from the organism to which they belong?"

I admitted that he had read my thoughts aright, and ventured the opinion that the electric energy manifested by the muscles might be due to chemical action going on in the tissues regardless of their being dead or alive.

A smile lit up his thin lipt mouth as he arose from his stool at the laboratory table and walked over to an ice box at the other end of the room. From it he brought the carcass of a rat. It had been dead for some time as it was thoroughly stiff, and when he subjected its muscles to the same experiments he had tried on the muscles of the dog, no variation of the needle was visible. And when I asked him for his explanation, he told me that the death of an organism was one thing, while the death of its component cells was quite a different proposition.

"The death of an organism is due to a cessation of the functional activities of its component parts, while the death of the cells takes place with the chemical disintegration of the protoplasm to a point where it ceases to be an instrument for the transformation of electro-magnetic energy into the kinetic energy of life," he explained. Then after a brief pause during which he arranged some bottles and pipettes on a nearby shelf, he went on with his explanation. "I might put it yet another way. Organic death is the cessation of the cooperative activity of the various organs and tissues composing the body, while the death of the cell may be defined as the cessation of its vital activity.

"This cat is dead," said he, "yet here in this jar"—pointing to a large glass bottle protruding out of a little box on a nearby shelf, "are its lungs, in quite the opposite condition. They are nourished by a modified sea water and a few glandular extracts, as well as supplied with super-oxidized air from the tank. By means of a system of tubes, they are supplied with the products essential to their nutrition and drained of the waste of their metabolism, in a manner not unlike that by which they were supplied and drained in their original habitat. The result is they continue to live and grow, while the rest of the cat returns to the elements."

"But why do you keep this bottle in that little metal box?" I queried.

"I am trying to stimulate cell growth by means of the radio-activity of uranium ore," he elucidated. "It has been proven that the plants will turn away from the sunlight, if a minute quantity of radium be placed near them. They will also continue to grow at night in the presence of this wonderful

(Continued on page 914)

ELECTRIC HEALTH AIDS



It is no Longer Only a Theory That Rolling Devices Remove Flesh. It is Now a Substantial Fact. Electricity Revolves These Elongated Rollers Which Flatten Out the Enlarged Abdomen as Mercilessly as the Street Steam Roller Repairs a Road.

Hot and Cold Water Alternately and Electrically Sprayed on One are Rather Breath-Taking Sensations. Nevertheless Medical Science Thoroly Approves of the Method as a Stimulant for the Recuperating Patient.





The Electric Horse is Equipt With Gear Shift Levers, Battery, Switches, etc. It Gives the Rider all the Muscular Exercise He can Gain by Horseback Riding, and Nearly all of the Pleasure. Its Speed can be Regulated by the Rider to Suit His Desires



To Quickly Dry a Convalescing Patient's Hair Place an Electric Toaster Behind an Electric Fan. The Heat From the Toaster is Drawn by the Fan Forward, So That it Quickly Finishes the Task of Hair Drying.



"The Inhalatorium" is the Official Name for This Little Closet of Enameled Steel. Menthol or Some Like Medicant is Placed in the Little Round Disc on the Wall. Steam is Electrically Regulated and Forced Into the Closet, and the Sore Throat and Bronchial Tubes are Quickly Soothed.



A Mechanical Osteopathic Machine Is This Weird-Looking Device Which Is Equipt With Eight Ball-like Revolving Parts. These Parts Grasp the Horns of the Spine, Giving an Electric Revolving Massage Stroke to Them.



"....For an Instant the Rat Seemed to Sit Motionless on the Desk Top; Then a Convulsive Shiver Shook Its Frame and It Seemed to Shake Imperceptibly. 'Dead,' Said Dr. Weeks, Glancing at Me Significantly. 'Heart Failure.' I Shivered. From a Pigeonhole of the Desk, She Drew a Second Phial, This Time Filled With a Black Solution. 'The Antidote,' She Said Briefly....."

Life or Death

By CHARLES S. WOLFE

WITHOUT looking up or pausing in his incessant, illegible scribbling, the city editor heard my recital. When I had finished, he promptly gave his decision.

"'Phone calls from unknown physicians are unusual enough in themselves to warrant investigation. This one goes a step farther, and actually promises a startling story. Run over and see him, at once. If t flivvers we're nothing out."

Accordingly I taxied forth to run down this strange scent which had trickled into the nostrils of we "news hounds."

As the cab jolted its way across town, I speculated on the outcome of my errand. The whole thing was so different from routine assignments that I was tempted to expect—or at least hope for—something real big at the end of the trail.

Chance, pure and simple, had brought the thing into my hands. Some one had called the *Star's* office and asked for a reporter. Being about the only one of the clan at liberty at the time, the girl at the board had summoned me.

A voice on the other end of the wire had informed me that Doctor Weeks had a story for the press, and asked that a man be sent to the physician's office to handle it. The address was given readily on request, and before laying the matter before the editor I had taken the precaution to look up the doctor in both 'phone book and directory.

The address and name appearing there corresponded nicely to that given by our unknown caller. Our little conference followed, and I got under way.

Sitting there gazing out into the electrically lighted streets thru which we were flitting, I tried in vain to recall the name of Doctor Weeks and connect it with anything of moment that had previously been brought to my attention.

This proved fruitless. The names of possibly a dozen of the city's medical men who had been in the lime-light in various connections occurred to me, but the name of Weeks was totally unfamiliar.

The address given was in a rather shabby section of the city. Not the slums, but a district inhabited largely by mill-hands and workers of a similar type. The possibility of a trap occurred to me, but after a minute's reflection I dismist the thought. No one had anything to gain by luring me into a mix-up.

The stopping of the taxi aroused me from my reflections, and I glanced out to find that I was at the address given. Getting out, I paid the driver, and dismist him. Gazing curiously at the building before me, I noted that it was one of a block of similar dwellings, differing only from its neighbors in that the window ledge bore the conventional brass plate of the practising professional.

Mounting the steps, I prest the button of the bell system, heard, muffled, the trilling of the gong, and waited, for it was well past regular office hours.

Presently there came the sound of footsteps, the rattle of shooting bolts, and the door opened to reveal a middle-aged man of rather short stature and commonplace features. He gazed at me expectantly, but did not speak.

"Dr. Weeks?" I queried.

"Have you an appointment?" queried the other, and I realized that I was dealing with the doctor's servant.

"Tell the doctor that Roberts, from the *Star*, is here as requested," I replied.

"Oh!" the tones told that I was expected. "Follow me, please."

Hat in hand, I trailed behind him thru the darkened hallway and into a dimly lighted outer office. The servant continued on toward large folding doors at one end of this room, and as I followed I took a swift inventory of my surroundings. The customary rather shabby waiting room of the average practitioner, nothing extraordinary or bizarre, was what I saw.

Clueless, I followed, awaiting developments. The man had opened the folding doors, and was standing to one side to allow me to pass.

"Mr. Roberts, from the *Star*, Doctor," he announced to the unseen occupant of the other room, and following hard on my announcement, I entered the inner office.

A beautiful young woman—she could not have been more than twenty-five—arose from a swinging desk chair and greeted me with an outstretched hand.

"Good evening, Mr. Roberts," the voice was indescribably pleasant. "It is very good of you to come."

As I stood there, dumbfounded, lower jaw sagging inanely, hat in hand, I surely must have looked exactly as I felt—like an ass. Nor was my recovery expedited in any way by the openly amused smile that played around the doctor's sensitive mouth.

"You did not expect to find 'Miss' Doctor Weeks, did you, Mr. Roberts?" she asked, mischieviously. "Really, I enjoy giving a thrill to a hardened newspaper man. Sit down," she waived me to an empty chair, "and I will give you an idea of why I sent for you."

Recovering myself to some extent, I dropt into the indicated chair. "I must confess that I expected to find Doctor Weeks a man," I admitted, "but the fact that you are a woman encourages me to expect something a bit out of the ordinary as a reward for my trip. In our first surprise, we see a good beginning."

"I can promise you something very much out of the ordinary," she remarked, dryly, swinging to her desk and presenting me with what our illustrators call a three-quarter back view as she rummaged among a litter of papers before me.

I was thinking that as she sat thus she was not at all painful to look upon, when suddenly she wheeled to face me again, holding a cabinet size photo in her hand.

I took the proffered picture questioningly.

(*Continued on page* 935)


VON GUERICKE WEIGHING AIR
VON GUERICKE'S EXPERIMENT ON PRESSURE OF ATMOSPHERE
VON GUERICKE'S AIR THERMOMETER
VON GUERICKE'S WATER BAROMETER
AIR PUMP
Otto von Guericke
Torricelli
Pascal
THE FIRST EXPERIMENTERS ON PRESSURE OF ATMOSPHERE
VON GUERICKE'S VACUUM GUN
TORRICELLI'S BAROMETER
EXPERIMENT ON ATMOSPHERIC PRESSURE
THE MAGDEBURG HEMISPHERES

Von Guericke, the Wizard of Atmospheric Pressure

By PROF. T. O'CONOR SLOANE, Ph. D., LL. D.

WHEN in the days of Galileo it was found that water would not rise by suction much more than thirty feet, the great philosopher was appealed to and could give no reason except that while Nature abhorred a vacuum, she only abhorred it to the extent of a column of water some thirty feet in height. This, of course, was no reason at all, and it is not the first time that the sage went wrong in his efforts to account for the ways of Nature.

It is often said that we live in an atmosphere just as the fish lives in an ocean of water, but there is an important difference; our specific gravity is much greater than that of the air, so we cannot float about in it as fish do in water. Nevertheless, the light, intangible air shows its material nature in storms and cyclones when the impact of its invisible molecules produces a destructive effect, and it is shown to possess weight from the fact that a vacuum involves a pressure of nearly fifteen pounds to the square inch, which pressure is due to nothing else but the weight of the air, just as truly as the pressure in the ocean's depths is due to the weight of the water.

Otto Von Guericke goes down in history as the first great investigator of atmospheric pressure, the first who proved by direct experiment that air possesses weight, and who showed what an astonishingly great pressure could be developed by the invisible and almost intangible aeriform fluid of the atmosphere. Realizing that air could be treated like water, he devised the air pump; he had to use considerable ingenuity, owing to the rudimentary knowledge of those days in devising ways of packing it. Having invented the air pump, he produced vacua in various vessels and developed an interesting line of experiments in connection therewith. The record of his experiments are preserved in an interesting old book publisht in Amsterdam in 1672. It was printed in the Latin language, and it is quite liberally illustrated; from its pages we reproduce some of the most striking experiments as described in it.

The Magdeburgh hemispheres are shown very clearly in the old book, and they are still in existence and preserved in the museum in their parent city.

As it was not easy to get a good ground joint in those days, leather packing was used to make a secure air-tight joint between the two air-tight hemispheres shown in the cut.

Putting them together, he applied his air pump and exhausted the air from them so that atmospheric pressure came into operation, and, on closing the cocks and removing the air pump, they were prest together with such force that two great teams of horses were unable to draw them apart. This striking experiment was carried out before the Emperor, Ferdinand the Third, in 1654 in Ratisbon when the Imperial Diet met there.

A curious fallacy is illustrated in his way of testing them, because if one of the hemispheres had been fastened to a fixt post, a single team of horses would have produced as great an effort as did the two teams; making one team pull against another is bad mechanics.

He now wanted to get some idea of the extent of atmospheric pressure and for this used a cylinder and piston. A good demonstration was given by having a whole crew

The Discovery of the Wonders of the Atmosphere

of men pull at it so as to draw the piston up or rather to attempt to do so, for tho we allow even a partial vacuum, a piston of the size indicated would require a very large weight to be applied to draw it up.

Some January Articles

The Wonders of Frost. With photographs. By Jerome L. Lachenbruch.

James Watt and His Predecessors—The Invention of the Steam Engine. By Prof. T. O'Conor Sloane, Ph.D., LL.D.

How Germany Scientifically Utilizes Her Scanty Crops. By Dr. Alfred Gradenwitz.

The Divining Rod—Is It a Fake?

"How We Feel." By Joseph H. Kraus.

Man-Made Falls Higher Than Niagara Produce Electricity.

Recent Surprising Experiments in Ultra-High Pressure. Popularly illustrated.

Making Microphotographs. With illustrations. By Dr. E. Bade.

Is Electrocution Humane? Answered by America's Greatest Nerve and Brain Specialist.

Fascinating Experiments in Chemistry. Part II. By O. Ivan Lee, B. Sc.

A New Scientific Story. By Charles S. Wolfe.

How to Charge Automobile Batteries at Home. By H. C. Petzwal.

In the book is shown a group of men pulling with all their might in an effort to raise the piston against atmospheric pressure. Then it was to be weighed and for this purpose a great scale beam and heavy weights took the place of the rope-pulling men so as to get a real figure in standard weights of what the pressure amounted to.

Again, a barrel filled with water cannot be pumpt out under power without a vent to admit air, and we see the men laboring away in their efforts to draw the piston out against air pressure. He found that the barrels leaked air and abandoned this line of experiment.

Going back to the column of water, by using a sectional tube supported against a house he constructed a water barometer. The upper section was of larger diameter than the rest and in it a figure floating in the water and carrying an index was raised and lowered with the variations of atmospheric pressure and is shown carrying an indicator to point to the markings on the glass tube indicating its position.

He weighed a globe exhausted of air and also full of air; the difference of weights gave absolute proof and measure of the weight of air.

Leaving the topic of atmospheric pressure, we also show some of his thermometers in which the expansions and contractions of air in a large globe operated a string passing over a pulley. A little figure attached to the string showed motion indicating the changes of temperature as the air expanded or contracted. This, however, also illustrates the changes in atmospheric pressure, because of course the air in the bulb will expand and contract with the rise and fall of the barometer even tho the temperature remains constant.

It is about here that Von Guericke's work ceased and the Italian Torricelli put in a bit of reasoning on the ground that if a column of water over thirty feet high was supported by air, then mercury, fourteen times heavier than water, would also be supported, but only to a height one-fourteenth as great. These are all approximate figures.

Accordingly, he constructed a mercurial barometer, and some representations of his barometer are given here, two varieties being shown. They of course were simply closed tubes which were filled with mercury, the open end was next closed by the finger; the tube was then inverted in a cistern of mercury, the mercurial barometer resulting and carrying out a logical reasoning of the experiment.

There was yet another step to be made. If the barometric column was sustained by the pressure of air, it would fall with it on going up a mountain, when less and less air would rest upon the mercury in the cistern, and then the column of mercury would descend in the tube.

It was Pascal who applied this test, ascending a mountain called the "Puy de Dome" in the Auvergne regions of France. On carrying out the experiment in which his brother-in-law was also deeply interested, the mercury fell as the mountain was ascended and at last the culminating principles of atmospheric pressure and demonstration of its cause on the most logical basis was supplied.

Von Guericke was born in 1602 before either of the other two, and he survived them by a number of years; thus the three may be regarded as co-workers in this field rather than as successors.

Otto von Guericke, who was burgomaster of Magdeburg, and who is often alluded to under his official title with name omitted, understood the value of size in rendering demonstrations impressive. For, while the school boy's wet leather sucker with which he can pick up a flat stone or brick, and while the imbibing of a fluid thru a straw demonstrate atmospheric pressure perfectly, they lack in impressiveness.

In the older days much greater attention was given to this side of experimentation. So the old burgomaster did things on the large scale and his name goes down the ages because of the magnitude as well as completeness of his demonstrations.

The modern experimenter often attains his results with comparatively simple and small-sized apparatus. In Paris there is preserved the elaborate large-sized apparatus of the lamented Lavoisier. It is a great contrast to what a modern scientist would use.

Water Curtain Protects Firemen

By J. R. SCHMIDT

RECENTLY the Cincinnati Fire Department has tried out a novel scheme to protect the lives of firemen. By this means it now becomes possible for a man to walk right into the hottest fire with flames playing all around him, without in the least endangering his life. Our cover illustration perhaps shows the idea better than words. It is simply a curtain of water which sprays the fireproof uniform with a continuous stream of water, enshrouding the fireman entirely with it. The water being transparent, he can see far enough ahead providing the flames do not cut off the view. He can then do all sorts of rescue work, an example of which is shown in our cover illustration. Here the fireman is seen holding a child closely to his breast, while the protecting water curtain not only protects him but the child as well.

This fireman can stand right in the midst of flames and will not get burnt. He need not fear the glowing embers around his feet. He can walk right into the fiercest fire and it will dwindle away and go out around him.



The Latest Thing in Firemen's Suits—It Sprays a Sheet of Water Down Between the Inner and Outer Coverings, as Well as Providing an Outer Water Curtain as Shown. This Water Curtain Protection is Supplied From the Main Fire Hose in the Manner Made Evident.

As for the uniform, it is made of fireproofed canvas of two thicknesses, between which water flows constantly. The water enters by means of a perforated brass tube which encircles the neck between the two thicknesses of canvas and flows down between the layers thru the arms and legs, finding exit at the finger tips and around the soles of the feet.

Water flowing only between the two thicknesses of canvas would not offer complete protection to the wearer, so, to keep him cool and comfortable while standing in the hottest fire, the brass perforated circular tubes encircle the helmet and give him a constant shower bath from the outside as well as within the folds of the uniform. This not only keeps him from becoming overheated but also acts to extinguish the fire around him.

Encased in this air-tight water-bathed uniform, some provisions must be made to get fresh air to the fireman. He need not fear his air supply giving out as long as water continues flowing thru the hose he is holding. The air supply comes from the atmosphere surrounding him no matter how much smoke, flame or gas is contained in it. It is sucked into a patented collar which fits onto the hose just back of the nozzle. In the mechanism of the collar the contaminated air is washed and made pure and sent by the pressure of the water flowing thru the hose up into the helmet for the fireman to breathe. The foul air or gases find their exit thru vents in the helmet.

The same collar which washes and purifies the air for the fireman to breathe also has the water hose connection which supplies the water curtain. With this uniform a fireman stood in the flames of a burning wood fire for ten minutes without becoming uncomfortable. Altho the fire was kept burning fiercely all around him he came out with a grin on his face and not even perspiring!

From our cover illustration it will also be noted that the water which flows to the helmet is secured from a by-pass which is attached to the main water hose. This new invention has given such good results that it is sure to be adopted by most of the fire departments of the country. The life of a fireman has long been rendered extremely hazardous owing to the lack of effective heat insulating means such as this to protect his person.

Acid-Resisting Alloy

ALVAH W. CLEMENT has invented and patented an improvement in acid-resisting alloys. The purpose of this invention is to provide an alloy of metals which is highly resistant to acids, more particularly sulfuric acid, even tho that acid be in a hot diluted condition.

Such an alloy is useful to form containers, pumps, pipes and cocks, and other articles by which acid may be handled the same as other fluids.

The principal ingredients of the alloy which is herein proposed are iron, chromium and carbon, the latter element being present as carbids of iron and chromium.

Small quantities of silicon may be used in fusing the mixture to render the alloy more fluid, in order that it may be more easily handled. The quantity of silicon thus used is small, however, preferably less than 1 per cent, and usually varying from seven-tenths to nine-tenths of 1 per cent.

In order to counteract any tendency for the silicon to throw down the carbon as graphitic carbon, a small quantity of manganese may be used, approximately three-tenths of 1 per cent.

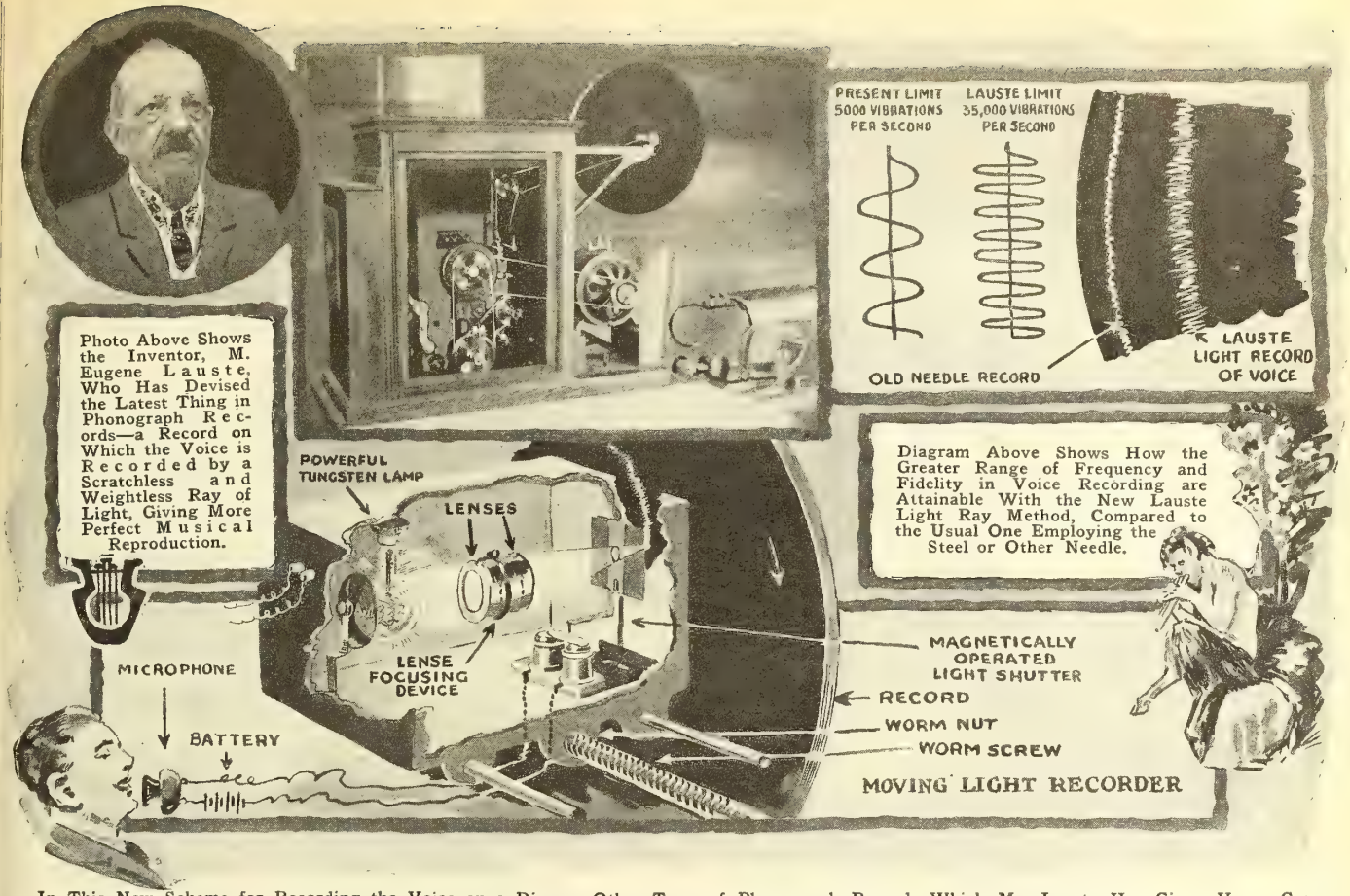
It will be apparent that the quantity of silicon and manganese present in the alloy is quite small, and so far as the ultimate properties of the alloy in its acid resistance are concerned, has very little, if any effect.

An alloy of pure iron and chromium would not be resistant to the various commercial conditions under which sulfuric acid is handled, but an alloy of chromium, iron and carbon, where the carbon exists in the alloy as carbids of chromium and iron in the proportion of substantially 60 per cent chromium, substantially 39 7/10 to 39 2/10 per cent of iron, and substantially three-tenths to eight-tenths per cent of carbon is to all intents and purposes resistant to all forms of sulfuric or similar acids.

One-quarter to one-half of 1 per cent of silicon may be added at fusion and just before pouring, to impart fluidity to the alloy.

Furthermore, such an alloy is machinable. Therefore it is suitable for acid-resisting pipes, cocks, and similar devices.

It may be desirable to add to the alloy a small amount of molybdenum, cobalt or vanadium, these various substances mentioned having the property of increasing the malleability and ductility of the alloy and thus rendering it easier to machine.



In This New Scheme for Recording the Voice on a Disc or Other Type of Phonograph Record—Which Mr. Lauste Has Given Us—a Concentrated Ray of Light is Caused to Record the Fluctuations of the Voice on the Revolving Record. The Carriage Carrying the Light, and the Voice Operated Shutter is Traversed Across the Record by Means of a Worm Screw as Shown. The Record, After Suitable Treatment, can be Reproduced by a Regular Metallic Needle, But Yields a Much More Perfect Vocal or Instrumental Reproduction Than Anything Heretofore Accomplisht.

The Light Ray Phonograph

By ERIC A. DIME

How the Newest Phonograph Record Is Made with a "Light Ray" Stylus

ALL sounds, speech or music, are recorded on the discs of the present day phonograph by means of a metal needle. This needle has a rate of about 5,000 vibrations per second, as it cuts the grooves on the disc. This method makes a reproduction of sound, but it is impossible to record all the overtones of music. Hence perfect music cannot be recorded by means of the metal needle.

How to overcome the drawbacks of the present method of recording sound on phonograph records has been solved apparently by a scientist and inventor who is widely known for several important inventions. We have reference to Eugene Lauste, a Frenchman, who is a pioneer in cinematography and the inventor of the *Laustophone,* the latter being an instrument for taking and reproducing talking motion pictures. Mr. Lauste was associated with Thomas A. Edison from 1886 to 1893, during which time he did some valuable laboratory work for the "Wizard of Menlo Park."

A few weeks ago I visited Mr. Lauste in his laboratory in Bloomfield, N. J., in order to secure some information about his latest invention which may revolutionize the talking machine industry. He was at work on what he calls the Electro-Phonograph, which will employ a radically new method of recording sound on phonograph discs. The machine is not yet finisht but the work done so far demonstrates the practicability of Mr. Lauste's theory and how he will be able to produce a disc which will contain every inflection of the human voice —something so far unheard of in the field of the phonograph.

Instead of the ordinary horn into which a person talks or sings when a record is made on the common phonograph, Mr. Lauste employs a *microphone,* similar to the instrument on your telephone, into which you talk. The horn distorts sound as it enters the machine, to which all familiar with acoustics will testify, whereas the microphone, which is one specially made by the inventor, will accurately convey the natural tones to the instrument for the recording process. In a room a person can stand at a distance of forty feet from the microphone and talk or sing—and still the sound will be received perfectly in the microphone for the recording process.

From the microphone the sound is electrically transmitted into a device that Mr. Lauste calls the *pantograph,* which intensifies the sound and transmutes the mechanical vibrations into electric light ray vibrations. The pantograph takes the place of the diafram to which the needle is attacht in the ordinary talking machine. The new instrument has a device for generating a powerful electric light ray, which is here used instead of the well-known needle for cutting or rather forming the grooves on the disc when a record is made. The guide for the light ray has its point within 1-16 of an inch of the record. This is done so as to narrow down the light beam to as fine a point as possible. In fact it is possible to obtain a finer point with an electric light ray than with the metal point.

The inventor told me that the light beam, thus used for recording sound on the specially prepared disc, produces about 25,000 vibrations per second, and this makes it possible to record clearly all the overtones in music on the coated wax disc. That the metal needle is capable of only about 5,000 vibrations per second, is due to the interference of friction and inertia in the needle and the diafram. The finer tones have not the power to speed up the needle to the necessary number of vibrations essential to the recording of all undertones and overtones. On the other hand there is practically no resistance to the light beam which is caused to vibrate at a terrific rate by the electro-magnets mounted in the pantograph of the instrument. The light beam cuts its grooves laterally in the disc.

After the first record is made, then the master record and duplicate records are run off in the same manner as are the records for the different makes of phonographs in use today. There is no special talking machine required for using the records made by the Lauste Electro-Phonograph. The new type of discs will fit any phonograph that employs a steel or other pointed needle for lateral grooves. And as the steel needle follows the grooves made by

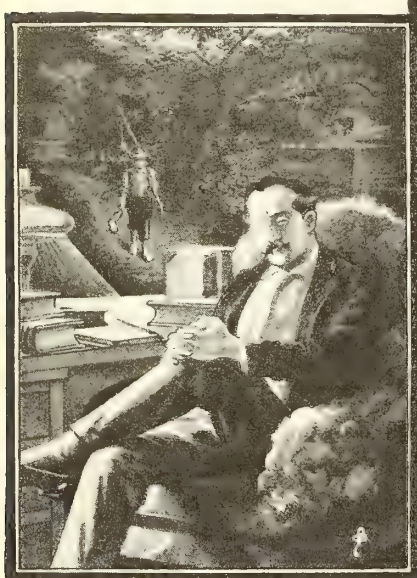
(*Continued on page* 924)

What Are Dreams?

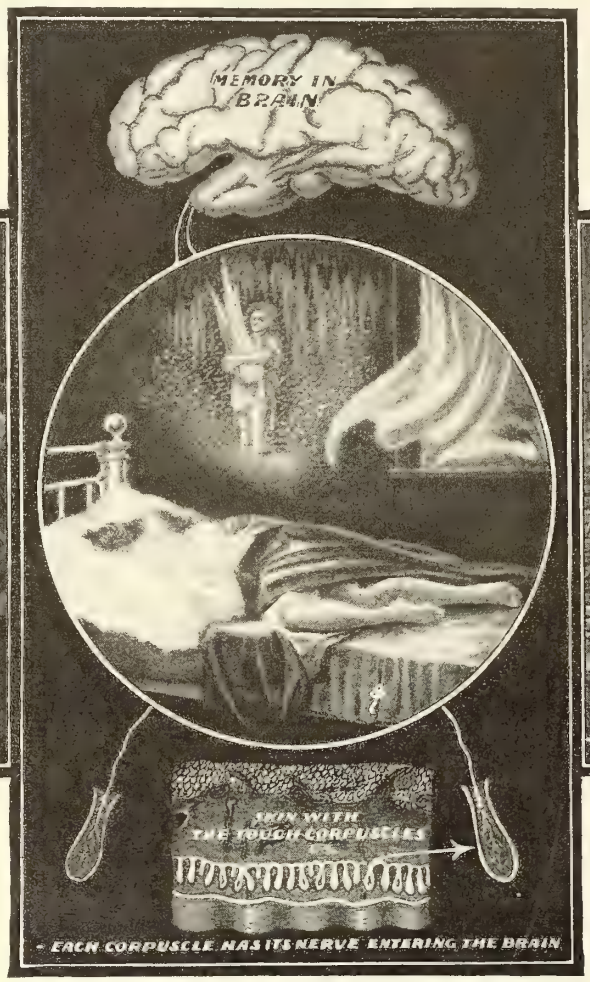
By WILLIAM M. BUTTERFIELD

Is the Dream Merely Subconsciousness?

DREAMS, "children of an idle brain, begot of nothing but vain fantasy," of what earthly substance are your fleeting phantoms compounded? The ape-man, sleeping in the crotch of a meozoic pepper-tree, dreamed and wondered just as his progeny, the highly cultured man of today, rising from his satinwood bed, has his periods of speculative inquiry.



A Busy Mind Constantly Engaged Very Often Desires to be Rested. In a Few Minutes It Will Take the Person Back to the Delightful Scenes of Childhood. Such Dreams are Stimulative and Very Often Occur in Little Catnaps, Day Dreams and Reflections of a Pleasant Summer or Childhood Days.



Above is Shown a Dream Induced by the Exposure of Parts of the Body to a Draught of Cold Air. The Sense of Touch Seeks to Arouse the Mind to Protect the Body and Forms a Mental Picture of the Sleeper's Knowledge of Cold, i.e., Ice, Snow, Icicles and Snowdrifts, All Unpleasant, in This Way Attempting to Communicate the Danger Which the Sleeping Body is in.



Nightmares Such as These Often Repeated are Generally Indications of a Diseased Body or Mind. Some Nightmares May be Caused by Food Which Did Not "Agree" with the Person, But a Continual Variation of Uncanny Nightmares Should Invite the Owner to Request the Services of a Reputable Physician.

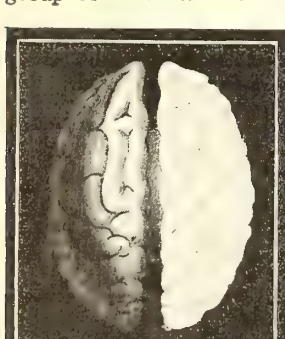
Millions of years of mental experience and development have not removed the veil of mystery, and the human race as a whole are as ignorant of the true cause or philosophy of dreams as was the hairy savage, shivering with fear and apprehension in his tree-top. Indeed, it is probable that many shiver more now, from fear and the effect of dreams as a result of this mental development, than the ape-man ever did.

Dreams of all mental sensations—elusive, fantastic or mystic as they may appear, have had more to do with the development of the mind than any other group of inflexes. No other operation of the mind has the power to arouse the same degree of pleasure, distress or terror—hence dreams have from the earliest days of human history exercised a powerful influence over the thoughts and acts of men.

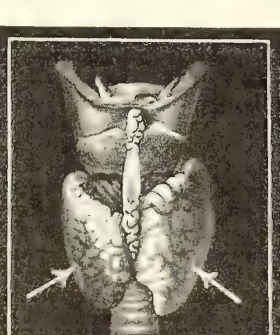
Our waking thoughts are exprest in unspoken or mental words, while our sleeping thoughts, or dreams, are exprest only in picture form; thus we *think while awake, in words,*—but *when asleep, in visions.* These dream visions are for the most part vivid and seemingly realistic, creating ideas in the early days more or less fantastic and untenable in modern thought, yet of such a character as to form the first conception or belief of the soul. One idea exprest is that the soul is a separate, non-physical part of the body; another, that the soul is the mind.

Robert Gray in his *"Theory of Dreams"* (1808) started what may be called our modern dream investigations, which have been followed by many theories such as: duplex-brain theory, vaso-motor theory, thyroid and hypophysis theory, chemical, histological and biological theories, and finally, the present 1919 psycho-biological theory. The earlier ideas, of course, are supposed to be wiped out and thrown into the discard by the presentation of this psycho-biological proposition. It is needless to say that this theory is already objected to and is threatened with extermination by a newer idea.

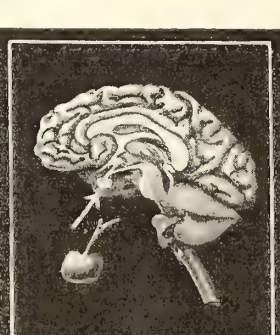
(*Continued on page* 898)



Duplex-Brain Theory Says One-half of the Brain is Fully Developed. We Use This Half When Awake; the Other Half is Only Partly Developed. We Use the Less Developed Half During Sleep.



Thyroid-Gland Theory Says Sleep is Caused by a Change in Secretion in the Thyroid Gland. This Gland is Below the "Adam's Apple" and is the One Enlarged in Goitre.



Hypophysis Theory Says that the Hypophysis is Responsible for Sleep. It is a Gland of Two Parts Which is Located Just Below the Optic Nerves Within the Cranial Cavity.



The Biologic Theory Says Sleep and Dreams are Instincts Developed from the Primitive Rest State of Animals, Which Man Inherited and Has Complicated.



Psycho-Biological Theory Accepts the Biologic Theory for the Body, but Says the Mind is the Soul and That it is Conscious When Dreaming or in Sleep—Therefore Superior to the Body.

Lamp Facts for the Householder

By JOHN W. HAMMOND

of the General Electric Co.

DELICATE, adaptable, indispensable—such is the incandescent lamp as developt and used today. Its history is the history of the method of producing light by artificial means. In modern lamps, tungsten is almost exclusively the light source.

That part, the slender, hair-like wire within the bulb of the incandescent lamp, which is heated by the passage of the electric current, producing the illumination that radiates from the bulb, is termed the *filament*.

The smallest tungsten wires drawn measure only four ten-thousandths of an inch—approximately one-sixth the diameter of the average human hair. These practically invisible threads of wire are used in small lamps for illuminated signs.

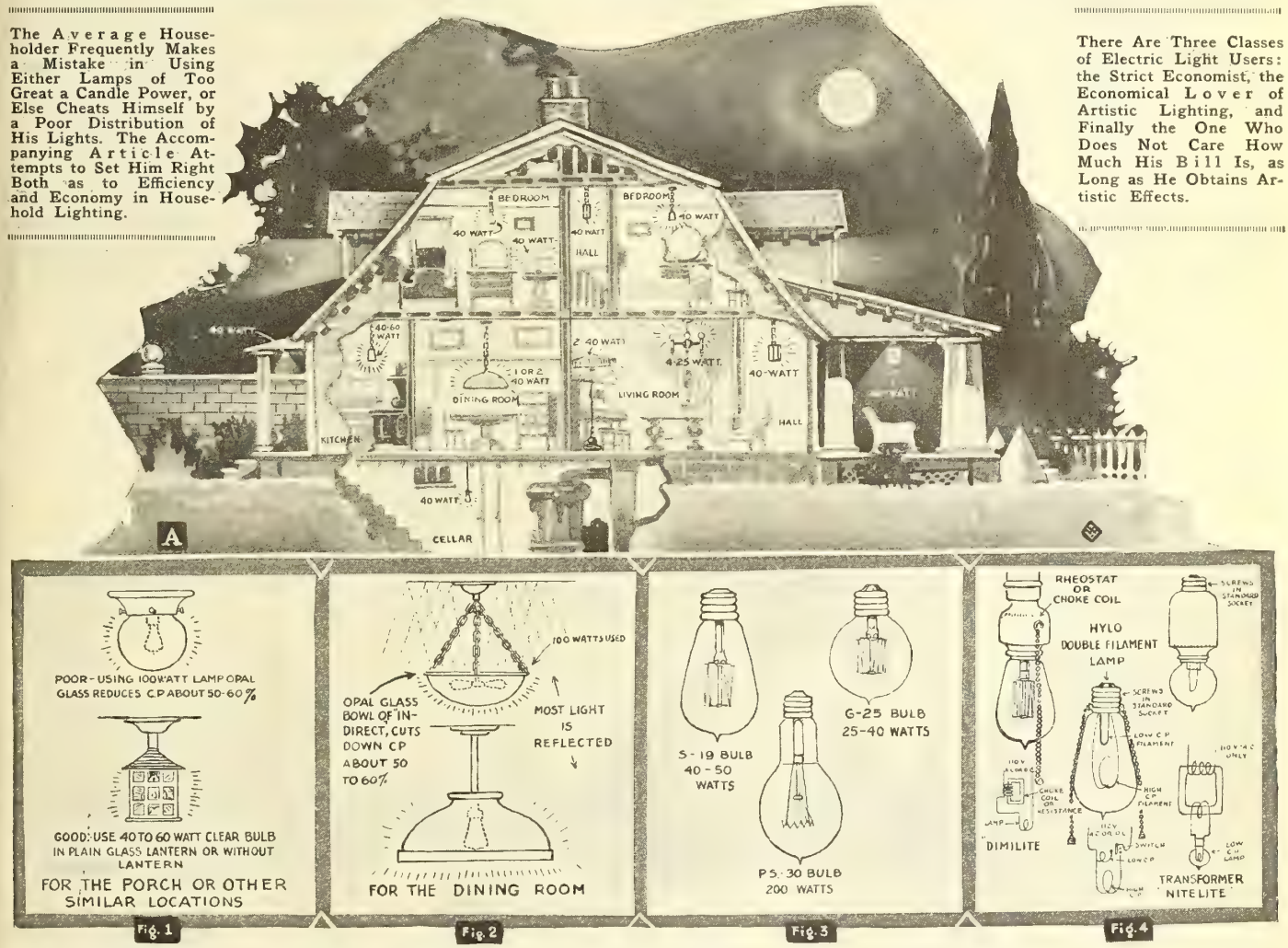
In general, the incandescent lamps familiar to this twentieth century world are divided into two broad groups—those in which the filament operates in a vacuum, as the Mazda "B" lamp of certain manufacturers, and those in which the filament operates in an atmosphere of gas, as the Mazda "C" lamp. These two classes are subdivided several times into other classifications.

The tungsten construction in Mazda "B" and Mazda "C" lamps is different in each case. In the Mazda "B" lamps, known also as the vacuum type, straight tungsten wire is draped over the supports, in order to get a sufficient length of wire inside the bulb for the voltages met with. Expensive and complicated machines produce in these bulbs the highest degree of vacuum in commercial use.

In the Mazda "C," or gas-filled, type of lamp (sometimes referred to as nitrogen-filled), coiled tungsten filaments are used, for three purposes: to increase the effective diameter of the filament, to reduce the losses, and to get sufficient length of wire inside the bulb for the voltages met with. Mazda "C" lamps are also carefully exhausted to produce a vacuum. After that, the bulb is filled with a gas (nitrogen, argon, etc.), which is high in density, low in heat conductivity and inert to tungsten and other parts of the lamp. This is done in order to make the lamp more efficient.

The Average Householder Frequently Makes a Mistake in Using Either Lamps of Too Great a Candle Power, or Else Cheats Himself by a Poor Distribution of His Lights. The Accompanying Article Attempts to Set Him Right Both as to Efficiency and Economy in Household Lighting.

There Are Three Classes of Electric Light Users: the Strict Economist, the Economical Lover of Artistic Lighting, and Finally the One Who Does Not Care How Much His Bill Is, as Long as He Obtains Artistic Effects.



Some Practical Hints for Those Desiring the Highest Economy in Electric Lighting Are Shown in the Lower Illustrations, Figs. 1 to 4. Fig. 2 Shows How Approximately One-half the Candle Power Produced Is Utilized in Reflecting the Light Upward to the Ceiling and Back Again. Fig. 3 Shows the Three Principal Types of Incandescent Lamps, While Fig. 4 Shows the Three Leading Types of Nite-lights, Which Also Have Many Other Uses, of Course.

CLASSIFICATION OF LAMPS

As already stated, these two broad groups of incandescent lamps are subdivided several times. The first subdivision groups them according to the size of the socket, which fits the base; the next subdivision classifies them on the basis of the watts consumed; and, finally, they are designated in accordance with the kind of bulbs used.

Under the first subgrouping, lamps are termed large or miniature. Large lamps, used for residence, store, office, factory and street lighting, have bases fitting three types of sockets: the medium screw, the mogul screw or the medium bayonet socket. The bases of miniature lamps, which are used chiefly for flashlights, auto lamps and decorative purposes, will also fit three kinds of sockets: the miniature screw, the candelabra screw or the candelabra bayonet socket.

In the second subdivision, lamps are known as 10 watt, 20 watt, 50 watt, or whatever the case may be, the number designating the approximate watts consumed by the lamp when operated at its correct voltage. A few types of lamps are designated by candle-power, chiefly lamps used in street lighting and automobile lighting. This variation is due to trade conditions.

The familiar varieties of lamps in the third subgrouping, in which the kind of

(*Continued on page* 906)

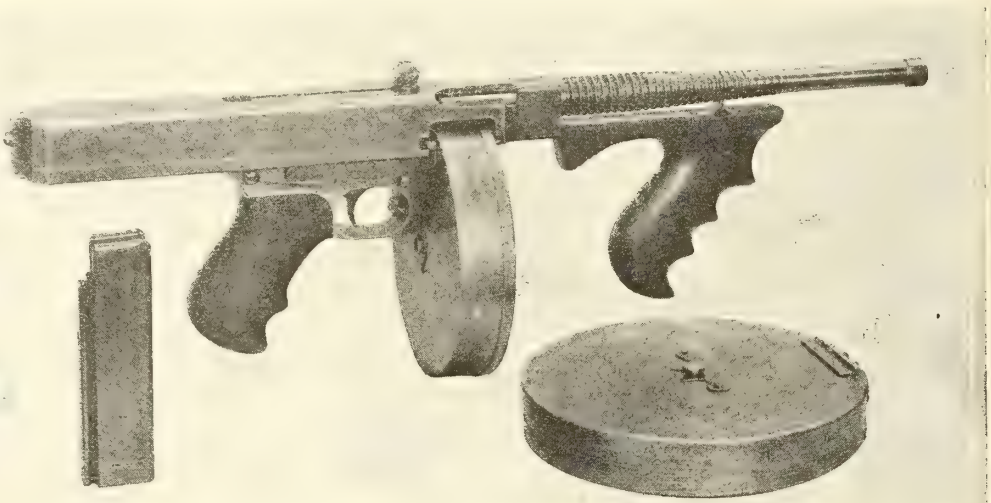
The Submachine Gun

By ERIC A. DIME

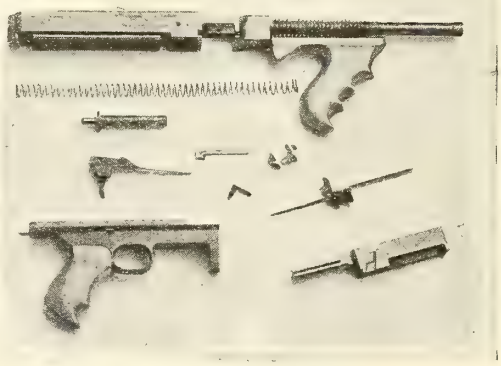
Seven Pound Gun—Range 1 Mile—1500 Shots per Minute



Soldier Holding New Submachine Gun, Which Weighs but 7 Pounds and Has a Range of One Mile. It is capable of Firing 1500 Shots Per Minute.



The Illustration Above Shows Closeup View of Submachine Gun With Pistol Type of Magazine at Left, and Circular Drum Magazine Holding 100 Cartridges, at the Right.



Showing the Few Parts Constituting the "Submachine" Gun—the Simplest Machine Gun Ever Devised.

SOME day a couple of yeggs, who make their specialty of robbing banks and getting away with the swag, while engaged in one of their precarious pursuits, are going to meet the greatest surprise of their lives. In nearly all recent holdups they have been able to elude their pursuers. After the robbers grabbed several thousand dollars of the bank's money, they hopped into a waiting automobile and sped away. Perhaps they were chased by a police officer who exchanged fire with the thieves. The officer fired every shot from his regulation pistol without hitting the crooks, because he was far behind them and it was hard to aim straight. At last the yeggs made good their escape.

But this performance will not be repeated in its entirety on the day in question—the day of the big surprise. As usual, the yeggmen will venture forth to increase their wealth by looting the safe of some bank that may look easy. There will be another order of "Hands up!" While frightened tellers and other people in the bank stand with their hands raised heavenward, currency and gold will be scooped into sacks carried by the thieves. Then for the get-away. Once more the crooks will slip into an automobile, with its engine purring, near the curb. Now they think they are safe, but they are reckoning without the host. Soon an officer of the law is on the trail. He sits in a motor car and levels what looks like a large pistol at the fleeting bandits. They see him and open fire. A few barks from their guns—then silence. The officer's weapon has spoken. From its barrel a deadly stream of bullets has poured at the rate of 1,500 shots per minute at the car ahead.

When the smoke of battle has cleared away, the bandits' machine presents a gruesome sight. It is riddled with bullets and all tires are flat from scores of punctures. In the body of the car are huddled the limp forms of the crooks, whose bodies are perforated by leaden pellets. The money is saved.

This turn of affairs will be due to a new type of gun which the officer carried. It is called the *Submachine Gun,* a machine gun in the form of a large pistol not weighing more than seven pounds. The new gun is the invention of General John Thompson, Director of Arsenals and chief of small arms production during the World War. The New York Police Department thinks so much of the Submachine Gun that it has officially adopted the weapon, a number of which will be turned over to the Riot Squad for use in riots and in chasing thieves and other lawbreakers in automobiles.

The Submachine Gun has only eleven parts. Any one can take this new weapon apart and assemble it in less than a minute and the operation can be performed without the use of a single tool. The gun is made for calibers .22, .32, .38 and .45. The weight of the gun, depending on the caliber, ranges from three to seven pounds. The length of the weapon over all is from sixteen to twenty-two inches, also depending on the caliber. It has a range of a mile at which distance it will kill a man. The firing mechanism is of such construction that single shots can be fired or else a stream of bullets, like those from a machine gun in action, can be poured from the muzzle of the Submachine Gun at the rate of 1,500 per minute, as before stated. The ammunition may comprise ball or buck shot. Two types of magazines can be used on the gun. One is of the straight type used on automatic pistols, altho larger than the latter, while the other is of the disc type, which holds from 50 to 100 cartridges. A spring in the magazine feeds the cartridges into the breech.

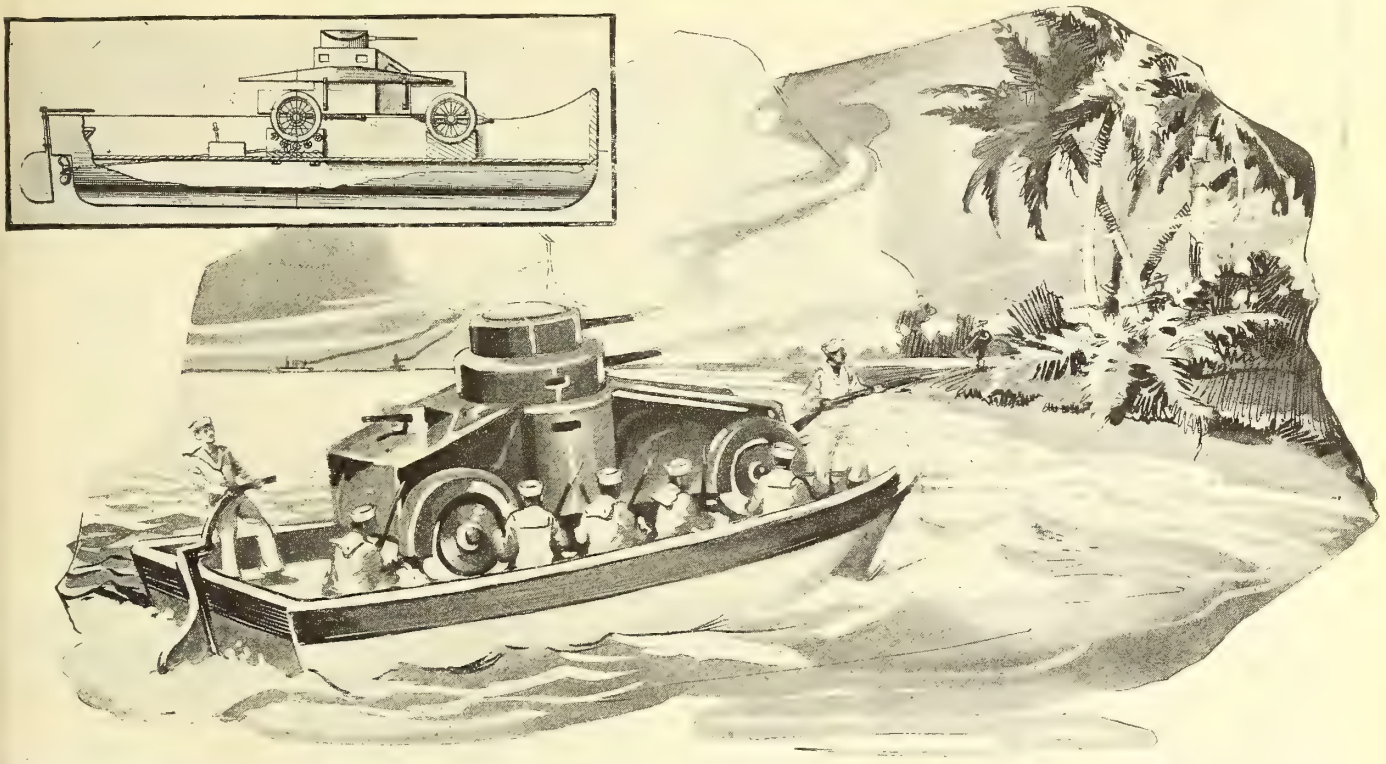
A striking feature of the Submachine Gun is a mechanism called the *Wedge* and this is the basis of a new principle in automatic gun design. By the use of this wedge the breech is automatically locked and released. This single part, weighing only a few ounces, replaces numerous heavy complicated pieces weighing several pounds, common to other types of automatic guns, and the result is an accurate, positive, automatic action.

A stock may be attached to the Submachine Gun so as to convert it into a semi-automatic shoulder rifle firing single aimed shots as fast as the trigger can be pulled. Firing in this manner one hundred hits per minute up to 500 yards is a possibility and this is a hitting speed unapproached by any other shoulder arm in the world.

A report of the United States Marine Corps, Quantico, Virginia, date of August 24, 1920, says: "The very simple, positive and extremely rapid action of this gun was by far the most striking feature from a military standpoint. Approximately 2,000 rounds were fired during the test without a stoppage. There were no broken parts nor any repairs made to the gun while under the observation of the board."

During an interview I had recently with General Thompson, he said that if the Germans had been equipped with Submachine Guns during the closing days of the war, when the German man power could not compare in numbers with the forces of the Allies, the Germans might have got the best of the troops opposing them. Undoubtedly future wars will see all soldiers of the infantry equipt with light rapid machine guns held to the shoulder.

Auto Propels Armored Landing Boat



A Recently Patented Idea Which Will Find Extensive Adaptation in Future Warfare Maneuvers, Especially in Landing Troops or Marines As Here Shown. The Armored Motor-Car Is Caused to Propel the Landing Boat By Placing the Hind Wheels On a Series of Friction Rollers, Suitably Geared to the Propeller Shaft in the Manner Indicated in the Diagram at the Top of the Illustration. The Guns of the Armored Motor-Car Can Be Used While the Boat Is Moving, When Desired. The Front Wheels of the Motor-Car Rest in Grooved Chocking Blocks.

THIS interesting and, withal, practical invention relates to improvements especially designed for use as an equipment for transporting troops from vessels to the shore and at the same time to provide a motor vehicle of the armored type construction which may be used while on the landing boat as a means of offense, and which can, thru its own driving mechanism by suitable connections, transmit power to the propeller of the boat, and when the shore is reached can be landed and used in the ordinary way as an armored motor car.

The invention, which has been patented by Waldo A. Ross of Washington, D. C., contemplates the provision of a suitable boat having the usual propeller and gearing, which may or may not be operated by its own gasoline engine, and in connection therewith he provides an armored motor vehicle for the purposes above referred to which may be so supported on the boat so that the driving mechanism of the automobile may operate the propeller; and which is so arranged that when landed from the boat it may be used for scouting purposes or for the ordinary warlike purposes of such a vehicle.

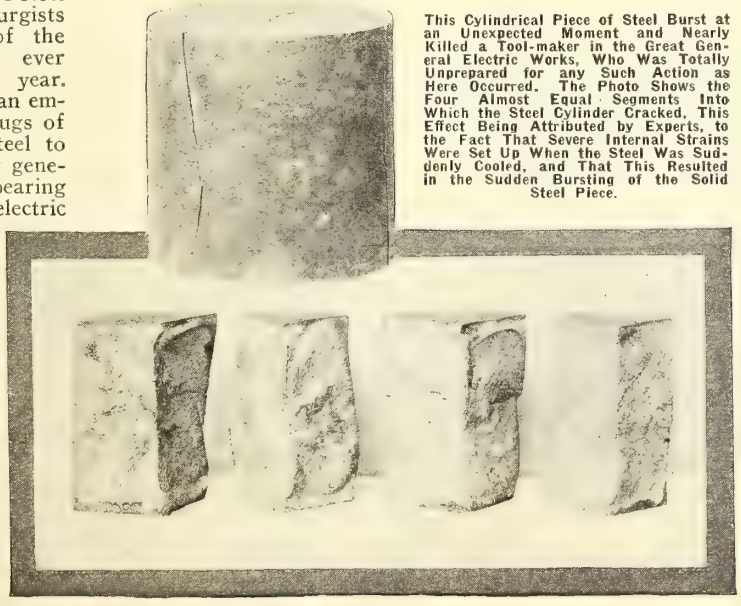
Journaled in the housings and on each side of the rollers are idle rollers arranged in an arc of a circle to correspond with the perifery of the tire of the vehicle, and upon which the wheels roll and which prevent the forward or rearward movement of the vehicle. The rollers, as shown, are below the upper edge of the housing so that the latter forms a guide for the wheels to prevent the sidewise movement thereof. The flooring of the boat forward of the housing is provided with blocks having convexed upper faces, in which rest the forward wheels of the motor car, and whereby the vehicle is supported in a level position.

Exploding Steel

By E. W. DAVIDSON

Who ever heard of a chunk of steel exploding? None of the metallurgists in the research laboratory of the General Electric Company ever had until one May day this year. On that day Herman Winkler, an employee busy hardening three slugs of ordinary Sanderson carbon steel to be used as plungers in making genelite, a new self-lubricating bearing metal, drew a slug out of the electric furnace at about 750 degrees Centigrade, quenched it in a tank and then took it in his left hand. With a rasp in his right hand he was about to test the slug's hardness when someone distracted his attention. In that moment the end of his rasp tapt the flat end of the slug.

"It flew to pieces with a crack like a pistol shot," said Mr. Winkler. "One chunk went by my ear, another went straight up and the remaining two dropt into the sink. It was peculiar. My hand was merely bruised a little bit."



This Cylindrical Piece of Steel Burst at an Unexpected Moment and Nearly Killed a Tool-maker in the Great General Electric Works, Who Was Totally Unprepared for any Such Action as Here Occurred. The Photo Shows the Four Almost Equal Segments Into Which the Steel Cylinder Cracked, This Effect Being Attributed by Experts, to the Fact That Severe Internal Strains Were Set Up When the Steel Was Suddenly Cooled, and That This Resulted in the Sudden Bursting of the Solid Steel Piece.

The only explanation advanced for the phenomenon is that the slug, which was about four and a half inches long and four in diameter, cooled a degree too quickly on the outside and the heat expanded core exerted a surface tension so unusual, that the slightest touch at that exact moment produced the violent fracture. The other two slugs from the same bar that day got what appeared to be exactly the same treatment, as have thousands of other steel slugs in times past, and not one ever responded as this one did. The photographs show there was no flaw in the metal, but the lines of core strain are obvious.

This phenomenon is indeed quite a remarkable one, and it is miraculous that the tool maker who had tempered the steel, just before it had exploded with great power, was not killed.

Safety Cowl for Airplane

A NEW safety cowling has been designed to lessen or eliminate injury to the pilot's face in the event of a crash. In practically every wreck that occurs, the pilot's head is thrown forward due to sudden stoppage of plane, and with the conventional construction of cowling or deck in front of him, even with the padding around edge of same, injuries to the face result of a more or less serious nature, such as broken nose, jaws, etc. In fact, in the minor crashes, the pilot and passenger often escape without any other injuries than these.

Some planes are constructed with a cowling entirely cut away in front of the pilot so that there is no obstruction between him and the instrument board. This not only results in poor streamlining of fuselage but the air currents blow into the cockpit. The most serious objection is that in case of a crash, the pilot's head will continue forward and strike the joystick or instrument board with even more serious results than by hitting the present cowling.

In the accompanying illustration is shown the new device as fitted to the Curtiss Training 'plane. The original line of cowling is cut away in a U-shaped opening in front of the pilot's head and the space is fitted with a flexible elastic and leather material marked "C" in the drawing.

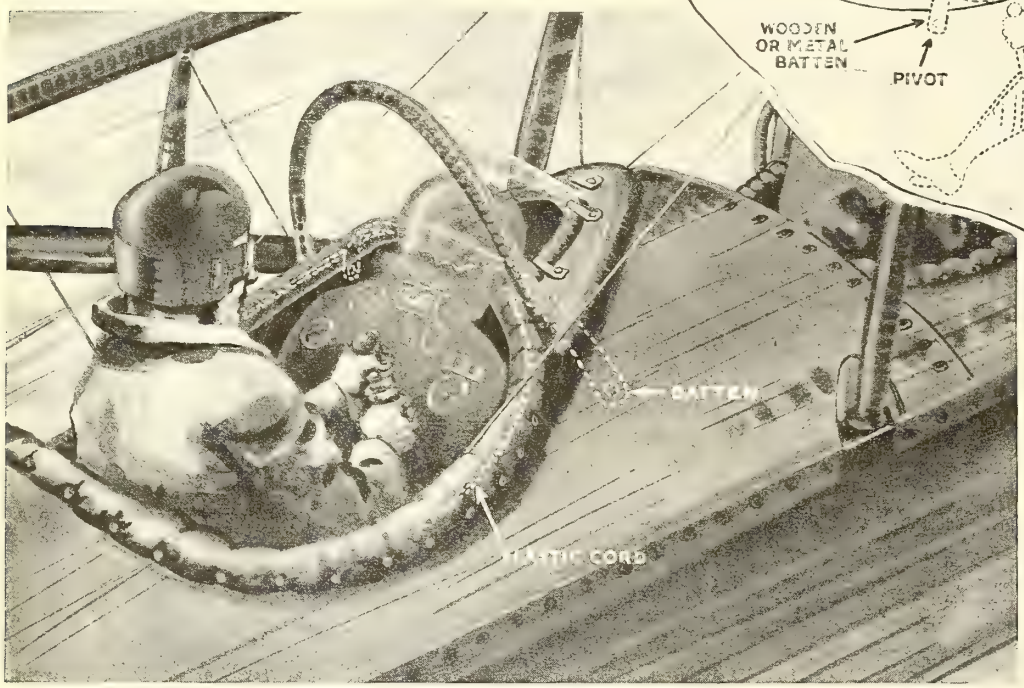
The padding around the original cowling edge is retained and also fitted with an elastic about the size used for shock absorbers, and with a small wooden batten. This in order to hold its shape gives a certain amount of rigidity yet due to the yielding nature of elastic and leather covering the arrangement will absorb a tremendous blow without any injury whatever to the pilot's face.

The celluloid windshield shown has its edge protected by a leather padding.

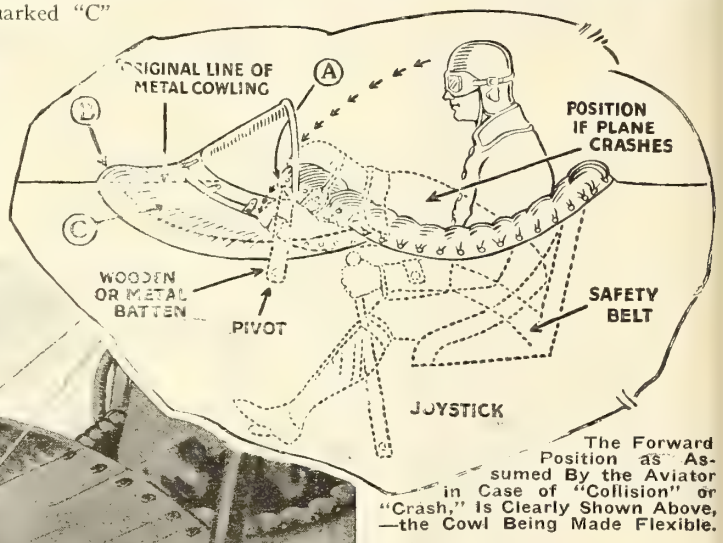
All the 'planes used at one of the Texas flying fields were equipt with the device shown, with satisfactory results, it is said, and it is the subject of a report by U. S. Army Flight Surgeons highly recommending same and suggesting that all future ships be so equipt.

The device was designed by Lieut. John M. Williams, Jr., of Montclair, N. J.

Gradually improvements are being made in aircraft, so that the aviator of tomorrow will have at least a fighting chance to save his life in case of a collision or a sudden fall. It has often seemed to us that a much safer cock-pit wherein the aviator sits, could be formed of aluminum or sheet steel, arranged in such a way that it would be very difficult to crush it in a fall. One becomes surprised at the regularity with which the wooden frame fails.



New Collision Type of Cowl for Airplanes. The Aviator's Head Is Shown in Phantom in the Position Assumed in Case of Collision.



The Forward Position as Assumed By the Aviator in Case of "Collision" or "Crash," Is Clearly Shown Above, —the Cowl Being Made Flexible.

Storm-Proof Windshield for Autos

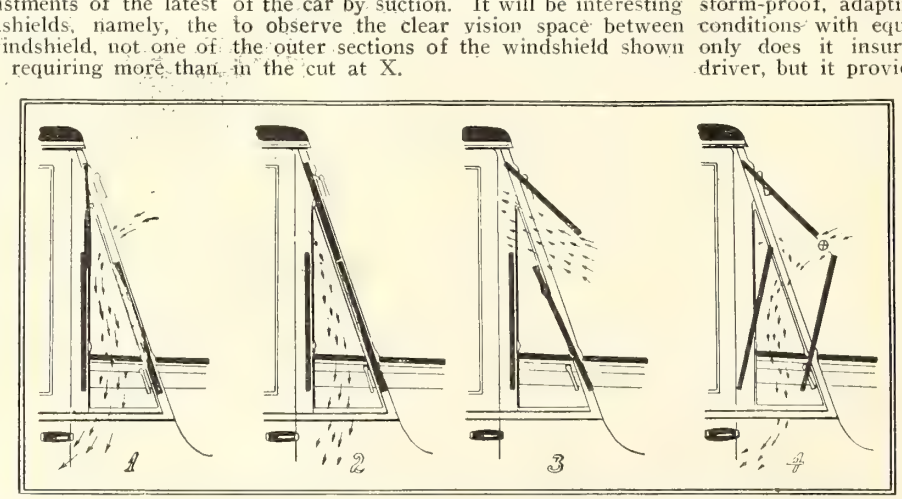
The drawings reproduced herewith show the four different adjustments of the latest improvement in windshields, namely, the storm-proof vacuum windshield, not one of these four adjustments requiring more than a moment's time.

At Fig. 1 is illustrated the ordinary cold weather adjustment, the arrows indicating the passage of air thru the shield. The mild weather adjustment showing the ventilation of the interior of the car by suction is shown at Fig. 2. At Fig. 3 we see the warm weather adjustment, the arrows depicting the circulation of the air, and at Fig. 4 the drawing shows the storm-proof adjustment, the arrows indicating the disposition of rain, snow, dust and also the ventilation of the interior of the car by suction. It will be interesting to observe the clear vision space between the outer sections of the windshield shown in the cut at X.

This shield, as its name implies, is thoroly storm-proof, adapting itself to all weather conditions with equally good results. Not only does it insure clear vision for the driver, but it provides draftless ventilation of the interior of the car, at all times.

A clear vision space, not obstructed by the glass of the windshield, is maintained constantly on a direct line with the driver's eyes, regardless of whether there is a dense fog, a heavy rainfall, a snow storm, a wind gale or other similar weather disturbances, and yet, not a drop of rain, a flake of snow, nor a particle of dust can enter the car.

This innovation will without doubt prove itself indispensable to automobilists.

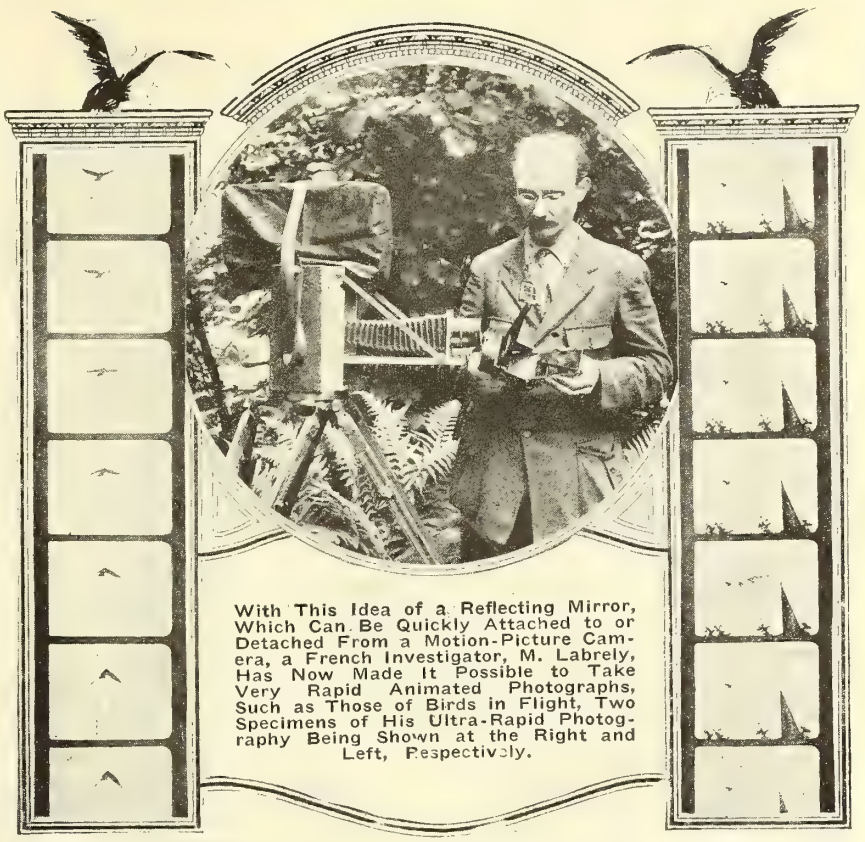


One of the Latest Innovations in Motor-cardom Is This Duplex Windshield, Which Can Be Made Storm-proof and Yet Provide Ample Ventilation, Simply by Manipulating the Component Parts of the Shield. The Arrows Show the Various Air Current Paths Which Can Be Provided at Will.

Filming Birds In Flight

WITH this newest rapid photography apparatus a Frenchman makes 250 pictures a second. This latest invention in moving picture cameras photographs moving objects with the aid of a flat mirror. By means of this ultra-rapid camera, invented by M. Labrely, the public will now see more details in moving objects, such as birds, animals, cannon balls, etc.

The new camera differs from all others. It is essentially composed of a flat mirror supported by a long handle set in a socket, which is attached to the lens with a tightening screw, thus making it possible to be turned around in any position. By the geometrical exactness of the mechanism, the optic axis and the focus of the lens is always at the desired angle with the mirror, whatever its position may be; it accurately follows the object reflected according to the angle of the lens and is always parallel with the plane of the lever, and can be turned to follow the remotest corners for photographing. One of the photos shows the newest 250-picture-a-second motion-picture machine and the inventor, M. Labrely, showing clearly the position of the reflecting mirror.



With This Idea of a Reflecting Mirror, Which Can Be Quickly Attached to or Detached From a Motion-Picture Camera, a French Investigator, M. Labrely, Has Now Made It Possible to Take Very Rapid Animated Photographs, Such as Those of Birds in Flight, Two Specimens of His Ultra-Rapid Photography Being Shown at the Right and Left, Respectively.

The right and left hand strips of movie film here reproduced, show how accurately this new invention of M. Labrely photographs the flight of a bird; the strip of movie snapshots at the left showing the successive yet extremely rapid changes of the bird's wings, as he flaps them in his effort to keep afloat in the air. Perhaps, offhand, you may not think this invention to be so very remarkable, as you recollect having seen an airplane in flight at the last "movie" show; but a bird flaps his wings very rapidly, especially a small bird, and an invention of this kind is not only of extremely great interest to the layman, for the wonderful novelty of the subject presented,—but particularly so to students of nature and naturalists everywhere.

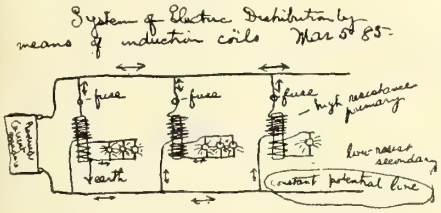
The First Practical A. C. Dynamo

THE illustration shows a photograph of a dynamo which is among the earliest built by Professor Elihu Thomson. It is really the machine which called attention of the gentlemen who first, in Philadelphia in 1879, started to develop a business of arc lighting, based on the inventions of Thomson and Houston. The machine itself was constructed in its entirety by Professor Thomson. He made the patterns, had them cast, built the frame, made the field bobbins and wound them, and also wound the armature, made the connections thereto and all the machine parts of the machine itself. It weighed about 350 pounds and the base of the machine was bolted together and made of pieces of plank. It will be noted that the field castings consist of two yoke pieces at the end, to which are bolted the horizontal field cores, four of which were used to save making a more complicated pattern. The two upper and the two lower field poles which meet in the center, are tied together by a piece of hard wood bolted to them. For lack of machine facilities, there is no boring or turning of the field or armature and the end yoke pieces were fitted to the cores by chipping, no planer being available.

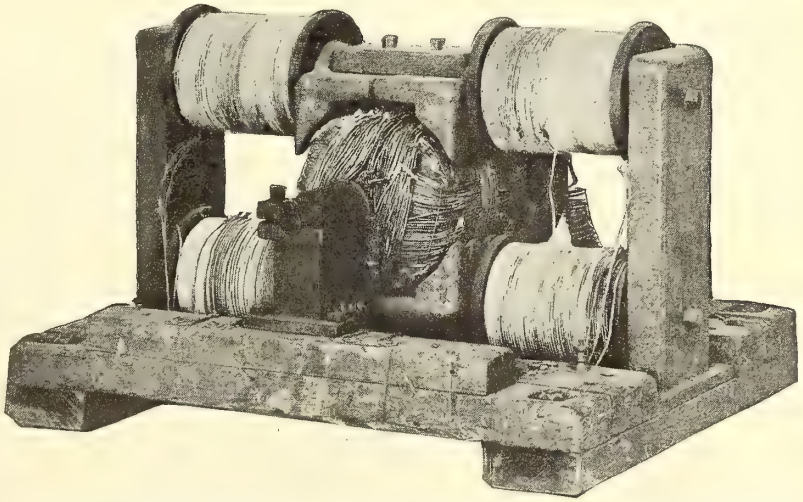
One of the curious mechanical features is the cast-iron boxes receiving the shaft, which, strange to say, worked without heating during the running of the machine.

The machine was started in the fall of 1878 and by the end of that year was ready to operate. In some respects it was unique. It really was a machine which could be coupled so as to give varying voltage and current. There were four field coils, which could be connected in series or in series-multiple, or the whole of them parallel, so that the virtual section of the wire was increased one, two and four. The same construction was adopted in the armature winding, there being in each of the two coils (which are clearly shown crossing each other at right angles) four separate wires which could be connected by a connection board, which is at the other end of the armature from that shown, so as to use wires in series, or in series multiple, or in multiple, and so varying the voltage

(*Continued on page* 908)



Interesting, Indeed, Is This Original Hand-Written Memorandum From the Notebook of Prof. Elihu Thomson, Made in the Days When Electric Arc-Lighting Was in Its Infancy.



The Photo Above Shows One of the Very First Practical Alternating Current Arc-Lighting Dynamos Built by Prof. Thomson. He Made the Patterns, Had Them Cast, Built the Frame, Wound the Field Bobbins, and Demonstrated the Machine Successfully to the First Staff of Electric-Lighting Critics, Which Started the Present Industry on Its Way.

100 Years of Electro-Magnetism

Centenary of Örsted's Discovery

By DR. ALFRED GRADENWITZ

FEW discoveries can be said to have exerted such a decisive influence on our scientific views as well as on the development of our economic life as Hans Christian Örsted's epoch-marking discovery—that of the the deflection of the magnetic needle by the electric current.

Previous to this great scientific achievement *electricity* and *magnetism* constituted two entirely separate realms of science, of relatively small extent and limited practical importance. Some scientists, truth to say, had occasionally believed that they noted some evidence of a correlation between those two forces of nature, but they had been unable properly to interpret these hints. Örsted, who at the beginning of the 19th century, while yet quite young, had been entrusted with the professorship of physics at the University of Copenhagen, had by theoretical considerations been led to believe in the existence of such a correlation, and with admirable perseverance was endeavoring to demonstrate by actual tests the correctness of his theory. For his eventual success he is mainly indebted to the fact that so far from expecting a parellel action of the two forces, he rather supposed the magnetic effect of a conductor traversed by electricity, *to be radiating from the conductor,* in the same manner that light and heat will radiate from a conductor heated to incandescence.



Hans Christian Örsted, Who Discovered That an Electric Current Passing Thru a Conductor Would Deflect a Magnetic Needle. This Year Marks the Centenary of Örsted's Epoch-Marking Discovery, Which Formed the Basis of the First Practical Investigations of the Electro-Magnet.

On the basis of such views, Örsted, in the beginning of 1820, again endeavored to seek the experimental proof of the hypothetical correlation. His first successful experiment was connected in a remarkable manner with his lecturing at the Copenhagen University. In fact, having just before the beginning of a lesson installed the apparatus for a decisive test, his conviction in the course of the lecture gradually became so strong that he eventually asked his hearers to proceed to his laboratory in order there to witness the final test. This is how the great discovery was made during a lesson, in the presence of the whole crowd of his hearers, all of whom could satisfy themselves *of the deflection of the magnetic needle by the electric current.* The effect, truth to say, was at first rather weak on account of the weakness of the current, but some months afterward Örsted, with a battery made up of 20 cells, was able to obtain much more intense effects and to investigate these in all detail. On July 21, 1820, he sent out to the scientific world of his day a short circular in Latin *"Experimenta circa effectum conflictus electrici in acum magneticam,* where all the fundamental experiments and results were explained.

Örsted did not content himself with investigating how the magnetic needle would move, when keeping the conductor in various positions with regard to it: he also showed the effect —in opposition to the electrical effects so far known—to penetrate, unweakened, it would seem, the most various materials, *insulators* as well as *conductors* of electricity. He further showed that the magnetic field does not exert any effect on a needle of non-magnetic material, such as brass or glass.

It is perhaps not quite so easy to understand Örsted's original memoir, the author using the rather unusual word "conflictus" to designate the electric current. Quaint and antiquated tho this appears at first sight, it will be found singularly significant in the light of modern theories of electricity, according to which electric particles or "electrons" moving to and fro in the interior of conductors, by their impact, produce what we call electrical phenomena.

It would be too tedious to point out here even the most important consequences Örsted's discovery has had on the further development of electricity. In the first place, it, of course, made possible the construction of an electrical telegraph, but this was followed by the whole series of marvels achieved by electricity, the applications of low tension as well as high tension currents, apart from electro-chemistry, being ultimately based on Örsted's discovery of the mutual effects between electricity and magnetism.

Facts About General Electric Works

By CHARLES M. RIPLEY, E.E.

The Simple Facts:

(1) In 1918 the Schenectady *shops* of the General Electric Company, *USED* over 66,000,000 kilowatt hours of electricity.

(2) The number of *shop* employees last year averaged approximately 21,500 men and girls.

(3) A kilowatt hour of electricity is equal to the work done by a big draft horse working for 1 1/3 hours.

(4) A horse can do the muscle work of ten men.

These are all the facts used in this article.

Here Are Some Thoughts:

Dividing the amount of electricity used by the number of workers, we see that last year the average employee used about 3,100 K. W. Hours.

This amounts to 4,150 horse-power hours, in round numbers.

Exprest differently, it means that the electricity furnished last year, to assist *each man and each girl* was equal to the energy of one horse working 4,150 hours; or 4,150 horses working for one hour:

For every employee in the Factory.

Now for the Imagination:

QUESTION: How many horses were working for each employee right along, while he was busy on the job?

ANSWER. A team of horses worked 9 hours per day—every day of 1918, to assist *each* employee.

This is obtained as follows: 4,150÷2,700 equals more than 1.5 horses working during a 9-hour day—continually, as long as each man worked; so a big draft horse, and an ordinary $250 horse, worked for the average employee.

Now, the draft horse does the "muscle" work of ten men: so last year every hour and every minute, there were 15 *imaginary* men working for each actual employee in the shop. The electricity used last year by the average worker equalled the work of 15 Roman slaves—ALL YEAR—working every minute for each man and girl on the job!

If that many REAL MEN had been employed to assist skilled workers in the factory, and if they had been paid as much as the average worker was paid, the cost of electrical machinery, supplies, sockets, lamps, etc., would be roughly *16 times* as great as at present.

An electric light socket instead of costing 30 cents would cost $4.80!

An electric toaster would cost $75 and a few of us would buy electric fans at $150 each. Then we would all be burning kerosene lamps or candles.

"Movie" Models Show How Machines Work

By ESTHER LINDNER

How Cardboard Models, Progressively Photographed, Illustrate Machine Action

EVER so often, almost everyone gets a distinctly bored streak—a time when, figuratively, if not literally, he sits down, folds his hands, and with a shake of the head mournfully sighs that "indeed there is nothing new under the sun."

Recently it is our old friend "the movies" that is supplying a brand-new jolt. And these same movies that formerly were nothing more nor less than a medium for entertainment have been supplying some very big steps toward progress in the scientific world. Every youngster loves to know "how the wheels go round"—and this is directly applicable to every youngster between the ages of fourteen months and eighty years or more.

It has remained for a motion picture inventor to hit upon a system of helping even the most unskilled mechanic to "watch the wheels go round"—to take any type of machine apart, look at it, and put it together again without the necessity of getting into soiled overalls or sweating or fuming or fussing over it. All that is necessary is for him to settle down comfortably in a seat in a motion picture theater. Thru an elaborate invention known as the *Mechnigraph*, invented and perfected by Howard Greene, we are now initiated into the "inside workings" of the machine.

The "animated cartoon" has been the medium heretofore for presenting on the screen, by means of moving line drawings, such explanatory bits as cannot adequately be shown in any other way.

The "mechnigraph" is much more elaborate than this, and goes many steps further, for it is a mechanical contrivance, an exact working replica, of a machine or a piece of mechanism, and it is made out of a specially prepared fibre-board. It moves just as the machine moves, and does all the things the machine does when it is in operation. And it has the added advantage of being moved and operated at the will of its maker—and the motion picture camera can be placed close to it, without the slightest danger, so that the most intricate bits of action may be clearly shown.

The making of the replica is more intricate than the planning of the most elaborate "cut-outs" that so delight children.

The actual machine is studied from every available angle—taken apart, put together again, watched carefully while it is dormant, and while it is in action.

From the specially prepared fibre-board is cut an exact duplicate, greatly reduced, but made to perfect proportion.

First an *exterior* view is cut out, with all details complete—front, back, joints—just as tho the actual model were being fashioned.

Then another set of parts, this time of the *interior*, is made. For each little section, each piece of wire, each separate part of the original, there is a tiny fibre-board duplicate, cut to the proper proportions. These are pieced together, with working joints of brass rivets. When an exact fibre-board interior of the machine is complete it is placed within the pieces representing the exterior, which are in turn hinged, riveted and jointed, just like the original.

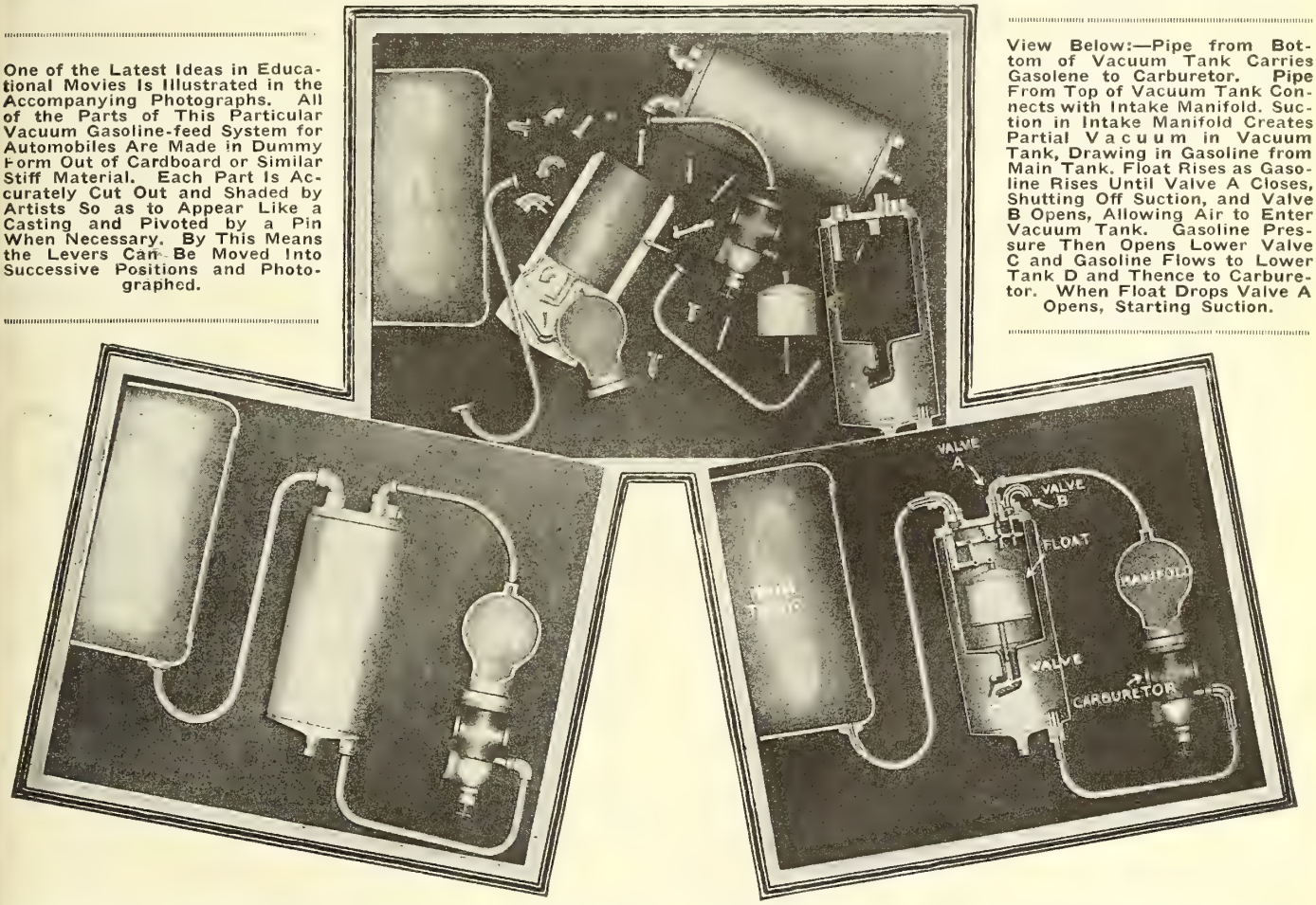
Artists who are specialists in making paper look like metal color and shade the completed replica. This matter of making fibre-board look like metal when it is reproduced on the screen is one of the most difficult problems in the making of the "mechnigraph." The problem of the fashioner of the duplicate which is to be picturized is an even harder one than that of the builder of the original model. He has only two dimensions in which to work. Fibre-board, his medium for expression, is flat, and yet, when it is shown in working order under the eye of the motion picture camera, the result he obtains must appear to have all the properties that are part of the actual machine.

Often hundreds of pieces go into the making of one of these duplicates, and each one of them must be absolutely correct in every detail, for the duplicate, when it is shown on the screen, is magnified hundreds of times. A tank that is made to measure ten inches in height in cardboard appears ten feet high when thrown upon the screen; and an error in its making that would be practically invisible to the naked eye shows up on the screen a glaring inaccuracy.

When the fibre-board machine is complete the most difficult part of the operation—the *animation*—begins. Each movement requires

(*Continued on page* 912)

One of the Latest Ideas in Educational Movies Is Illustrated in the Accompanying Photographs. All of the Parts of This Particular Vacuum Gasoline-feed System for Automobiles Are Made in Dummy Form Out of Cardboard or Similar Stiff Material. Each Part Is Accurately Cut Out and Shaded by Artists So as to Appear Like a Casting and Pivoted by a Pin When Necessary. By This Means the Levers Can Be Moved Into Successive Positions and Photographed.



View Below:—Pipe from Bottom of Vacuum Tank Carries Gasolene to Carburetor. Pipe From Top of Vacuum Tank Connects with Intake Manifold. Suction in Intake Manifold Creates Partial Vacuum in Vacuum Tank, Drawing in Gasoline from Main Tank. Float Rises as Gasoline Rises Until Valve A Closes, Shutting Off Suction, and Valve B Opens, Allowing Air to Enter Vacuum Tank. Gasoline Pressure Then Opens Lower Valve C and Gasoline Flows to Lower Tank D and Thence to Carburetor. When Float Drops Valve A Opens, Starting Suction.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory

Has the Earth's Rotational Period Changed?

THE earth, as is well known, is not a perfect sphere in form. As a result of rapid axial rotation it is flattened at the poles and bulging at the equator. In the words of the mathematician it is an oblate spheroid of revolution and the amount of its polar compression is 1/297th of its equatorial radius or thirteen and three tenths miles. That is if we imagine a sphere described about the earth with radius equal to the earth's equatorial radius the poles of the earth will fall short of the corresponding poles of the sphere by about thirteen and three-tenths miles.



The Earth Rotates at the Rate of 24 Hours for Each Revolution. If It Were Revolving Approximately Seventeen Times as Fast, in Other Words, Making a Complete Revolution in 1.41 Hours, Instead of 24, Then, Due to Centrifugal Force, Objects at the Equator Would Weigh Nothing. The Above Illustration Shows a Scene Somewhere Near the Equator Under Such Circumstances. It Then Would Be a Simple Matter to Build a Sky Scraper, as All Materials Such as Steel Beams. Marble Columns and Any Other Building Material Could Be Tossed About as Shown. There Would Be Only One Trouble and That Is the Person to Whom a Steel Beam, for Instance, Was Tossed Would Have to Be a Good Catcher. If Not, the Beam Would Keep on Flying in the Direction in Which It Was Tossed, Never to Return.

The more rapidly a non-rigid spheroid rotates the greater becomes the polar compression and the greater the equatorial bulge, and such rotary motion also produces a very appreciable effect upon the attraction of the spheroid of our earth for objects on its surface. The axial rotation sets up a centrifugal ("center-fleeing") force that is directly proportional to the *square* of the velocity with which the earth's surface is rotating. At the equator where the earth's surface is moving most rapidly the centrifugal force has its maximum value. At the poles with zero rotational motion of the surface the centrifugal force is also zero. Moreover, centrifugal force acts in direct opposition to gravity at the equator and so its effect is to reduce the weight of a body at the equator, and to a less degree in higher latitudes, while at the poles it exerts no effect on surface gravity (See Fig. I.). So as a result of centrifugal force an object at the equator weighs less than it would weigh at the poles. At the earth's present rate of rotation the centrifugal force at the equator is 1/289th of gravity.

The more rapidly the body rotates the greater becomes this centrifugal force. Since it is proportional to the *square* of the rotational speed it is evident that it would equal gravity at the equator if the earth should rotate seventeen times more rapidly than at present, that is, if it turned on its axis in about one hour and twenty-five minutes. Under such conditions a body at the equator would possess no weight whatever and a greater speed would send it flying from the earth's surface tho in midlatitudes objects would still possess very appreciable weight because the rotational speed decreases with distance from the equator and, moreover, only one component of the centrifugal force, that directed away from the earth's center, is effectual in reducing gravity. At the *poles*, an object would possess *greater* weight on a rapidly rotating spheroid than on one rotating slowly. This is due to the fact that the flattening or polar compression increases with the speed of rotation of the spheroid and this brings objects at the poles nearer to the earth's center and the effect is to increase the earth's attraction. The nearer the earth's surface is brought to its center the greater the attraction of gravity. If the earth were rotating at the rate of one revolution in four hours, say, instead of in twenty-four hours, a man who now weighs 150 pounds at the equator and 150¾ pounds at the poles would weigh about 128 pounds at the equator and about 157 pounds at the poles. If the rotational speed increased to seventeen times its pres-

ent value a man would weigh *nothing* at the equator while at the poles he would weigh considerably more than he weighs there at the present rate of rotation.

There are two factors operative, then, in producing variations in the force of gravity for different points on the earth's surface—the centrifugal force and the consequent change of shape, involving polar compression, and their combined effect is to *decrease* gravity in equatorial regions and to *increase* it at the poles. The more rapid the rotation the greater the difference in gravity between the equator and the poles. As the rotational speed increases, objects at the poles *increase* in weight while in midlatitudes there is a point where surface gravity changes but slightly for different rates of rotation.

So far we have considered only the effect of an increased rotational speed upon the value of surface gravity and the changes that result in the weight of all surface objects.

Let us consider now what would be some of the effects upon the form and condition of the earth's surface crust arising from a considerable change in rotational speed.

According to the tidal theory of the origin of the earth-moon system it has been assumed that at one time in the far distant past the moon was much nearer to the earth's surface than at present and that the earth was then rotating rapidly in a period of four or five hours, the moon being driven back to its present position and the earth's rotational speed slowed down to its present value thru tidal reactions.

Assuming that the earth did at one time rotate on its axis as a solid body in a period of four hours or less, it has been shown by geologists that the changes in the condition of the earth's surface crust would have been so pronounced that the evidence would have been preserved even to the present day in the condition of the strata of the earliest geological ages.

If the earth were rotating in a period of four hours the polar flattening would amount to one-eighth. Thus the polar radius of the spheroid of that day would have been five hundred and fifteen miles shorter than its equatorial radius and about three hundred and forty miles shorter than the polar radius of today. A man would gain nearly 23 per cent in weight by moving from the equator to the poles. The equatorial circumference would have been about one thousand miles greater than it is today which would correspond to an equatorial bulge of one hundred and sixty-five miles in vertical height above the present surface of the earth.

To mould the earth to its present form it would have been necessary for the equatorial belt to contract gradually one thousand miles in circumference and one hundred and sixty-five miles in vertical height.

Geologists estimate that a mountain range of the height of the Alps represents a folding or contraction of about seventy-four miles of the earth's surface and to dispose of an equatorial bulge one hundred and sixty-five miles in vertical height, which corresponds to an increase in equatorial circumference of one thousand miles over the present value, the crust would have to contract and fold gradually into the equivalent of twelve mountain ranges of the height of the Alps extending longitudinally across the equator.

It can be shown mathematically that the changes that would take place in the spheroid to adapt it to the longer rotation period of today would be effective chiefly in the equatorial and polar regions. The radius of the earth in 35° North and South latitudes would remain practically unchanged for all rotational speeds.

The crumpling of the equatorial bulge in the course of ages then would be taken up in the form of lofty mountain ranges stretching across the equator in a north and south direction and dying out in latitudes 35° North and South. It is very unlikely that all traces of the development of numerous lofty mountain ranges crossing the equator would have been completely obliterated by this time. As is well known three-fourths of the equatorial belt of today is *submerged* and the Andes, the one mountain range, that crosses the equator, is not confined to within 35° of the equator as required by the theory.

The changes in the condition of the earth's surface crust in polar regions as it adapted itself to a slowing down of the earth's rotational speed, should be quite as radical as the changes in equatorial regions tho opposite in kind. Instead of the shrinkage and compression of the earth's crust that would take place in the equatorial belt, accompanied by increase of pressure and tangential stress, there would be a gradual elevation and stretching of the crust in the polar regions along meridional lines as the flattening at the poles gradually decreased and the curvature and swelling of the surface increased. A state of tension of the surface would exist in high latitudes which would rapidly increase toward the poles and which would manifest itself in a radial gaping and fissuring of the surface. In equatorial regions there would be a gradual increase in surface gravity and in pressure and tangential stress which would be adverse to volcanic action, while in polar regions there would be a decrease in surface gravity and an increase of surface tension that would be particularly favorable to volcanic activity.

There is, however, no evidence that volcanic action was more prevalent in high latitudes in the earliest geological ages than in the equatorial belt. There is, according to the geologists, no difference in the characteristics of the sedimentary rocks of the Archæan Era, which are the earliest known rocks, for different latitudes. The rocks of that era possess the same characteristics in all parts of the world which would certainly not be true if the earth's surface at that time was being subjected to an increase of gravity and compression in equatorial regions and a decrease of gravity and surface tension in polar regions.

There should exist, moreover, geological evidence that the polar regions were deeply submerged in that era. If the earth's axial rotation were then much more rapid than it is at the present time, the surface at the poles would be far more flattened then than it is now. The elevation of the polar surface would have increased by many miles during the intervening ages. As a matter of fact the lands of the earlier geological ages that are best exposed and longest out of water are those in the polar regions and there is no geological evidence whatever that a gradual increase in the curvature of the earth's polar surface has been going on thru the ages.

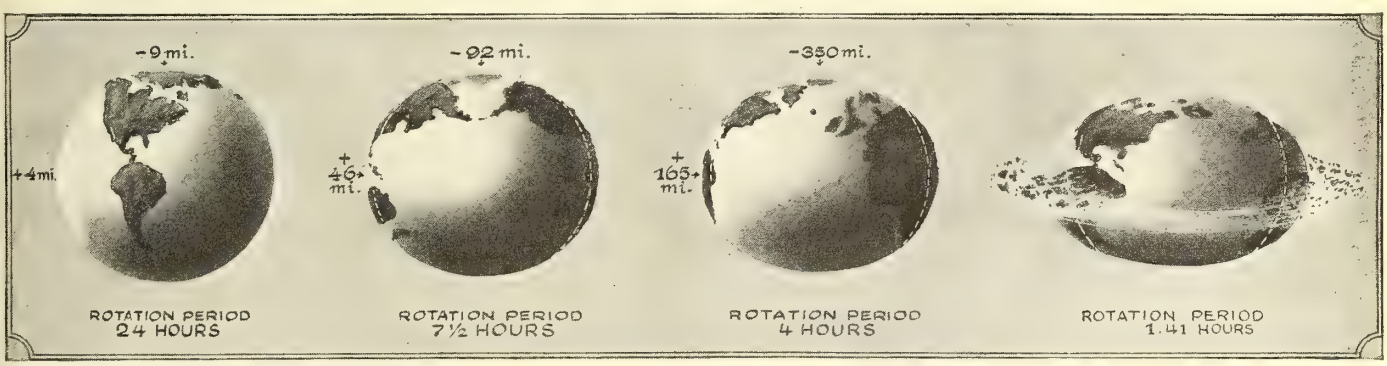
So tremendous would be the surface changes brought about thru the remodeling of the earth from a spheroid of revolution with a rotation period of four hours and a polar flattening of one eighth to a nearly perfect sphere with a flattening of only 1/297th, and a rotation period of twenty-four hours that they could not escape preservation in the geological records of the earth's early history.

The theory that the moon was originally thrown off from a rapidly rotating earth-mass thru centrifugal force and that the distance between the two bodies was gradually increased and the earth's period of rotation gradually slowed down thru tidal reactions between the two bodies, was developed upon the assumption that the earth was formerly and is now a *viscous* body. Since the tidal theory was first developed it has been proven in a number of independent ways that instead of being viscous the earth is highly elastic and that the tides developed in the earth-mass by the attraction of the moon are of the nature of elastic strains and that neither now nor in the far distant past have they had any appreciable retarding effect upon the period of the earth's rotation.

It has also been proven mathematically that the effect of the tides raised in the earth's atmosphere and in its surface waters by the gravitational attraction of the moon are practically negligible in their retarding effect upon the earth's rotational period.

Moreover, if the earth had formerly rotated in a period of four or five hours and the moon were then much closer to the earth than at present the tides raised in the ocean by the attraction of the moon

(*Continued on page* 892)



Our Earth Bulges About Four Miles at the Equator and Is Flattened About Nine Miles at the Poles, Due to the Rotational Speed of the Earth, Which at the Equator Is 1039 Miles An Hour. If the Earth Were Standing Still, the Globe No Doubt Would Have Been a Perfect Sphere. The Other Illustrations Show the Equatorial Bulge of the Earth and the Polar Flattening As the Earth Increases Its Rotational Speed. If It Were to Make a Complete Revolution In 1.41 Hours, the Bulge Would Become So Great That Objects Near the Equator Would Begin to Fly Off As Shown In the Last Picture, and As a Matter of Fact the Earth Would Begin to Break Up at Such a Tremendous Speed. Chances Are That the Earth Before It Had Cooled Revolved At a Different Speed Than It Does Now, But All Geological Data Point to the Fact That the Earth's Rotational Speed Has Neither Increased Nor Diminished Appreciably During the Ages.

Home Electrics

NEW ELECTRICAL "FIRELESS" STOVE.

By Dr. Alfred Gradenwitz

An ideal kitchen apparatus that will prove a boon to harast housewives is here



This New Electric Fireless Cooker Is Provided with an Automatic Switch, Which Cuts Off the Current from the Heater as Soon as 100 Degrees C. Is Reached—That Is as Soon as the Food Begins to Boil, and the Rest of the Cooking Is Done by the Retained Heat in the Food.

illustrated and is an electrical outfit designed by a Leipzig engineer, Mr. R. Reinhold, for cooking, roasting, baking, sterilizing, etc. Tho sufficing for a fairly large family, it only consumes trifling amounts of electricity, just a few cents during three hours' working, an additional advantage being that the food will never burn or boil way.

The heat required for cooking, of course, is just 100 degrees C., any excess being a waste of energy. The new apparatus, accordingly, is designed for having an automatic switch to cut out the current as soon as 100 degrees C. is reached; that is, as soon as the food begins boiling.

Inasmuch as the apparatus, like an ordinary "fireless stove," is surrounded by poor conductors of heat, the food will go on cooking for some time without any further supply of heat. As the temperature then drops somewhat, the current will be thrown in again automatically, thus keeping the heat continually at 100 degrees C. The food accordingly will go on cooking without any interruption, and as there is no excess of heat, there will be no risk of *burning*.

The result obtained by this automatic control is that during three hours' cooking there will only be a consumption for about 46 to 60 minutes of current.

Moreover, this apparatus is fitted with a clock switch that can be adjusted to any given time and at the moment desired it completely and definitely cuts out the current. If a dish of peas requiring three hours to become soft is put into the cooker, the switch is adjusted to three hours, thus preventing any excessive softening, tho the "fireless stove," that is to say, the heat-insulating material surrounding the pot, keeps the dish ready for use at a minute's notice.

If, for instance, the housewife at any time in the morning, after getting everything ready, puts the dish into the apparatus, she has only to adjust the clock to the proper time for cooking the food, after which she need no longer trouble herself about it until the time for *serving* the dish.

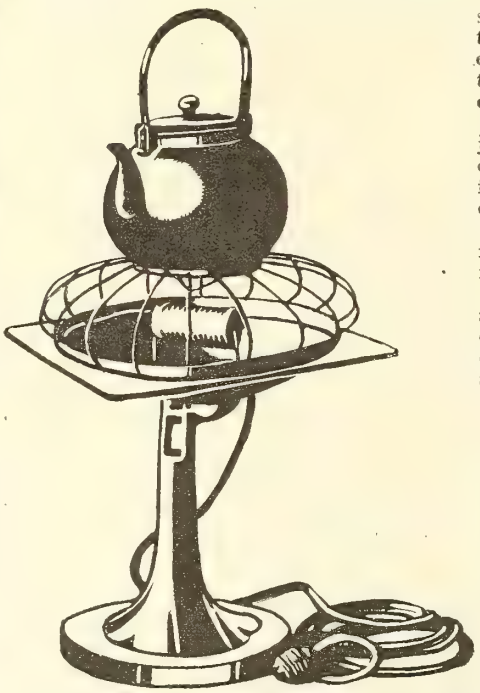
However, the electrical "fireless stove" possesses a further advantage:

"Cooking without water, roasting without fat" has for some time been recognized as the only rational culinary method, according to which potatoes and vegetables, without any addition of water and meat, fish, fowl, etc., without any fat, are put into *a paper bag* and cooked or roasted there, thus allowing all nutritive constituents of the food to be preserved and obtaining dishes more savory as well as more nutritive. Now, as this process obviously can only be resorted to if provision is made *never to exceed a given temperature*, the apparatus above described lends itself admirably for the purpose.

The apparatus consists of a wooden case lined with poor conductors of heat, and containing in its interior a metal box inside of which are 4 pots.

JAPANESE MAKE TEA ON ELECTRIC HEATER.

In Japan, the land of the most insatiable tea drinkers in the world, they've discov-



It Took a Clever Oriental from the Sunny Island Empire of Nippon to Find a New Use for the Electrical Reflector Heater, Thousands of Which Are Now Being Daily Adopted. Simply Place the Reflector in a Horizontal Position by Means of a Swivel Joint and Place Your Tea Pot on Top of the Wire Guard, When, Presto! You Can Make Your Tea (or Coffee) in a Few Minutes.

ered a new way of making tea. A radiant electric heater of the reflector type is tipt up so that the wire guard is on top. Then the inventive Orientals set their tea pots in the center of the guard.

Might not the Occidental boarding house girl of proverbial fame discard her obsolete gas jet and do her cooking the new electrical way? The accompanying photo was taken of an advertisement in a Japanese paper.

It takes an Oriental to use his wits in figuring out a new use or a new way to use an old apparatus or device. This is not because he has not the money to pay for whatever he may need at all, but illustrates once again, their proverbial economy, which we of the Western Hemisphere are wont these days, to disregard entirely, or at least to a great extent. The children in the Oriental countries are trained constantly to practise economy, and to their credit, it can be said that practically never do they display extravagance, either in their homes or in their social activities.

Contributed by ARTHUR P. HIROSE.

IT'S HERE—THE ELECTRIC BUTTER CHURN!

The new electric buttern churn possesses some very clever and exclusive features, namely, a complete housing over all moving parts, and is directly driven off the motor by means of a worm gear, using a friction gear to prevent burning of motor in the event dasher is retarded or held, also to avoid stripping of gears. The entire mechanism is arranged and attached to the cast plate which forms the left side of gear housing; and by simply removing the plate the complete driving mechanism rests in one's hand.

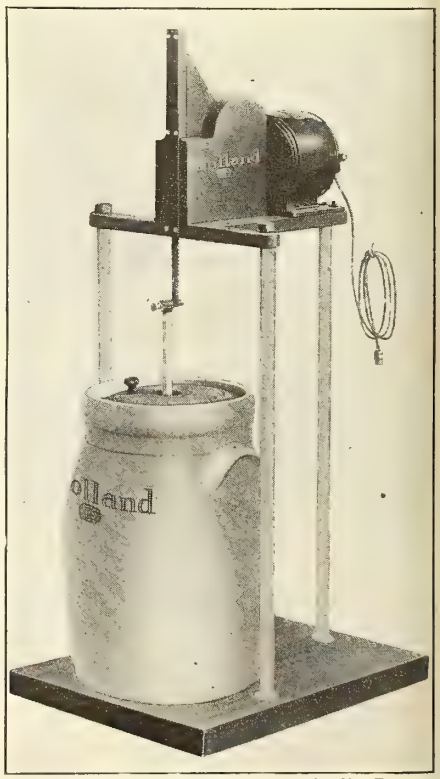
The base of the churn is stained wood, supporting three iron uprights which in turn support the driving mechanism mounted on a T-shaped base. Suitably located on the base are three pins which keep the earthenware container in proper place.

The container is a double-glazed stone jar with suitable side handles, making it easily handled and cleaned. It has a close-fitting top, rendering it impossible for cream to splash out.

The dasher includes a dash rod of aluminum, which cannot rust or corrode and is easily kept clean.

The machine is designed for home use and will churn from one-half to three and one-half gallons at a time. It can be equipt with motor, either for 110 volts alternating current or direct current, or 32 volts direct current.

(*Continued on page* 900)



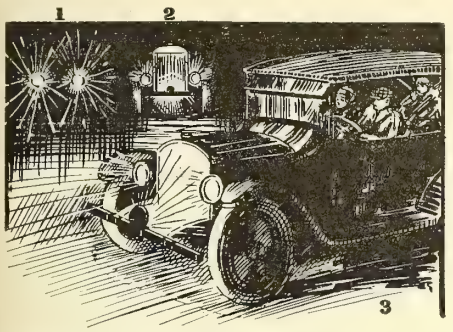
Attractive New Form of Electrically Driven Butter Churn. This Churn Will Produce Butter in a Very Short Time with the Utmost of Cleanliness—and Besides, It Is Not Noisy, Nor Does It Require a "Tip."

MOTOR HINTS

FLOOD-LIGHT IN FRONT OF RADIATOR

First Prize $25.00

Place an electric lamp, with reflector, in front of radiator. It can be clampt on buffer or cranking-axle projection, springs or any available place so that the light rays are turned against the front of the auto or truck.



"No-glare" Flood-light Suggested for Use on Front of Automobile. The Headlights Light Up by Reflection. The Rear View Image Is a Silhouette.

Fig. 1 shows usual effect of an approaching auto. Fig. 2 shows the front of auto lit up by such an in-facing lamp as above described. Fig. 3 shows how the light may be place on buffer.

Some headlights have no dimmers and the laws require that strong lights be shorn of their blinding glare, so that a lamp as described will shine into the regular headlight reflectors and on the radiator, thus preventing accidents to pedestrians and other autos, as well as safeguarding the car so equipt.

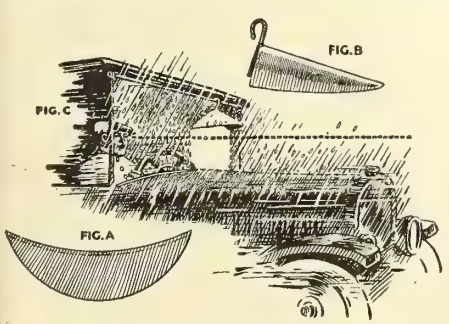
Contributed by GUS WEST.

RAIN PROTECTOR FOR WIND-SHIELD

Second Prize $15.00

During the rainy season a great many accidents are due to the poor vision thru the wind-shield. Why not make a protector for almost nothing and avoid accidents? It can be made with either celluloid or card-board. First cut it into the shape as shown in Fig. A. It can be any size, but about 8 inches by 12 inches is best. Then place strip of tin edge as shown and solder the hook at the middle. Hook the protector on the top of the wind-shield rather tight and all is done. If the protector is made of card-board, thoroly paraffin it, and it is not a bad idea to make several and keep them in auto and change once in a while.

Contributed by ROB'T Y. MATSUMOTO.



At Last a Simple and Effective Rain-shield, Attachable to the Wind-shield in the Manner Shown.

$50.00 IN PRIZES

Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

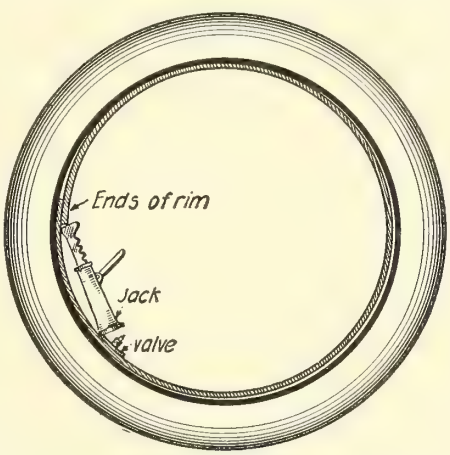
FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

A RIM REPLACEMENT

Third Prize $10.00

Everyone who owns a car which has detachable rims has been out and had the not-wisht-for blowout. You don't mind very much the trouble taking off the rim and mending the tube, but when it comes to the trouble experienced in making the ends of the rim "meet," you stop—give up



One Way of Replacing Auto Tire Rims With a "Jack." If the Valve is Not in a Suitable Position a Special Hole Can Be Drilled and a Bolt Inserted in It Temporarily.

a while, and then again worry unnecessarily; maybe you know the old strip of wood stunt which is merely a get-by and one which gives results enough to get you work half a day, but the stunt shown herewith is completely explained within itself. But, to be sure you understand this feat, I am going to explain a little.

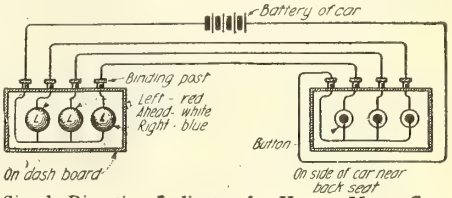
Set your jack on the rim where the valve comes out (here you will find a little hump which will prevent the jack from slipping) and the other end against the rim that laps over; now tighten up on your jack and tap the rim with a hammer or wrench, pulling your best at all times on the jack; you will easily put the rim together properly in this way. If your valve does not set right for your jack to push on the end of the rim, you must drill (or have drilled) a hole in the rim the proper distance and put in it a bolt or something until the rim is together.

Contributed by TROY F. WATTS.

"DIRECTION INDICATOR" FOR CHAUFFEUR.

Procure a small piece of wood, large enough to accommodate three small lamp sockets. Then screw four screws on to it to serve for binding posts. Three lamps —one red, one white and one blue, are used. The red one will indicate to the (left); the white one (ahead), and the blue one to the (right). The lamp board is screwed to the dash board.

Next obtain a piece of wood of a size for three push buttons and screw them on the side of the car, with four screws for



Simple Direction Indicator for Use on Motor Cars.

binding posts. Screw this in a convenient place in reaching distance of the arm. Connect wires as shown in diagram. This device is very successful and your chauffeur will be greatly benefited.

Contributed by ANDREW M. SCHROEDER.

AUTO-TRANSFORMER FOR FORD HEADLIGHTS

Being somewhat annoyed with the system of the Ford lighting circuit when one light goes out, whereby both became inoperative, I hit upon the plan of placing an auto-transformer in the lighting circuit that would not materially drain on the magneto and still permit one light to burn, even tho one bulb may be blown.

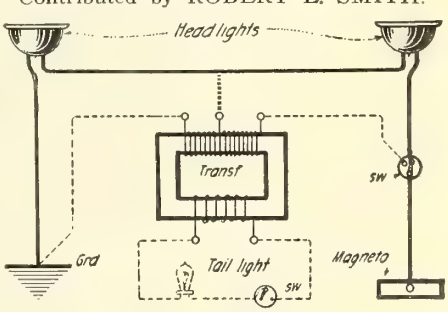
Cut thin sheet iron in strips to the following dimensions: Two piles ½ inch wide and 1 inch high and 1½ inches long. Also two piles ½ inch wide and 1 inch high and 2½ inches long.

These are shellacked and dried and built up in the usual dove-tail fashion.

Make two coils wound in the same direction on one long leg. Each coil contains 120 turns of No. 20-gage insulated wire, and are connected in series; series connection is brought out to a binding post.

An auxiliary winding for the tail or dash-light of a voltage lower than that of the magneto so as not to use excessive pressure, namely 18 volts. This winding is on the remaining long leg of the transformer. No. 20-gage wire is used for this also and the required number of turns will be 17 times the voltage of the lamp. I used a three-volt lamp, being suitable for a small battery when the motor is not running. Seventeen times three volts equals 51, the number of turns required for the three-volt tail lamp.

Contributed by ROBERT L. SMITH.



Wiring Diagram With Home-made Auto-transformer for Ford Headlights, Permitting One Lamp to Burn if the Other Goes Out..

Heat for the Household

By H. WINFIELD SECOR

Associate Member of the American Institute of Electrical Engineers

EVERYONE today, whether he be rich or poor, or resident in city or country, is bound to be interested in the best and most economical kind of fuel to use for heating the home. Of course, the standard fuel for heating residences and buildings in general, is hard or anthracite coal as it is correctly known. Soft coal is generally used by railroads, factories and ships only. For residence heating, the anthracite or hard coal is the most satisfactory all around fuel, providing you are lucky enough to obtain a good grade of coal. There are seventy-five different grades of coal in the American market alone. Coke has come greatly into favor in the past few years as a source of fuel for house furnaces and even stoves, in which a special, small grade of coke is used or also the compromise idea,—a mixture of small coke and anthracite.

Among the fuels which have been and are being used for residence heating, either in part or in whole, are crude oil—used by blowing into furnaces; kerosene or coal oil burners placed in stoves such as kerosene ranges, in the same fire-box as that previously used for coal; electrically heated range boilers; coal dust or other coal briquettes, and electric radiators or stoves. All of these are shown in the accompanying illustration, besides several other features of economical importance such as well-fitted storm sashes and the relative bulk and heating value of coke, coal, wood, etc. These will be described in order.

Oil Instead of Coal for House Furnaces

A number of suburban residences, some of which in the vicinity of New York, were inspected by the writer, have arrangements installed for burning heavy fuel oil instead of coal or coke. The arrangement of the oil container or tank outside of the house is shown at Fig 1. The tank can be placed in the cellar, but it is safer, of course, out-of-doors. The tank is provided with a filling pipe which extends above the ground and is provided with a suitable air-tight cap.

Instead of loading dirty coal into the cellar and carting away a still messier load or loads of ashes from time to time, there is nothing to be handled whatever with this system. The oil is fed into the furnace by gravity or under air pressure so as to give a blast effect in the fire-box. The relative cost of this system of heating ranks very well with the cost of furnishing coal or coke, and all the bother of shoveling coal and handling the everlasting ashes is done away with.

Kerosene burners for ranges and stoves: As a substitute for coal or coke in the kitchen range or other stoves, there has been developed and marketed for several years, a very clean and highly efficient source of heat in the form of a kerosene gas burner, or pair of burners, provided with a suitable length of feed pipe connected to a tank which is placed on the wall or in a closet, or in any other out-of-the-way place.

The writer has seen these burners in use and it is surprising what a fine blue flame blast of heat they provide, heating the range and water box much more quickly at the start than with coal or other fuel, and proving also more economical in the long run, as those who have used the blue-flame wickless oil stoves have had occasion to note already.

The Comparative Heating Value of the Various Household Fuels

Electric Heater for range boilers: The illustration at Fig. 3 shows an electric heater especially devised for insertion in kitchen range boilers in the manner shown. This heater, several types of which are on the market, comprises in most cases, a thin metal tube such as copper, inside of which there is placed an electric heating coil or grid. A high thermal efficiency is claimed for this particular form of electric boiler heater, owing to the fact that a high percentage of the heat produced is transferred directly thru the thin metal wall to the water, and practically none of it can escape by radiation outside of the boiler, which is the case with sensibly all other forms of heat applied for warming water in a boiler, either directly or indirectly.

THE accompanying article describes the various fuels available for heating of residences and features some of the newest sources of heat such as fuel-oil, coke and electric heat. The use of coke has greatly increased in the past few years and some householders have found it efficient even in the smaller stoves. However, it usually works best in the small stove, unless it has an exceptional heavy fire box, when mixed about half and half with coal.

With the best grade anthracite coal, the best quality coke gives about nine-tenths the same heating value. Coke requires about twice the storage space of coal, ton for ton. Recent scientific tests in the laboratory have shown that a ton of coal may be considered as the equivalent in heating value of one cord of heavy wood or two cords of light weight wood.

Among the other features of prime interest to the householder, with the rapidly mounting cost of fuel, which are discust in the present article, are the use of storm sashes, electric fans for improving the furnace draft, and numerous other features often disregarded by those seeking the highest economy in fuel saving

Relative Heat Value of Coal, Coke and Wood

We often hear some heated arguments as to the relative cost and heating values of coal, coke, wood and other fuels. It is somewhat difficult for the layman to figure out the comparative cost of operating a stove of furnace for these various fuels, and the calculation required for the comparison of electric and oil heating is such a variable and complex one, that the suggestion is here given that for oil or electric heat, the householder had best make some inquiries of neighbors or friends who have used, or are at the present time using one of these specific sources of heat.

The relative heating values of coal, coke and wood are, however, quite well known, and those interested in this subject, will find a wealth of information given in *Kent's Mechanical Engineers Handbook,* or other engineering text-books covering various fuels and their heating values.

The heating value of various fuels is exprest by the number of heat units realized per pound of fuel burned. The best hard or A-1 anthracite coal, such as that which is produced from the Pennsylvania coal mines, yields 14,000 B. T. U's or heat units per pound. The best grade of coke, made from coal of selected grade, gives but 12,600 B. T. U's per pound. We can therefore see at once, that if we burned one pound of A-1 high grade anthracite coal, and one pound of the best coke obtainable, on a test run in a furnace or boiler, the coke will show only nine-tenths the heat efficiency of the coal. Many people are misled on this point and believe the coke to be more efficient than coal, but this fallacy is easily explained by the fact that it is very difficult to obtain the very best grade of coal to-day, and it frequently happens that coke appears in a much better light with regard to efficiency and heating value when compared to the low grade coal.

One has to go easy when attempting to burn coke in furnaces or stoves not intended for its use, as it is liable to burn out the fire box or warp the top of the stove or other parts very badly, in fact cracking them in some cases. If the stove or furnace does not appear to be sturdy enough to stand the intense heat produced by the free-burning coke, it is the best practise to endeavor to mix the coke about half and half, with coal. A mixture such as this is the best in all instances, for stoves and particularly kitchen ranges, but recently several large coke producers have marketed various sizes of coke, corresponding to all the sizes of coal commonly known, such as pea, egg and nut. They recommend the small sizes of coke for use in the average size stove, etc., but you will find the best conservation, so far as prolonging the life of the stove is concerned, is to mix coal and coke. Coke weighs about 28 pounds per cubic foot for standard size, while anthracite coal weighs about 50 pounds per cubic foot. It will be seen therefore, that a ton of coke will require twice the volume or cubic feet of space, occupied by a ton of anthracite coal.

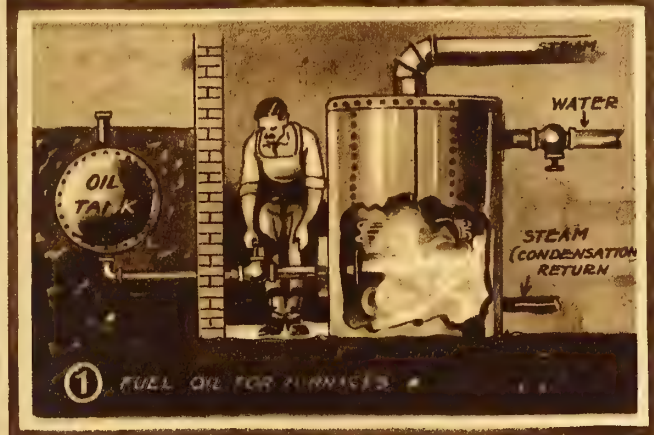
According to tests recently conducted by the Forest Products Laboratory at Madison, Wisconsin, two pounds of dry wood of any non-resinous species, have about as much heating value as a pound of good coal. In terms of tons and cords—a ton of coal may be considered as the equivalent in heating value of one cord of heavy wood, or two cords of light weight wood. One cord, or 128 cubic feet of hickory, oak, beech, birch, hard maple, ash, elm, locust, long leaf or cherry is equivalent to one ton of coal. One and one-half cords of shortleaf pine, western hemlock, red gum, Douglas fir, sycamore, or soft maple equals one ton of coal. Two cords of cedar, red wood, poplar, catalpa, cypress, basswood, spruce or white pine equal one ton of coal.

Briquette Firing

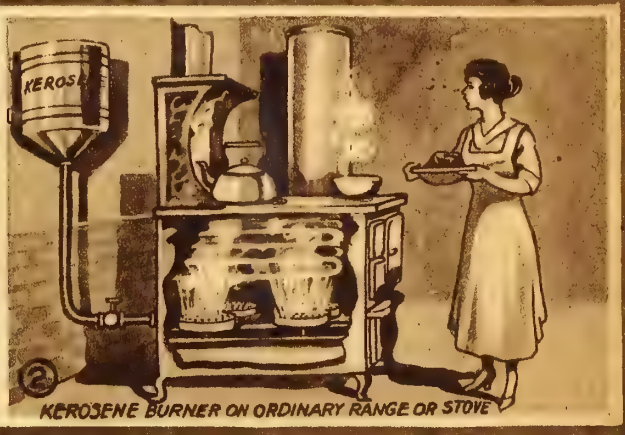
The illustration at Fig. 5, shows briquettes in use as a fuel for stoves. Americans are not so familiar with this source of heat as are Europeans, for several reasons—probably due to the fact that coal is not so common or plentiful in European countries as it is here. In Ireland, for instance, they make fuel briquettes of peat or moss, which have a surprisingly high thermal value. Briquettes have also been made

(*Continued on page* 910)

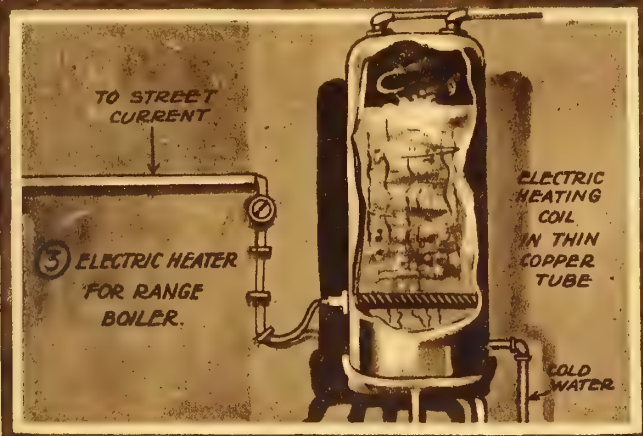
HEAT FOR THE HOUSEHOLD



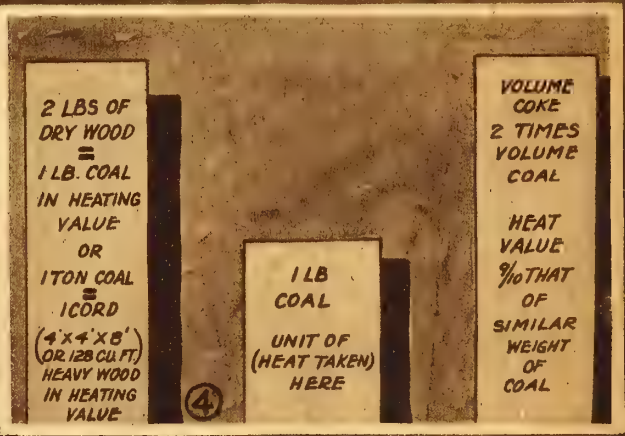
① FUEL OIL FOR FURNACES



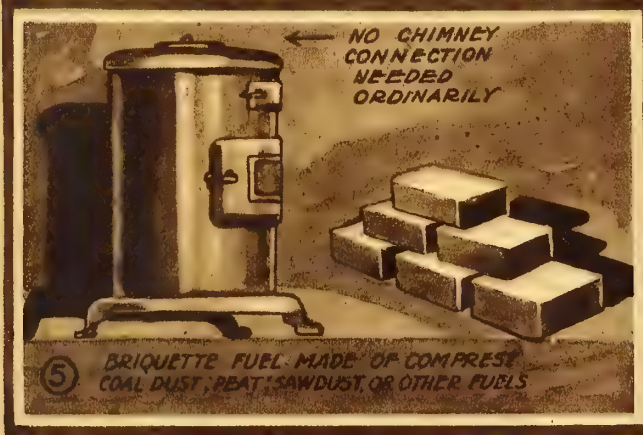
② KEROSENE BURNER ON ORDINARY RANGE OR STOVE



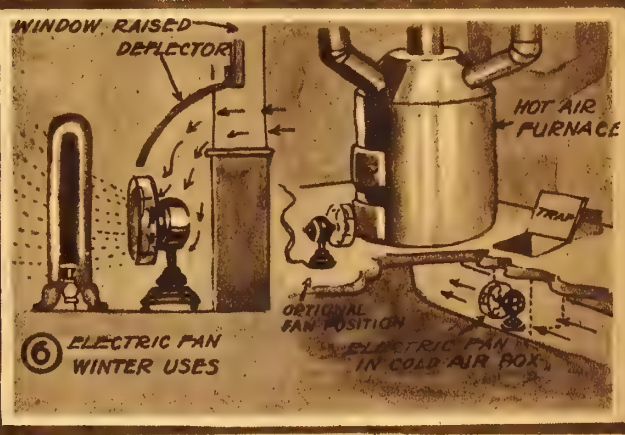
③ ELECTRIC HEATER FOR RANGE BOILER.



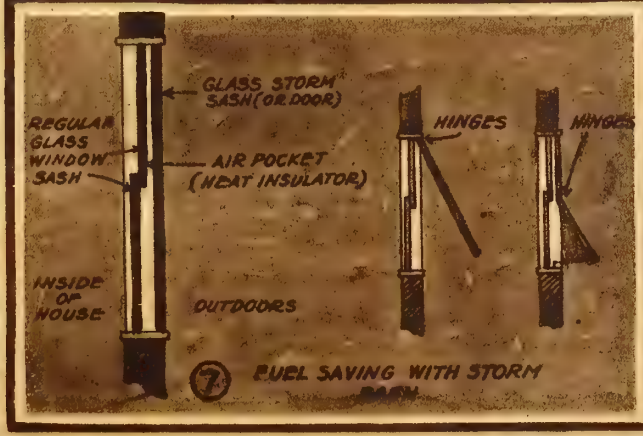
④



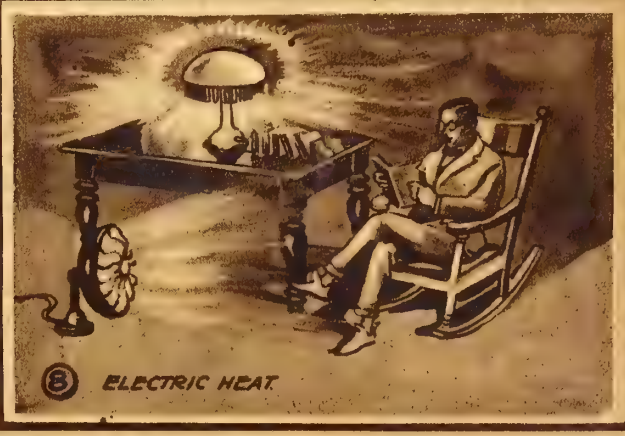
⑤ BRIQUETTE FUEL MADE OF COMPRESSED COAL DUST, PEAT, SAWDUST, OR OTHER FUELS

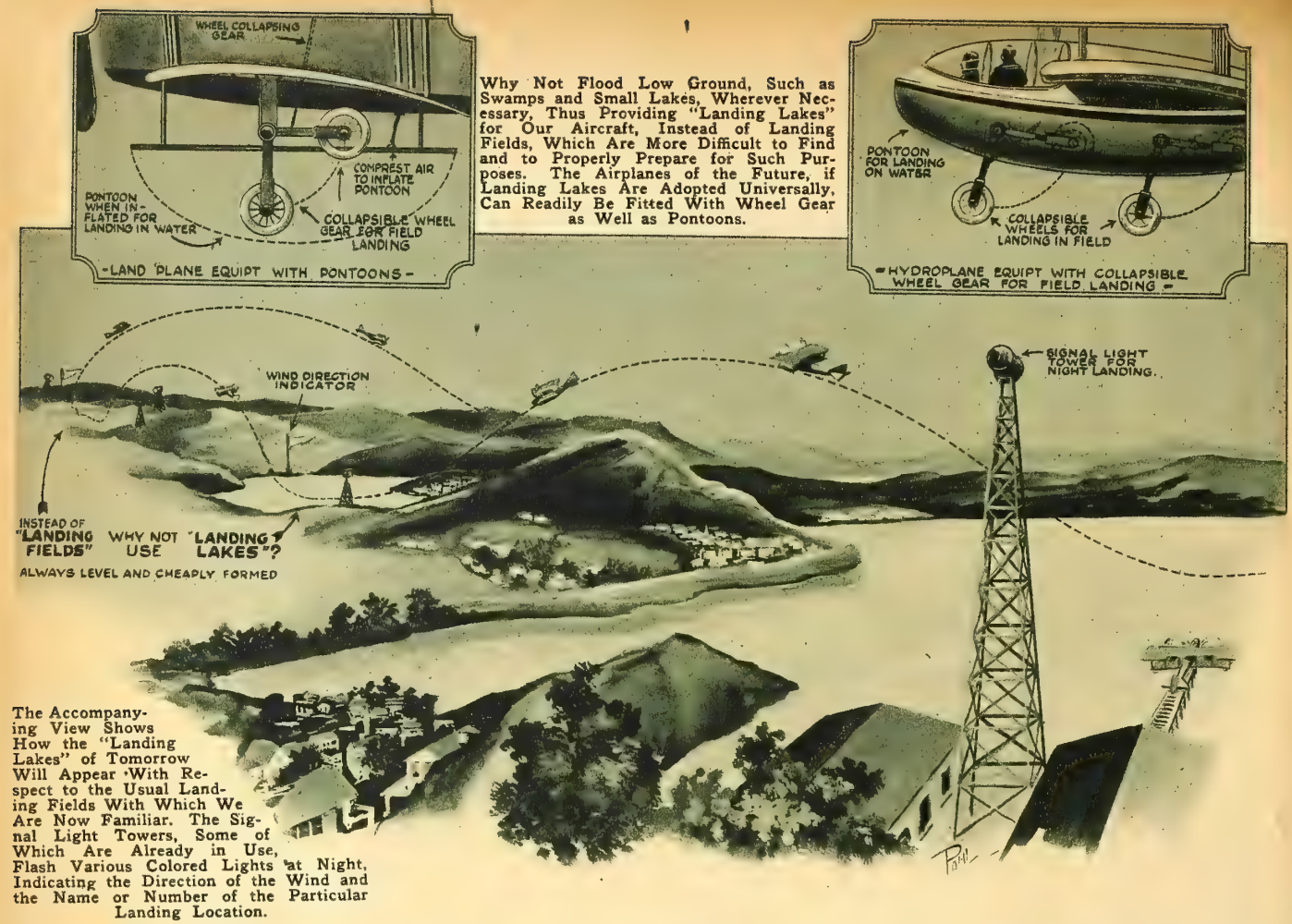


⑥ ELECTRIC FAN WINTER USES



⑦ FUEL SAVING WITH STORM SASH


⑧ ELECTRIC HEAT



Why Not Flood Low Ground, Such as Swamps and Small Lakes, Wherever Necessary, Thus Providing "Landing Lakes" for Our Aircraft, Instead of Landing Fields, Which Are More Difficult to Find and to Properly Prepare for Such Purposes. The Airplanes of the Future, if Landing Lakes Are Adopted Universally, Can Readily Be Fitted With Wheel Gear as Well as Pontoons.

The Accompanying View Shows How the "Landing Lakes" of Tomorrow Will Appear With Respect to the Usual Landing Fields With Which We Are Now Familiar. The Signal Light Towers, Some of Which Are Already in Use, Flash Various Colored Lights at Night, Indicating the Direction of the Wind and the Name or Number of the Particular Landing Location.

"Landing Lakes" for Aircraft

By R. T. CARABIN, Ex-Lieut. A. E. F.

YOU have watched a large airplane soaring over the aviation field in preparation for landing. Perhaps you have seen the great bird come gracefully to the earth without the slightest mishap. But if you talk to the pilot of a large fast plane, he will tell you that once he is in the air there is little to worry him except that he may make the return to earth without damage to himself or his ship.

Let us take for example the little fighting plane of the "SPAD" type—almost a toy to look at—a machine where wing area had been cut down to the lowest limit in obtaining greater speed. To get this little fellow with its ponderous motor into the air requires a large field and a fast run.

Once in the air, however, it has no equal in speed and is as graceful as a swallow, but unlike the swallow it cannot beat back the air with its wings when it desires to land, but must come to earth with almost the same speed it maintained in the air and here is the danger, especially if the ground is not perfectly smooth. But these planes were for war purposes and a few machines more or less smashed in landing, were of little consequence, provided they excelled the enemy in the air.

With the bombing planes it was much the same problem, except that more personnel and equipment were endangered.

These are the general conditions brought about by the war and now that we are on a peace footing we look for improvements in a radical way which will make the air a safe and fast medium to transmit passengers and material from place to place.

Bigger airplanes are being built, and while we are not in quest of machines of extreme size or speed, we hope for ships which will safely carry fairly large cargoes of personnel to their destination. Just as every other commodity which we now enjoy, started with its small model and then slowly approached, and finally exceeded the practical limit, coming back finally to a size somewhat smaller than the largest constructed, we may look for the same development in aviation.

It is easy to conceive that when aviation is in the same state of development as our marine and rail transportation, the planes will be monstrous indeed compared with those we know today. As we picture these great airships of the future, with their large cargoes of precious human freight, it is evident that landing on the ground would be accompanied by too much hazard to be practical.

We must then look elsewhere for the solution of our landing problems, and turning to water as a possible medium on which to land our giant craft we are promised success, as our present hydroplanes land on the surface of a lake as gracefully as water fowl. But this is only a suggestion of what the future will develop along this line. A better idea of how well water adapts itself to bringing safely to rest great bodies weighing hundreds of tons is gathered by observing a battle-ship in the launching. Slowly it starts its glide, then gathering speed at it goes down the ways, it meets the water and this immense craft is quickly and gently brought to rest—it may be with no other aid than the water itself.

This gives us an idea I believe, of the direction in which we should work. The problems of overcoming the adhesion of the water in getting the ships into the air again, are problems which our designers will solve as we proceed. Whether the planes will carry pontoons or be equipt with all metal wings which will also form the hull for landing; whether they will be fitted with folding landing gear for emergency descents, are all things which will be worked out as time goes on. Here I will only treat on the landing "lakes" of the future, as I see them. And proper landing fields (or will it be lakes?) we must have, in whatever direction we proceed.*

Now when we take into account that the airplane is going to be an exceptionally long distance hauler; and also that three-fourths of the earth is covered with water, it is at once evident that nothing would be lost by adopting water points as the locations where aerial transportation is to begin and end. But we are not limited here. In most localities where men live in any great numbers, there are swamps or low lands which could be flooded as cheaply as dry land could be prepared, even to the extent we require today.

And if the art develops along present lines the landing fields will be required to be larger and smoother every year.

Other advantages which the water covered fields will have are these: Easy to locate, day or night. Absolutely level. No policing required and at length we would find our country dotted with pleasant shallow lakes instead of strange markings on level stretches of valuable land.

*(A similar suggestion was made by Mr. H. Gernsback in his recent article, "Airplane of the Future." Sept. issue, page 577.—Editor.)

Great Britain's Mystery Towers

THERE were launched recently at the little English village of Southwick, between Shoreham and Brighton on the Channel coast, two extraordinary "mystery ships" which have long aroused the curiosity of the English public and surely must have given some sleepless nights to the heads of the erstwhile imperial German spy system.

The two mystery ships were laid down during 1918 and have recently undergone completion. These towers, due to their shape, have been nicknamed by the British public the "wedding-cake ships" and not without good reason.

The entire height of each of the two ships is about 200 feet, and they are constructed in such a manner that the concrete bases can be flooded or pumped out at will, thereby raising or lowering the ungainly craft. One of the towers was floated by a flotilla of Portsmouth steam tugs toward Spithead in the English Channel. Only one of the vessels has been sunk in the channel so far, but just where has not been divulged, the British Admiralty being careful not to give out the proposed location of the craft.

The launching took place on September 12th without much ado, as few people had been informed what was to take place. There was as much secrecy as possible, every workman having been sworn to secrecy. Naturally, in a case like this, where not much is known as to the ultimate purpose or even the *raison d'être* for these ships, not only public curiosity but the curiosity of many scientific men has been aroused. Many speculations have been made as to how these mysterious towers will be used ultimately, and so far one guess is as good as another.

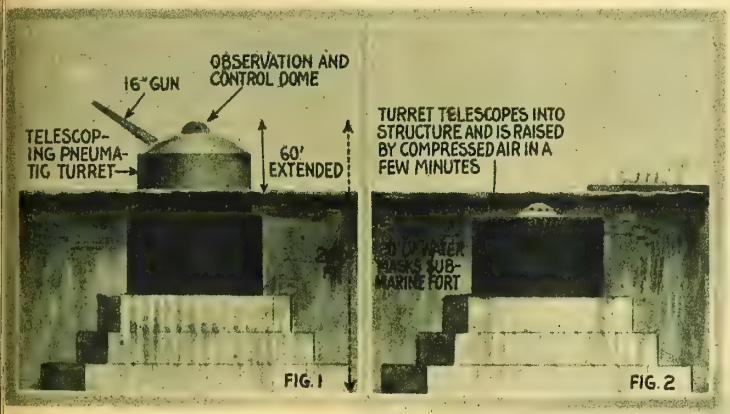
One authority thought that these floating fortresses were to be sent against the Germans to blockade their harbors. They were to be towed by submarines thru the mine fields, and inasmuch as the towers can be submerged considerably below the level of the water, this explanation, fantastic as it seems, deserves some credence. The towers were to be sunk or blown up at the mouth of the German harbor, thus blocking the exit of the submarines.

Still another authority thinks that the device is to be used to raise sunken vessels, but it is not quite apparent why the British Government should go to so much secrecy and spend about five or six million dollars a piece on such towers when there are far better salvaging appliances.

As for ourselves, we offer an explanation which may or may not be the correct solution. Our illustration here reproduced explains the idea. If we study the photographs of the mystery towers we are struck by the false woodwork surrounding the upper part of the tower. Evidently this was done simply as a blind, so as to hide some of the constructional features of the towers. No doubt this woodwork has been removed or will be removed in due time when the towers are in place.

Our explanation is that these towers are simply submersible fortresses placed at strategical points. The top of the towers would carry a huge gun, a 14 or 16-inch rifle, or even larger if possible. Outside of the armament, i. e., the guns, etc., there would be only sufficient machinery contained within the towers to raise and lower the top of the fortress telescopewise, as clearly shown in our illustration. The action would then be as follows:

By means of airplanes the position of enemy battle-ships would be signalled to the towers by radio as shown. Immediately the top of the tower, which heretofore was just awash with the ocean, would begin to rise and within a few minutes would have risen sixty or seventy feet above the surface of the water. Its huge guns would start belching fire almost at once, and the range would be corrected by the airplanes overhead so that few shots would go astray. Note that we are firing from a solid platform and not from a moving vessel. It is difficult to shoot from one moving vessel to another one, but comparatively simple to score a bull's-eye if we fire from a land station, which these submersible fortresses really are in a sense. During a battle the mystery towers can, if they choose, remain above water, but if attacked by superior force, it becomes possible to submerge within a few minutes, thus offering the enemy no target whatsoever. Even if they do not submerge, the enemy will have difficulty in scoring a hit for the simple reason that these towers only measure about fifty or sixty feet in diameter against a ship's length of 500 to 600 feet.





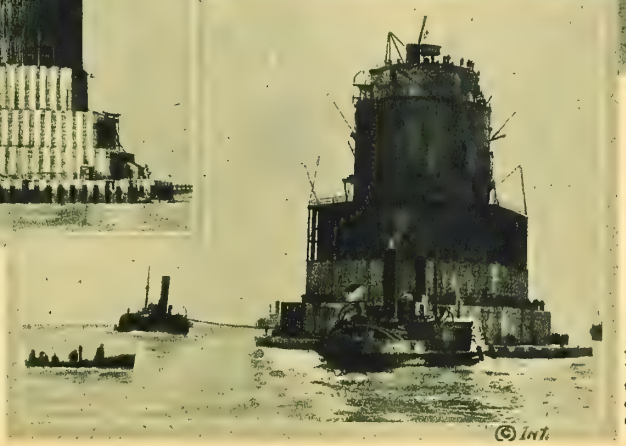


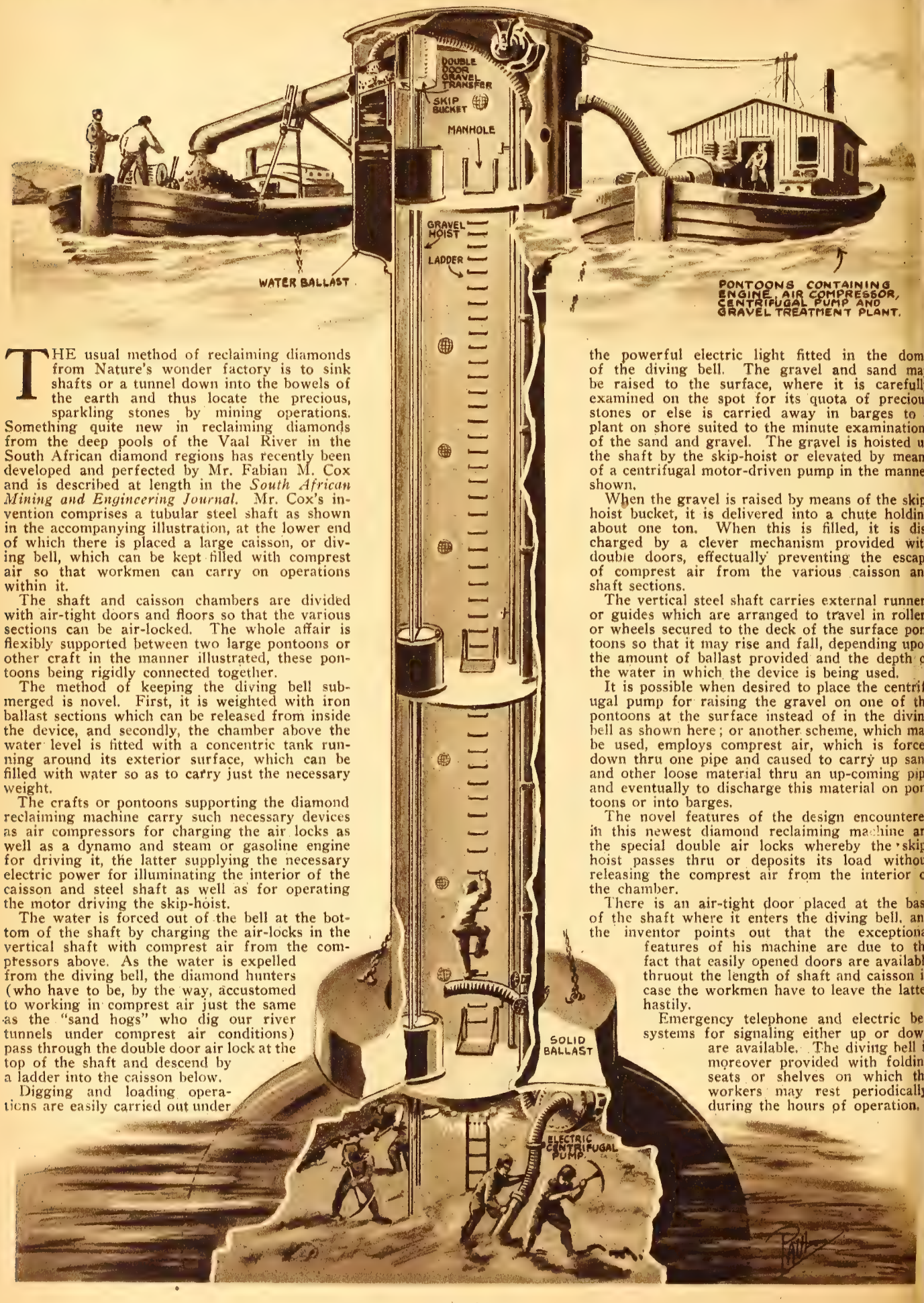
Fig. 1 and 2 Gives a View How the British Mystery Towers Might Be Used As a Disappearing Sea Fortification.

Fig. 3 Shows How They Would Operate in Actual Naval Combat. It Will Be Noted That When Submerged, the Fortresses Are Entirely Invisible and Thus Protected.

The Two Lower Views Show the Actual Photographs of the Two Mystery Towers, the Top One Before Launching, and the Bottom One of the Towers Launched and Being Towed to Its Destination Somewhere in the English Channel.

Note Particularly the False Wooden Work Put Up By the British to Camouflage the Towers.

Mining Diamonds With Diving Bell



THE usual method of reclaiming diamonds from Nature's wonder factory is to sink shafts or a tunnel down into the bowels of the earth and thus locate the precious, sparkling stones by mining operations. Something quite new in reclaiming diamonds from the deep pools of the Vaal River in the South African diamond regions has recently been developed and perfected by Mr. Fabian M. Cox and is described at length in the *South African Mining and Engineering Journal*. Mr. Cox's invention comprises a tubular steel shaft as shown in the accompanying illustration, at the lower end of which there is placed a large caisson, or diving bell, which can be kept filled with comprest air so that workmen can carry on operations within it.

The shaft and caisson chambers are divided with air-tight doors and floors so that the various sections can be air-locked. The whole affair is flexibly supported between two large pontoons or other craft in the manner illustrated, these pontoons being rigidly connected together.

The method of keeping the diving bell submerged is novel. First, it is weighted with iron ballast sections which can be released from inside the device, and secondly, the chamber above the water level is fitted with a concentric tank running around its exterior surface, which can be filled with water so as to carry just the necessary weight.

The crafts or pontoons supporting the diamond reclaiming machine carry such necessary devices as air compressors for charging the air locks as well as a dynamo and steam or gasoline engine for driving it, the latter supplying the necessary electric power for illuminating the interior of the caisson and steel shaft as well as for operating the motor driving the skip-hoist.

The water is forced out of the bell at the bottom of the shaft by charging the air-locks in the vertical shaft with comprest air from the compressors above. As the water is expelled from the diving bell, the diamond hunters (who have to be, by the way, accustomed to working in comprest air just the same as the "sand hogs" who dig our river tunnels under comprest air conditions) pass through the double door air lock at the top of the shaft and descend by a ladder into the caisson below.

Digging and loading operations are easily carried out under the powerful electric light fitted in the dome of the diving bell. The gravel and sand may be raised to the surface, where it is carefully examined on the spot for its quota of precious stones or else is carried away in barges to a plant on shore suited to the minute examination of the sand and gravel. The gravel is hoisted up the shaft by the skip-hoist or elevated by means of a centrifugal motor-driven pump in the manner shown.

When the gravel is raised by means of the skip hoist bucket, it is delivered into a chute holding about one ton. When this is filled, it is discharged by a clever mechanism provided with double doors, effectually preventing the escape of comprest air from the various caisson and shaft sections.

The vertical steel shaft carries external runners or guides which are arranged to travel in rollers or wheels secured to the deck of the surface pontoons so that it may rise and fall, depending upon the amount of ballast provided and the depth of the water in which the device is being used.

It is possible when desired to place the centrifugal pump for raising the gravel on one of the pontoons at the surface instead of in the diving bell as shown here; or another scheme, which may be used, employs comprest air, which is forced down thru one pipe and caused to carry up sand and other loose material thru an up-coming pipe and eventually to discharge this material on pontoons or into barges.

The novel features of the design encountered in this newest diamond reclaiming machine are the special double air locks whereby the skip hoist passes thru or deposits its load without releasing the comprest air from the interior of the chamber.

There is an air-tight door placed at the base of the shaft where it enters the diving bell, and the inventor points out that the exceptional features of his machine are due to the fact that easily opened doors are available thruout the length of shaft and caisson in case the workmen have to leave the latter hastily.

Emergency telephone and electric bell systems for signaling either up or down are available. The diving bell is moreover provided with folding seats or shelves on which the workers may rest periodically during the hours of operation.

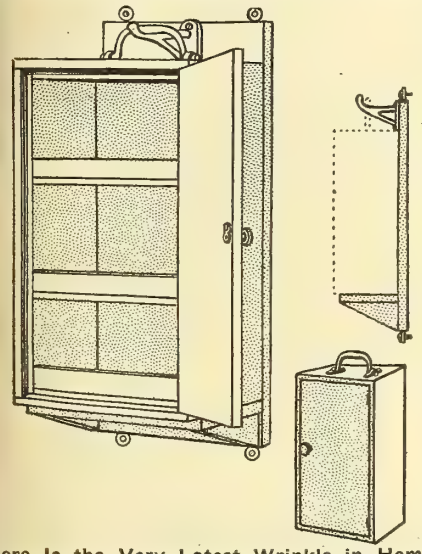
Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

A COMBINATION PORTABLE AND BRACKET MEDICINE CABINET.

THE medicine cabinet is usually fastened in some more or less convenient location—where one is compelled to journey to it for each dose of medicated compound, an arrangement that under ordinary conditions is quite all right; but there are hurry calls for its aid, when the particular remedy, or the amount of the dose, is known only to the patient who for the time is just able to point it out, perhaps, in the exigencies of the moment. The whole household supply is wanted in the sick-room or place of accident; at such times a portable cabinet will be preferable. In order to meet this desired innovation, a combination portable and bracket cabinet is here shown.

This cabinet consists of a wall frame permanently fastened to the wall with a supporting shelf, a retaining hook and the cabinet proper. The latter, a plain, undecorated case with a carrying handle has shelves and door. The retaining hook is an ordinary clothes-hook, four screw-eyes



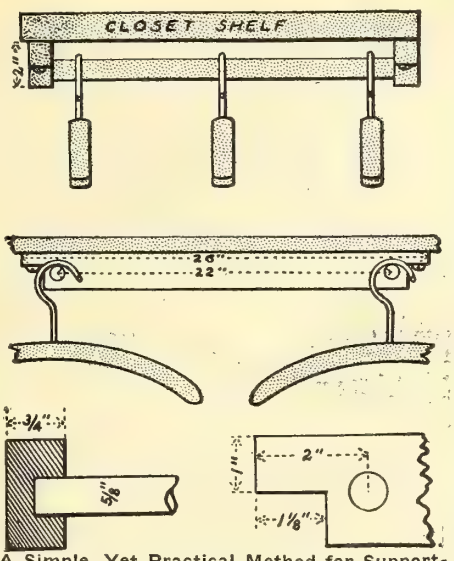
Here Is the Very Latest Wrinkle in Home Medicine Cabinets—Arrange the Cabinet to Be Supported on a Bottom Shelf With the Handle Engaging a Hook on the Top So That the Cabinet Can Be Picked Up in an Emergency and Carried Anywhere Desired.

screwed into the frame, form sockets for the wall-screws; the handle, hinges and knob for the door can be obtained at the ten-cent store, and the cabinet and frame are both simple and easily made, thus providing in its entirety, a medicine container that will surely appeal to every "Home Mechanic."

CLOTHES-HANGER BRACKET.

A clothes-hanger bracket that can be taken down or put up at each moving day pilgrimage, is desirable and if it is a good, serviceable bracket—standing all kinds of wear and supporting all sorts of loads—the pilgrim will wish to pack it in his trunk with the rest of his worldly possessions.

The one illustrated is all of this and a little bit more, the more being in the fact that it can be manufactured by anybody, even in a hall bedroom, if no other workshop is handy. The bracket consists of one or more ⅝" metal or wooden rods, 11 inches long, made by sawing or filing an ordinary wood or metal curtain rod into the given lengths; four button-head screws 3-16x⅜ inches; and two wooden end pieces ¾ inch thick, two inches wide, and the required length—say six inches for one rod, 26 inches for two rods, and 37 inches for three rods.

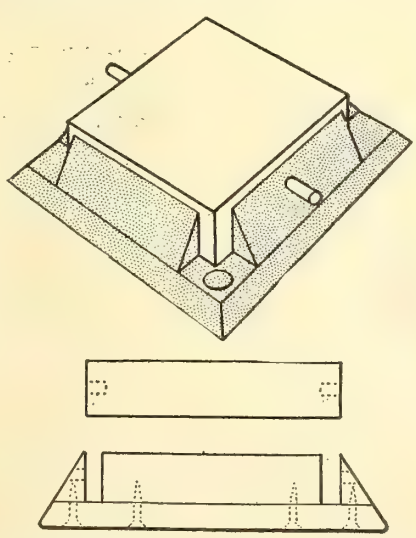


A Simple, Yet Practical Method for Supporting a Large Number of Clothes Hangers, Which the Home Mechanic Can Build at Practically No Cost.

Most closet shelves are 12 inches wide so that we say the rods may be made 11 inches long, but if the shelf is narrower, the rods must be one inch shorter than its width whatever it may be. The holes for the rods are bored 22 inches apart, two inches from the ends and in the center of the two inch sides of the end pieces; using an 11-16 bit and going only half way thru the wood. The screw holes are bored with a 3-16 inch bit, and all the way thru the wood, the jogs being sawed first to measurements given.

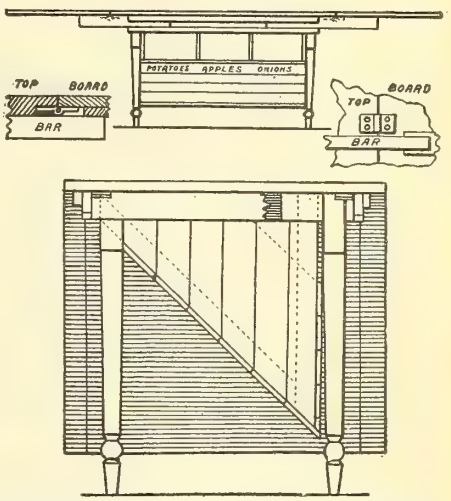
HANDY BREAD OR MEAT BOARD.

A bread or meat board with the desirable end-of-the-wood-surface found on the *butchers' block* is always wanted round the kitchen, yet one cannot always have this kind of a board for the simple reason that there is no such board on the market. The one here illustrated is of this kind, but to have it, one must make it—a task not at all difficult providing the part under the knife can be obtained. This is not altogether impossible, for we give a view of an actual part, now in use—one purchased at a shop providing such blocks to wood-engravers. It is of the cheaper grade of block used for large poster work, about ⅞ of an inch thick and 8 inches square—the area could have been anything up to 30 inches if wanted. The wood is usually maple—a very hard wood. Such pieces are sold by the square inch, costing about two dollars for the eight-inch square, and are worth that for the purpose, as the wood is practically indestructible.



This Invaluable Meat or Bread Board for the Home Kitchen or Pantry Is Constructed From a Piece of Hard Wood Such as Maple, and Possesses the Advantage That It Can Be Thoroly Cleaned, and Is Withal Light in Weight.

The holder is made as shown, using brass screws and wooden pins, care being taken to have the holes both in the base and block bored so that each pin will be tight in the frame and loose in the block, the object of the pins being merely to keep the block from falling out when the board is hung up. The holes should be placed so that the block can be put in the frame and secured either side up, or in any direction (four holes in the block and two in the frame), thus insuring against warping.



Here We Have a Kitchen Cabinet Built Right Into the Work Table With Compartments for Potatoes, Apples and Onions—a Very Useful Wrinkle, Indeed.

A CABINET FOR THE KITCHEN TABLE.

Take a table of the ordinary kitchen variety (which at one time was thought expensive at a dollar), as the foundation for this space-saving device.

First attach two wing extensions, one at either end, using large size bread-boards, trimmed to the width of the table top, as the extended parts—this makes the table double its original capacity—the ends being attached with hinges and let down in the usual way; sliding bars, fastened to the table with stationary bars as shown hold the ends when in use. A small drawing shows the method used if the table top and board extensions are of different thicknesses as will very likely be the case when the common commercial ready-made boards are used.

Next make a cabinet to hold potatoes, apples and onions. This consists of any convenient box, fastened to the table, and divided into compartments. We show one made wedge-shape, which will thus cause the contents of the compartments to always lie at the front within easy reach. It is made of narrow boards nailed to extended corner-pieces that are finally fastened to the table as shown. The partition boards are also set at an angle, chiefly for the purpose of saving lumber.

The Amateur Magician

By JOSEPH H. KRAUS

The Coin Wand

PROFESSOR HARGRAVE had not yet recovered from the effects of his long vacation, when I pounced in on him just prior to a terrific thunderstorm which a short time later enshrouded the entire villa in a veil of darkness, except at the frequent intervals in which livid lightning flashes illuminated the scene, each flash being accompanied by an incessant roar a second or so later, proving that the storm was very close. After answering each other's questions for half an hour or so, the storm abated sufficiently to allow us to proceed with the main mission of my errand.

Hargrave answered my question with, "Do you know, old timer, when I go away on a vacation I take a complete rest and do not attempt to ferret out any further mysteries. I have a little stunt here, however, which will please your readers, particularly in view of the fact that it is simply made and employs, as do my other tricks, electricity in the very simplest manner. Let me have your hat—no, this will never do: I thought perhaps that you might have secreted about you one of those stove-pipe affairs. Wait a second until I procure one of mine."

A few moments later he was back in the room with a high silk hat in one hand and a little black stick about 15 inches long in the other, which he called his *Coin Wand*. Proceeding to demonstrate the effectiveness of his little instrument he said, "A very simple method of making counterfeit, as you undoubtedly know, is to pass a stick of this nature thru the air and collect the particles of silver floating in the atmosphere into one unit mass, forming them into a coin at the same time. You see each time that we handle a silver coin we rub off some of the silver. That accounts for some coins becoming thin from wear. This silver of course does not remain on our fingers but is brushed off, and due to the air circulation we soon have floating about millions of particles of this silver substance in a pure state, exactly identical with the coin content!! If all of this silver which is annually rubbed off coins could be collected, we would be quite wealthy, but meanwhile we can collect all that is floating around us."

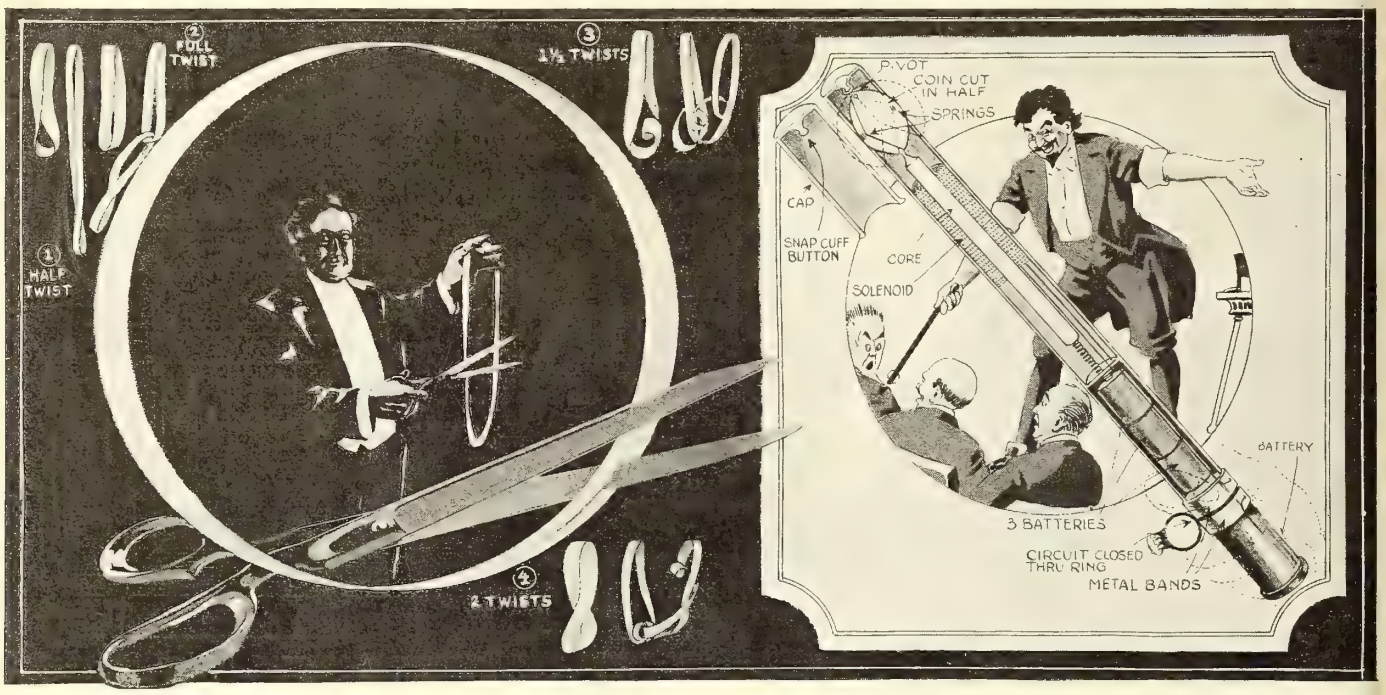
So saying he swept his wand thru the air and there—lo and behold—was a coin right at the end of that instrument! With a quick shake the coin could be heard clattering into the hat, to meet its mate, and before I knew it he had collected 12 to 14 coins.

"You see if it weren't for the noise made by the coins falling into the hat you could scarcely hear them." After assuring me that the coins were not counterfeit, I requested to examine the wand which he did not hesitate to let me do. There was nothing unusual in its construction. A black metal band fitted on one end, and two parallel nickel-plated bands on the other. Aside from that it was quite a solid construction with nothing to indicate the way in which the coins came or were even suspended around the end of the wand.

After toying with me a little longer he gave me the secret of one of the cleverest little devices which he had ever originated. Saying this he took the wand from my hands with: "You're not as green about magic as I thought you were,—you're worse." Pulling at the metal cap at one end he removed it, and then the trick could be readily seen, for a slot in each side of the wand concealed half of a coin. Of course I desired more details of constructions which with Professor Hargrave's frank and willing manner to help, were not difficult to obtain.

Taking the wand apart he showed me its construction, explaining it in the following manner: "The original magicians' coins, as you know, resemble half dollars which are cut in the manner shown, so that an obtuse angle on the cut side is formed. These are hinged as near to the end of the wand as possible and over-lap each other. The little spring holds them in a closed position so that they cannot be seen unless the wand is in operating condition. The springs are mounted as you can readily see by this rough sketch enabling this position to be maintained. The wand itself is ½ inch in diameter, which is amply sufficient to conceal the half dollar. At the same time when this opens, the coin projects on both sides, giving rise to the illusion that the coin is being held at the end of the wand in some manner not readily ascertained, which in itself constitutes quite a puzzle. In order to enable the opening of the coin we have a solenoid (electro-magnet) embodied in the wand. This solenoid has a soft iron core three inches long, the core coming to a flat point at one end. This core moves within the solenoid coil which is 2½ inches long and wound very compactly with No. 28 wire, or wire which can be taken from an old bell, until a total thickness of 7/16ths of an inch is eventually realized. This makes a very snug fit into the metal wand. A spring is attached to the core of the solenoid to draw it back so that it will not interfere in any way with the proper closing of the coin whenever the current is shut off. In the other part of the wand is the battery, simply removed by this end cap which must be pulled quite hard in order to remove the same. As you will note, two springs hold the cap in place. No one on examining a wand attempts to pull it apart or handle it roughly, particularly if cautioned beforehand. Therefore, the closure of this end is quite effective, and as it can be turned all around if one tries to unscrew the end, it is never thought to be 'part of the game.' The positive pole of the battery goes directly to the solenoid and the negative is past out thru the wand

(*Continued on page* 908)



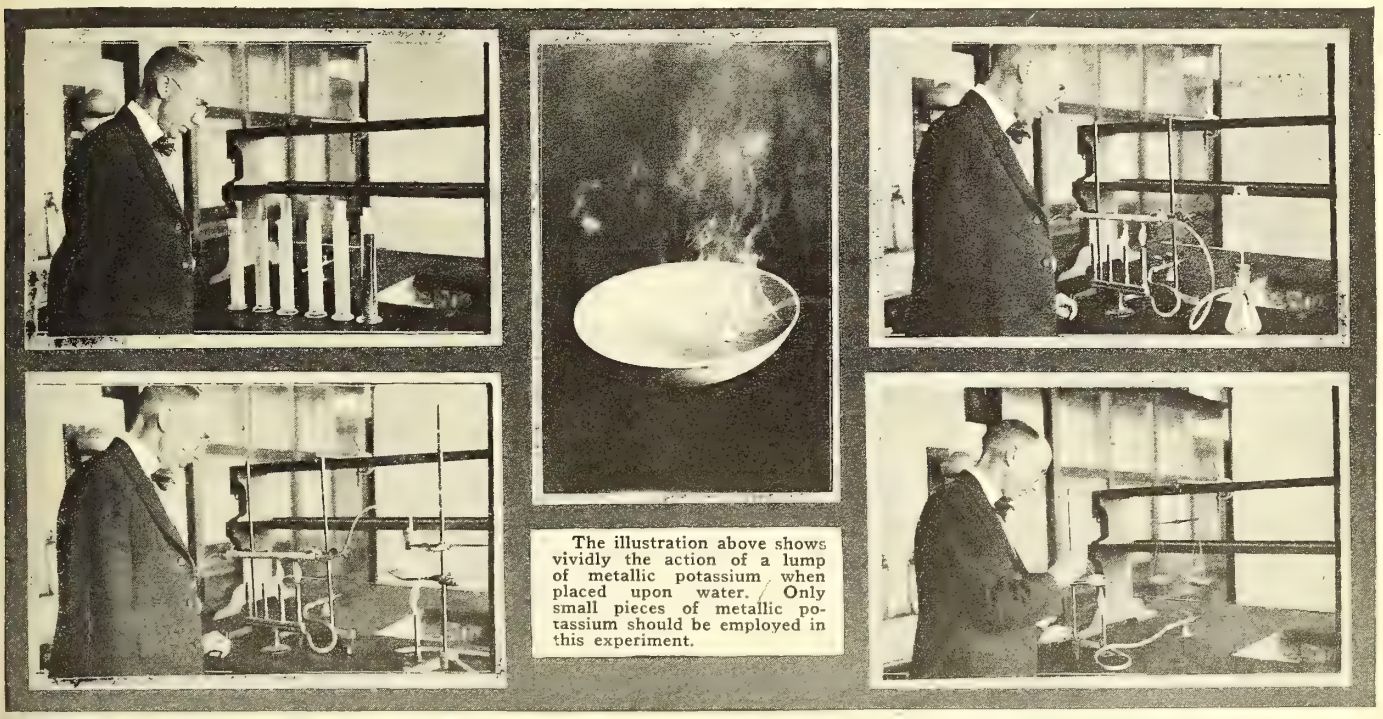
Above We See the Paper Cutting Trick Wherein, Try as Hard as You Will, by Cutting a Band of Paper in Half, Longitudinally, You Cannot Help But Make Two Bands. Yet When You Know the Art of the Trick, by Cutting the Band in the Same Manner, You Can Make One Continuous Band or a Linked Band, or Even One With Several Knots.

Here is a Diagram of a Magic Coin Wand Which Foils Detection. It is Electrically Controlled. Note How the Ring Makes Contact Between the Two Metallic Bands on the Handle Closing the Circuit, and in This Way Causes the Current to Flow Thru the Solenoid, the Core of Which Separates Two Split Coins, Making it Appear as Tho the Coin Was Caught in Mid Air.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

Some Metals and Their Properties



The illustration above shows vividly the action of a lump of metallic potassium when placed upon water. Only small pieces of metallic potassium should be employed in this experiment.

Above:—Displacing metals from their solutions by the action of zinc and copper.
Below:—Oxidizing heated copper by passing a stream of oxygen over it.

Above:—Reducing hot copper oxid by passing a stream of hydrogen over it.
Below:—Determining the weight change on heating a metal in the air.

FROM prehistoric days to the present moment metals and metal-working have been supremely important in the affairs of men. Indeed, the progress of the race may be measured by its growing proficiency in the working of metallic ores and particularly in the metallurgy of iron and steel. At what time in the dim and distant past primitive man thru his mastery of fire past to a knowledge of metals and their wonderful properties, so indispensable to his conquest of the earth, no record discloses. Certain it is that for long centuries before the Christian Era, metal working was a highly perfected art. Doubtless gold and copper, which occur in the free state, were the first metals known to man. Tin was also one of the early metals. History tells us that copper and tin in their alloyed form of bronze characterized a long period in which other metals were little known. Tools found in ancient ruins and their easy metallurgy show this to be true. And yet iron has been found in the pyramids of Egypt built centuries before Christ. Much evidence, too, points to a knowledge of iron by the Assyrians, Chaldeans and Babylonians, who occupied the plains of Mesopotamia at a much earlier period. But whatever the truth, the mastery of metals and their skillful adaptation to the varied arts of peace and war have spelled power and dominion—dominion at first over the material elements of nature, followed by the military and political sway of empire.

But it was not the utility of metals that first arrested the attention of savage men. As some cave man raked over the dying embers of his camp fire, he doubtless discovered globules of bright metal. This happy accident at first aroused only his curiosity and excited his superstition. But the repetition of the discovery led him to investigate and in time the high lustre and properties of toughness, hardness and malleability must have demonstrated the superiority of these new substances to wood, bone and stone for implements of hunting and warfare.

Some Properties of Metals: The properties of all elements are divided into two classes—physical and chemical. From the physical standpoint metals, in the pure state, have a high lustre and are good conductors of heat and electricity. Many of them are tough and malleable. Chemically, metals vary from those of great activity, as sodium and potassium, to gold and platinum which are little affected by some of the strongest reagents. Some metals readily liberate hydrogen from acids while others do not.

Heating Metals in the Air: One of the most marked differences in metals is to be

(*Continued on page* 913)

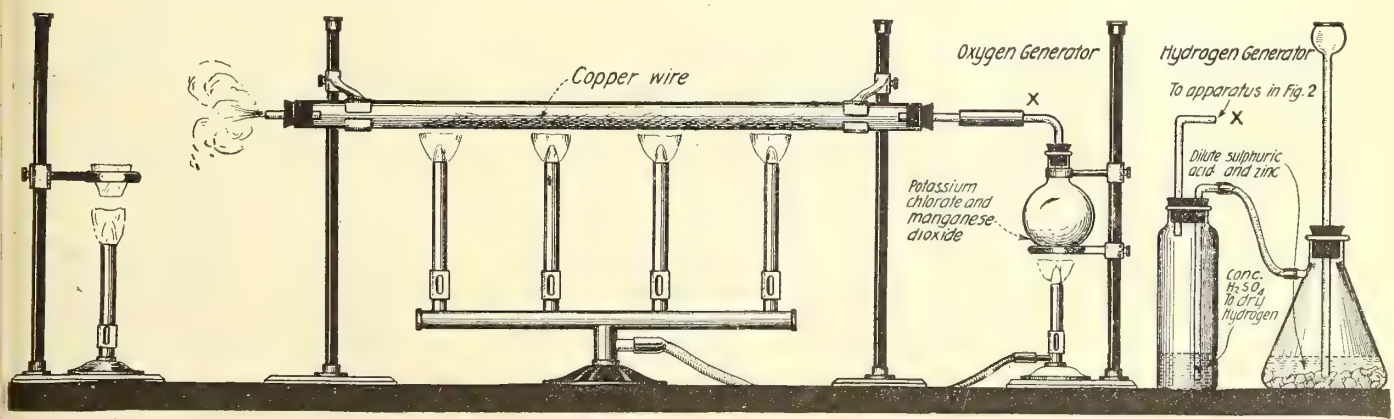


Fig. 1

Heating a Metal in the Air, the Metal Being Placed in a Crucible.

Fig. 2

Apparatus Set Up for Performing the Oxidation of Copper Experiment.

Fig. 3

Reduction of Copper Oxide to Metallic Copper by Means of Hydrogen.

Xmas Electric Amusements

How to Connect Xmas Tree Lights; Also How to Construct Electric Carousel, Scenic Railway and Church

EVERY Yuletide season those of us who possess electrical ideas endeavor to work up something new for the amusement of the children, both young and old. The layman usually has trouble in deciding upon the connections of electric lights for the Christmas tree, and Fig. 1 shows the principal and predominating forms of circuit in use with the small decorative lighting festoons.

There are two main subdivisions of the forms of circuit which can be used for tree lighting, namely, *series* and *parallel* circuits.

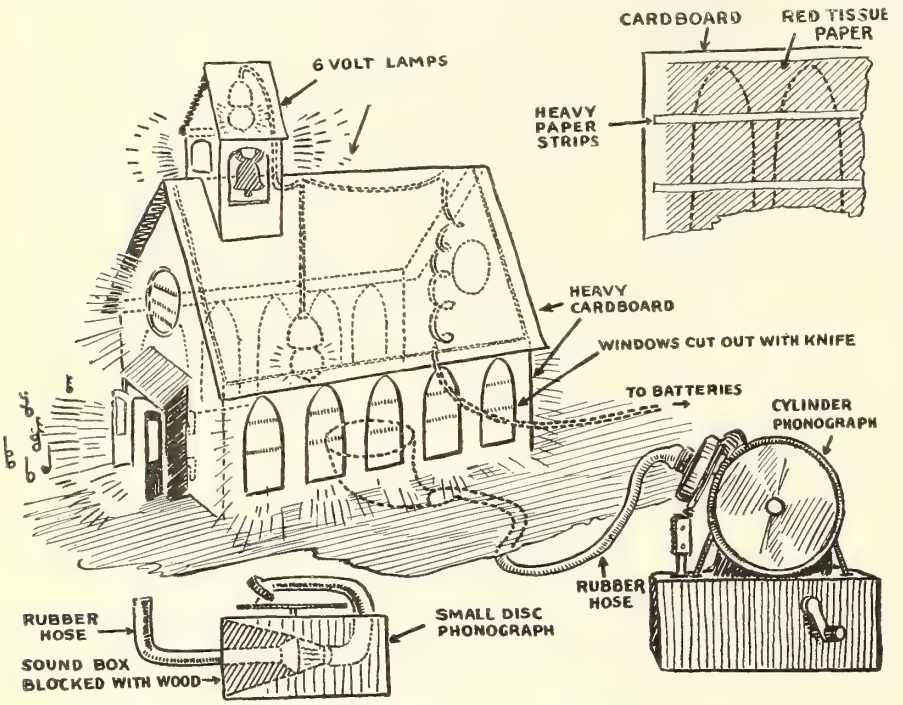


Fig. 2.—With Very Little Labor, This Pretty Model Church Can Be Constructed from Cardboard and a Few Pieces of Wood, Together With a Battery Lamp or Two With the Necessary Receptacles and Wire. Music May Be Introduced from a Phonograph in the Manner Shown.

In the series circuit, as shown in Fig. 1, the current travels thru one lamp, then passes on and thru the second lamp, etc. It is evident in this case that if one of the lamps or sockets becomes defective, the whole series will be affected until a new lamp or socket is substituted.

In the parallel circuit each lamp is connected across two wires of the circuit, all in parallel with each other, like the rungs of a ladder. With the parallel-fed circuit, one lamp becoming defective will not interfere with the lighting of the others. For low-voltage dynamos and battery-current supply, parallel lamp circuits for Christmas tree circuits are invariably used, the full voltage required for the whole circuit in this case being that required for one lamp with a slight excess in the circuit conductors, and the current in amperes necessary is computed by multiplying that required for one lamp by the number of lamps connected in parallel.

For 110-volt A.C. or D.C. circuits the *series* lamp festoons are invariably used. Eight 14-volt lamps connected in series are equivalent to 112 volts, and this is a common arrangement of the 110-volt festoon. The voltage of each lamp in this case is determined by dividing the 110 volts by the number of lamps. The 14-volt lamp is used because it is a standard type. In some cases those who own an automobile remove the storage battery, or else run wires from it into the house and operate the lights on the Christmas tree from it. In other cases a small water turbine fitted to a spigot drives a low-voltage dynamo, say one rated to give 4 to 8 amperes at 6 to 8 volts.

An Electrically Lighted Church for a Miniature Christmas Village

One of the most common decorations used by the Christmas tree decorator is of course the *toy electric railway*. This is operated either from dry or storage batteries or else from the 110-volt A.C. or D.C. lighting circuit, thru the agency of a step-down transformer or rheostat. As everyone is familiar with the toy electric railway nothing more will be said here with reference to it as complete instructions are available from the makers or the stores selling these railways.

Last year we constructed a very pretty little church, like the one shown at Fig. 2, which was made out of nothing but cardboard and a piece of wood or two, together with the electric lights of course and any other details which the builder may wish to work out.

The dimensions of the small cardboard church shown were approximately 14 inches long by 8 inches wide by 14 inches high. The sides of the building were made of fairly strong cardboard, the windows being laid out and measured off with a rule so as to be evenly spaced, and the complete openings for the windows were cut out with a sharp knife, placing the cardboard on a piece of soft board while doing this.

In this case the windows were covered on the interior with a piece of light pink tissue paper, but blue or any other color may be used, and by using two or three different colors placed across the windows in strips a multi-colored effect will be produced similar to the leaded glass windows of a church. A similar effect can be obtained by using several variously colored electric light bulbs inside the building, and, for those who are ambitious to make the church particularly attractive, these lights can be winked on and off by means of a flasher constructed from a toy motor or an old clock movement rigged up with a commutator and brush as shown in one of the illustrations.

The church as shown may be made with an ordinary steeple on it, inside of which an incandescent lamp of the same size used in illuminating the Christmas tree can be

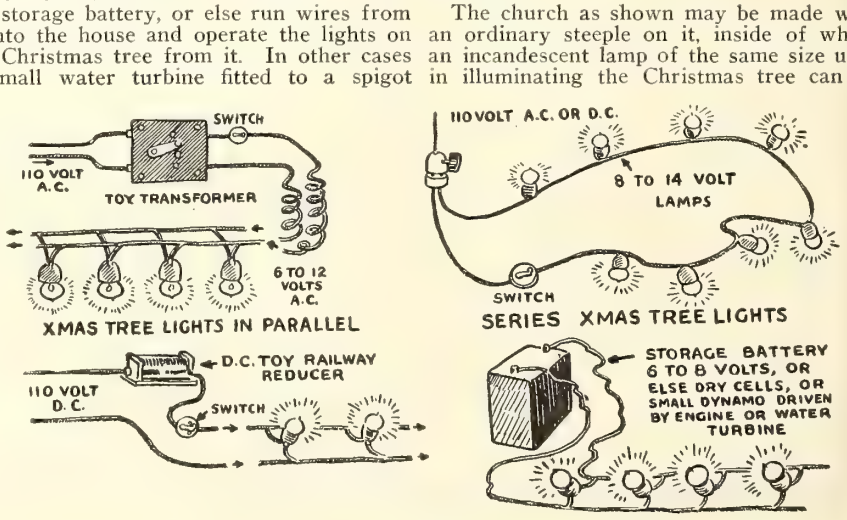


Fig. 1.—Above Shows Series and Parallel Circuit Connections for Christmas Tree Lights; Low-Voltage Lamps for Battery or Other Low-Voltage Current Supply Are Connected in Parallel. Lamps Are Connected in Series to Balance a 110-Volt Circuit.

placed and the outline of a bell can be painted on the tissue paper covering the windows of the steeple. If desired, of course the steeple may be fitted with a pointed spire made of wood or cardboard several inches in height. The church windows may be left plain without any cross-rails, but the cross-rails are easily formed by cutting several strips of heavy paper about ⅛-inch wide and gluing these across the windows over the top of the tissue paper as shown in detail at Fig. 2.

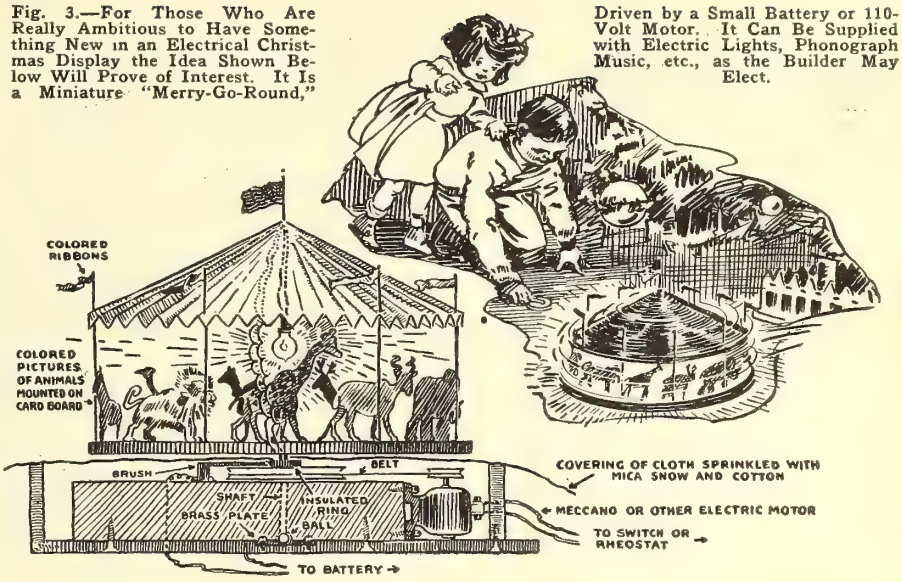
The rest of the details can be easily worked out by the builder as everyone will probably want to make some variations in the style of the building for himself. The outside of the church, particularly the front, may have its appearance or effect greatly enhanced by the application of water color paints, and in the writer's design the front door was boldly painted on in good strong water colors. By using white tissue paper for covering the windows a clever leaded-glass effect may be imitated by the use of water color paints. If the four sides of the church have been completed, they may be tacked to a base of ½-inch or 1-inch board, which is cut to the right size of course, and the cardboard can be held in place with a few small wire clips or pins.

A few small pieces of cotton can be laid out around the church and over the top, a little artificial snow (powdered mica) thrown over the building and also some cotton. In making these Christmas tree decorations, while constructing the village scene and in arranging the base of the tree we covered up the intervening space between buildings, railways, etc., with a piece of cloth. This may be of any color desired, but a white sheet is about as good as anything. This is then covered with pieces of cotton here and there, and then the whole scene sprinkled with some artificial snow.

In the illustration showing details of the miniature church it will be seen how a small phonograph which may be placed in a sound-proof box fitted with suitable cover is used to provide music and instead of being allowed to come from the phonograph directly, it is conducted thru a rubber tube passing thru a hole in the wooden base of the church. In this way the music will seem to come from inside the church.

If you possess a toy music box which toy shops sell for a small sum, this can be rigged up with an electric motor and played whenever desired inside the church by a suitable switch placed on the exterior.

Fig. 3.—For Those Who Are Really Ambitious to Have Something New in an Electrical Christmas Display the Idea Shown Below Will Prove of Interest. It Is a Miniature "Merry-Go-Round," Driven by a Small Battery or 110-Volt Motor. It Can Be Supplied with Electric Lights, Phonograph Music, etc., as the Builder May Elect.



An Electric Carousel

Something new for the home Christmas tree scenic artists is shown at Fig. 3—a real, live, electric carousel. With a little ingenuity and patience this can be made quite a realistic affair and one that will be enjoyed by everyone from little baby to grandad.

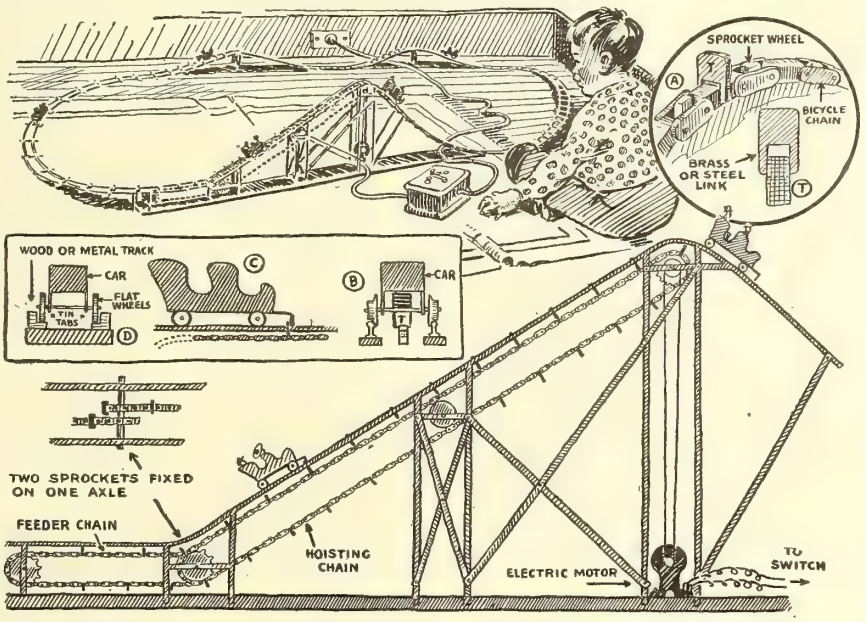
One of the first things which will make this a howling success will be to endeavor to fit either behind the carousel or on it, if possible, a small music box or toy organ; or again, a small phonograph (under the display) and rig this up so as to be operated when desired in connection with the revolving carousel.

Little need be said in connection with the building of the carousel, except of course it should not be made too heavy or clumsy for the size of motor one has at hand. The motor should be mounted vertically if it will run well in that position; but if not, it can be placed with its shaft in a horizontal position and the belt simply given a one-quarter twist as it passes around the pulley groove in the base of the carousel.

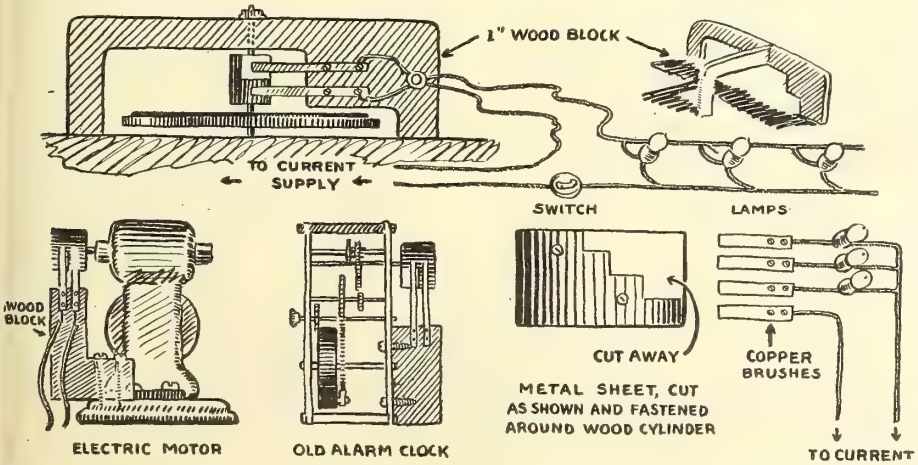
A great part of the friction on the steel shaft supporting the carousel can be mitigated by placing it upon a large ball-bearing. A brass or iron plate should be under the hole, which is drilled in a piece of plank or board, thus forming the bed of the display, on which the ball may rest. The hole supporting the merry-go-round shaft may be a suitable size hole drilled into the wood base supporting the affair. It should be liberally lubricated with vaseline and a little oil applied now and then.

The outfit may or may not be fitted with an electric light, as the builder may elect; if an electric battery light is fitted inside the carousel, it can be supplied with current thru an insulated brush and a metal ring mounted on a piece of wood or fiber fastened to the shaft and rotating with it, as indicated, the other side of the circuit being formed thru the shaft and bearing of the turn-table.

(*Continued on page* 904)



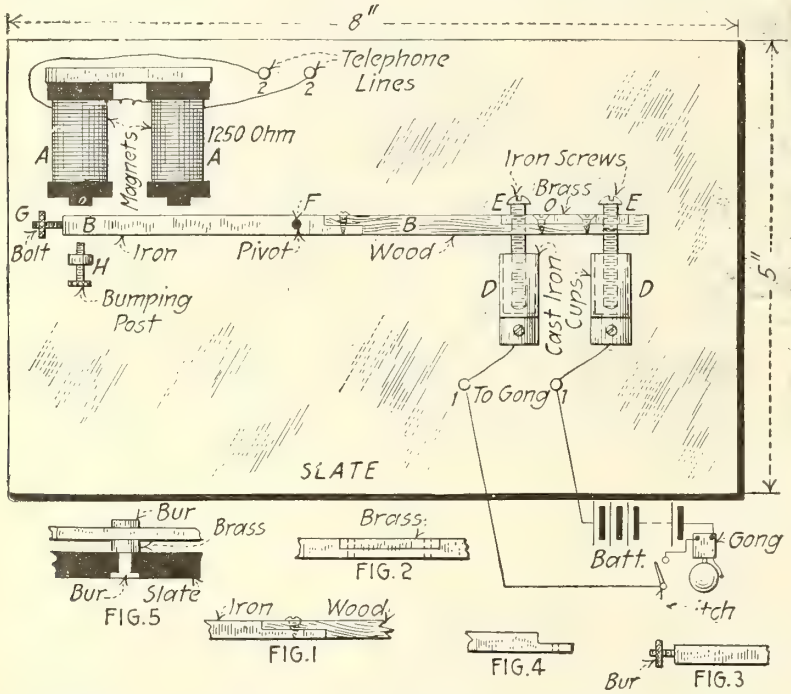
And Here We Have a Toy Scenic Railway Which Can Be Built by Anyone Handy with Tools and With a Fair Idea of Mechanics. Instead of the Bicycle Chain a Flat Belt May Be Used With Studs Secured to It for Hauling the Cars Up the Grade. Fig. 4.



An Interrupter or Flasher for Christmas Tree Lights May Be Constructed in Several Ways, as Here Shown. It May Comprise a Segmental Drum, Rotated by a Phonograph Motor, by a Battery Motor, or Again by an Old Alarm Clock. Fig. 5.

Telephone Ringing Relay

I give herewith a drawing of a very good telephone relay which I have found to work successfully. The magnets A are of 1,250 ohms which are fastened to a slate (fiber O.K.) base. The rod B is eight inches long and is made of iron and fiber as shown in drawing The cups D, D, are made of cast iron or steel and are filled with mercury. The screws E, E, are of iron and are screwed thru the rod into the mercury cups. The piece of brass, O, is put in the fiber as shown in Fig. 2 so as to close the circuit in the two screws E, E. The pivot F is made of brass as shown in Fig. 5. The stop post, h, is a piece of brass with a screw that can be adjusted so as to stop the length of the stroke of the rod.



Frequently it Is Desired to Ring a Good-Sized Extension Bell Whenever Your Telephone Signal Rings. The Best Way to Do This Is to Use a Telephone Relay, Which Closes the Local Battery and Bell Circuit, and Instructions For Building Such a Relay Are Illustrated Herewith.

On the end of the iron part of the rod make some threads for a large burr as shown in Fig. 3, to be used for a weight-adjusting screw or counter-balance. The figures 2, 2, go to the telephone line, figures 1, 1, go to the bell or gong. Fig. 1 shows how the iron and fiber are fastened together. Fig. 4 shows how the cast iron cups are made. When the current enters the magnets, A, it pulls the rod B, which dips the screws E, E, into the mercury and closes the gong battery circuit.

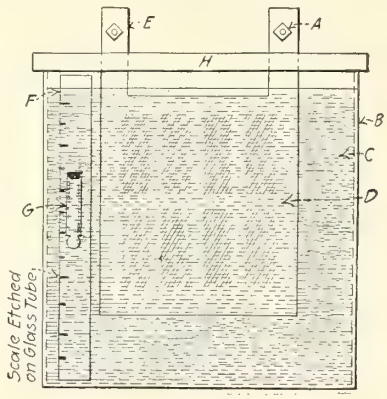
It will be found best to make a small metal or wooden cover to fit over the relay so as to keep it free from dust, particularly on account of the mercury switch. The electro-magnets used for operating this relay can often be procured from a discarded polarized telephone ringer, and it will save you the trouble of building the iron frame and cores and the winding of the magnets. In checking up the resistance of the magnet coils, this may be done with the aid of a Wheatstone bridge, or else if you have a voltmeter and ammeter handy, you can measure the resistance.

Contributed by SHERMAN HEALD.

Automatic Indicator for Storage Cells

Having use for an accurate, inexpensive and entirely automatic device to indicate the chemical and electrical condition of the storage cell, I constructed the following device.

A glass tube (F) see drawing, just long enough to rest on bottom of glass jar of cell (B) and allow top (H) of cell to fit tightly, was placed inside of the storage cell vertically between the plates (D) and jar. Contained in the tube is a small glass tube, having one end closed in a gas flame, the other end being closed by a paraffined cork of such a diameter that it is free to move up and down in the containing cylinder.



The inner tube is regulated by placing lead filings (or small buck shot) inside so that it rises or sinks according to the strength of the electrolyte and whether the cell is charged or not. To make the device more accurate a scale may be scratched with a glass cutter, carborundum, a diamond, or else etched with hydrofluorspar on the outer tube.

In concluding I would like to add that I have used the device in my laboratory with entire success and have found that when the battery consists of a number of similar cells only one of these devices is needed.

Contributed by
WITOLD DE ZYCHLINSKI.

Experimental Arc-Light

I herewith present a description and drawing of an experimental arc-light which I have constructed with my Meccano outfit. It is very simple and works nicely.

The carbons are held in place by double-bent strips (A) and nuts and bolts (B). The movable carbon is on a car or carriage (C) which runs on a track (D) 2½ inches wide and 12½ inches long. It is moved by chain (E) which passes over wheel (F) and back to gear box (G) and is moved by crank handle (H). By moving the handle the carbon is moved slowly and enables you to keep the light steady. On the crank-handle is a brake or pawl (I).

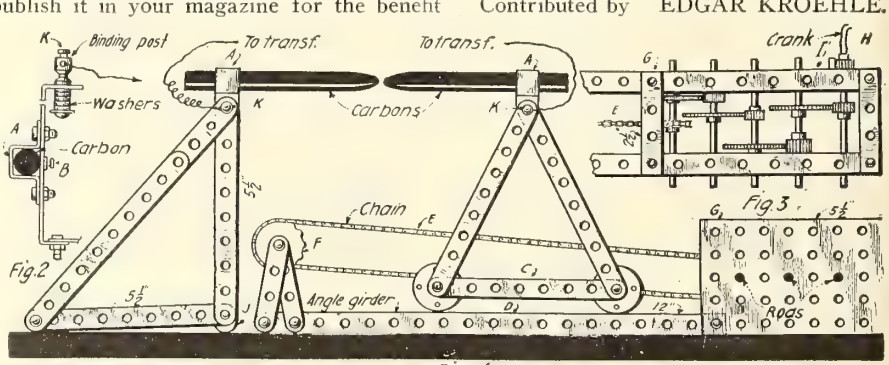
The drawing shows the gears clearly.

The stationary carbon is raised to the level of the movable carbon by angle-bracket (J). The wires are connected to the frames by binding posts (K) and are separated by space (L).

I have had good success with this light and run it on my toy transformer, at twenty-six volts. When finished I screwed it on a board. I am a subscriber to your magazine, which I like very much, and trust you will publish it in your magazine for the benefit of other interested electrical experimenters.

I will send you a photograph of my model as soon as I get it printed and developed.

Contributed by EDGAR KROEHLE.



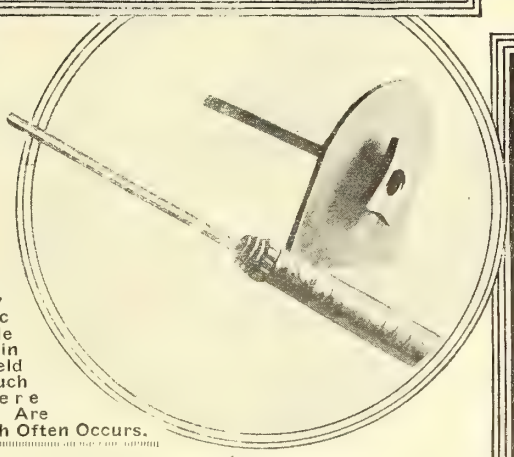
A Clever Experimental Arc Light Built From Meccano Toy Parts. The Arc Light Was Successfully Operated From a Toy Transformer on 26 Volts.

Electric Arc Welding Electrode

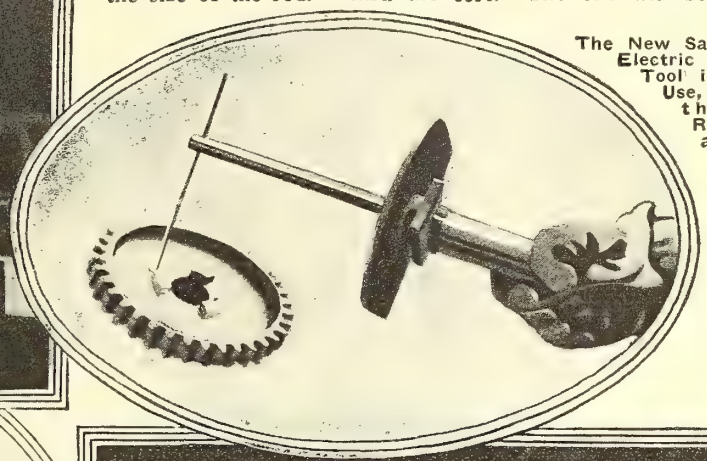
By E. W. DONALDSON



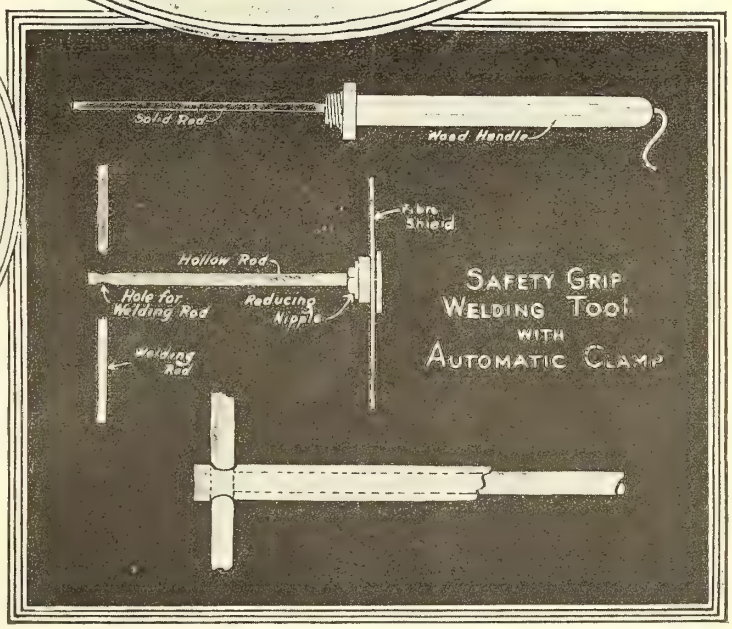
Photo Above Shows Operative Electrically Welding Steel Parts Together at a Temperature of 3,500 Degrees Centigrade, Equivalent to That of the Oxy-Acetylene Flame.



This Shows the Parts of the New Electric Arc Welding Electrode Here Described in Detail. The Shield May Be Made Much Larger Where Heavy Currents Are to Be Used, Which Often Occurs.



The New Safety Grip Electric Welding Tool in Actual Use, Showing the Fine Rigidity and Balance of the Tool.



Drawing at Right Shows the Working Details of the Safety Grip Electric Welding Tool, with Automatic Clamp, as Built and Used by the Author with Success.

All materials used in constructing the arc welding clamp illustrated were odds and ends around the machine shop where the device is used. The first contrivance was merely a spring clip, which would often slip and was hard to adjust. The idea of improvement produced a somewhat better and safer handle which was developt by degrees into the one here shown, which is a time-saver and easy to operate.

The outer hollow tube encloses a solid rod which comes flush with the hole in the end of the rod. A slight twist of the handle threads the solid rod up tight against the welding metal rod, which is threaded thru the hole. Several sizes of welding rods may be used as the clamp engages regardless of the size of the rod. a hollow core is attached to the end of the welder, allowing the welding rod to pass thru the core. The coil will be a short

The fiber shield cuts off some of the glare and flying particles as well as acting as an insulating stand when laying the handle aside.

The designers of this tool are working up an idea in which a magnetized coil with distance above the job when working, so that the operation takes place within the magnetic field. With adjustments to the current the spread of the arc may be cut down to a point eliminating much of the glare, and permitting greater accuracy by the operator.

Saving Battery Expense

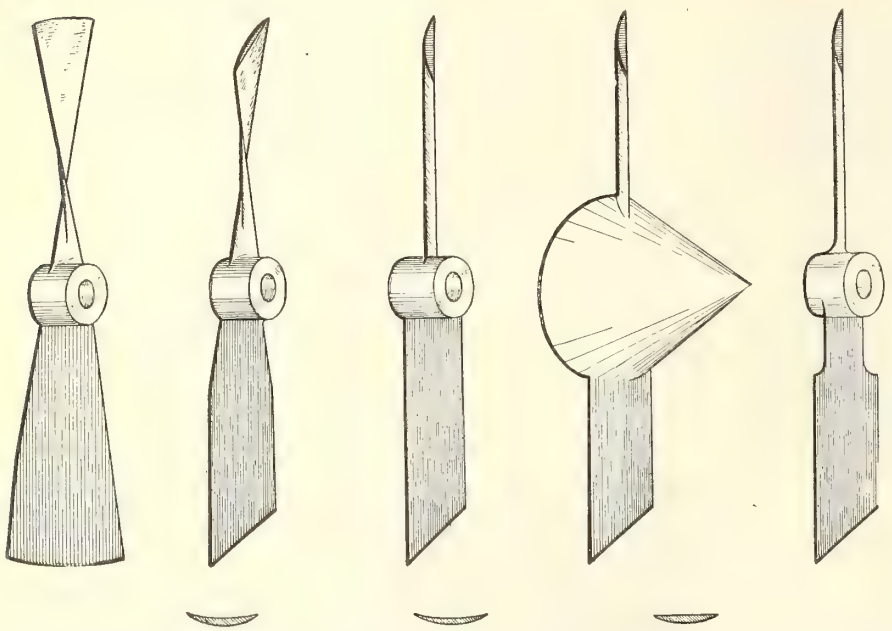
Some years ago, the writer was sent out on a hurry call to repair the call-bell system in a nearby small manufacturing establishment. On arriving at the plant, I found it to consist of two rooms, one of which served as office and shipping-room while the other served as the work-room or shop. Upon making myself known to the "boss", he showed me a simple return-call bell system between the office and the shop, all the while excitedly explaining that they had worked perfectly the day before, but which showed no signs of life at that moment. Fastened to the side of his desk was a highly polished nickel-plated buzzer and a very fancy brass push-button. Being handy to them I was tempted to pry off the cover of the buzzer and started to do so. It was a tight one, for it took two or three minutes before it popt off. With the cover off—I found the "works" of the buzzer practically "burned out". Everything was charred and blackened, all insulation having entirely disappeared. Having received a secret clue to the trouble I removed the top of the push-button and found the contacts frozen together so hard as to make it almost impossible to pry them apart. This proved the clue that I had already found. Going out into the shop and examining the bell and button on that end, I found the same results. My mind was now made up and I set out to find the place where the bell system had gotten mixed with the lighting lines. Happening to look up over a work-bench I saw a box containing three dry cells. A drop light with several feet of extra cord hung down in front of this box and the extra wire was neatly coiled on top of the cells. Climbing up on to the bench I made a close examination, and found the cord to be bare of insulation in a number of places—which gave it the appearance of having been dragged over something rough. Without disturbing it, I made an investigation of the battery binding posts and found them to be in contact with the lamp cord at two of the bare places. Of course, they were opposite sides of the circuit.

After having made this discovery, I called the "boss" and explained the whys and wherefors. I had to explain to him also why a common bell or buzzer would not operate for any length of time on a 110-volt system. It is needless of course to say that the lighting circuit was out of commission and had to be "re-fused." New apparatus was installed in place of the burned out material and the system put into operating condition again. When I reported the affair to the "Old Man" he figured it out as a fine joke and made out his bill accordingly—which was, by the way promptly paid.

Contributed by W. F. PERRY.

For Better Fans and Air Propellers

By H. M. DECKER



The Author's Experiments with Various Forms of Propeller Blades Intended for Use as Fans or Airplane Propellers, Either for Models or Commercial Machines, Are Outlined in the Drawings Above. The Author Suggests That to Get More "Push" Out of an Airplane Engine, Longer Blades Which Are Out Further from the Shaft and Act on a Larger Weight of Air, Should Be Used. This Will Reduce Propeller "Slip," the Common Source of Loss.

THE propeller uses the reaction of the air that it sends astern to move the airship ahead. The propeller thrust that drives the airplane is obtained by forcing a column of air tailward. For a given diameter that propeller is the best that gets the most *push* out of its engine. Likewise, with a given size of electric motor and fan guard the best fan turns out the greatest bulk of air. It gets the most push out of its motor which you feel as breeze.

Within the limits of my experiments to date, the simple form described in this article proved to be the most efficient. It is true it is not scientific and involved in appearance, but it is there with the performance.

The kind of blades tested had flat, true-screw and increase pitch or hollow driving faces of different widths.

Measurements were made on the shaft of an electric motor, of the power used, the air reaction or the thrust from the blades to the shaft, and the pressure on a large plane surface of the air current generated. Thrust and wind pressure were found to be proportional as would be expected.

Exploring the air movements around the blades while in action proves the air flow to be rotating before it reaches the blades. The air is drawn in from all directions—even radially toward the tips—crossing the blades diagonally and leaves in a stream that shows a maximum contraction at one or two diameters distance. All of which is like the flow of water from an orifice. An orifice located at the trailing edge of the blades would represent it.

A return eddy or whirl is created around the air column close to the blade tips. This eddy is reduced by cutting the blade tips off diagonally with a marked gain in efficiency.

The most efficient blades were those that imparted the least rotation to the air, and the worst were those that caused most twisting opposite the hub.

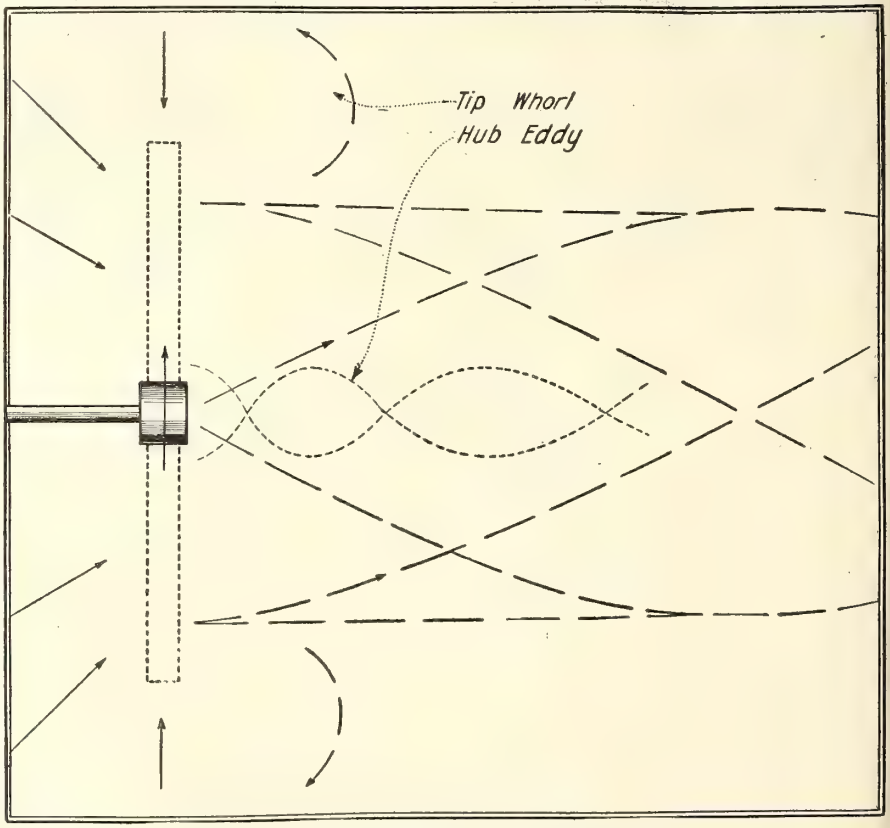
Most of my fans were made of wood and fined and trimmed to get the best form for that type of face. In all cases a two-bladed fan, with the width of each blade equal to about one-ninth the diameter, gave the best results. And, when the blades were cut away for about one-third their length from the center of the hub so as to look like paddles on flattened spokes, there was a small further gain.

Use only two blades when the blade angle is less than 30°, and make the blades flat-faced with the angle the same from the hub out, the width of each blade to be one-ninth of the diameter, the ends to be cut off diagonally, about 45°, so that the leading edges are longer than the trailing edges. Make the blades as thin as practicable and round off the back of wood or cast metal blades to meet the driving face in sharp edges.

If you want to get more *push* out of your airplane engine, try longer blades that reach out further from the shaft and act on a larger weight of air. This will reduce *propeller slip*, which is a common source of loss and waste power. But, if you are limited in diameter, the flat-faced design advocated here will give better results than any you have had and allow a "stick" to be made of one piece of wood.

Ventilating fans are fashionably designed with six or more curiously shaped blades. It takes power to cut the air up like that. Try results in your ventilator with a simple, two-bladed propeller, as described here, easily made of hard wood. It should be enough larger than the casing to bring the shorter following edges of the blades just in the opening. You will get more air, less noise and lower power bills.

If you want to get more breeze from your 16-inch electric fan, take off all but two opposite blades, trim the two remaining ones to a width of one and three-fourths inches, and cut off the blade ends diagonally to an angle of 45°, so that the leading edges are longer. Flatten the blades—that is, hammer out the dishing—and set them to the same angle. The fan will now run faster, propel more air, and use less electric current. Or set the two trimmed blades to a greater angle—say five degrees more, and you may get twice the air for the original consumption.



Analytic Diagram Showing Direction and Scope of Various Air Currents, Including the "Tip Whorl" and "Hub Eddy" for Rotating Propeller Blade. Much Can Be Gained by a Little Study of the Science of Air Propellers, Whether for Fan Blades or for Airplanes, as There Is Entirely Too Much Waste at the Present Time in Both of These Types of Propellers.

Building Machines Accurately

By EARLE W. GAGE

How the Micrometer, Snap Gage and Scleroscope Pave the Way

WHEN we are told to do or make things *accurately*, we cannot hope to know what the real meaning of the word accuracy is, as used in the great machine world, which converts raw steel into everything from automobiles, tractors, threshing machines, down to the finest instruments used in the medical field.

Let us say that two crankshafts are delivered to the inspection department of a machine shop of a modern American factory. To all appearances they are as near alike as the proverbial two peas in a pod. Ordinary standards of measurement reveal not the slightest difference between the two shafts. But when they come from the inspection department one is tagged "O. K.," the other is marked "Rejected." The one, measuring up to the exacting standards of perfection, is past on to form a part in the construction of an automobile or tractor—the other, varying from the first in degree of hardness that can be detected only by wonderfully accurate tests, or varying in measurement a fraction of the thickness of a human hair, is scrapt—barred from ever taking a useful part in this busy world of affairs, fit only for the scrap-heap.

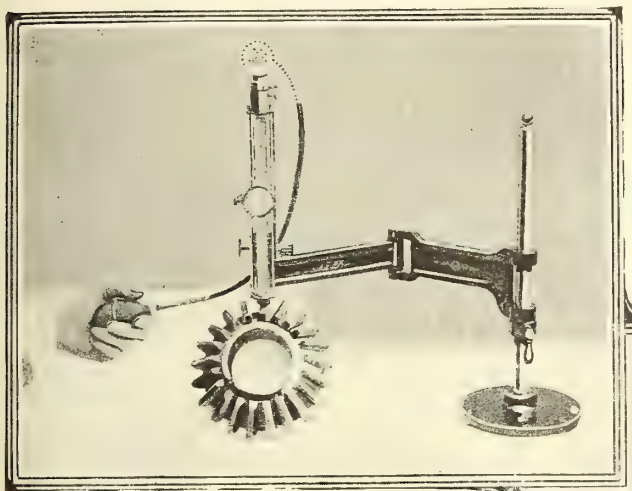
WHY ACCURACY IS ESSENTIAL IN MACHINERY.

Why all this accuracy? Why such rigid standards of inspection? To produce a tractor, let us say, that will give maximum service, longest life, freedom from breakage and delays. Almost any tractor will give fairly good service for a few months, or a year. But the tractor that is built to the highest standards will give the same satisfactory service year after year. It costs more to build these machines, but the time has come when Americans are willing to pay for the better-built machine. And another advantage of accuracy in manufacturing is that it effects *standardization*, which enables owners of the machines to secure new parts when needed that will accurately replace the original parts of the machine.

Making parts to a standard does not mean that all parts are made to a hair-breadth exactness. One fact must first be recognized—that perfection in the eyes of the scientist is impossible. Take, for example, the piston of a gasoline motor. The design requires that this shall be of a certain diameter. The cylinder, too, must have a certain bore, and the dimensions of cylinder and piston shall allow sufficient *clearance* to permit the maintenance of an oil film between the two. But to make the piston the exact dimension called for is impossible, and to make a second piston exactly like the first is likewise impossible. Measure the two with a rule and they show no difference. But that is far too crude a method for even the roughest workman. Measure them with calipers—still no difference; but even calipers, long recognized as the standard of the machine world, are today far too crude for the careful machinist. Measure them with a micrometer that shows differences to thousandths of an inch; but even that is too crude for the scientist. Even after the possibilities of the most accurate measuring tools are exhausted he will still insist that if more accurate measurements were possible they would show differences. So that machinists and scientists both agree that, to make a certain part like another, is and probably always will remain an impossible attainment.

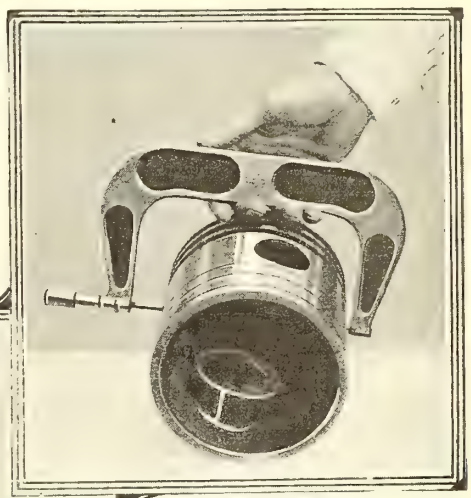
Every part may vary from the set size, yet some vary more than others. Take, for example, a stove lid. If you break one you can get another to take its place. It may be as much as an eighth or a quarter of an inch larger or smaller, yet it serves all practical purposes. To make stove lids within a thousandth of an inch of a standard would be more costly, and no useful purpose would be served. But to permit an eighth of an inch variation in the size of a piston would be a serious error. The designer of a motor knows that to permit too wide variations from the standard results in a motor in which the parts are poorly fitted, causing excessive wear, vibration and strain, breakage, undue oil and fuel consumption, and other evils. Carrying the accuracy too far, however, means striving for an end that is practically unattainable as well as needless. But in the design of such machines as tractors and motor cars, accuracy is carried at present to the farthest practicable limits,

(*Continued on page* 926)



The Machine Shown Above Is Known as the "Scleroscope" and Is Used for Testing the Hardness of Steel or Other Metals by the Degree of Rebound of a Tiny Ball of Metal. This Ball Is Dropt from a Fixt Height to the Surface of the Metal, Rebounding Within a Glass Tube on Which Graduations Are Marked, the Reading Being Observed Thru a Magnifying Glass.

Illustration at Right Shows Large Size Micrometer Being Used to Caliper or Measure Accurately in Inches and Thousandths of an Inch, the Diameter of an Automobile Engine Piston. Such Parts Are Usually Ground and Polished on a Grinding Machine to One-thousandth-inch or Finer Precision. Instrument Below Can Be Used for Testing or Measuring in Thousandths of an Inch the Accuracy of Curvature on Round Parts, Etc.



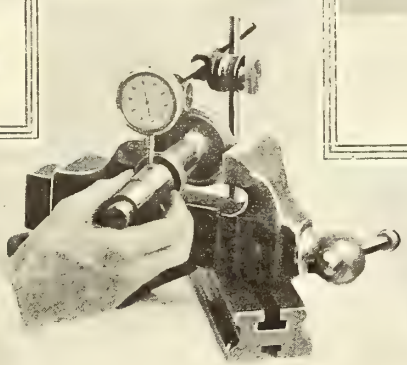
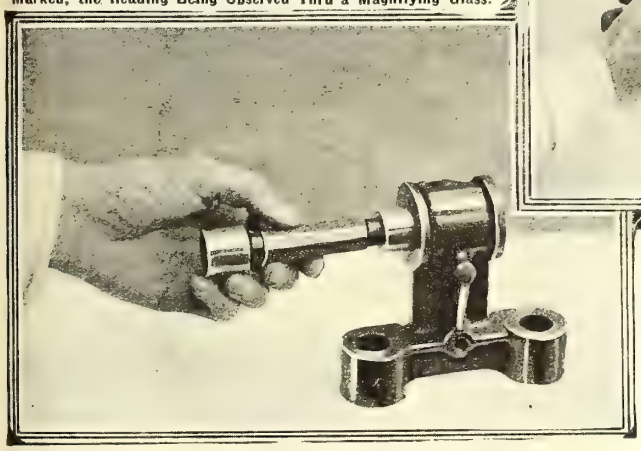
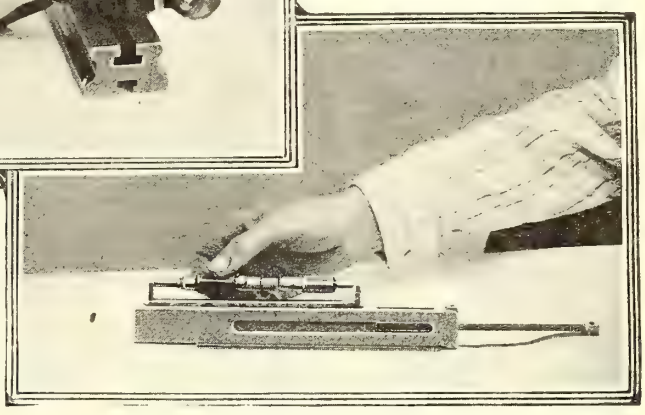


Photo Below Illustrates Tool-maker Using an Internal Micrometer or One Used for Measuring the Distance Between Two Surfaces. Micrometers Are Often Provided with a Vernier Scale so as to Read in Ten-thousandths of an Inch.



A Standard "Plug Gage" Thousands of Which Were Used During the War in Turning Out Standardized Machine Parts Accurately.



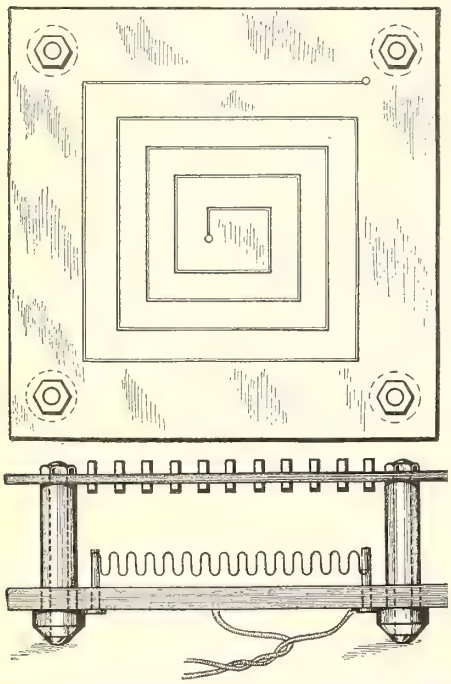
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

A HOME-MADE ELECTRIC HOT-PLATE

Herewith is a diagram showing how I made an electric hot-plate. The heating element is composed of the metal from the stays of a Spirella Corset. Three to four of the stays work best on 110 volts alternating current. The drawing is to scale, the complete hot-plate measuring 8" x 8". The base of the apparatus is made of rigid asbestos shingles. They are easily cut to shape with a hack saw. Any size holes may be made by using metal drills. At each corner of the base is placed a porcelain tube. Thru the tube is a bolt which serves to hold the sheet iron grid in place. The grid is made from sheet iron by cutting slits in the metal and bending these pieces at right angles to the original sheet. This makes a fine support for utensils. The heating element is fastened to nails or rivets which are forced thru holes in the asbestos base.



What Is More Useful Than an Electric "Hot Plate"? Here's How to Make One.

Complete the job with flexible cord and plug.

Contributed by W. W. MONTANO.

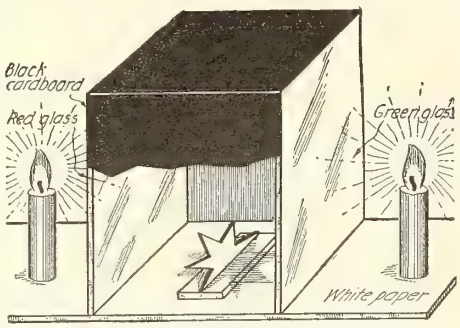
BUILDING ELECTRO-MAGNETS

The magnet core is best made of soft wrought iron or mild machine steel. The outside diameter of the coil should rarely be greater than three times the diameter of the core; in other words, the depth of the coil should be approximately equivalent to the diameter of the iron core. Enameled magnet wire gives the most turns in a given space, single silk-covered wire the next highest number, and double silk next.

SECOND PRIZE, $3.00

MYSTIC-COLORED SHADOW STAR

By means of an interesting experiment it is possible to show that, in certain circumstances, *a colored shadow* can be obtained



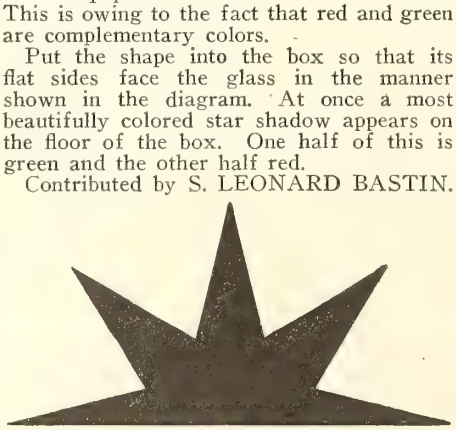
Arrangement of the Apparatus for Producing the Mystic-Colored Shadow Star—an Unusual Experiment.

from an opaque object. In the first place prepare a box formed of two sheets of glass (one red and the other green) and two pieces of black pasteboard. The sides of the box should be rather taller than they are wide and neither a top nor a bottom is required. Where there is any difficulty in getting colored glass plain sheets can be painted with the varnish dyes so widely sold for treating hats, etc. In this way very good colored glass can be prepared in any shade. The box might be of any convenient size; a good measurement for the sides would be about twelve inches wide by fifteen inches high. Now, from another piece of black pasteboard, cut out a shape similar to that shown in the diagram. This, as will be seen, is exactly half of an eight pointed star. The shape is fixt with an adhesive to a small flat piece of pasteboard so that it is held in a vertical position.

Place the box on a sheet of white paper. Then put a lighted candle on either side near to the glass. Extinguish all other lights in the room. Altho the rays of the candles pass thru the colored glass the light on the paper floor of the box is white. This is owing to the fact that red and green are complementary colors.

Put the shape into the box so that its flat sides face the glass in the manner shown in the diagram. At once a most beautifully colored star shadow appears on the floor of the box. One half of this is green and the other half red.

Contributed by S. LEONARD BASTIN.



Star Cut from Cardboard, to Be Mounted in the Center of the Box Shown in the Figure Above.

THIRD PRIZE, $2.00

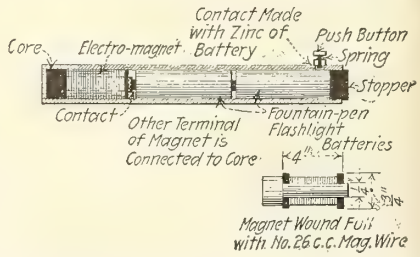
THE "MAGIC WAND"

Herewith is a sketch and description of a "Magic Wand" that will lift light objects and drop them at the command of the performer. But, mind you, this cannot change pictures into real stuff.

A cardboard tube, electro-magnet, two fountain pen flashlight batteries, and a small push button are all that is required. The sketch is so simple that no explanation is necessary for its construction. If you have no electro-magnet a suitable one can be made as detailed in the sketch.

The objects to be lifted must not be heavy, and for cardboard boxes, etc., a small piece of thin tin must be glued on them so as to be attracted by the magnet.

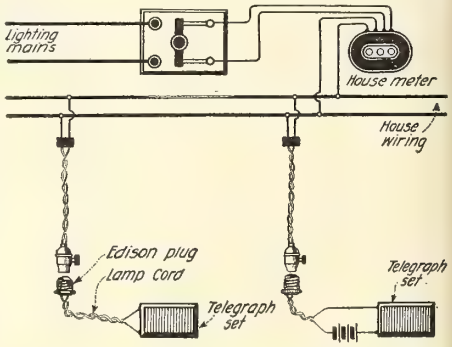
Contributed by GILBERT HENDERSON.



The Magic Wand Here Shown Can Be Built from an Old Electro-Magnet and a Fountain Pen Flashlight Battery.

NOVEL TELEGRAPH LINE

In these expensive times, when Old Man H. C. L. frowns with disfavor upon any attempt to install a telegraph wire line, the



Telegraph Practise Sets Can Be Operated Nicely on Household Lighting Circuits if the Main Switch Is Opened.

following wrinkle may prove of use to the "Bugs" who have more brains than money:

Arrange two telegraph or buzzer sets as shown. Then disconnect the house wiring from the lighting circuit by opening the entrance switch or unscrewing the fuse plugs in the "cut-out." Then you can attach one of the sets to any socket in the house, attach the other set to any other socket in the house, and "get to work!" Practise will have to be confined to the daylight hours, when the lights are not wanted.

Contributed by THOS. C. McVEAGH.

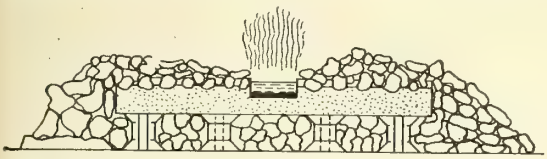


Some Fascinating Experiments in Chemistry

By O. IVAN LEE

How to Make a Witches' Cauldron

Get a tin pie-plate and place it in the middle of the floor on top of half a dozen spools placed under the edge at equal distances. Pour sand or gravel on the pie-plate until about half full, smooth it over somewhat, and in the middle set the top of an empty baking-powder or cocoa can like a little well. Stick a lot of stones and pebbles in the sand and place some bigger stones on the floor around the rim of the pie-tin in order to hide it.



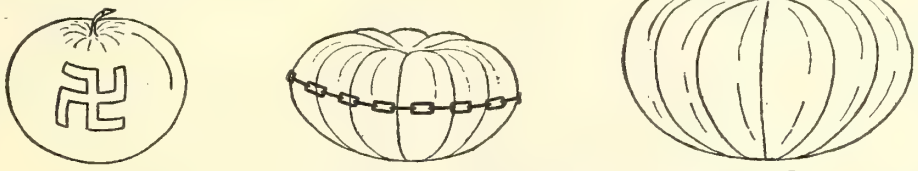
Arrangement for Safety as Well as for Effect in Using the "Witches' Cauldron."

Now pour some *wood* alcohol into the little tin cup an inch below the top, stir in about a teaspoonful of boracic or boric acid (You'll find this powder in the medicine chest). Also add half a teaspoonful of salt to the mixture. Have everyone seated on the floor around the cauldron, put out all the lights and light the alcohol as you would do a lamp or gas light. Don't be afraid, because alcohol never explodes in an open dish; but don't forget that the fire is very hot. The flames will leap up several inches and will be colored a beautiful apple green and bright yellow. The light will make all your friends look so ghastly that you will scarcely know them. It it just the thing for Hallowe'en and ghost stories. There is no smell and only a very little white smoke which is quite harmless, so that the cauldron may be burned indoors without objectionable fumes. For convenience, however, it may be found advisable to erect the whole arrangement on a piece of sheet metal or even a board. One thing must be remembered very carefully, tho: *Never pour any alcohol into the cup while the fire is burning.*

How to Print Pictures on Apples, Tomatoes or Pumpkins.

If possible, select apples growing on the tree and of a variety which is known to be colored (yellow or red) when ripe. Pick out a dozen or so which are easily reached and have developed to full or nearly full size. They must, however, be green, or better, just beginning to show a tinge of color. See that they are smooth and firm, free from worm-holes, and firmly attached by the stem.

Now get some glazed black paper or some of that black paper which comes around camera plates and films, and cut out any silhouette figures which suit your fancy such as a swastika sign, initial letters, etc. If you are ambitious and clever with the scissors, you may even essay dancing figures or something equally artistic. Do not make them too large—an inch and a half in height is about right. Now wipe the fruit with a cloth moistened in a little alcohol, and shellac the cut-out figures firmly and smoothly on the apples, favoring the sides which you think will get the most light. Some care will have to be exercised so as not to break the apples from their stems. When the paper figures are quite dry and show no signs of peeling at any point, go over them once with a light coat of shellac. This will effectually prevent dew or rain soaking the paper off. Little remains but "watchful waiting." Inspect your "prints" every day, repairing any curling which may occur. When the fruit has attained a decided color, pick and soak a few minutes in cold water, sponging off any shellac remaining with a little alcohol. You will find a sharp impression of your paper cut out in green on a yellow or red background as the case may be, the contrast being very striking.



How to Write Your Autograph on Your Fruit—Then You Will Know It.

A Liquid Which Will Dissolve Cotton, Paper or Linen

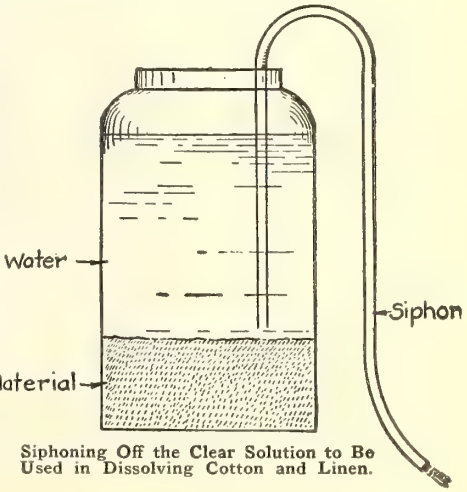
From the druggist or electrician, get three ounces of some of those beautiful blue crystals called Blue Vitriol or Blue Stone. A more correct name is copper sulfate. Dissolve them in about a quart of cold water in a glass jar or vessel—a two quart fruit jar is convenient. Stir with a clean stick from time to time. It may take quite a while, even overnight, before the crystals are all gone, especially if they are large. Meanwhile, in a pint fruit jar, dissolve an ounce of soda lye or potash lye (the kind used for making soap), stirring with another clean stick, and afterwards screw the cover on until the blue solution is ready. Then slowly pour the lye solution into the copper solution, stirring all the while with a stick. A very pretty cloudy light blue substance will immediately be formed and after the lye is all in, will show a tendency gradually to settle down to the bottom of the jar. Enough lye should be added so that no copper sulfate is left to make a more or less clear blue solution above the blue substance.

Now comes a time when you will need the patience of a real chemist. When the blue compound has settled as far as it will go, take off the water above it, either by dipping it off very carefully with a small glass or porcelain cup or better by using a siphon. (It is not advisable to try to pour it off.) For this you need only a rubber tube about eighteen inches long. Fill it *completely* with water, pinch both ends, slip one end into the water in the jar, keep the other below the level of the bottom of the jar, draining into the sink. When you release your fingers, you'll be surprised how easily the water runs up hill and down again. Don't kink the tube; keep the inside end under water, keep the lower (outside) end below the water level. Get off as much water as you can without disturbing the blue sediment, fill the jar with pure water and stir everything up again with the stick. When the blue precipitate has gone to the bottom again, drain off the top water as before, add more fresh water, stir and let settle. Repeat this washing process ten times after you can no longer taste anything in the water above the blue stuff.

Finally, after draining off the water for the last time, add ammonia water* to the blue residue little by little, stirring this time with a long piece of glass. It will slowly dissolve the blue mud and make a beautiful deep saffire blue solution.

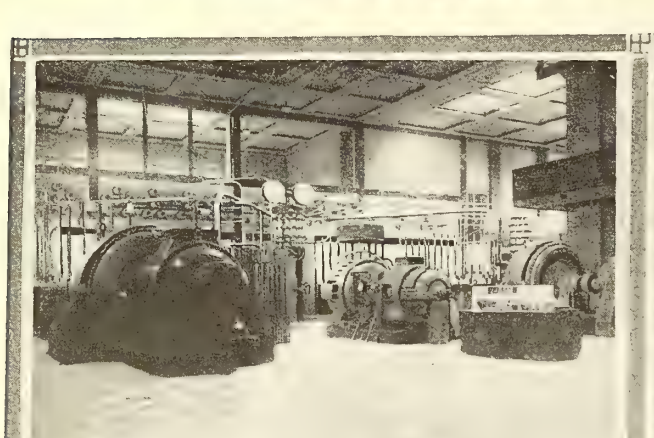
Pour off the deep blue liquid resulting and hold a piece of cotton in it. In a very short time the cotton in the liquid will melt like snow and disappear completely. Now try a piece of unglazed paper. It will dissolve like sugar in hot coffee. After this, try a piece of linen from an old handkerchief or napkin. Presto! and it is gone! But if you put a piece of wool or silk in this wonderful solution, nothing happens, because they are of animal origin and very different chemically from the cotton, paper and linen of the vegetable kingdom.

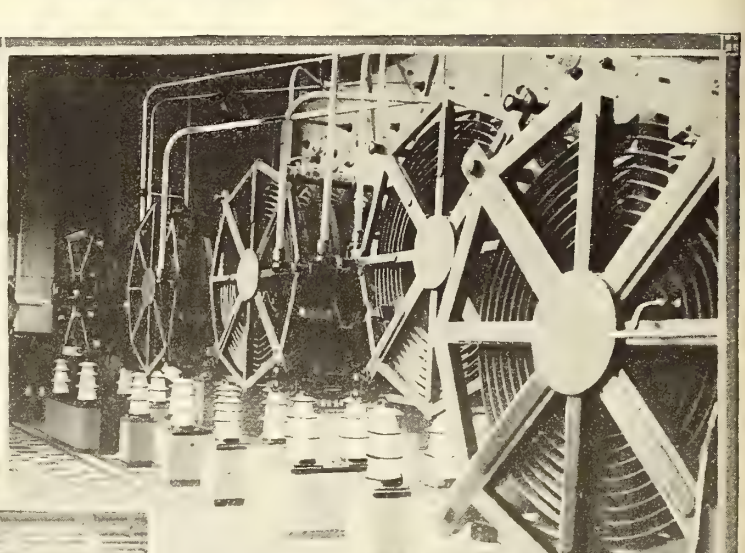
*Household ammonia will do nicely, provided it is pure and clear and hasn't any soap, etc., in it. Anything of this kind can be detected by letting a spoonful of ammonia evaporate in a saucer near the stove. Pure ammonia solution will disappear and leave nothing behind.

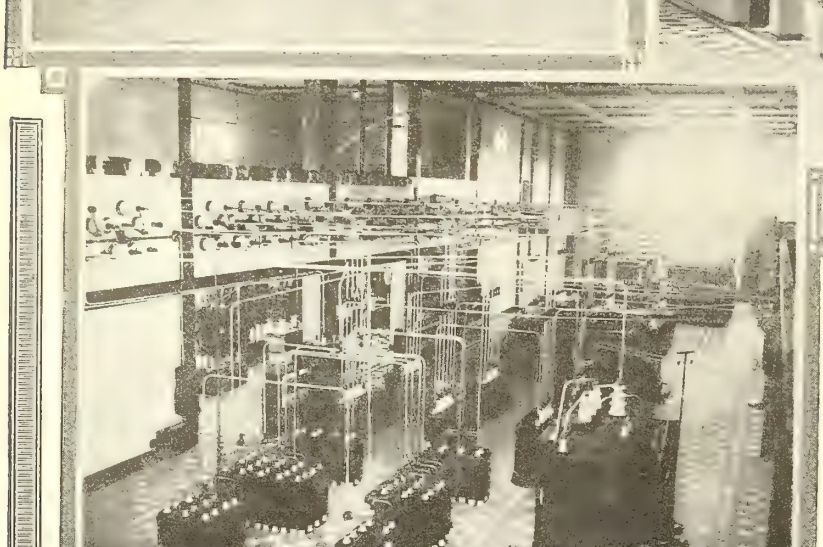


Siphoning Off the Clear Solution to Be Used in Dissolving Cotton and Linen.

The Nauen Radio Station







Upper Left-hand View Shows the High Frequency Dynamos in the Transmission Station at Nauen. It Will Be Noted How Carefully and Artistically the Apparatus Is Laid Out With Inlaid Rubber Floor Mats to Protect the Attachés From Shock When Touching the Machines While in Operation. In the Center of This View Can Be Seen a Centralized Switch for Directing the Energy From Each of the Dynamos to the Condenser and Other Power Rooms.

View Above at Right Shows a Close-up of Some of the Inductance Coils Used in Tuning the Powerful Transmitter at the Nauen Station. Note How the Inductance Spirals, Composed of Flat Copper Ribbon, Are Rigidly Mounted on Insulating Frames, Which Are in Turn Carefully Supported and Insulated on Porcelain Petticoat Insulators.

View at Left Gives Some Idea of the Extreme Care With Which the High Tension Bus-bars in the High Tension Transmitting Condenser Room Are Arranged. The Condenser Plates Are Immersed in Oil in Steel Cases.

IN a recent article describing the great Nauen wireless installation, a German journalist says: "Lessing has asserted that to him it seems the greatest of wonders that true wonders become everyday affairs to us and that they have to become such."

Nauen, he says, was *once* a wonder; now it is a telegraph station. It communicates with the other great stations of the world and is now in public service, undertaking to telegraph or transmit messages in the order in which they are received. Its construction dates back to 1906, when the original building with an experimental outfit was erected, and it is said that in those days the ear drums of the operators suffered more than did the ether on account of the piercing noise produced at each make and break of the key.

At present it is claimed that the great building no longer covers anything experimental. It no longer shelters a laboratory, but covers a perfected apparatus for producing ether waves.

The president of the German republic sent out a wireless message, directed "An Alle," which means "to all." Two hours past and answers came in from all over the world—Rio de Janiero, Pekin, Shanghai, Santiago in Chili, Java and from any number of nearer stations.

The question is then asked by the writer: "Is *that* a wonder?" and he illuminatingly adds that for Nauen it is no wonder, for such is only its daily work.

Nauen has to take care of 10,000 wireless messages monthly.

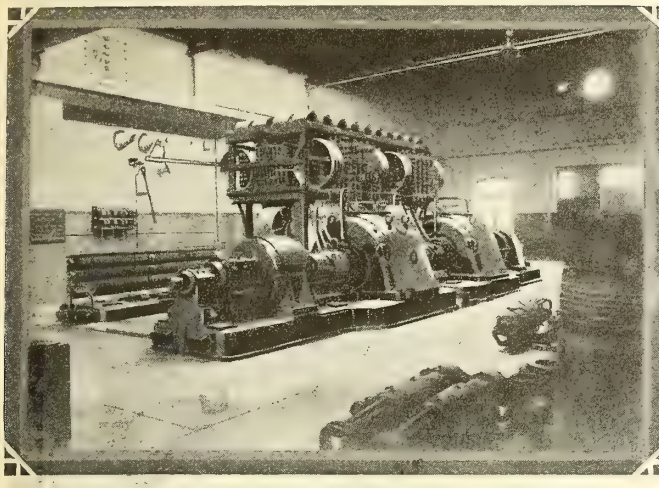
The great Nauen station was officially dedicated on September 29 in the presence of a distinguished company of engineers and government representatives, among whom was Mr. Ellis Loring Dresel, United States Commissioner to Berlin. The company present included members of the American Commission as well as representatives of several other countries and newspaper reporters from American and German journals.

The President of the German republic, Ebert, who spoke at the official opening and dedication of the Nauen station, highly commended the builders of the station on their skill and ingenuity. The design of the plant involves some of the very latest features in European radio developments. The mast and aerial, which are used to communicate with the Americas and which have just been completed, are claimed to have a range of 12,000 miles and a transmission speed of seventy-five words per minute.

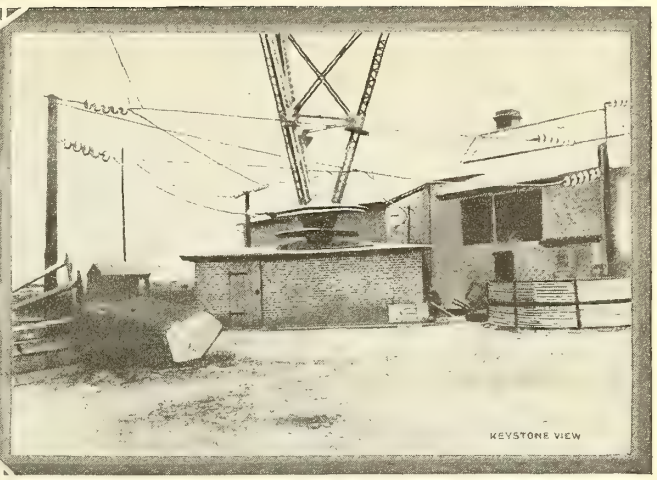
A remarkable and interesting feat was the official opening of radio communication between Buenos Aires, South America, which was inaugurated with the transmission of a message from the Nauen station, addrest to President Irigoyen.

The three accompanying views of the famous Nauen station gives some idea of the magnitude of the high-power radio apparatus in use. The upper left-hand view shows the high frequency dynamos in the transmission power room. It is interesting to note how carefully and accurately all of the apparatus is arranged—whether it be condensers, inductances or the dynamos themselves. From the inlaid rubber-covered floor to the panelled ceiling above, everything is well taken care of both artistically as well as mechanically and electrically. The rubber-covered floor is quite essential to safeguard station operatives from receiving severe shocks when touching some of the machinery which may be highly charged.

An excellent specimen of high tension wiring is that shown in the lower view.



View of Radio-Frequency Room at Eilvese Station, Germany.



The Base of the Aerial Mast is Placed on a Gigantic Insulator.

Eilvese Radio Station

THE accompanying two photographs show an interior as well as an exterior view of the powerful German radio station at Eilvese, near Hanover. The exterior view shows the foot of the steel mast which is arranged to rest with its triangular point on a gigantic insulator. In most of the stations having an aerial mast constructed on this principle, the steel mast itself is used as part of the antennæ, which is permissible as will be seen by the fact that it is insulated from the ground, owing to its peculiar construction as just explained.

Practically all large stations such as this one, use a ground in the form of a counterpoise, which comprises a series of copper wires, connected like the spokes of a wheel, directly under the aerial and covering a similar area of ground. These wires are all connected together at the center, which is usually at a point directly under the radio station building, and which central connection is used as a ground terminal. The wires are invariably buried a foot or two in the ground and care is taken to secure damp soil and if dry, it is soaked with water daily.

The interior station view is an interesting one as it shows the remarkable care with which the machines have been arranged—the generators shown are radio frequency alternators of the type devised by Prof. Goldschmidt. The Goldschmidt alternator has met with great respect on the part of radio experts in Europe, but it has given way to a much simpler and more easily built machine known as the Alexanderson alternator in this country.

The difficulties met with in operating the Goldschmidt alternator, which produces a very high frequency current of 50,000 cycles per second or more, are principally the very high speed at which it is operated—and particularly the extremely small clearance between the rotor and the stator, which means that the rotor has to be very accurately mounted and balanced on its shaft so as not to hit the field and destroy or injure the machine as it rotates. The American naval experts at the Tuckerton, N. J., station during the war, found that it was quite difficult to keep the machine in perfect tune, owing to slight yet readily perceptible changes in the speed, and the corresponding changes required in the tuning condensers and other apparatus with which the Goldschmidt alternator is equipt.

The Goldschmidt machine as it was built in the German factory is a very fine piece of workmanship. In fact, it was said at the time when the first machines were turned out, that they marked a new exactitude in machine construction. The clearance between the rotor and the stator was so slight that a piece of ordinary writing-paper could just be placed between the rotating and fixed members.

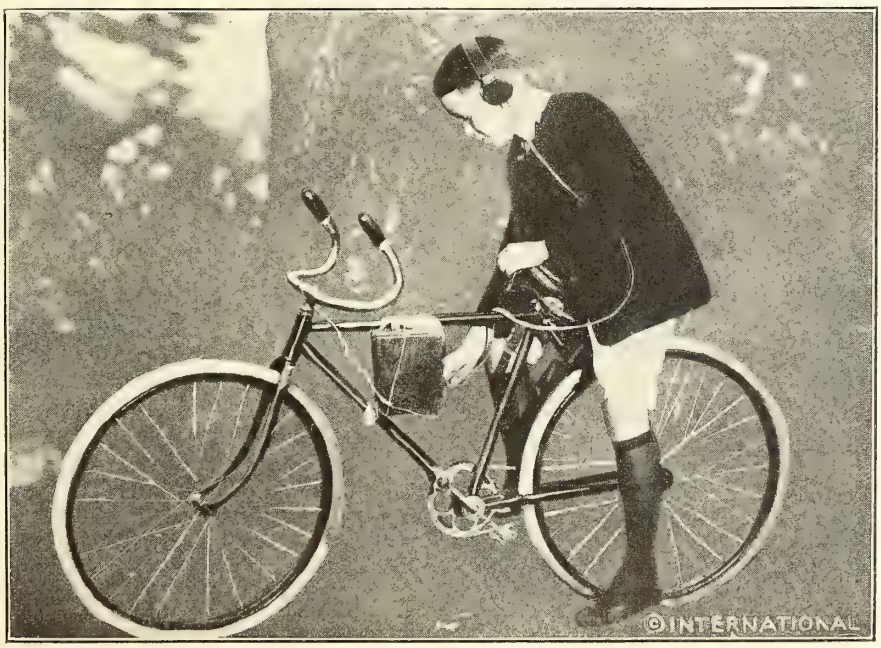
Some idea of the ingenuity and skill exercised in building one of these machines can be imagined when it is realized that the rotating member weighs several tons, and rotates at several thousand revolutions per minute. A good illustration is to imagine a machine almost as intricate as a fine watch, with its rotating parts magnified 10,000 times in mass.

Secretary Baker's Son a Radio Enthusiast

The accompanying photograph shows Jack Baker, only son of Secretary of War and Mrs. Baker, with his radio-equipt bicycle.

Master Baker has a radio outfit placed on his "bike," and while riding about Washington he receives messages from Arlington and other radio stations. He recently stated that he intends rigging up a transmitting set so that he can communicate with his home while riding about town.

Automobile and bicycle radio stations have slowly but surely come more to the front in the past few years than was ever thought possible by the early workers in radio telegraphy, which is due of course to the greatly improved detail in the apparatus, and particularly to the rapid strides made in the development of the vacuum tube. Today it is possible to procure a vacuum tube having a pedigree as long as your arm, and for special compact radio sets, either transmitting or receiving, there are available vacuum tubes as small as one-half inch in diameter by one and one-quarter inch in length.

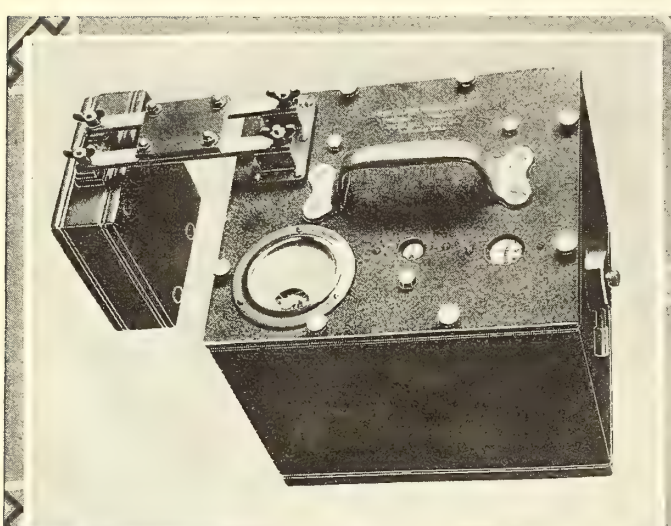


Youthful Son of Secretary of War Baker, With His Bicycle Radio Set.

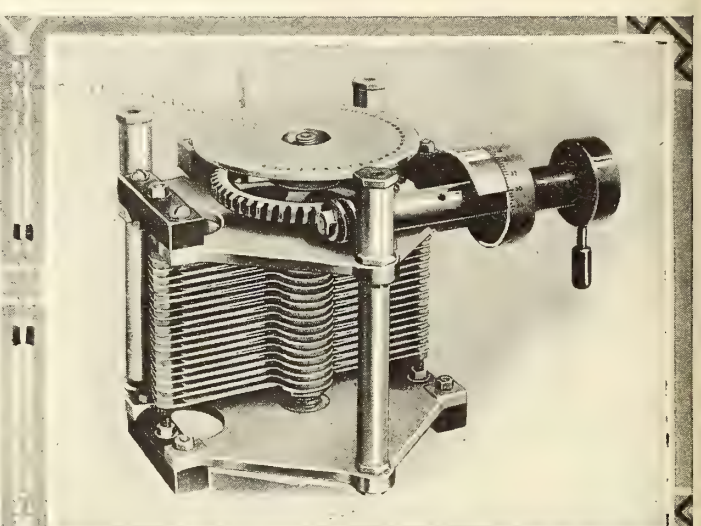
Some few years ago radio experimenters endeavored to put transmitting sets on their bicycles or automobiles, but they had to make arrangements for carting along a formidable and weighty pack of instruments, including at least one-half dozen heavy dry cells and a spark coil giving at least a one-inch spark, besides condensers, helices and other apparatus, which all had to be designed of sufficient size to give a good spacing between the turns in order to withstand the high voltage employed.

All this is now happily changed.

New Precision Condenser and Wavemeter



New Precision Wavemeter Designed for the Use of Students and Engineers Who Desire the Highest Accuracy in Making Various Wave-length, Inductance and Frequency Measurements. This Wavemeter Comprises a Very Accurate Plate Condenser as Well as an Inductance and a Thermo-galvanometer. No Buzzers or Other Paraphernalia are Included in the Circuits; Thus Providing an Instrument Having a Minimum of Leads and Permitting Their Resistance to be Made Negligibly Small. Range Is 75 to 24,000 Meters.



View Above Shows the Fine Workmanship on New American Built Precision Condenser. This Condenser is Suitable for All Kinds of Radio Work, and Particularly for High Class Receiving Sets and Various Radio Measurements. It is Provided With Two Finely Graduated Dials of the Highest Accuracy, and the Slightest Movements of the Rotary Plates can be Effected by Means of the Worm Wheel and Gear Shown, the Worm Being Turned by the Insulated Handle Shown at the Extreme Right.

CONDENSERS used as standards and for precision measurements must have many features not usually found in ordinary laboratory condensers. For variable standards it is essential that the plates be sufficiently rigid and well spaced so that handling of the condenser will not cause a change in capacitance. It is not alone sufficient that the power factor be low but it is also important that the dielectric losses be substantially constant throughout the entire range of the condenser.

The precision condenser is not intended for use as an ordinary laboratory experimental condenser, but rather for those places where precision is essential. In its design the mechanical as well as the electrical features have received special attention. There are two sets of substantial semi-circular aluminum plates with wide spacing. The steel shaft runs in brass cone bearings, which are positively locked in position. After assembly of the entire condenser the shaft is rotated for several hours to insure its perfect alignment and the wearing in of the bearings.

The rotary plates are turned by a worm and gear, thus permitting fine control. The worm is held by spring tension in position against the gear to prevent backlash due to wear. This is the same method used in accurate dividing engines. The rotation test referred to above includes the worm and gear so that they are well worn into place before the condenser is accepted. Attached to the main shaft is a scale, 180 degrees of which are divided into twenty-five equal parts. To the worm shaft is attached a second scale the circumference of which is divided into 100 equal parts. Since one complete turn of the worm shaft moves the main scale through one division, the position of the rotary plates may be read directly to one part in 2500. As the divisions on the sub-scale are placed 1/16 inch apart it is possible to estimate easily to fifths.

Since there is only a small amount of solid dielectric used in the entire condenser, and since this dielectric is carefully selected, and is all placed in a weak electrostatic field, the power factor is very low, being approximately .01 per cent. at a capacitance of 1500 micromicrofarads. As the dielectric is not in the direct field of the rotary plates it is not influenced by their position. Thus the dielectric losses remain nearly constant throughout the entire range of the condenser. This is a particularly valuable feature in measurement of the properties of dielectrics. It permits the assumption that the condenser is equivalent to two parallel condensers, one of which is fixed and has all the losses and the other variable and has no losses. This condenser is adapted for use with potentials up to 1000 volts. With each condenser is a calibration table giving the calibration with an accuracy of .01 per cent. for twenty-six points.

Articles to Appear in December Issue of "Radio News"

The Eiffel Tower Radio Station
By a French Radio Engineer

A Three Tube Combination Radiophone Transmitter and Receiver
By Robert E. Lacault

Pocket Radio Receives Time Signals

How We Came to Have a V. T. Transmitter on the U. S. S. Princess Matoika
By Chief Operator Daggett

An Amateur Trans-Oceanic Feat as Reported by Pierre H. Boucheron

A Practical Receiver
By Volney G. Mathison

A Christmas Presentation
By Erald A. Schivo

The case is of polished mahogany and is lined with a copper shield grounded to the rotary plates. A ¼-inch aluminum plate finished in a permanent crystalline black forms the condenser top. Other metal parts are finished in polished nickel. The top is fitted with a carrying handle. In order that the condenser may be kept free from dust the two scales are read through glass windows set into the aluminum top. A hard rubber rotating handle extends into the box and engages the worm shaft.

Remarkably Accurate Wavemeter

Similar in general design to the Precision Condenser is the new Precision Wavemeter here illustrated. Accuracy and permanence of calibration are cardinal feaures of this instrument. To insure this accuracy under all conditions no extra circuits such as a buzzer or detector are incorporated in the wavemeter. There is but one circuit, the calibrated oscillating circuit, which consists of a condenser, inductance, and thermo-galvanometer. Such an arrangement requires a minimum of leads and permits their resistance to be made negligibly small.

The condenser is the precision condenser previously described, with a capacitance of 1500 micromicrofarads. The low losses of this condenser permit the obtaining of a very sharp resonance point. The scale arrangement, consisting of a primary scale and a sub-scale, is the same as used on the precision condenser. This arrangement permits a direct reading of capacitance to one part in 2500. When measuring the wave-length of a vacuum tube or other undamped oscillating circuit, it is possible to determine the resonance point to better than one-half a division on the sub-scale which is equivalent in wave-length to one part in 10,000.

The inductance coils are wound with stranded wire with the separate strands insulated from each other. Five coils are furnished covering a range of from seventy-five meters to 24,000 meters with a good overlap between coils.

Resonance is indicated by means of a Weston thermo-galvanometer mounted in the top of the condenser case.

Wave-length data is furnished for twenty-four points with each of the five coils. Capacitance data is furnished for twenty-six points on the condenser.

Transmitting Photographs By Radio

By PIERRE H. BOUCHERON

A General Exposition of the Problems Involved and How Some of Them Are Solved in the Martin System

IT is a curious fact that English, French, Italian and German radio engineers who are hampered more or less by stringent radio laws should be so far ahead in that branch of radio devoted to the transmission of illustrations by means of radio waves than we Americans who are blest with more generous and certainly broader radio laws and regulations.

Paradoxical as it may seem, our apparent lack of interest is probably due to these better laws of ours which are so broad in comparison to those of European countries that we are indolently laying back, as it were, imbued with the spirit of *laissez faire*. We may say to ourselves, "Let others look into the matter; we have our hands full at present with VT transmission of both speech and telegraphic signals; we are not ready for radio photography; when the time comes we shall look into the matter."

This philosophy, if so it be, and if the writer is right in assuming it to be the present state of mind of our radio research men, would seem to be decidedly an unhappy one. While we are thus browsing on the hillside of this branch of radio, our European contemporaries are making such rapid strides that some fine day in the near future we shall find ourselves in the proverbial rôle of the hare whose cocksureness over his adversary, the turtle, caused his defeat in the matter of a simple race which he could easily have won had he been less sure of himself.

These remarks are not idle jesting. There is hardly a foreign technical paper reaching this country which does not mention some new development or some new appliance slowly but surely paving the way to ultimately successful and commercially practical radio photography. Let us, therefore, be on our guard, as there are today several foreign experimenters systematically perfecting some already excellent methods which, tho still in the laboratory, give great promise of emerging into the commercial field, particularly that having to do with the transference of international news items.

THE WIRE METHOD.

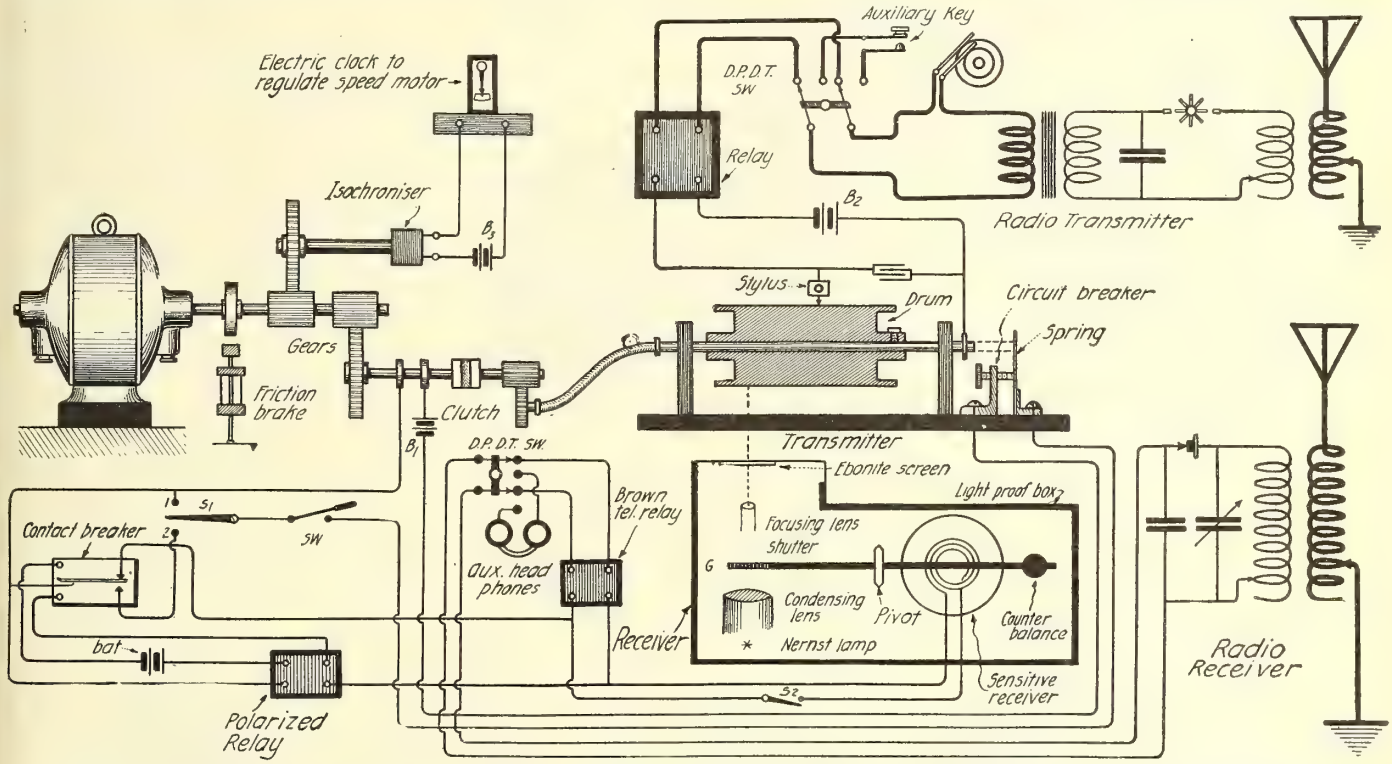
Many of us, when the subject of radio photography is mentioned, naturally enough will ask what has been done in the matter of first developing the land wire system of telephotography. The statement may be made that until such time as this system is a practical one in the sense that *wire* telegraphy and telephony are, there is no advantage to be gained by trying to apply the method to the less concrete and certainly more elusive Hertzian waves when so little is known about the early wire system. This may be answered in the following manner:

In the present methods of quick and certain mail deliveries accomplisht by fast transcontinental trains and by still faster airplanes, there can be no great advantage in devising a somewhat sluggish system of telephotography applicable for short distances only. The use of long wires, on the other hand, those of 1,000 miles or more, involves the undesirable encountering of capacity and inductive effects. The exchange of illustrations, therefore, is more needed between distant nations separated by great expanses of water. Naturally enough, we think of the submarine cable, but here we are met with still greater undesirable capacity effects. It is said of the cable that the electrostatic capacity of one mile of its length is equal to the capacity of 20 miles of overhead wire. This large capacity effect of the cable retards the transmitted impulses of energy to such an extent as to considerably reduce operating speed. Thus, telephotographic distance-experiments with the cable are so much reduced as to be unworthy of serious efforts in that direction.

With what has been previously said, and judging from present indications, it is both timely and logical that attention should be directed to the employment of radio as a medium for the transference of energy needed to transmit impulses corresponding to the black-and-white variety of shadings of a photograph or other illustration. Since great distances would seem to be the goal toward which telephotography would strive in order to become useful and practical, an accurate and dependable radio method should turn out to be much more economical and speedier than telephotography as applied to regular land lines and cables.

From the above it must not be inferred that the transmission of photographs thru the medium of electrical conductors is not a practicable thing. During the past few years, and particularly before the great war, excellent results were obtained by wire over distances slightly exceeding 400 miles and by submarine cables, such as the one connecting London and Paris. In these experiments speed reduction on account of line capacity was greatly overcome by the use of special apparatus; but, after all, it is a question whether ultimate results warrant further research with line systems when radio offers considerably better inducements. Thus we proceed to radio photography

(*Continued on page* 932)



This Diagram Shows Some of the Interesting Details of the Martin System for Transmitting Photographs, Drawings, or Script by Radio. This Diagram Shows the "Receiving" as Well as the "Transmitting" Apparatus. The Photograph Is Prepared in the Form of a Cross Lined Metal Plate or Cylinder Over Which a Stylus Passes, as Seen. The Successive Impulses Are Transmitted by Radio Waves and When Received, They Are Caused to Act Upon a Sensitive Electro-Magnetic Shutter Arrangement, in Such a Manner That the Picture Is Re-Constructed, Dot by Dot, so as to Cause Light and Dark Shades to be Imprest Upon a Sensitive Photographic Film in the Identical Order of Their Original Transmission.

WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

This Month's $5.00 Prize Winner—Gilbert Carter



THE three accompanying photographs are views of my electrical and chemical "lab," my workshop and my radio apparatus which I desire to put into the contest. The chemical cabinet contains about one hundred and fifty chemicals, including acids, salts and reagents, many of which are used in compounding photographic formulæ.

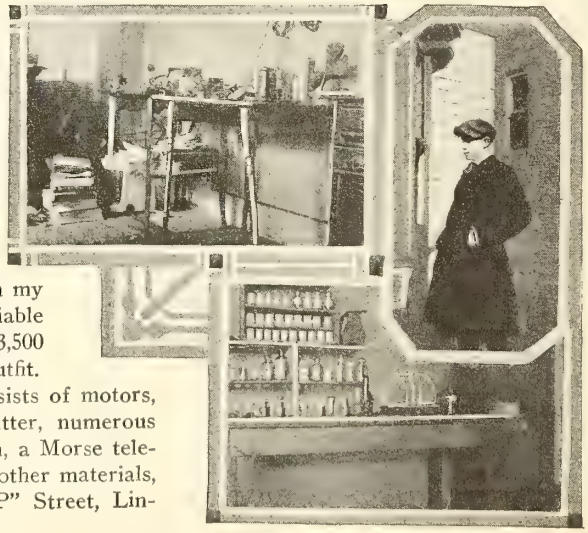
The chemical apparatus consists of the usual flasks, beakers, etc., also a desiccator, Liebig condenser, copper retort for oxygen, wash bottles, crucibles, a horn pan balance and a platform balance with metric weights up to one kilo.

The electrical apparatus comprises a Toepler-Holtz static machine with accessories, which is run by a small water motor shown in one of the photos. I also have a 110-volt D.C. generator, several small motors and generators, induction coils, an Oudin coil and other odds and ends of every description. I perform many physical and chemical experiments, including simple chemical analysis.

One photo shows a corner of my workshop, containing a small lathe and grinder with countershaft. I have a small D.C. generator (not shown), which is also belted from the countershaft. I use this lathe mostly for woodturning and polishing.

I have spent many enjoyable hours in my laboratory and workshop with the help of the SCIENCE AND INVENTION magazine, and the usual text books.—Gilbert Carter, Box 330, New Hartford, Conn.

Honorable Mention—Raymond McCormick, $2.00 Prize



THE photos herewith show my chemical and electric "labs;" also my "study" at my home in Lincoln, Nebraska. At present my chemical "lab" is of the greatest interest, as I have recently performed some exciting experiments—you know, explosions, etc.

I have a good variety of chemicals and apparatus, including some balances which are accurate to a fraction of a grain, also a microscope, which comes in handy in analytical work.

My electrical "lab" boasts of a complete receiving outfit, with which I can catch Arlington, Key West and other equally large stations.

By getting "wireless time" I am able to keep all of the clocks in my house correct. A Brandes 2000-ohm head set, a Murdock variable condenser, a fixt condenser which I constructed myself, and a 3,500 meter loose coupler receiving transformer make up my receiving outfit.

I also have a small sending outfit. Some of my other *junk* consists of motors, buzzers, bells, electro-magnets, a telephone receiver and transmitter, numerous batteries, many sizes of wire, part of an automobile ignition system, a Morse telegraph key and sounder, a couple of spark coils, an electric fan and other materials, favorites with "bugs" like myself.—Raymond McCormick, 1238 "P" Street, Lincoln, Nebraska.

What to Invent

By JAY G. HOBSON

RECENT accounts of the great loss of life in hotel fires remind us that more and better protection should be given guests stopping at up-to-date hostelries, and proper safeguards for use in case of sudden danger should be provided. While the law requires all public buildings to maintain fire escapes and to display notices or red instruction signs and lights in the hallways leading to the exits yet on close observation it will be seen that the system now in use is far from safe and satisfactory.

I have in mind several prominent hotels of the most modern type boasting of their fire-proof construction, but such protection as provided is only good so far as it can be used properly and quickly in case of urgent need.

How many travelers ever give passing notice to the location and operation of fire escapes upon renting their rooms? I believe it is safe to say not one in a hundred knows how to get out in case of fire, because they only think of such catastrophes when the great danger knocks on their own door, at which time they usually lose control of themselves and many perish, if the fire is of a serious nature.

For this reason, if for no other, an improvement in fire protection for hotels is greatly needed. An improvement or device to *think* for the thoughtless could be used with great saving in life and property.

In each room, secured to the wall in plain view, should be established a small *Electric Fire Guide* operated from the office downstairs to warn the guests of fire individually and to give them easily understood directions how to save themselves, which way to go, where to go, how to get out and when to go!

The mechanical construction of this device would be simple and the device itself could be easily manufactured. The *Fire Guide* could be made of an oblong metal box with a small red light and a bell enclosed, and the front part of the box would be of glass, with words of direction and instruction painted thereon.

Wires from each guide box would connect to the control board downstairs in the lobby. In case of danger the operator throws on the master switch which immediately lights all the red lights in each guide box and rings the warning bells. The guests, of course, are awakened gently by the persistent, yet not exciting alarm, and read the direction on the illuminated guide box which is plainly visible.

Having the instructions directly before them while dressing, enables the mind to grasp the facts firmly and thereby remember details of escape. Travelers learning of the hotels with such thoughtful protection for themselves and families would prefer to patronize this kind, even tho such installation might necessitate slightly higher rates of accommodation than hotels without it.

Mr. Hobson Here Illustrates and Describes in the Accompanying Discourse, a Most Invaluable Improvement in Our Hotel Service, Especially When It Comes to Conflagrations. Anyone Who Has Ever Been Caught in a Hotel Fire Will Appreciate the Fact That We Really Need Something Better Than the Present System. Mr. Hobson Suggests an Electric Fire Alarm Signal and Bell to be Placed in Each Room, So That by Turning a Single Switch at the Clerk's Desk, All of the Signs Will Light Up and the Bells Start Ringing. The Signs Indicate in Which Direction the Guest Should Turn to Locate the Nearest Fire-Escape.



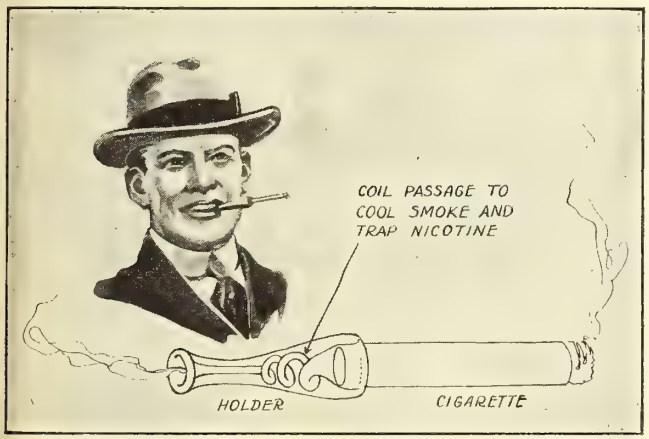
Automatic Phonograph Winder

If you own a man-wound phonograph, you will readily appreciate the significance and importance of this suggestion for an improvement to utilize the metal lid support of the modern phonograph to wind the spring automatically, as you raise and lower the lid after playing.

When a person stops to consider the enormous amount of cranking required to obtain pleasant music from *the machine that talks,* it will be seen the cranking is more in evidence than the music. The spring of the machine must be wound sufficiently each time to run the record around against the needle fast enough to reproduce the music record on the disc.

My idea is simply this: to do away with the unsightly crank altogether, and in place of it, to arrange the metal cover support so as to wind the spring half way as the lid is raised, to change the records, and then to wind it completely when the cover is lowered. This construction would not be complicated, as a proper placing of gears connected to the phonograph spring and the metal cover support would so enlarge the ratio that the distance required for the cover support to travel would only be of such length as the present machine lid travels when raised and lowered.

The illustration will make my idea clearer. Undoubtedly an improvement of this class would meet with instant favor both with the manufacturer and the phonograph public, because of its convenient and novel features.

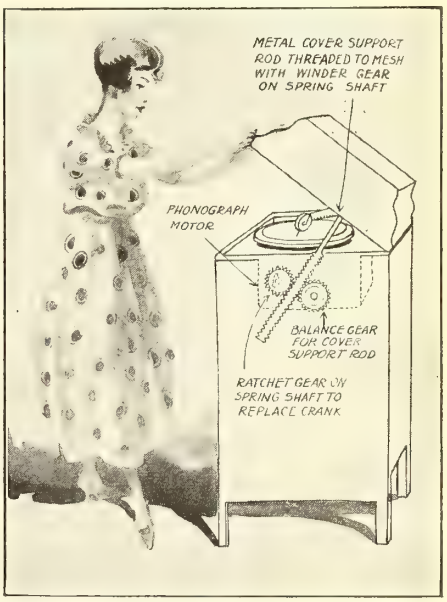


For Those Who Smoke, the Present Suggestion for an Improved Cigarette and Cigar Holder Will be of Interest. It is Well Known That Lip Cancer Has Often Been Caused by the Hot Cigar Holder or Pipe Stem Held in the Mouth, and Not Only is This Objection Overcome in Mr. Hobson's Suggestion Shown in the Accompanying Illustration, but He Has Also Provided a Nicotine Trap, Which to Function Properly Should be Cleaned Thoroly and Frequently of Course. Certain It is That There is a Small Fortune Awaiting the Man Who Will Invent Something Real New and Thoroly Efficient in the Line of Smokers' Supplies.

Improved Cigarette Holder

Anatomists maintain that the harmful effects of cigarette smoking come from inhaling the hot smoke containing nicotine in

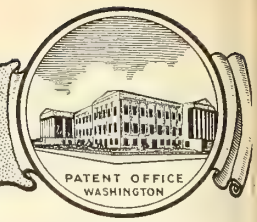
(*Continued on page* 912)



Why Not Make the Phonograph Lid in Its Rising and Falling Motion, Performed After Playing Each Record, Wind Up the Spring Motor Driving the Turn-Table?



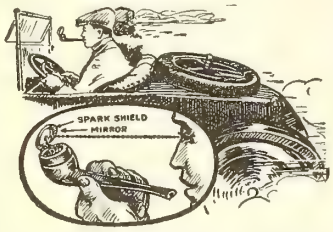
LATEST PATENTS



Pipe Mirror.

(No. 1,349,276. Issued to Harry J. Hays.)

Here is a clever adjustment to a pipe so that the smoker has abso-

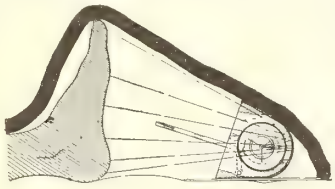


lute mental control of the smoking condition of the tobacco. In the daytime, he is able to do this by watching the smoke, but is denied this pleasure at night. The inventor, therefore, has placed a guard on the pipe, the surface of which is properly mirrored and so arranged that the glow of the burning tobacco will be conveyed to the eye of the user. At the same time, this guard prevents the wind from affecting the proper burning of the tobacco when automobiling or sailing a boat.

Foot Warmer.

(No. 1,348,506. Issued to Jose A. Mata.)

There are several new improvements in this foot warmer, which is provided primarily to be used in bed. It consists of a reflector or shade so adapted to reflect heat rays coming from the lamp and at the same time protects bed clothing from coming in direct contact with the heated lamp, preventing in this way spontaneous combustion of the bed

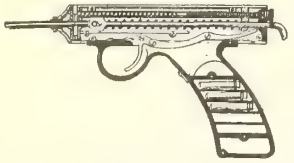


clothing. A pull-chain socket for the lamp is employed, the pull of which is connected to a sort of pedal so that the person lying in bed can, by pressing on the pedal, automatically turn the lamp on or off and thus regulate the heat coming from same.

Vaccine Injector.

(No. 1,347,622. Issued to Arthur E. Deininger.)

This invention will make it much easier to vaccinate many head of stock without necessitating the reloading of the instrument after each injection. It consists of a magazine wherein lie a plurality of vaccine tablets. When the spring plunger is pulled backward one tablet automatically drops into the ejector. Upon pulling the trigger after the needle has been pusht

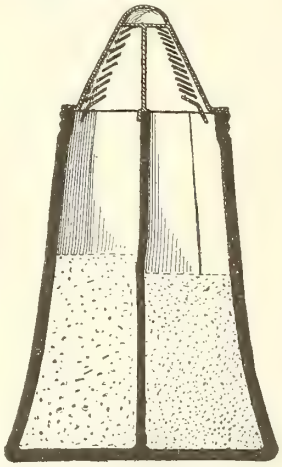


under the animal's skin, a tablet is automatically shot into the proper position. In the handle of this vaccine injector a space is provided wherein a number of bottles of vaccine tablets may be kept. The instant that the magazine is empty an automatic device prevents resetting of the trigger, and the operator then knows that the pistol is empty and needs reloading.

Combination Salt and Pepper Shaker.

(No. 1,349,795. Issued to Otto M. Vogel.)

This is an improved combination shaker whereby it is not necessary to close one or the other of the apertures in order to allow the salt and pepper to be shaken out. In the head of the shaker are a number of baffle plates directed downward to the openings so as to form a grid wall. When the shaker is tipt toward one side, the vanes there allow the salt, for instance, to flow out freely, but the baffle plates in the adjacent compartment will be

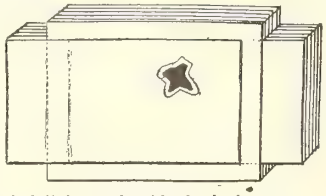


inclined upwardly thereby preventing the flow of pepper. The cap is detachable, so that the shaker can be filled, and ample provision has been made to prevent a mixture of the internal contents.

Self-Protecting Condenser.

(No. 1,350,010. Issued to William Dubilier.)

This patent, issued to the well-known inventor, resides in a condenser of such construction that, upon subjection to an abnormal electrical condition or pressure, it protects itself after puncture. The arrangement of the plates and dielectrics are the same as in the ordinary condenser, except that the

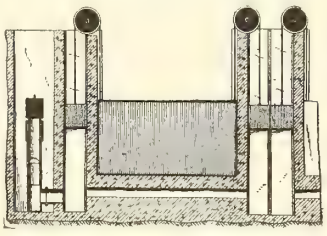


tinfoil is preferably in intimate contact with mica sheets and held there by insulating wax or some adhesive. The tinfoil has a thickness of about .00025 of an inch and the intervening mica sheet is about 3 mils in thickness. When the mica becomes punctured by an abnormal voltage stress, it causes a flow of current between two adjacent tinfoil sheets. The heat produced is sufficient to cause this tinfoil to melt or vaporize for a considerable margin around the aperture until a condition is reached which prevents the passage of electrical energy thru the aperture because of too large a distance between the two tinfoil plates.

Automatic Dam Gate.

(No. 1,344,043. Issued to Joel De Witt Justin.)

In this invention the patentee uses the water head pressure to automatically operate the dam gates in a simple yet ingenious manner, and he makes the device adaptable to every kind of gate dam. The method of operation is quite simple. A valve is employed which moves

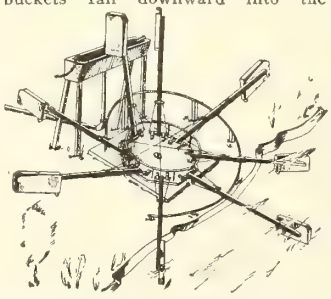


up and down in a sleeve and the projection of which either causes the water to operate directly on a mechanism to open the gate or closes a water port, allowing the gate in that way to close itself whenever the head has again been reduced to a proper level. Due to the counterweights on this valve, the device can be set for any predetermined waterhead or pressure, and when once set requires no further attention.

Current Motor.

(No. 1,346,285. Issued to Thomas H. Walker.)

Here is a rather clever device which can be used wherever there is a flow of water and it is desirable to pump the same to any great distance. The motor is so aranged that a series of paddle-buckets fall downward into the

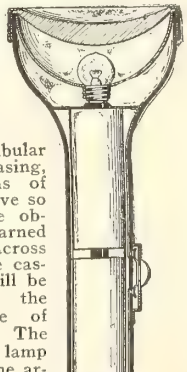


water where, due to the current, they are caused to rotate and at the same time automatically fill with water. Rising upward, they are lifted by a circular track which rises from the river or stream. Upon reaching their highest point an automatic trip opens the water outlet and allows the water from the paddle-bucket to flow through a trough, whence it is conveyed to the distant point by means of suitable piping arrangements.

Electric Darning Ball.

(No. 1,349,979. Issued to Lucinda Ritter.)

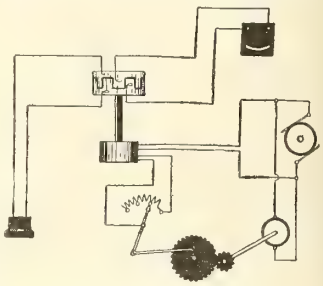
This is a rather clever improvement on grandmother's darning ball with the modern scientific touch to it. It consists of a tubular flash light casing, the glass lens of which is concave so that when the object to be darned is stretched across the end of the casing, a space will be provided for the ready passage of the needle. The light from the lamp shining thru the article materially facilitates the darning operation.



Detection of Low Frequency Impulses.

(No. 1,348,825. Issued to Reginald A. Fessenden.)

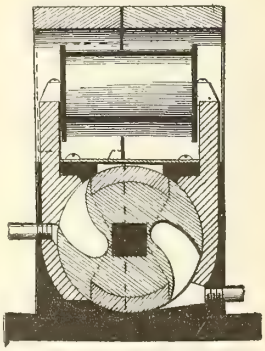
A clever device for the detection of low frequency impulses is the subject of this patent. It employs a commutator such as used for rectifying alternating currents, to which brushes are connected leading from an oscillator. Another set of brushes are connected to a Weston microammeter. Because of the toothed character of the commutator and the arrangement of the brushes each brush engages first one element and then the other, as can be seen from the diagram. When the oscillator is placed in the water and low frequency impulses approach it, a low frequency electric current is generated, particularly



when a submarine is in or near the vicinity. The speed of the motor-driven commutator is then regulated by a field rheostat, which is adjusted to the motor thru a reducing gear which shifts the resistance of the rheostat slowly so as to vary the speed of the motor from its lowest range—about one turn in 10 seconds—to its maximum speed of 20 turns a second. At some one speed the revolution of the commutator will be such as to commutate the low frequency impulses generated by the submarine and give a rectified and easily readable indication on the microammeter.

Combined Generator and Pump.

(No. 1,349,397. Issued to Harry Randolph Van Deventer.)



This machine has a rotor so designed that not alone will it generate a current, which when controlled by a suitable interrupter mechanism mounted in the casing will produce a suitable potential for the spark plugs of the gas motor, but also because of the peculiar construction of the rotor it will act as a centrifugal force pump, causing a circulation of oil which will lubricate both the generator and the engine. The generating coil is remote from the rotor of the pump but housed in the same casing. The invention promises to do away with the extra pumps now being applied to gas-driven vehicles.

Scientific Humor

Probably Sea-Sick.—"Father, what does a volcano do with its lava?" asked Teddy.

"Give it up," replied the long suffering one.

"That's right," said Teddy.

—*Harry L. Moody.*

All the Same to Jupiter.—PROFESSOR OF ASTRONOMY: "How many moons has the planet Jupiter?"

STUDENT: "Seven."

PROF.: "Enumerate them."

STUDENT: "One, two, three, four, five, six, seven!"—*Harry L. Moody.*

En-Lightened.—THIN: "I've discovered that the heavy end of a match is the light end."

THICK: "What do you mean?"

THIN: "Strike one and you will see."

—*J. Lawrence Bartley.*



Gone to Seeds.—Someone went into a seed store and asked the new clerk for some sweet potato seeds. He hunted all over the store and finally appealed to the boss, who explained that he was being made fun of. A few days after a lady came in and asked for some bird-seed.

"Aw, go on," grinned the clerk; "you can't fool me! Birds is hatched from eggs."

—*Edward J. Rife.*

A Non-Conductor.—Superintendent to applicant for a position:

"What is your name?"

"Wood, sir."

"You want to be appointed conductor?"

"Yes, sir."

"Can't take you, my man."

"Why not?"

"Because electrical experts say that wood is a poor conductor."—*No Name.*



Where Did He Expect to Wake Up?—A surgeon was performing an operation on a patient when a fire started in a warehouse across the street, illuminating the whole operating room. Having finished, the doctor said to the nurse: "I think the patient is coming to; you had better pull down the shade. I don't want him to think that the operation hasn't been a success!"—*M. Goldberg.*

Same Here!—The scientific man was looking for information for his "facts and figures" notes. "How many people work in your office?" he asked the president of a large corporation.

"Oh," said the president, "I should say, at a rough guess, about two-thirds of them."

—*J. Kent Smith.*

She Didn't "Ring" Off!—"How about that telephone girl who married for love?"

"The line's still busy."

"What do you mean?"

"She's doing the family washing."

—*Elmer Edwards.*

FIRST PRIZE $3.00



And the Milk, Too, "Turned"—Visitor: "Don't you ever use electric milkers?"

Farmer: "Not any more. We never could remember to shut 'em off, and they turned the cows inside out."—*E. McAvoy.*

We Knew Something Was Loose!—"Who was the first bookkeeper?"

"Can't imagine."

"Why, Eve was the first bookkeeper, when she introduced the loose-leaf system."

—*Harry Humbertson.*

"Henry" Should Get Wise to This!—Ad in *Journal of A. M. A.*:

Married man to milk and drive Ford. Write F. J. B., 721.—*Vivian Gluson.*

How About Honeydew?—"When does grass become wet with dew?" asked the professor.

"In dew time," was the answer from a pert freshman.—*No Name.*

ALL jokes accepted and publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

Inventors! Wanted: Typewriter—Manicure Attachment.—"I'm sorry I asked the girl to clean the typewriter. She took fifteen minutes to clean the type and two hours to manicure her finger-nails afterwards."—*S. Fishman.*

From The Caledon Press.—For sale, cheap—small Evinrude Boat Motor; owner no further use.—Wire L76, this office.—*K. McLean,*

Caledon, C. P., South Africa.

The Graft of These "Grafting" Jokes!—First Boy: "My father grafted an apple tree on a pinetree."

Second Boy: "And what fruit does it bear?"

First Boy: "Pineapples, of course."

—*Ronald Jones.*



Thermal Efficiency.—"It is said that paper can be used efficiently in keeping people warm."

"That's so. I remember a note of mine that kept me in a sweat for thirty days!"

—*Abe Jackson.*

A (W)Hopper.—Professor (discussing organic and inorganic kingdoms): "Now, if I should shut my eyes—so—and drop my head—so—and remain still you would say I was a clod. But I move, I leap. Then what do you call me?"

Bright Pupil: "A Clodhopper, sir."

—*No Name.*

Nor Indigestion!—Jimmy: "Father, why do we belch?"

Father: "Because there is gas in our stomachs."

Jimmy: "Huh! Balloons have gas in them and they don't belch."

Father: "That's because they have no stomach."—*Noah M. Thompson.*

Quite Plane.—Smiles: "To what ailment are aviators most susceptible?"

Miles: "Oh—er—falling sickness, I suppose."

Smiles: "No! Plane dropsy."

—*H. D. Collins.*

Help Wanted!—An East India station-master had been cautioned to do nothing without instructions. That probably accounted for his sending the following message:



"Superintendent's Office, Calcutta.

"Tiger on platform eating conductor. Please wire instructions."—*D. Sheriff, Jr.*

Back-Fired.—When the clock struck "12" the other night father came to the head of the stairway and in a rather loud tone of voice said:

"Young man, is your 'self starter' out of order tonight?"

"It doesn't matter," retorted the young man, "as long as there's a crank in the house."—*Robert Friend.*

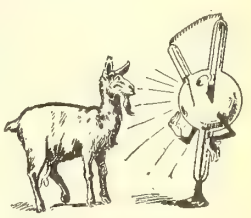
When East Is "Yeast."—Scientist, asking his daughter, who is taking cooking lessons:

"Magnesia, why does the sun rise in the east?"

Magnesia, thinking of her cooking: "Because yeast makes everything rise."

—*Adolph F. Lonk.*

He Felt Like 30 Cents.—Goat: "Notice any change in me?"



X-ray: "No; why?"

Goat: "I just swallowed thirty cents."

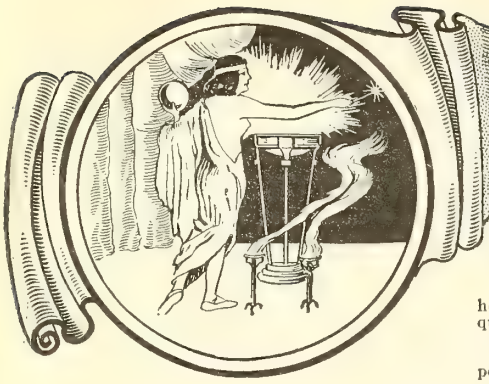
—*Carley Connor.*

Must Have Been Joke Editor!—An editor at a dinner-table being asked if he would take some pudding, replied in a fit of abstraction: "Owing to lack of space, we are unable to find room for it at present."—*E. E. Newcomb.*

And Is Infinitive.—Teacher to young miss—"Parse the word kiss."

Y. M.—"This word is a noun, but is usually used as a conjunction. It is never declined, and more common than proper. It is not very singular, in that it is usually used in the plural. It agrees with *me.*"

—*H. F. Hyson.*



THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Automobile Storage Battery

(1068) Thomas H. McGuire, Long Beach, California, inquires of this Department:

Q. 1. If it is good practice to charge a storage battery frequently, say a little each day, instead of charging it fully all at one time.

A. 1. It has been the "Oracle" editor's experience in storage battery charging that it does no harm to keep the battery charged up to a fairly even rate by giving it frequent short charges, and that is the method frequently followed in general practice. Whenever the battery electrolyte falls to a certain minimum value, the battery is given a charge, and this may be two to three times weekly, more or less, depending upon the load put on to it. Occasionally, it is well to discharge a battery down to a fair minimum value, according to the best authorities, at least for lead plate cells. However, in support of your idea as to frequent charging, we have the modern ignition battery of large size, fitted in the motor-car of today, which is kept in a state of constant charge automatically, by means of an automatic charging cut-out or relay and a dynamo driven by the engine. Here the lead plate storage battery is charged constantly, or whenever it needs recharging, periodically.

We do not know who makes the small electric runabout used at the Panama Exhibition which you speak of, but undoubtedly you can obtain the address of a manufacturer of a similar vehicle, by communicating with the General Electric Co., Schenectady, N. Y. We do not see any reason why a small motor vehicle, if built light enough, could not be propelled by a "Smith" motor-wheel, as you state, and we have recently seen a light buckboard operated with a Smith motor-wheel, put behind the vehicle (the buckboard being fitted with four bicycle wheels), running along the country road at a speed of nearly twelve miles an hour and carrying two passengers.

Resistance for Given Voltage Drop

(1069) John L. Murphy, 507 Fifth Avenue, New York City, asks for method of figuring resistance to step down 110 volts D.C. to any potential desired.

A. 1. The data you request on voltage changes has not been thorough enough inasmuch as you did not give us the amperage you desire.

We are herewith giving you an example by means of which you can figure out the voltage obtained and the number of lamps necessary for any problem you may have. First, we will quote Ohm's law.

Suppose we desire 8 volts; but you have not told us the amperage you need. Let us assume this is to be 4 amperes. Then we use this formula in which E is equal to the voltage drop. R equals E divided by C. 110 V. minus 8 is equal to 102, which is the residual voltage drop. Substituting in the above formula we get 102 divided by 4 = 25.5, or the resistance in ohms necessary to be inserted to give us 8 volts and 4 amps. This means that four 1-amp lamps joined in parallel may be inserted into the circuit. These lamps should give a resistance of 25.5. Four 100-watt lamps will answer very nicely for this purpose.

From the above data, we believe you can easily figure out the remaining voltage changes which you desire.

Data for Building 100-Volt, 25-Cycle, 1-KW Radio Transformer

(1070) Alfred A. Reiser, Buffalo, N. Y., inquires of the "Oracle":

Q. 1. Please give construction data for building a step-up high tension radio transformer suitable for use on 110-volt, 25-cycle alternating current circuit, as well as the dimensions of a suitable glass plate condenser to be connected across the secondary of this transformer.

A. 1. We give herewith the data you desire on the transformer in question. The laminated or annealed sheet-iron core should measure 15 inches by 8¼ inches, outside dimensions; each leg of the rectangular closed core measuring 2¾ inches by 2¾ inches in section.

The primary winding should comprise 344 turns of No. 11 B. & S. gage, double cotton-covered magnet wire, wound in even layers along one of the longer legs of the core. Before winding on the primary coil, the iron core should be insulated with six layers of oiled linen. Taps may be brought out from each 100 turns, so as to give adjustability in controlling the transformer output.

The secondary coil is wound with No. 32 double cotton-covered, copper magnet wire, formed in pies or sections ¼ inch thick, each pie having a radial coil depth of about 2½ inches; *i.e.*, actual wire depth. The secondary comprises 38,664 turns in all, and by finding the mean radius and diameter of one turn, you can readily compute the total feet of wire and in turn the weight required, by consulting any electrical catalog or wire tables given in text-books.

The secondary potential with all primary turns cut in, will be 12,300 volts; with 300 primary turns the voltage will be 14,176 volts, and with but 200 primary turns cut in, the secondary potential will be 21,265. The glass plate condenser suitable for connection across the secondary winding of this transformer should have a capacity of .15 microfarad. You will find full details, together with graphic curves showing the proper capacity for various voltage and kilowatt ratings and the area of glass plate and tin foil surfaces required, given in the book entitled "The How and Why of Radio Apparatus."

There is no use in giving the exact size of condenser here, as we do not know what size glass you want to use, nor what kind of glass, the dielectric constant varying for different grades of glass. The approximate capacity in microfarads for unit areas of common glass are as follows:

For each 1 square inch of ⅛ inch thickness of glass coated on both sides with foil or other metal charging leaves, the capacity is .00000562774 mf.

The unit capacity per square inch of 1/16-inch glass, coated on both sides with metal charging leaves, is .00001125548.

ARTICLES WANTED!!!

There is at the present time an excellent opportunity for writers of semi-technical, popular scientific articles and stories, as we are publishing more material of a popular nature each month. Stories should be as snappy as possible and should have well-rounded plots and characters. They should of course revolve around a scientific, electrical or radio focal point, to prove available for the columns of "Science and Invention." Good rates are paid on publication for stories accepted and publisht, and usually 2,500 to 3,000 words are sufficient. We also desire short write-ups with clear photographs on new scientific, electrical and radio subjects. Address all manuscripts to the Editor, "Science and Invention," 233 Fulton Street, New York City.

Hughes' Induction Balance for Locating Ore

(1071) James Conroy, of Troy, N. Y., asks:

Q. 1. For some specific data on building the coils on the Hughes' induction balance described in the June, 1920, issue of this journal by Victor H. Todd.

A. 1. In reply to your query we would advise that the two large coils mentioned have 100 turns of No. 14 B. & S. gage enameled copper wire and the transformer mentioned is similar to an induction coil, with a primary wound on an iron wire core about 3 inches long and ½ inch in diameter. The primary consists of one layer of No. 14 B. & S. gage enameled copper wire, wound with two wires in parallel. The secondary has about 10,000 turns of No. 36 B. & S. gage enameled copper wire. The inductor balances comprised 12 turns of No. 14 copper wire, wound about ¾ inch in diameter.

The rheostat contains about 10 inches of No. 14 B. & S. gage German silver wire. The battery is of four dry cells, and 1,000-ohm telephone receivers were used.

Magnitude of Tesla High Frequency Currents

(1072) James T. Wilson, Jr., Brooklyn, N. Y., writes this journal:

Q. 1. About an apparent error in the "Wireless Course," by Gernsback, Lescarboura and Secor.

A. 1. With reference to the error which you cite as appearing in the Electro Importing Co.'s "Wireless Course."

In the first place, the "Wireless Course" is being rewritten in considerable detail so as to include some valuable and timely material on vacuum tubes.

We note what you have to say concerning the statement on page 135 of the "Wireless Course," concerning the giant Tesla transformer, and the coils which Dr. Tesla used in his famous Colorado experiments, and in which you doubt that the discharge was of the magnitude of 800 amperes, at a potential of a billion volts or more.

We cannot vouch for the exact figures of this discharge, but you can figure it out for yourself as to the approximate potential and the amperage, when we tell you that Dr. Tesla's records and photographs which we have had the pleasure of seeing, show he absolutely produced tremendous discharges, the like of which have never been duplicated. They measure 100 feet in length in some instances, and the various sparks have diameters ranging from a few inches up to a foot or more.

Where most of the people who try to figure out the Tesla experiments mathematically err lies in not allowing for the great difference between the actual and the apparent watts, or in other words, they forget the low power factor, which the editor has often discust with Dr. Tesla; and further, the fact that these tremendous energy rates are dependent upon or based upon a very short *time interval.*

Simply explained, the theory of the apparatus and the tremendous discharges obtained, is as follows:

If you have 100 kilowatts in the form of low frequency A. C., and you use this energy for a period of one hour, then you would call the amount of energy expended 100 kilowatt-hours; but if you were able to charge this energy into huge condensers and then discharge it in less than a minute, or 1/60th of an hour, then the rate of discharge would be 60 times 100 kilowatts, or 6,000 kilowatts. Another thing in regard to the amperes of current passing thru a high frequency circuit, such as a Tesla circuit, is that the current does not act in the same way as a low frequency, 60-cycle A. C., or direct current, and is not computed in any such manner.

To prove this point in a simple way, take, for instance, the fact that if you apply sufficient potential to the human body, less than 1/10 ampere passing thru the heart causes death invariably. But Tesla, and thousands of others, have readily past tremendous currents thru and over the body with a current registering many more amperes than anyone would ever believe possible—in fact, to such an extent that whole banks of incandescent lamps have been lighted up by the current after it had past thru the body.

In other words, we enter into an entirely new realm of electrical calculation when figuring on Tesla currents and circuits.

Send No Money

Silvertone

Let Us Send You This SILVERTONE Phonograph for Two Weeks' Trial in Your Home Without Expense to You

WE WANT you to try this beautiful Model K Special SILVERTONE Phonograph in your own home for two weeks without a cent of expense and without obligating you to buy if you are not fully satisfied with the instrument.

Fill in the order blank and mail it to Sears, Roebuck and Co. today. We will ship the phonograph on two weeks' trial. You take absolutely no risk, nor do you obligate yourself in any way by taking the SILVERTONE on trial. All we ask you to do is to give the phonograph a thorough test. Examine its mechanical features, cabinet work, workmanship and finish. Try it with any disc record you desire, and note its beauty of tone and fidelity of reproduction. Give it every test necessary to prove the truth of our claims for it. And then compare the price of the SILVERTONE with that of any other phonograph of the same size, beauty and musical excellence.

If, at the end of two weeks' trial, you are not fully satisfied with the SILVERTONE, if you do not believe that it is in every way the equal of any phonograph on the market selling at prices from 25 to 50 per cent higher than the SILVERTONE, simply notify us and we will take away the phonograph at our own expense and will refund any transportation and cartage charges you have paid. The two weeks' test will not have cost you one cent, nor placed you under any obligation.

Play as You Pay—Very Easy Terms

If, after two weeks' trial, you are fully satisfied with the SILVERTONE and desire to keep it, simply send us the first monthly payment of $4.00 and then the same amount each month until the total is paid.

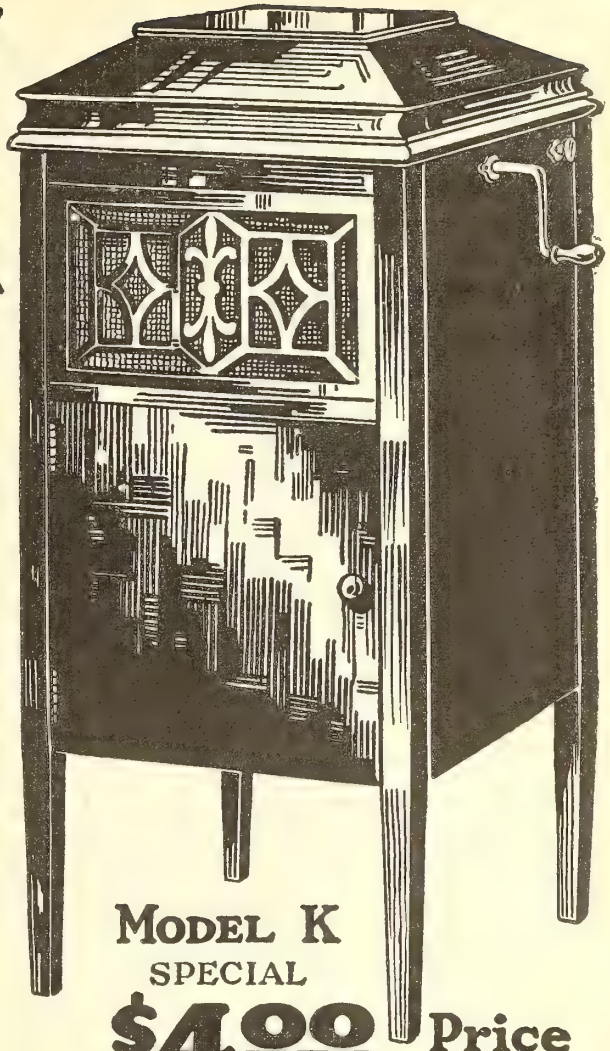
Compare our terms with those offered on any other phonograph of the same high quality. The small monthly payment required makes it easy for you to own a really fine instrument without incurring a heavy financial burden.

This Liberal Selling Plan Is the Best Guarantee of SILVERTONE Quality

We know that the SILVERTONE Phonograph is right in every respect—mechanically, musically and in design and finish. That is why we can offer them on this liberal no money down trial basis. We know that when you get a SILVERTONE Phonograph in your home for two weeks' trial you will be convinced of its high quality and will agree with us that it is the best phonograph on the market at anywhere near the same price. We have sold over 330,000 SILVERTONE Phonographs, and the unanimous praise of their owners is the most convincing proof of SILVERTONE quality.

Plays All Disc Records

The SILVERTONE convertible tone arm is so constructed that it permits the playing of any make of disc record, either vertical or lateral cut. It is almost as easy to adjust the reproducer for different types of records as it is to change needles.



MODEL K SPECIAL

$4.00 A Month **Price $79.00**

Quarter Sawed Fumed Oak

This beautiful cabinet is made of genuine quarter sawed oak in the popular dull fumed finish. The design is simple, yet graceful and dignified. It is 42¼ inches high, 21⅜ inches deep and 18¼ inches wide, a size admirably adapted to the average living room. All visible metal parts are heavily nickel plated and polished. An assortment of needles is included. Net weight, ready to play, about 66 pounds.

Sears, Roebuck and Co.

Chicago · Philadelphia · Seattle · Dallas

MAIL YOUR ORDER TO THE NEAREST OF OUR FOUR STORES

Sears, Roebuck and Co. 82F92 Date_____ 192__

You may ship me the Model K Special SILVERTONE for two weeks' trial.

If after two weeks' trial I decide to keep and use the instrument, I will send $4.00 as first payment for the phonograph and pay the balance at the rate of $4.00 each month, until paid in full; then the SILVERTONE becomes my property.

Should I decide after two weeks' trial that the SILVERTONE is not satisfactory, I will notify you and you are to give me instructions so that I may send it back at your expense, and you are also to return any amount I paid, including transportation charges.

I have always been faithful in paying my obligations and am making this statement for the purpose of inducing you to grant me these terms, and I give you my pledge that you may feel safe in trusting me to pay as agreed.

Sign Here ☛_____

(Sign your name here plainly and carefully. If under age, some member of your family who is of age and responsible should sign this order with you.)

R. F. D. No._____ **Box No.**_____ **Street and No.**_____

Postoffice_____ **County**_____ **State**_____

Shipping Point_____ **County**_____ **State**_____

I have been located in this town since_____ **If less than five years, give former address**_____ **Do you wish shipment made by express or freight?**_____ (State which)

Please give name of HEAD OF HOUSEHOLD to prevent mistakes and simplify the keeping of our records.

Name of HEAD OF HOUSEHOLD_____ **My business, profession or occupation is**_____

(Please give Names of TWO References.) **References:**

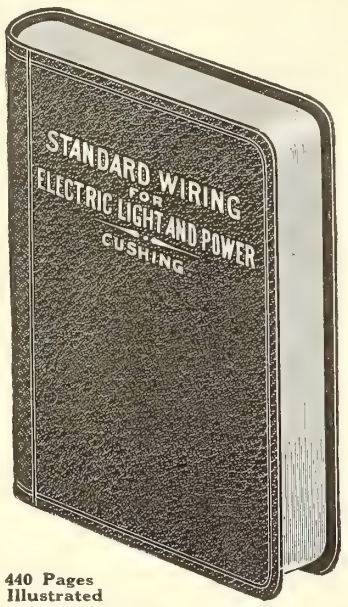
Name	Address	Business or Occupation

Give it to Him for

CHRISTMAS

It will make him an Expert Wireman and he can Earn $75 a Week

Don't wait—Order today



440 Pages
Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. 250 Electrical Units and their Definitions and Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve any wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges. Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.

8 West 40th Street New York

Einstein Theory and the Fourth Dimension

By H. Gernsback

(*Continued from page* 840)

think that the earth contracts just the same due to its speed. But what is a speed of 69,000 miles *an hour* (or 101,200 feet per second) compared to the speed of light moving at the rate of 186,000 miles per *second!* As far as the speed of light is concerned, the orbital velocity of the earth is insignificant.

Coming back to the contraction theory in the Michelson-Morley experiment, it becomes apparent that if the earth contracts a certain amount, not only the latter *but the measuring instruments as well would shrink* in the same proportion, which would account for the fact that we cannot detect the difference in size which we hoped to measure. It is as if we were living in a world of curved mirrors (see Fig. 3). Take a man with divided rules or measuring sticks and place him in front of a cylindro-convex mirror. He naturally shrinks *and so do his measuring sticks.* The same man standing in front of a plane mirror will be reflected along with his measuring sticks in his true proportions; yet a man standing in front of a convex mirror, with axis vertical, will have his yard-stick contracted in the opposite way analogous to the man standing in front of the other convex mirror. Every measurement of this man would be wrong, and yet in a way the measure would be correct! This seems hard to understand, but a study of Fig. 3 will make this plain.

Once we admit the Lorentz-Fitzgerald contraction theory, we must also accept another equally astonishing one, and that is what is called the theory of *local time.* Take two clocks running together in perfect accord. If one of them is placed upon a moving platform, or if both of them are placed upon such a moving platform, their times will not be the same any longer but will vary in order to vindicate the Michelson-Morley experiment. Thus while the clock which moves keeps perfect time, yet the seconds it ticks off are longer than those of the clock at rest. We have thus two different sorts of time! So far the Lorenz-Fitzgerald contraction theory has not been confirmed by experiment nor has the local time experiment been confirmed. It is doubtful whether either will ever be actually proven by experiment.

How Are the Airplanes Moving?

We now come to another aspect of relativity. Consider Fig. 4. Here we have two airplanes passing one another, each moving at the rate of 200 miles per hour. This gives us a relative motion of 400 miles per hour considering both of them. We also find the astonishing result first laid down by Einstein, viz., that it is impossible for an observer on a moving body to ascertain the speed of the other moving body by any means or by any instruments known to science.

For the two airplanes, moving at a relative motion of 400 miles per hour, *are moving in many other directions* as far as the earth, or rather the universe, is concerned. For while the airplanes are moving at a certain speed, the earth's atmosphere, which carries the planes, is moving at a different speed. Again the earth moves itself. This is made more apparent by studying Fig. 6. We first have the axial rotation of the earth from west to east at a speed of 1,039 miles an hour. But, while the earth is spinning like a top, it also moves forward in its orbit around the sun (see illustration) at a speed of 65,533 miles an hour; but this is not all. We still have the cosmic drif as our picture clearly shows, whereby th earth as well as all the other planets an the sun itself are carried forward in spac in a sort of huge spiral. In other words *the earth is moving in three directions a at once.* First, axial rotation, second orbita motion, third cosmic drift.

But let us revert to Fig. 4 and our avia tors. It now seems hopeless to figure ou not only at what speed they are really fly ing, *but in which direction they are going*

(*Continued on page* 892)

2 FLANNEL SHIRTS $3.69

Direct from Factory Send No Money



Two wonderful Susquehanna Broadcloth Flannel Shirts only $3.69. Direct from factory. No Middleman's profits. Would cost $6 or more elsewhere. Perfectly tailored. Cut extra full. Comfortable fitting. Winter weight. Soft turn-down collar. Two extra strong, large pockets. Double stitched throughout. Thoroughly shrunk. For work or semi-dress. An amazing bargain. Send no money. Pay postman only $3.69 plus postage after arrival. Then try them on. If not pleased, return at our expense; your money returned at once. Order by number FS359. State size. Specify gray or blue. Only two shirts to a customer on this special offer.

WAREWELL COMPANY Dept. FS359 Philadelphia, Pa.

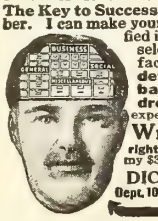
The Key to Success

Stop Forgetting



Make Your Mind a File—Not a Pile

The Key to Success is the ability to remember. I can make your mind an infallible classified index from which you can instantly select thoughts, facts, figures, names, faces. Enables you to concentrate, develop self-control, overcome bashfulness, forgetfulness, address an audience. Easy. 20 years' experience developing memories of thousands.



Write Today for free booklet, "How to Remember" and **Copyrighted Memory Test,** and how to secure Free my $3.00 book, "How to Speak in Public."

DICKSON MEMORY SCHOOL

Dept. 101 1041 Chicago Av. Evanston, Ill.

Study Microbiology, Bacteriology

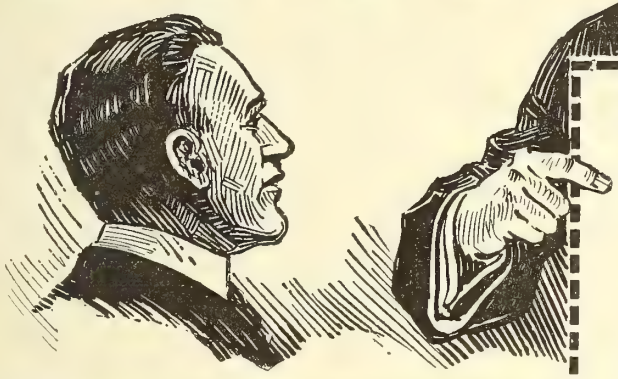
and Sanitary Science. Home Study and Residential Courses, including Parasitology, Serology and Wassermar test. Interesting and Profitable Professions. We teach the above Sciences quickly and thoroughly, as well as Urinalysis, Blood Analysis, Detection of Poisons, Blood Stains, etc. Diplomas and Degrees granted. Many positions open. Write for free Prospectus.

PHYSICIAN'S AND SURGEON'S COLLEGE OF MICROBIOLOGY

546 Garfield Ave. Dept. 3Z Chicago

CLIP THAT COUPON





Are You Technically Trained? If Not, Clip That Coupon

Chicago Technical College, 1245 Chicago "Tech" Bldg., Chicago, Illinois

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below:

[ ] Architectural Drafting	[ ] Auto. Engineering
[ ] Machine Drafting	[ ] Aero. Engineering
[ ] Electrical Drafting	[ ] Gas Engines
[ ] Structural Drafting	[ ] Plan Reading—Buildings
[ ] Sheet Metal Drafting	[ ] Estimating—Buildings
[ ] Topographic Drafting	[ ] Plan Reading—Machinery
[ ] Surveying	[ ] Plumbing—Estimating
[ ] Designing	[ ] Heating and Ventilating
[ ] Contracting—Buildings	[ ] Steam Engineering

Name .....

Address .....

Post Office.....State.....

College or Home Study. State which.....

Free Lesson when inquiry is for Draftsmanship or Plain Reading.

Learn Draftsmanship At Home



THE employer today knows the value of technical knowledge. He surrounds himself with experts—not merely good mechanics but technically trained practical men. He is ready and willing to pay their price, for he wants expert advice and service.

Get the facts about the Chicago "Tech" Course in Draftsmanship (or any of the other big paying professions listed on the coupon). You can master all these courses quickly by spare time study at home. Draftsmen earn bigger salaries than ever before, because trained men are scarce. Hundreds of big paying jobs waiting and not enough experts to go around.

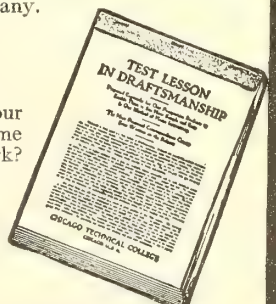
Constant and Growing Demand for Trained Draftsmen

Proficient men are needed badly in the drafting departments of big manufacturers, architects, railroads, electrical plants, etc. Many experts earn $60 to $150 weekly.

This is your big chance. See how well qualified you are before you spend one penny. Send for the Free Test Lesson described below. Also learn how and why a Chicago "Tech" course will make you the man chosen from among many. Clip and mail the coupon—now.

Experts Teach You Their Practical Methods

The Chicago "Tech" method trains you under experts who equip you for important positions in the shortest practicable time. You learn exactly the methods which they use in their own practical work. They give you the training that ranks you with draftsmen of long experience—that is required of men who aim to hold executive positions. Why be content just to take orders when you have it in you to *Give* orders, once your training gives you the confidence to assume charge of the men who do the actual work? The practical knowledge you get from Chicago "Tech" experts fits you to step right out and earn a big salary.



Choice of 18 Courses that Will Increase Your Salary

There is no better way to spend your leisure hours than in fitting yourself for the big jobs above you. If you want to master quickly any other technical study, make your choice from the wide range of big paying professions listed on the coupon. If you cannot come to the College, you will get the same course—the *same thorough individual instruction from the same experts by mail.* It does not matter where you live. Your lessons are directed and every exercise read and corrected by experts who make every point clear. You progress as quickly as your lessons show that you have mastered their subjects. With the practical knowledge you have gained from a Chicago "Tech" course, an employer need not take long to decide. You will be the man chosen—the man pushed ahead—because you will not only *know how to do things* but *why they should be done.* And no matter which course you decide on, you learn just the things you need know from practical men who give you the benefit of their long training. They fit you to start at a good salary and to win rapid promotion.

Act Today Decide right now—get the facts. Find out how hundreds of ambitious men have prepared themselves for high positions merely by using their spare time for study. This information costs you nothing. Just put X in the square on coupon opposite the course you want to know about. Then clip, sign and mail the coupon today.

Send for FREE Test Lesson

Shows you how well qualified you are for draftsmanship. Other schools ask you to enroll and send money first. We send the free lesson first. Read it—practice the exercises—no obligation. Decide for yourself whether you want to take the course or not.

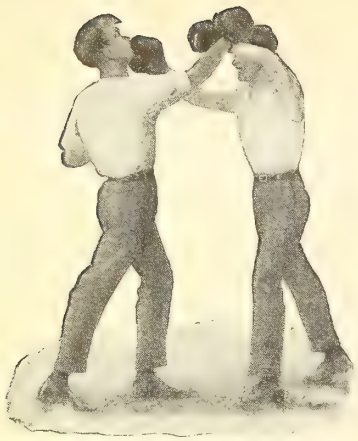
FREE OUTFIT

With our home study course is included a complete set of high-grade instruments, drawing board, T-square, etc. Same as leading draftsmen use. Credit given if you already have an outfit.

Chicago Technical College

1245 Chicago "Tech" Bldg.
Chicago, Illinois

CLIP THE COUPON NOW



Surprise the Best Boxer

JUST imagine how tickled you'll be, the next time your pals have a boxing bout, to meet that chap who thinks he "knows it all" and box rings around him—show him blows he never knew existed, hit him wherever and whenever you please, and guard, duck and side-step so cleverly that he can't even land on you! This is easy when a fellow has learned the methods used by professionals.

Marshall Stillman, the pupil of the famous Professor Mike Donovan, is teaching boxing to hundreds of live young men—and to men as old as 60—right in their own home. Over 10,000 pupils have studied his old course and think it wonderful. His new course is better still—and bigger. It teaches boxing, jiu jitsu, wrestling and physical development.

The system is unique. Lessons are practiced before a mirror, and you start with such simple movements as reaching out your hand for a coin, the breast stroke in swimming, etc. Step by step you are led into striking heavy blows, guarding, ducking, feinting, side-stepping, just as if you had a real opponent before you. You are taught every good blow used in the ring, when to use it, where to land it, and how to guard against your opponent's blows.

To develop your speed, you practise three rounds of shadow boxing daily, using such scientific blows as the Mike Donovan Double, the Jack Dempsey Triple, the Bennie Leonard Triple, the Fitzsimmons Shift, etc.

Then comes instruction in Jiu Jitsu—how to disarm an opponent with pistol, dagger or club, how to stop a kick, how to break a strangle hold on your throat, etc. The Wrestling Lessons include the Gotch Toe Hold, the Stecher Scissor Hold, etc.

The Health Exercises are designed to build strength and endurance—not simply muscle—and include the Colon Exercise, a remedy for constipation, and Synthetic Breathing, a great lung developer and aid in curing nervousness.

Other features are a history of 69 great prize fighters, with their pictures (tells inside stories not generally known, their pet blows, etc.), lessons in Mass Boxing, an article on training, and a copy of the new International Sporting Club's Boxing Rules.

There are 246 illustrations—some course, eh?

SENT FREE ON APPROVAL

We send the entire course (6 books) on approval. Order now, and pay for it on the 15th of next month ($5 in the United States, $6 in Canada, $7 in foreign countries). If you don't like the course, return it in 10 days, and that will end the matter. But you'll keep it all right! Mail the coupon now to the Marshall Stillman Association, Suite E-112, 461 Fourth Avenue, New York.

COUPON

MARSHALL STILLMAN ASSOCIATION
Suite E-112, 461 Fourth Avenue, New York

You may send me your complete course in Boxing and Self-Defense, including extra instruction described above. I give you my pledge that you may feel safe in trusting me as agreed, and that I will pay $5 ($6 in Canada, $7 in foreign countries) for the course on the 15th of next month or return it in 10 days after I receive it.

Name.....

Address.....



WANTED-Railway Mail Clerks

$1600 to $2300 year

Hundreds needed. Examinations Coming Everywhere.

FRANKLIN INSTITUTE
Dept. E181 Rochester, N.Y.

Sirs: Send me without charge (1) sample of Railway Mail Clerk Examination questions; (2) list of government jobs open to men and women and (3) free book describing them.

Name.....

Address.....

Popular Astronomy

By ISABEL M. LEWIS, M.A.

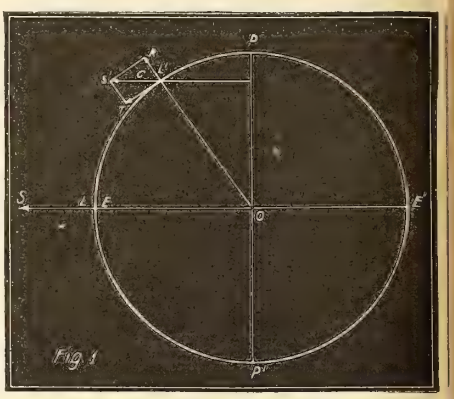
(*Continued from page* 861)

would have had a much greater vertical range than they have at present and the sedimentary deposits along the early coastal lines would have been much coarser than they are today. There is absolutely no geological evidence to this effect.

So both the geological evidence and the development of the tidal theory upon the assumption that the earth is highly elastic, instead of viscous, lead to one and the same conclusion—that the earth's rotational period since the formation of its surface crust has never been appreciably greater than it is at present; and for the moon to have separated thru centrifugal force from a fully formed earth and to have revolved close to the earth's surface during the earliest period of the earth's history would be contrary to the known facts and a physical impossibility.

The theory that the moon was once an integral part of the earth has had many adherents and has been put forward by many of the world's most greatest scientists, and from the foregoing facts and considerations it would seem that this is indeed a physical possibility.

One of the reasons why this would seem so is the fact, as shown clearly in the tabulated data given below, that when the earth rotates in a time-period sufficiently short to increase its periferal velocity at the equator to the point where centrifugal force would overcome gravitation, then practically total disintegration of the earth itself would undoubtedly occur.



The Circle Represents the Section of the Earth With Axis PP' and Equator EE'. The Arrow SL Represents the Centrifugal Force at the Equator. Nearer the Pole S'L' Represents the Diminished Centrifugal Force and of This Only a Part, the Radial Component RL', Operates to Reduce the Weight of Any Object.

SHAPE OF THE EARTH AND DISTRIBUTION OF SURFACE GRAVITY FOR DIFFERENT PERIODS OF ROTATION.

Rotation Period hours	Equatorial Diameter miles	Polar Diameter miles	Polar Flattening miles	Polar Weight (of man weighing 150 lbs. at Equator) at 24 hours rotational speed lbs.	Equatorial Weight lbs.	Centrifugal Force (at Equator) dynes
24.0	3963	3950	13.3	150¾	150	3.4
14.0	3972	3932	40	151	149	8.0
7.5	4005	3867	138	156	144	34.9
4.5	4090	3680	410	156	133	99.6
4.0	4124	3609	515	157	128	124.5
1.41*	....	....	...	...	0	981.4

*Note:—For this rotational period a man would weigh nothing at the equator but considerably more than 150 lbs. at the poles. For higher velocities objects in equatorial belt would leave the earth's surface, and the earth would be in such unstable equilibrium that it would disintegrate.

Einstein Theory and the Fourth Dimension

(*Continued from page* 890)

You see everything is relative in this world. To make the latter clear, consider Fig. 5. When you take a train from New York to San Francisco you have every reason to believe that you are moving from east to west at the speed of the train, which let us say is 60 miles an hour. You are quite certain you are going west. Fig. 5 shows that you do nothing of the sort. *You are going due east,* because the earth revolves from west to east, and, while you move west at the rate of 60 miles an hour, *you are really going east* due to the rotation of the earth at a speed far exceeding many times 60 miles an hour. In other words, while you think you are going west at the rate of 60 miles an hour, you are really going east at nearly ten times as great a speed. This is another instance of relativity.

The Fourth Dimension.

This brings us to the fourth dimension. As we have just seen everything is moving. Nothing really stands still. Anything that we can imagine really moves, whether it is stationary on earth or anywhere in the universe. Heretofore we said that an object, let us say a cube, had length, width and depth. This is our classical three dimensional body, but in Einstein's world we must now add another dimension, the fourth dimension, viz., TIME-SPEED (see Fig. 2). Here we have first the so-called stationary body (altho it really is not stationary at all). If we move this body, which let us say is a brick, at a speed of about 100,000 miles per second, we find that it contracts somewhat in the order as shown in the illustration. While moving at a speed of about 175,000 miles per second—in other words, almost as fast as light itself—we find that our brick has contracted sufficiently to almost form a cube. Thus our rectangular brick, while at rest, shortens or contracts in the direction of its axis when speeding at a tremendous speed. Inasmuch as this contraction or shortening only takes place while the brick speeds on, and because you cannot have speed without time, the fourth dimension of this brick is now termed time-speed. This is an astonishing result, but it probably comes nearer the truth of what the fourth dimension really is than any of the older theories in vogue heretofore. It is rather difficult for us to comprehend just what this fourth of the four dimensions, viz., length, width, depth, time-speed, really means because on earth, as far as we ourselves are concerned, there are no such speeds as 175,000 miles per second, or even 100,000 miles. We simply cannot comprehend such speeds.

(*Continued on page* 897)

Hurry Call=

The Price of the CROFT LIBRARY of PRACTICAL ELECTRICITY must go up

It is doubtful if you will ever again have the opportunity to procure an accurate training in electricity at such a low cost.



8 flexible pocket books—over 2,000 illustrations, the best illustrated and most easily understood electrical library in existence.

ANYONE acquainted with the paper situation in this country understands the absolute necessity for increasing prices of all printed literature. While other commodities have doubled and trebled in price during the past few years, technical books have remained nearly stationary, and as a result hundreds of publishers have been compelled to close up shop.

NOT ONE CENT IN ADVANCE

There is plain evidence before us every day that the opportunities in the world of electricity are increasing constantly. Opportunities have always been abundant, but today there are more high-paying positions open than at any time in the history of electricity—even during the high production period of the war. The educational institutions simply cannot train men fast enough, because new uses are being found for electricity every day, and the progress of the world more and more depends upon it.

Terrell Croft is doing his share in teaching men the correct principles of electrical practice. He knows the game from experience. He has poured out all his secrets, all the short cuts, all the time savers, in language that even the common school boy can easily grasp. Yet the text is so scientifically correct that thousands of the highest paid electrical engineers are using the books as references.

The Croft Library of Practical Electricity is inexpensive, and still it contains more real practical working data than is probably embodied in any existing course, even those costing hundreds of dollars.

You will surely want the Croft methods some day, and by ordering now you will effect a very considerable saving.

Fill out the coupon today, now, and get your set at the old price.

Read This—

Electricity, from the simplest principles to complete and economical operation of a central station—

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect in accordance with the National Electrical Code.

Wring of finishing buildings. Underwriters' and municipal requirements. How to do the complete job, from estimating it to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the short-cuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

McGraw-Hill Book Co., Inc.

239 West 39th Street, New York

Publishers of Books for Engineers Since 1876

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.
239 West 39th St., New York.

Gentlemen: Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions. (Price subject to advance.)

Name .....

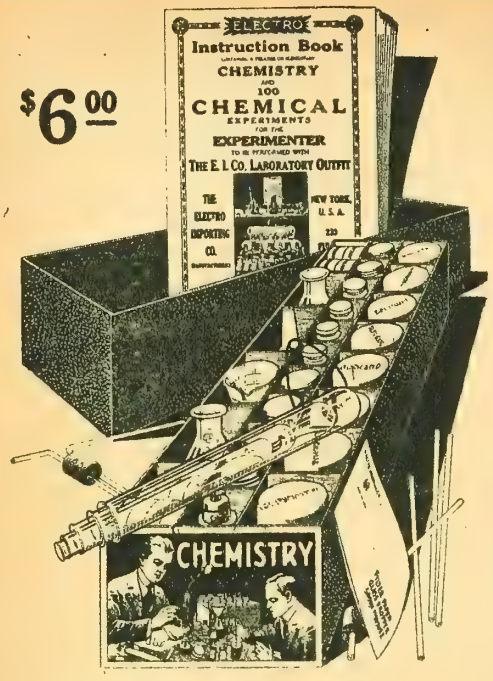
Home Address .....

City and State .....

Where Employed .....

Occupation ..... S & I 12–20

Chemical Laboratory



$6.00

No. 4889

We present herewith to our friends our **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform real chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

DESCRIPTION OF THE OUTFIT:

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The Instruction book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the Elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English System and the U. S. System are fully explained.

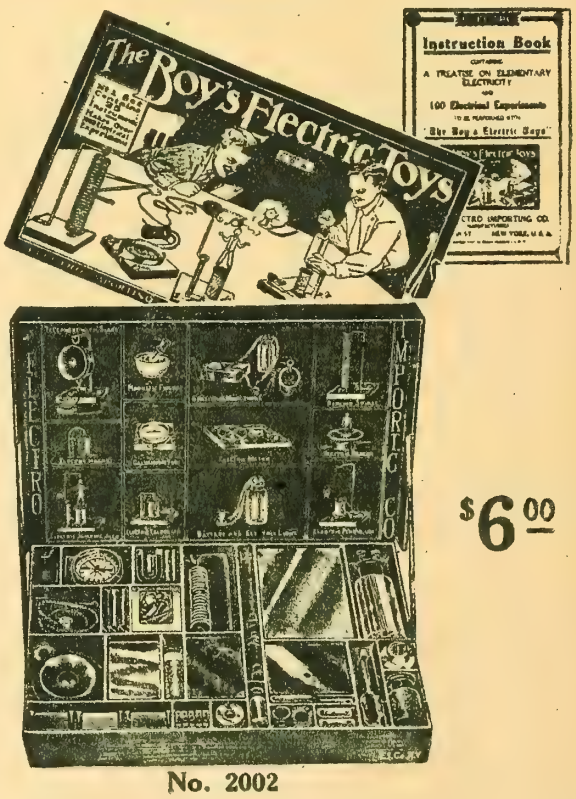
The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the 100 Experiments are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and Smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make Chemical Colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

Price $6.00. Shipping Weight 10 lbs. (Can be shipped by Express only.)
Immediate Shipment

The Boy's Electric Toys



"THE BOY'S ELECTRIC TOYS" contains enough material TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size over all of the outfit is 14 x 9 x 2¾. Shipping weight, 8 lbs.
No. 2002 "The Boy's Electric Toys," outfit as described.....$6.00

IMMEDIATE SHIPMENTS

$6.00

No. 2002

"The Livest Catalog in America"

IN this cyclopedia you will find all about radio. One of the greatest catalogs of its kind in print.

You will find in it dozens of wireless instruments of the famous E. I. Co. make.

Other things you will find listed in this catalog: Electrolytic Interrupters, Bulldog Spark Coils, Chemical Outfits, Code Practice Sets, Primary Batteries, Storage Batteries, Hydrometers, Volt and Ammeters, Batterymeters, Electrolytic Rectifiers, Rheostats, Tesla Coils, Microphones, Loud Talkers, Electro-magnets, X-ray Tubes, Telephones, Magnetos, Low Tension Transformers, Books, etc., etc. IN A WORD THE MOST COMPLETE CATALOG IN PRINT.

FREE with this wonderful cyclopedia —20 coupons for our 160 page Wireless Course in 20 lessons. 350 illustrations, 30 tables. Catalog explains how you can get this Course absolutely free.

The Electro Importing Co.,

231 Fulton Street **New York**

"Everything for the Experimenter"

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

I enclose herewith 10 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 22 as described.

NAME .....

ADDRESS .....

STATE..... S.&I. 12-20

15 Automobile Experts at Your Command



Let these fifteen world-famous auto engineers help you into a big paying job. They can do it. The Library of Automobile Engineering written by these men will tell you everything you need know to earn $50.00 to $100.00 a week or more in the auto game. Start right now. More men are needed—thousands of men are needed to keep the country's eight million cars in good going condition. Over 75,000 sets of these great books have been sold on our no-money-down-easy-payment-plan. See our free offer below.

You can Earn $50 to $100 a Week

Auto Books
6 Volumes SENT FREE

No matter if you don't know a thing about automobiles now, you can learn the auto game backward and forward with these books to help you. They explain everything. They turn every make of car inside out—show you how it is made—how to repair it—how to keep it in good condition—how to go into the garage business for yourself. 6 big books bound in flexible American morocco containing 2600 pages of money-making facts and more than 2000 pictures, blueprints and diagrams. Anyone who can read can understand them.

Send No Money

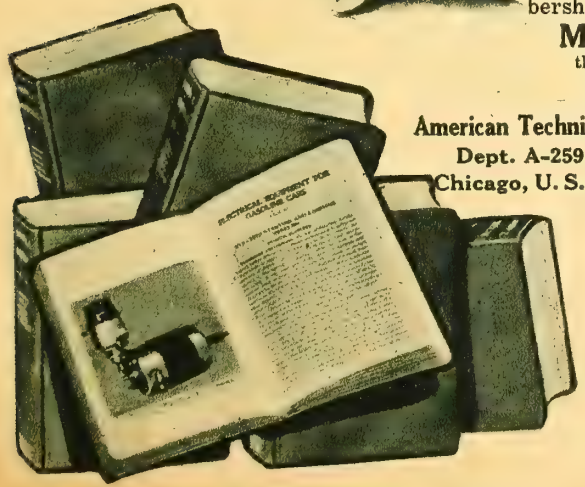
You don't have to pay one cent in advance. Just mail the coupon and use the books for a whole week in your home or shop—then decide whether you want to keep them or not. If you like the books, send us only $2.80 in seven days and $3.00 each month until $29.80 is paid. If you don't like them, just ship them back at our expense and you won't owe us a cent. Along with each set goes FREE a membership in this society, worth $12.00. Mail the coupon now, before the membership is filled.

Mail Coupon Now The coupon is all you need. See the books before you pay anything. This is our guarantee that you will be satisfied. There is no risk on your part. Mail the coupon now.

Learn All About

Automobile Motors—Welding—Motor Construction—Repair—Carburetors and Settings—Valves—Cooling—Lubrication—Flywheels—Clutches—Transmission—Final Drive—Steering—Frames—Tires—Vulcanizing—Ignition—Starting—Lighting—Shop Kinks—Garage Design and Equipment—Electrics—Storage Batteries—Care and Repair of Motorcycles and Trucks—Gasoline Tractors and How to Repair Them.

128 Blueprints Electric Wiring Diagrams



American Technical Society
Dept. A-259
Chicago, U. S. A.

FREE EXAMINATION COUPON

AMERICAN TECHNICAL SOCIETY
Dept. A-259, Chicago, U. S. A.

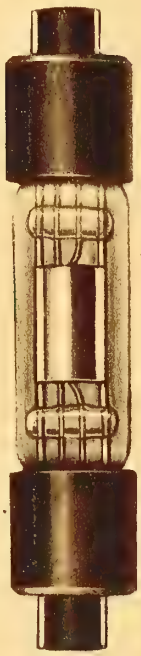
Please send me the 6-volume set of Automobile Engineering for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within 7 days and the balance at $3.00 a month until the $29.80 has been paid. Then you send me a receipt showing that the books and the $12.00 Consulting Membership are mine and fully paid for. If I think I can get along without the books after the 7 days' trial, I will return them at your expense.

Name .....

Address .....

Reference .....

$3.50



Actual Size

The First Universal AUDION



Audio Frequency Amplifier
Radio Frequency Amplifier
Audion Oscillator



Universal Audion Receptacle $ 1.00

RADIO AUDION COMPANY INC.

90 OAKLAND AVE., JERSEY CITY, N. J.

Manufactured under De Forest Patents No 841,387 and No 879,532

Einstein Theory and the Fourth Dimension

(*Continued from page 892*)

Yet every time we have ourselves X-rayed, the particles that are shot off from the anode of the X-ray tube travel precisely at such tremendous speeds and, due to their speeds, produce such extraordinary results.

Light Is Four Dimensional.

Take a ray of light traveling 186,000 miles per second. Interpose a cube of glass that may be a yard thick between yourself and the ray of light. Altho glass is one of the hardest and densest substances known, the light ray passes right thru it as if the wall of glass were not there. Yet we have reasons to believe that light really has substance. In other words, the particles which make up light are just as solid and real as the brick shown in Fig. 2, but in moving at such a tremendous speed, these particles undergo certain physical changes, of which as yet we are ignorant because these particles truly move in the fourth dimension and, as such, are subject to entirely different laws than those which we know now.

The same is the case of radium. We know that radium shoots off highly charged alpha particles at a speed approaching that of light. These particles, which are just as real as those which make up a brick, are hurled right thru glass, metals, a human hand and most other substances as if these substances did not exist. These alpha particles, moving as they do, have a real fourth dimension otherwise they could not and would not do what we know them to do.

The Pressure of Light.

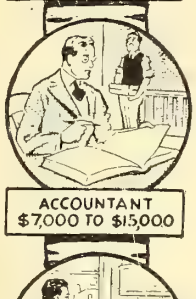
Once upon a time it was thought that light was simply a wave motion of the ether without having any substance. We are, however, slowly reverting to Newton, who, steadfastly asserted that light is corpuscular, in other words, made up of small particles, and recent investigations tend to show that Newton was not altogether incorrect. We know, for instance, that the sun exerts a certain amount of pressure on the earth, amounting to over a hundred tons. This pressure is just as real as if fine streams of water shot from the sun were pressing upon the surface of the earth. This pressure of the light is proven most effectively by a comet's tail. The tail of a comet, as we know, is always turned away from the sun no matter where the head is located in its orbit around the sun. As is well known, the tail of the comet, which is made up of thin gases, is moving in a vacuum. As the tail is sprayed with the rays of the sun a certain amount of pressure is brought to bear upon the gas particles, and they thus move away until they encounter the least resistance, which is right behind the comet's head. The comet's tail in this case behaves exactly in the same manner as a weather vane, which always places itself in the line of least resistance, pointing with the arrow to the direction whence the wind is blowing strongest. The pressure of light has been verified by many experiments on earth as well. It is shown in Fig. 7. Here we see the light ray coming from a distant star being deviated by the gravitational field of the sun. This experiment has actually been proven on a photographic plate.* If the ray of light shown in Fig. 7 was merely a wave motion of the ether, it is inconceivable how it could possibly be deflected by the sun's gravitational field.

**See "Electrical Experimenter," January issue, page 887.*

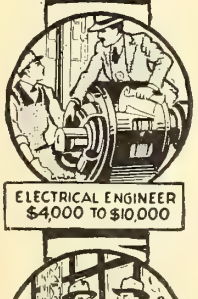
"I'm A Man- I Want Man's Pay!"



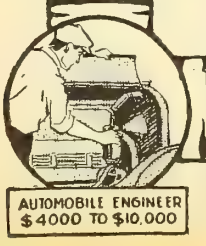

ARCHITECT $5,000 TO $15,000


ACCOUNTANT $7,000 TO $15,000


BUSINESS MANAGER $ 5,000 TO $15,000


ELECTRICAL ENGINEER $4,000 TO $10,000


CIVIL ENGINEER $5,000 TO $15,000


AUTOMOBILE ENGINEER $4,000 TO $10,000

That is what Albert Foster wrote us eighteen months ago, and he goes on: "I'm tired of being bossed for $25 a week. I want a He-Man job with real pay. I want to get into the $100 a week class. Tell me how to do it." We showed him how. Today he has a He-Man job and He-Man pay. We tell of his experience because it's typical.

WHAT ARE YOU? A man who is up and doing, getting real money, or are you simply marking time on $25 or $30 a week? $100 jobs don't go begging. If you want one you've got to go after it. Are you satisfied with your present condition in life? If you are, we have nothing to offer you, but if you want one of these real jobs with big pay, then we can help you and help you in a hurry.

A REAL MAN with a real man's pay is what you want to be, and we will show you how. Without loss to you of a single working hour, we will show you a sure way to success and big pay. A large number of men in each of the positions listed are enjoying their salaries because of our help —we want to help you.

Make a check on the coupon against the job you want and we will help you get it. Write or print your name on the coupon and send it in today. You will be under no obligation.

American School of Correspondence
Dept. G 926 **Chicago, U. S. A.**

AMERICAN SCHOOL of CORRESPONDENCE

Dept. G-926 Chicago, Ill.
Explain how I can qualify for position checked:

Architect $5,000 to $15,000	Accountant and Auditor $2,500 to $7,000	Steam Engineer $2,000 to $4,000
Building Contractor $5,000 to $10,000	Draftsman and Designer $2,500 to $4,000	Foreman $2,000 to $4,000
Automobile Engineer $4,000 to $10,000	Electrical Engineer $4,000 to $10,000	Photoplay Writer $2,000 to $10,000
Automobile Repairman $2,500 to $4,000	General Education In one year	Sanitary Engineer $2,000 to $5,000
Civil Engineer $5,000 to $15,000	Lawyer $5,000 to $15,000	Telephone Engineer $2,500 to $5,000
Structural Engineer $4,000 to $10,000	Mechanical Engineer $4,000 to $10,000	Telegraph Engineer $2,500 to $5,000
Business Manager $5,000 to $15,000	Shop Superintendent $3,000 to $7,000	High School Graduate In two years
Certified Public Accountant $7,000 to $15,000	Employment Manager $4,000 to $10,000	Fire Insurance Expert $3,000 to $10,000

Name _____

Address _____



"At Last—a *Real* Job and *Real* Money!"

"And if only I'd started earlier, I could have had them five years ago. I didn't realize at first what spare time study would do for a man. Taking up that I. C. S. course marked the real beginning of my success. In three months I received my first promotion. But I kept right on studying and I've been climbing ever since."

Every mail brings letters from some of the two million students of the International Correspondence Schools telling of advancements and increased salaries won through spare time study. How much longer are *you* going to wait before taking the step that is bound to bring you more money? Isn't it better to start *now* than to wait five years and then realize what the delay has cost you?

One hour after supper each night spent with the I. C. S. in the quiet of your own home will prepare you for the position you want in the work you like best.

Yes, it will! Put it up to us to prove it. Without cost, without obligation, just mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6172-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

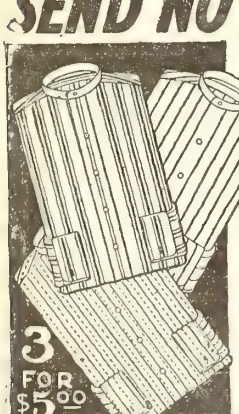
Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

SEND NO MONEY



Write quick for this amazing shirt bargain. Only limited lot. Wonderful quality fine count percale. Record breaking cut price. Guarantee $8.00 value for only $5.00 C. O. D.

Send No Money just your name and neckband size on postal or letter for these **three wonderful percale shirts.** Cut extra large, roomy armholes. This season's latest black, blue or lavender stripe effects on white background. Guaranteed fast color. Best quality pearl buttons, soft French turn back cuffs, finest workmanship.

We guarantee to refund your money if you can match these 3 shirts for less than $8.00. **Save money**—write today before this astounding offer is withdrawn. We pay delivery charges. You pay only $5.00. Just send your name, address and neckband size.

BERNARD, HEWITT & COMPANY
Dept. B 3912—900 West Van Buren Street Chicago, Illinois

What are Dreams?

By WILLIAM M. BUTTERFIELD

(*Continued from page 852*)

Dreams Are Exaggerated Memories, It Is Thought

Dreams are memories; memories are recollections of past physical experiences. These experiences are obtained usually thru the sense organs. These operations are mechanical, hence dream-thoughts are mechanical reflex operations, corresponding in a reverse way, we may say, to the original spontaneous operation in the memory center. This being the case, *a dream-thought can only be of some impression already in the mind.*

Helen Keller, born blind, deaf and dumb, never had dreams of things that can be seen, things that can be heard, or of letters, figures, pictures, etc. Her mind was ignorant of these things and of course could not furnish dream-thoughts such as are common to people with normal sensation. Her dreams were of talking with the fingers, for example.

Innumerable cases can be given to prove the fact that dreams are mechanical operations of the brain and sense organs; that dreams are created from mental impressions obtained from previous experience; and that they are aroused by some natural stimulus, either outside or inside of the body. The mind is actively receiving impressions from the earliest infancy to the last instant of consciousness, and it is evident that new impressions are received and recorded, as additions to memory, even at the moment of dreaming.

So vast and intricate is this store of personal knowledge that the individual is unaware seemingly of the major portion of it, and it is only when some stimuli causes memory to produce a recorded portion,—very often to the wonderment of the person,—that he realizes that he possesses the bit of knowledge. A very large part of our store of sense experiences are received subconsciously, and as the mind undoubtedly retains each and every impression thru life, *a considerable part of our knowledge is subconscious.* Subconscious knowledge is recalled by stimuli just as is any well known impression.

Day Dreams and Sleep Dreams

Such biological facts are confusing, and would be unbelievable were it not that every rational person is constantly experiencing mental reflexes that prove them. Sleep-dreams and day-dreams are common to us all; we all realize that our day-dreams at least are shaped by our personal experience; it does not, therefore, require much reflection to convince us that sleep-dreams are evolved from our personal experiences also. We are aware that many of these dreams are confused,—jumbled together,—a piece of recollection here, another there, so that no matter what effort we make we cannot, even when awake, straighten them out.

If this confused state of mental action is of common occurrence in reflection during our waking hours, we should not be surprised that sleep reflection is often jumbled, fantastic, undefinable. Sleep thoughts are composed almost entirely of impressions received from the sense of vision, and for this reason are rarely more than pictures of things, places or persons that have been seen. If the sleeper recalls words, letters, figures, drawings, and the like, it will invariably be found that these have been seen at some time also.

When words are spoken, sung or otherwise used, as in shouting or declaiming, they are in the language or languages that

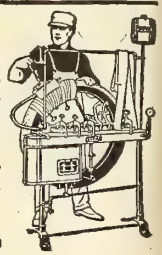
(*Continued on page 902*)

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

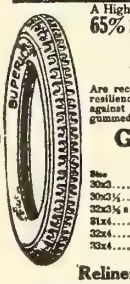
FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2211 Fourth St. Waupun, Wisconsin

TIRES GT'D 5000 MILES ORDER THEM BY MAIL SAVE 65%

A High Standard reconstructed tire at prices equal to 65% Saving regardless of the constant increase in tires. Ask for them by name.



Superior Tires

Are recommended for their durability, long service, and resiliency. Each tire has supplemental reliner as precaution against blowouts, pinches, etc., and three extra layers of gummed fabric.

Guaranteed 5,000 Miles
and adjustments made on that basis

Size	Tires	Tubes	Size	Tires	Tubes
30x3	$5.50	$2.00	34x4	$9.25	$2.60
30x3½	6.50	2.10	34x4½	10.75	2.85
32x3½ as a only	7.50	2.20	35x4½	11.00	2.90
31x4	8.50	2.40	36x4½	11.50	3.00
32x4	8.75	2.45	35x5	12.25	3.20
33x4	9.00	2.50	37x5	12.75	3.35

Reliner Free With Every Tire

State whether you want straight side or clincher, plain or non-skid. Send $2.00 deposit for each tire; $1.00 deposit on tubes; balance C. O. D., subject to examination, or 5% discount if full amount is sent with order.

SUPERIOR TIRE & RUBBER CO.
633 First Avenue Department 612 New York City

The Seneca MOTOR CAR — Built for the Owner — $1185



Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. Comfortable E-Z riding

4 cyl. - 27 H. P. 108 in. wheel base

Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. Write or Wire NOW.

THE SENECA MOTORCAR CO., 52 Seneca Factory, FOSTORIA, OHIO

Learn Autos and Tractors



Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

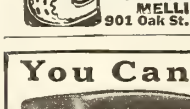
Cleveland Automobile School, 1807 E. 24th St., Cleveland, O

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. **Guarantee Bond for 8000 Miles.** (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.
901 Oak St. Kansas City, Mo.

You Can Save $50.00



$8.46 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

CONVERT YOUR BICYCLE INTO A MOTOR CYCLE



by using a STEFFEY ATTACHMENT
Simple-Reliable-Economical

Fits any ordinary wheel, diamond, double-bar or truss frame. Easy to attach. Send stamp for circulars.

STEFFEY MFG. CO.
Dept. E, 5025 Brown Street, Philadelphia, Pa.

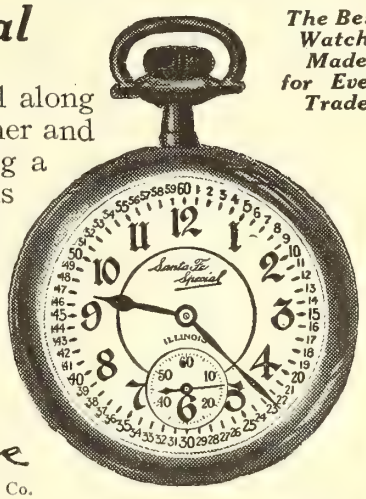


Buy the Best Watch Right

MY GUARANTEE
If a Santa Fe Special Watch fails to perform its duty properly through original defective material or workmanship it will be repaired by us without a cent of expense to you or replaced by a watch of the same grade. This wonderful watch will without a doubt last a lifetime and give satisfactory service and is within the reach of every working man.

It's Easy to Own a Santa Fe Special

The Best Watch Made for Every Trade



A Railroad Man is always a good judge of watches. And all along the line, from the engineer and the dispatcher to the telegrapher and the track-walker, whenever you find a railroad man carrying a SANTA FE SPECIAL you will find him satisfied with it. This watch has enabled me to boast that I have customers who are boosters in every section of the United States. Why shouldn't I be so proud of it that I will advise you to buy no other? If you need a watch for yourself, or are thinking of buying one for a friend or relative, let me tell you about this wonderful timepiece and explain my easy payment plan before you buy. I will give you the greatest guarantee of service and satisfaction that can be made.

Signed, Aloyzo A. Thomas
Pres. Santa Fe Watch Co.

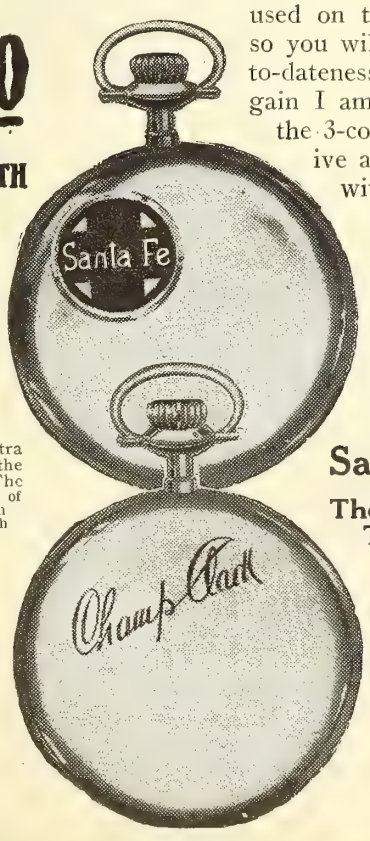
Christmas orders and orders for special occasions should not be delayed. ***Don't wait! Send in your order today.***

The ILLINOIS Famous $ Santa Fe Special 21 JEWEL RAILROAD WATCH 3.50 A MONTH

The Standard Railroad Watch that is GUARANTEED FOR A LIFETIME OF SATISFACTORY SERVICE. These watches are now in service on practically every railroad in the United States and in every branch of the Army and Naval Service. Thousands of them are distributed around the world. Your name or monogram and any emblem you may desire will be engraved in the case to suit your own ideas. Write today for my Free Watch Book to make your selection.

Save One-Third to One-Half of your Money—Most Liberal Offer Ever Made.

Our "Direct-to-you" low wholesale terms and Extra Special Distribution Plan is fully explained in the New Santa Fe Special booklet just off the press. The "Santa Fe Special" plan means a big saving of money to you and you get the best watch value on the market today—Watch sent for you to see without one penny down.



New Case Designs

I want you to see the newest designs in cases used on these "Santa Fe Special" Watches, so you will fully realize their beauty and up-to-dateness, as well as the value of the Bargain I am offering you. I want you to see the 3-color inlay work—think how distinctive and personal Your Watch would be with your own name, monogram or some appropriate emblem engraved in the case, just to suit your own ideas. You will also want to see the new French Art designs in engraved cases—all shown in My New Free Watch Book, printed in beautiful colors. Write today, it will be sent FREE.

Santa Fe Watch Company
Dept. C-80
Thomas Building,
Topeka, Kans.

Hon. Champ Clark,
House of Representatives,
Washington, D. C.

"I have carried a 'Santa Fe Special' for three or four years and find it to be an admirable timepiece."

CHAMP CLARK.

A letter, post card or this coupon will bring my Beautiful Watch Book FREE

SANTA FE WATCH COMPANY
Dept. C-80, Thomas Bldg., Topeka, Kans.

Please send me your New Watch Book with the understanding that this request does not obligate me in any way.

Name .....

Address .....

State .....

Listen



TO ME!

Be A CERTIFICATED ELECTRICIAN

THIS IS YOUR CHANCE OF A LIFE TIME

I am Chief Engineer of the great Chicago Engineering Works. I am in close official touch with the electrical world. I know how badly we need trained electricians who can take charge of important work as experts. Right now there is such a need for executive electricians that I am making a special effort to help meet the demand. I am publishing this special announcement to secure a certain number of ambitious men whom I will personally train by mail for the wonderful opportunities that are open.

I WILL MAKE YOU a Trained Electrician

I don't care how young or old you are, just as long as you can read and write and have a spark of ambition. I don't care where you live or what you do. I don't care if you don't know a blessed thing about electricity. Just give me a little of your spare time for a short period and I'll show you the quick way to success in electricity. You can qualify to earn $65 to $175 a week with opportunities for greater earnings.

I Train You By Mail!

Your spare time will do. No interference with your regular duties. I understand just what you must know and I have devised a wonderful way of instructing by mail. I positively guarantee your satisfaction.

FREE Wonderful Electrical Outfit

Absolutely free. Not a penny cost to you now or later. To those who enroll now I will give a wonderful set of Electrical Equipment with my compliments. Write me at once. I have only a limited number of sets to be given free. Drop me a post card or letter.

Write! You will have to act quick to get in on this opportunity. Write me today for full particulars. Drop me a post card. *Write Now.*

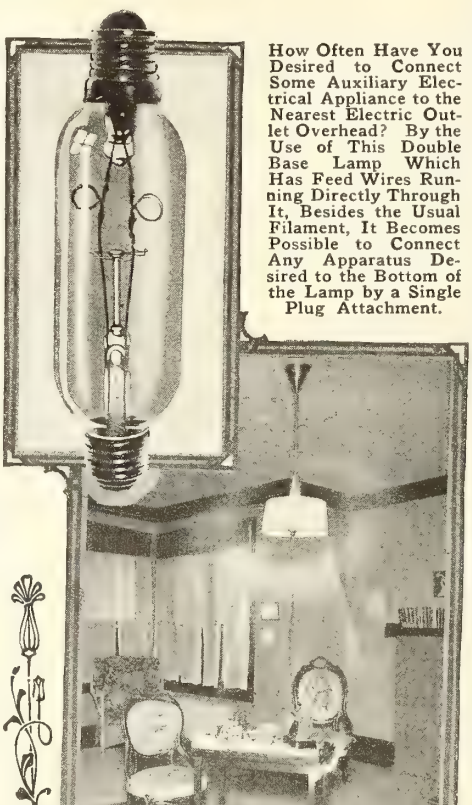
CHIEF ENGINEER COOKE
Chicago Engineering Works
Dept. 520y
1918 Sunnyside Ave. Chicago, Illinois

Home Electrics

(*Continued from page* 862)

A New Double Base Lamp

After considerable experimentation with extensible equipment of various kinds, the double base lamp shown has been developed by E. O. Schweitzer. This lamp may be made up in any style and capacity, but the one shown in the figure is a 60-watt Mazda B lamp, that is, the filament and filament mounting details are the same as for the standard S-21 bulb, 60-watt, 115-volt Mazda B lamp, but the lead wires and the details connected with them are standard 500-watt, type C, 115-volt specification. These heavy lead wires continue thru from base to base and the lamp filament is tapped off from them. The cane glass stops about one quarter of an inch from the secondary press, and furthermore the lead wires are formed into what might be termed an expansion loop, so that altogether there is no possibility of strain being set up due to unequal contraction and expansion of the bulb, cane, and lead wires.



How Often Have You Desired to Connect Some Auxiliary Electrical Appliance to the Nearest Electric Outlet Overhead? By the Use of This Double Base Lamp Which Has Feed Wires Running Directly Through It, Besides the Usual Filament, It Becomes Possible to Connect Any Apparatus Desired to the Bottom of the Lamp by a Single Plug Attachment.

Incidentally this is a tipless lamp, exhaustion of the bulb being carried out by means of a sealed-off tube concealed within one of the bases.

The lead wires are given a quarter twist in passing between the two ends of the lamp so as to provide clearance for the filament anchors. The lamp is furnished with the simple receptacle connector shown in Fig. 2, which is merely a duplication of the threaded portion of a medium screw base socket shell surrounded by either a fiber ring or with the addition of a light brass shell beaded at each end for use with any standard shade holder. This connector makes the lamp safe to manipulate and allows of any standard attachment plug being screwed in from the free end; or it permits any number of these double base lamps to be strung in parallel for such purposes as window or showcase lighting, etc., etc.

FREE Puncture Proof Tube
6,000 Miles Guaranteed



For a limited time only we are offering **absolutely free a puncture proof tube guaranteed 6,000 miles,** with every purchase of one of our famous Reliable Double Tread Tires which are guaranteed 6,000 miles and often give 8,000 to 10,000.

4 Reasons for Buying at this Bargain Offer
1—6,000 miles without a puncture!
2—Save repair bills!
3—Save entire cost of tube!
4—Save money on tires!

Price Includes Tire and Tube

Size	Tires	Size	Tires
30 x 3	$6.95	35 x 4	$12.00
30 x 3½	7.95	36 x 4	12.50
32 x 3½	8.75	34 x 4½	12.75
34 x 3½	9.00	35 x 4½	12.95
31 x 4	9.95	36 x 4½	13.25
32 x 4	10.25	37 x 4½	13.75
33 x 4	10.90	35 x 5	13.95
34 x 4	11.25	37 x 5	14.50

Free Reliner With Each Tire
In ordering be sure to state size wanted, also whether s. s. clincher, plain or non-skid. Send $2.00 deposit on each tire, balance C. O. D. subject to examination; 5 per cent discount if you send full amount with order. Rush your order today.
RELIABLE TIRE & RUBBER CO.
3473 Michigan Ave. Chicago, Ill.

YOU Can Do YOUR Own SOLDERING and All Metal Repairing With
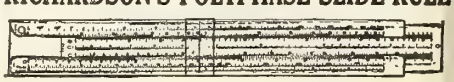
USED BY U. S. AND ALLIED GOVERNMENTS IN WAR



25c PER TUBE
TORCH $1.25

A PASTE THAT TURNS INTO METAL WHEN HEATED
A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.
SOLDERALL CO., Dept. E,
129 Sussex Ave., Newark, N. J.
COMBINATION SET Tube and Torch Complete **$1.50**
Dealers Send for Quantity Prices.
Look for Trade Mark "SOLDERALL"
Beware of Imitations with similar names

RICHARDSON'S POLYPHASE SLIDE RULE



has the regular A, B, C, and D Scales; also a CI or Polyphase Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10". A 100 page Instruction Book which teaches all there is to know about slide rules, is sent with each order.

Price of the Richardson's Polyphase Slide Rule, in case with 100 page Instruction Book $2.00.

An ideal Slide Rule. It is low priced and an equal to any other rule in appearance, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

Send for our 40 page catalogue of supplies. It describes rules ranging from 50c to $10. each. Instructions in Logarithms and Trigonometry free with every catalogue.

GILSON SLIDE RULE CO. NILES, MICH.

Send No Money

Profit Smashing Bargain—Just send your name, address, size and color for 6 pairs of these handsome, durable, genuine Duo-Web silk socks. Pay only $3.19 for 6 pairs on arrival. **GUARANTEED $5.00 VALUE.** Wonderful quality, extra heavy silk. Elastic ribbed top. Double toe and sole, high spliced heel. Choice of brown or black. Fast colors Write today for this astounding offer. Limited quantity. Only 6 pairs to a customer. Shipped delivery charges paid. Pay only $3.19 on arrival. Money back if you can match them for $6.00. **Dept. L-3912**



SMASHING OFFER 6 PAIRS SILK SOCKS. Guaranteed $6 value.
Don't send a penny. Pay only $3.19 on arrival.
BERNARD-HEWITT & CO., 900 W. Van Buren, CHICAGO

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. Only finest approval sheets, 50 to 60%. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Estab. 25 yrs. **10c.** Hussman Stamp Co., Dept. 118, St. Louis, Mo.

Get Pulsating HEALTH

From the Vibrant Forces of High Frequency Electricity

Sold On Trial

Not limited to a few days—but giving ample opportunity to determine benefits in your case.

Renulife VIOLET RAY

You Can Expect Results Like These Users:

"The Renulife Violet Ray High Frequency Generator is superior in efficiency because of its perfect character and control of current, compactness and perfect insulation. The smallness and lightness of Electrode holder is also a great advantage." "The doctor told me that the trouble was hardening of the arteries. I would not be without it for all the money in the world." "I cannot recommend it too highly." "I have been using mine now for a week for Sciatica and I am highly pleased with results." "I think it is one of the best little machines that was ever invented." "I have used it with excellent results for the restoration of hair and stiff and sore rheumatic finger joints." "Am well pleased with the Generator, and the kind treatment received from your Company." "My Generator has stopped my neuritis." "Every house should have a Renulife Violet Ray High Frequency Generator for the treatment of Neuralgia; Neuritis; Sore Throat; Kernels in Neck; Cramps; Headache; Stiff Neck; Muscular Soreness; Rheumatism; Paralysis; in short, pain of all kinds."—M. D.

"I have been much relieved by the use of your Violet Ray Generator."

"It is fine for insomnia."

"I find it such a help in nervousness."

"I would not part with it for five times the price. It is sure a little wonder."

"I am more than pleased with the Generator; the whole family are using it."

Get FREE Violet Ray Book

The application of electricity in this harmless and pleasant form—the Violet Ray—is the modern way to re-establish natural and healthy conditions. Write for Book giving full explanation.

In Your Own Home

Are you in bondage to ill-health? Suffering or handicapped by the lack of success-attaining, energetic, vigorous, natural *Health?* Then learn of Nature's inexhaustible store of *Health-bearing* forces—now ready to help you overcome suffering—build up strength—recuperate normal, healthy conditions. You can get this beneficial cooperation and help right in your own home. Recharge your body with the vibrant forces of electricity—through the *Renulife Violet Ray*—a source of pulsating dynamic health—the foundation of happiness and success.

Electricity is sprayed into your body—thousands of volts—quickening circulation, purifying the blood, imparting new vitality and strength. Local pains, aches and disorders disappear, while the entire physical being takes on new tone. Send for book explaining all this interesting subject.

Many Thousands Benefited

The wonderful RENULIFE VIOLET RAY GENERATOR transforms the electric current from your light socket into this powerfully effective health-giving administration as safe and pleasant as a ray of sunshine—No Shocks or Jolts—just a feeling of well being—permanently beneficial. Simple and safe for anyone to use.

Most remarkable results have been obtained in many chronic cases of nerve disorders, faulty circulation, anemia, paralysis, rheumatism, neuritis, catarrh, lumbago, soreness, lameness, etc. See list on coupon. Get the record of hundreds of cases.

RENULIFE ELECTRIC CO. 1212 MARQUETTE BLDG., DETROIT, MICH.

New York City 27 Warren St.

Canada { Windsor, Ont. Netting Bldg.

SALES DISTRIBUTORS WRITE
For Proposition on Exclusive Territory

COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO.,
1212 Marquette Bldg., Detroit

Please send without obligation your book "Health," explaining Violet Ray treatments with Renulife Generators; also give full particulars as to its application for ailments checked below.

TREATS SUCCESSFULLY

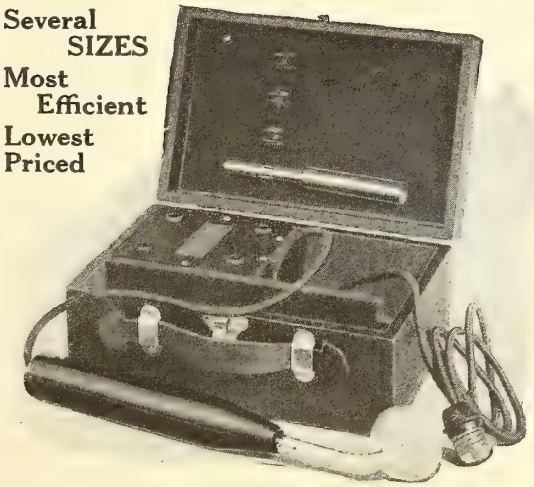
Abscesses	Facial Neuralgia	Obesity
Anemia	Failing Hair	Pain in Abdomen and chest
Asthma	Female Complaints	Paralysis
Arteriosclerosis	Goitre	Piles
Baldness	Gout	Pimples
Blackheads	Haemorrhoids	Pyorrhea
Brain Fag	Hay Fever	Rheumatism
Bronchitis	Infantile Paralysis	Scars
Bunions	Insomnia	Sciatica
Bruises	Lameness	Skin Diseases
Catarrh	Locomotor Ataxia	Sore Throat and Throat Diseases
Colds	Lumbago	Sprains
Childbirths	Nervous Affections	Toothache
Dandruff	Neuralgia	Weak Eyes
Deafness and Ear Diseases	Neuritis	Wrinkles
Eczema		Warts and Moles
Enlarged Prostate		

Name .....

Address .....

.....

Several SIZES
Most Efficient
Lowest Priced





Energizer. Saturate your body with revitalizing Violet Rays.



Stops Aches. The quick action in abating pains and aches is truly marvelous.



Rheumatism, Lumbago, neuritis greatly benefited.



For Skin and Scalp. Have beauty parlor at home.

Learn in Spare Time to be a CIVIL ENGINEER



Earn $1500 to $5000 Yearly

Here's your big chance to become a full-fledged Civil Engineer! With this set of books you can fit yourself to make big money in the greatest outdoor profession on earth! Offer fully explained in coupon. Good only within boundaries of the U. S. and Canada.

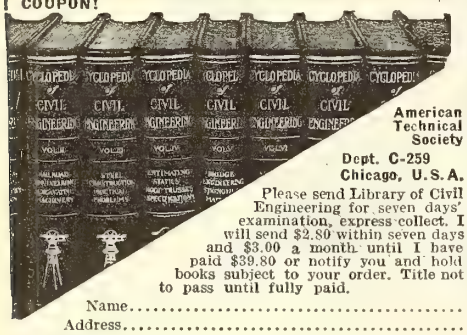
Great Books Shipped FREE

75c a Week if you keep them after 7 days' FREE TRIAL.

Nine big leather-bound volumes; 3900 pages 7x10 inches; 3000 plates, maps, diagrams, etc. Written by world's greatest civil engineers. Books tell you ALL ABOUT surveying; highway construction; railway engineering; earth work; specifications; estimating contracts; bridge engineering; masonry; reinforced concrete; water supply; sewers and drains; water power equipment; irrigation; engineering, etc., etc. Written in simple language—every point made plain.

Consulting Service Free

A $12 Consulting Membership solves your difficult problems for a whole year. FREE with the set of books. **SEND NO MONEY—JUST THE COUPON!**



American Technical Society
Dept. C-259
Chicago, U.S.A.

Please send Library of Civil Engineering for seven days' examination, express collect. I will send $2.80 within seven days and $3.00 a month until I have paid $39.80 or notify you and hold books subject to your order. Title not to pass until fully paid.

Name.....
Address.....
Reference.....

Different from all others—the NEW BENJAMIN AIR RIFLE



shoots harder and farther than any other. Made on a new principle. Is really a strong air-pump, compressing air in the air-chamber to any degree of power desired. Each stroke gives increased power, one to six strokes being sufficient.

Works like air-drills and air-hammers—with this difference:

You control shooting force. This block of hardwood shows penetrating power of each charge. No other air rifle can duplicate this feat.

The Benjamin is *safe*, because you control the power. Never loses shooting force—has no springs to get out of order.

Write for interesting folder about this wonderful gun.

At all dealers, $5.00. Ask your dealer for demonstration.

Benjamin Air-Rifle & Mfg. Co.
619 N. Broadway
St. Louis, Mo.

Pacific Coast Representatives:
McDONALD & LINFORTH, Call Bldg., San Francisco.

LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries. Thousands needed today. We give you personal and thorough training—practical, technical courses three months to two years, under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. **Not a trade school.** Enroll anytime. Do not judge us by size of ad but write for free illustrated catalogue.

FINLAY ENGINEERING COLLEGE
Greatest of its kind
1001 Indiana Avenue Kansas City, Mo.

Handwriting Tells You Secrets

Be successful. Find out what holds you back. Send us an ink specimen of your handwriting and $1.00. Our expert Graphologists will tell you your faults, virtues, talents, etc. Your $1.00 back if you are not satisfied.

ROBERT R. ROSS, 110 West 40th St., N. Y.

What are Dreams?

(*Continued from page* 898)

the user is familiar with, or has heard. It is during sleep that the most remarkable exhibitions of recalled subconscious knowledge are manifested. It is often exprest by the sleeper, speaking words in a foreign tongue, words that have been heard but the meaning of which is unknown. Other subconscious impressions are recalled to create a mental picture that appears new or original.

Prophetic, inventive or creative dreams are developed from our subconscious knowledge. Nightmares, night-terrors,—common to the child and the feeble-minded,—as well as most dreams of a mysterious nature are created from subconscious mental complexes. Dr. Sigmund Freud attempts to trace all dreams to infantile and childhood complexes, because he sees hidden in every dream a wish—fulfillment,—that is, dreams express yearnings, cravings, hopes, and desires that have not otherwise been fulfilled. Tho it is true, that all our acts, or thoughts governing them, are really directed by our desires, we can hardly say that a nightmare or night-terror is a wish-fulfillment or a reflection of a wish.

The stimuli that recalls knowledge to the mind may be an incitement or spur as intricate and elusive as the thought that produced it. It may be received consciously or subconsciously, and from without or within the body; thus we have dreams caused from the want of food, or from food, drink or drugs, that abnormally excite sensation. Cold, heat, light, sound, odor, all form external stimuli. Whatever form the inciter or inciters may have, they are all received thru the sense organs,—or to a degree thru the bone, tissue and other parts as some investigations claim—and indicate physical or external conditions which the mind is to determine by means of memory as favorable or unfavorable to the welfare or contentment of the person.

Dreams are therefore, in common with all thought, important aids to our physical machinery, and are formed seemingly to rest the body by a pleasing assurance of safety or to arouse the mind to action in an effort to protect the body from some threatened danger. Dreams or thoughts that dwell continually upon one subject are incited usually as danger signals and are commonly the product of a diseased mind or an infected physical organ. It is advisable when dreams or thoughts persist in this way to consult a physician, for dreams are not as Shakespeare says "children of an idle brain," but are, in this case, as well as all other cases, children of an active brain, seeking to arouse or to soothe the mind in its subdued control of the body in sleep.

Healthy Versus Unhealthy Dreams

When a person's body and mind are in a healthy, normal condition, he often has day dreams which are of a pleasant character, recalling and visualizing incidents of bygone days. Such visions are restful to the man who comes home tired, after long business hours and constant poring over books of law or other work, necessitating great mental strain. More often, however, we have dreams, which, as have been explained before, may be excited by either internal or external stimuli. Thus, in our center illustration, we see a dream caused by the cold air blowing upon a child's legs. Immediately this stimulus is transmitted to the brain where a picture

(*Continued on page* 904)

Order Your Scientific and Technical Books *Now.*

They are difficult to obtain and prices are constantly increasing. We will quote present price on any book of this nature and the price will hold unless the publisher should increase his price in the interim.

Write for our 96-page catalogue—the most complete scientific and practical catalogue now issued. In addition, our 1920-1921 list will be sent you as soon as ready, and the prices in this list will hold good in possibly 80 per cent of cases; but you will be notified of any change before filling order.

There will be no obligation in requesting catalogue for we want you to know our Book Department. Write today. You'll find it valuable for suggesting books you need.

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Room 655, Woolworth Bldg., New York City

Electrical Engineering In One Year

men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete



Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 28th year opens Sept. 29, 1920
BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

WONDERFUL WIRELESS TELEGRAPH



Two Instruments & 2 Codes, with which you can Telegraph from house to house without wires. **10 CTS.**
UNIVERSAL CO., DEPT. K Stamford, Conn.

GET ON THE STAGE



I Tell You How! Stage Work and Cabaret Entertaining successfully taught by mail. Your **BIG** opportunity. Travel, see the world as vaudeville actor or actress. My great Professional Course—only one of its kind—**COVERS ALL BRANCHES.** Develops **Personality, Confidence, Skill** and tells you **just how** to get on the Stage. Send 6c postage for illustrated booklet, **"All About Vaudeville."** State age and occupation. Write for this free Stage Book **today!**
FREDERIC LA DELLE Box 557-W LOS ANGELES, CALIF.

Cleartone Phonographs

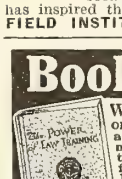


$4.00 to $200.00 Retail
Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.
LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B East 12th Street, N. Y.

STAMMER NO MORE

Kill the **fear** of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Order a copy today. **THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago, Illinois**

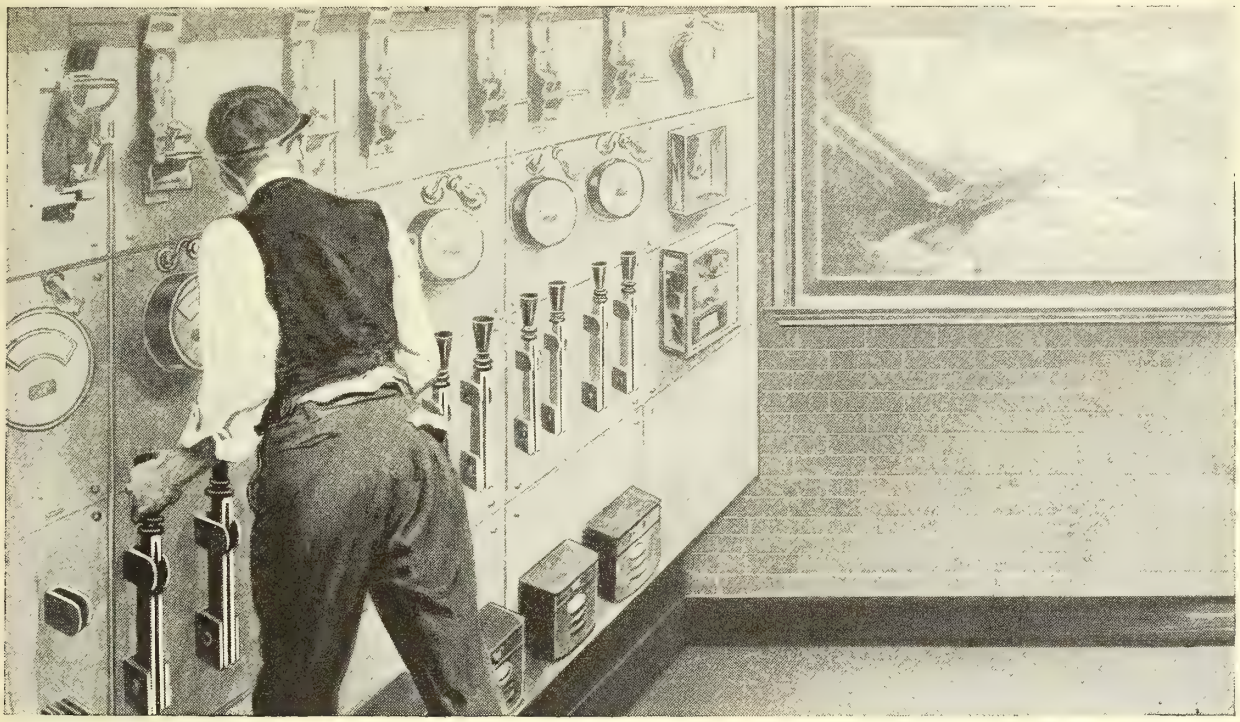
Book on Law Free



Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.
Write Today—now while we are making a special reduced price offer.
American Correspondence School of Law
7449-3601 Michigan Ave., Chicago, Illinois

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address **The Veritas Science Institute, 1400 Broadway, New York, Desk 15.**



Electricity
Learn At Home

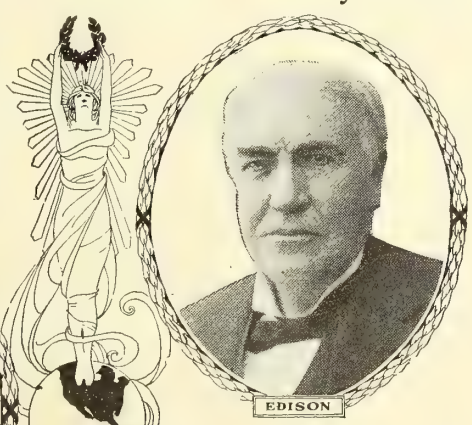
THERE is a wonderful opportunity right now for young men who like electricity. If you are ambitious and will train yourself in spare time you can step into a good position and get experience that will give you a real start toward success in life. Good salaries are offered with rapid promotion.

For 29 years the International Correspondence Schools have been training young men for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of men, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

"I am familiar with the text-books and method of instruction used by the International Correspondence Schools in their Courses in Electrical Engineering, and I also know of a number of young men who have taken these courses with great benefit. I believe that any young man will find it a practical and economical way to acquire a knowledge of the profession."
—DR. CHARLES P. STEINMETZ.


STEINMETZ


EDISON

"I have watched the progress of the International Correspondence Schools. To me their rapid growth is easily understood, because I realize the practical value that is back of them and know something too of the success attained by many ambitious men who have taken their courses.

"May your institution continue to so grow and flourish that the world will come to appreciate the actual worth of the I. C. S. trained men."
THOMAS A. EDISON.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6170-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Car Running	☐ Outdoor Sign Painter
☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ BOOKKEEPER
☐ Mechanical Draftsman	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Public Accountant
☐ Machine Shop Practice	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ Common School Subjects
☐ MINE FOREMAN OR ENGINEER	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ STATIONARY ENGINEER
☐ PLUMBING AND HEATING	☐ Textile Overseer or Supt.
☐ Sheet Metal Worker	☐ AGRICULTURE ☐ Spanish
☐ Ship Draftsman	☐ Poultry Raising ☐ French
☐ Navigator	☐ AUTOMOBILES ☐ Italian

Name _____

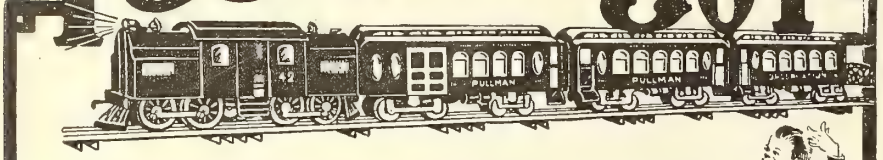
7-26-19

Occupation & Employer _____

Street and No. _____

City _____ State _____

"I JUMPED FOR JOY"



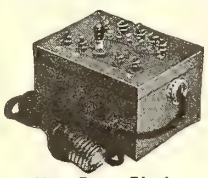
That's the Happy Message of a Lucky Boy

after he had been given a Lionel Train by his parents. It will be the *big joy time* of your youth when you open that nice box with its beautiful label and find inside—wrapped in soft tissue paper to keep it from being marred—a splendid Lionel Electric Train with a "Multivolt" Transformer.



Hooray!

Oh! Boy—Imagine it! A complete railroad system with electric lighted trains, powerful quick-acting electric motors, stations, tunnels, bridges, semaphores—good for years of daily fun. Send quick for



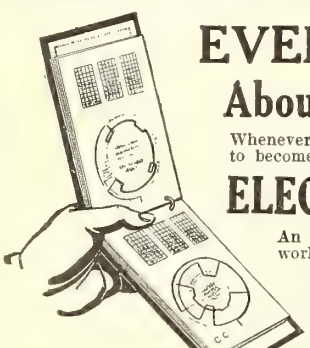
Your Power Plant
Lionel Multivolt Transformer
Runs your trains on house current at less cost than batteries. Get one with your train.

BIG FREE CATALOG in COLORS

Then Get Your Train From Your Dealer
Catalog shows trains, stations, tunnels, bridges, 'n' ev'rything in actual colors. Free—send for it, pick out your train, then take Dad down to your dealers and show him the dandy railroad system you want for Christmas. If your dealer hasn't Lionel Trains write us his name and address and we'll see that you're supplied.

THE LIONEL CORPORATION
50-X, East 21st St. New York City

LIONEL ELECTRIC TOY TRAINS
& Multivolt Transformers



EVERYTHING You want to know About A. C. Motors and Repairing

Whenever any question arises regarding motors, or if you are anxious to become a specialist on electrical motor work, you need the

ELECTRICAL WORKERS FRIEND

An invaluable collection of diagrams and instructions for electrical workers, students, amateurs, etc.

This book contains 66 motor diagrams with complete instructions for rewinding and reconnecting A. C. Motors. Shows how to put each coil in the slots, giving all internal and external connections. For reconnecting they cover all practical changes showing which diagram to use for the change wanted. Bound in loose leaf form for handy reference. The only complete book of its kind on the market. So simple anyone can understand. It is helping thousands of other workers—it will help you too, as hundreds of testimonials prove.

SPECIAL PRICE, COMPLETE $4.00. Order today. If desired we will ship C.O.D. by Parcel Post.

YOU CAN EARN YOUR COPY FREE

We offer all owners of the Electrical Workers Friend a commission of 50c on every book they help us sell. All you have to do is show your book and recommend it. You can earn the full price of one of these books in a few days. Write immediately for full particulars—this offer is limited.

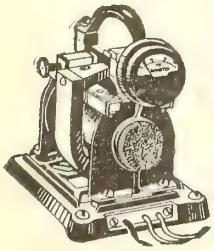
SMITH & SMITH PUB. CO. 1524 Lowrie St., N. S. Dept. B, Pittsburgh, Pa.

10c CHARGES YOUR BATTERY AT HOME WITH AN F-F BATTERY BOOSTER

IT PAYS BIG

or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current.

Bantam type 6-6 ampere 6 volt battery.	$15	Bantam type 12-5 ampere 12 volt battery.	$20
Type 16-8 ampere 6 volt battery.....	24	Type 112-6 ampere 12 volt battery....	24
Type 166-12 ampere 6 volt battery....	32	Type 1612-7 ampere 12 volt battery....	32
Type 1626-12 or 7 amperes in combination for both 6 and 12 volt batteries.....			48



F-F Battery Boosters are entirely automatic in operation. Screw the plug in lamp socket in your garage, snap charging clips on battery terminals without disconnecting or removing battery from car, turn switch and lock garage door, knowing your battery will be charged in the morning. You do not forego the use of your car for a single day. High charging rates are best for large batteries, or where time is limited. Shipping weight complete with **AMMETER** and **BATTERY CLIPS**, 11 to 15 pounds. Include postage and insurance with remittance for parcel post shipment. Keeping your Starting Storage Battery in charged condition makes it delightfully responsive and last longer, requiring fewer expensive battery renewals. Other F-F Battery Boosters for Farm Lighting Plants and Direct Current.

Battery Stations and Garages Use the F-F Rotary Rectifier for Group Charging.

SEND FOR BULLETIN NO. 12 NOW, IF NOT YET READY TO ORDER

THE FRANCE MANUFACTURING CO., 10321 Berea Road, Cleveland, Ohio

What are Dreams?

(*Continued from page* 902)

of the child walking thru a blizzard forms and she dreams she is lost in an ice cave, carrying a tremendous icicle in her arms and walking barefoot in snow six inches deep. This is one of Nature's ways of announcing to the individual the danger she is in.

Again, we can have a dream induced by internal conditions, such as a heavy indigestible meal just prior to bedtime, which generally will produce nightmares. Such nightmares are always of objects previously seen but often somewhat distorted.

The cat and dog in our right-hand illustration assume fantastic shapes and cause the individual to arise in terror. A nightly repetition of such dreams indicate a diseased body or mind, and it is advisable for those having them to consult a reputable physician, for such dreams are but one of Nature's methods of warning the person of some physical ailment.

Xmas Electric Amusements

(*Continued from page* 873)

There are several ways in which to procure the "animals" for this miniature merry-go-round, the five-and-ten cent stores supplying several different kinds made out of celluloid, cardboard, etc. Or you can make them yourself and paint them with water colors; or again, they may be cut out of children's picture books of animals and glued on to cardboard or thin wood and cut out with a fret saw or jack-knife. The animals may also be made of tin.

Building a Toy Scenic Railway

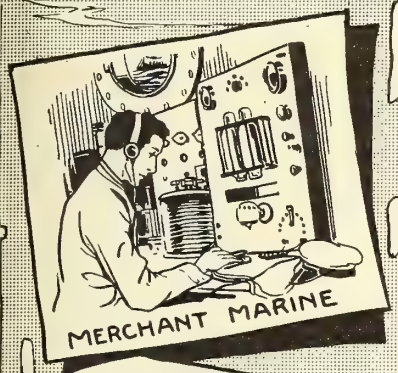
Fig. 4 shows a scheme for building a miniature electric scenic railway which can be placed around the base of the Christmas tree or elsewhere to provide a great deal of fun; besides it shows the operating principles of the real scenic railways to be found at all large summer resorts. The mechanical details are practically few and quite simple. The track may be an ordinary toy railway track or else it may be home-made from wooden L-shaped strips. The cars are small toy railway cars or else a number of low-priced tin automobiles to be found at toy shops, which are afterward adapted to the purpose of the present venture.

The cars are hauled up the main and highest grade by a moving belt or bicycle chain fitted with projecting clips, as shown clearly in the diagrams, and as the cars reach the top of this first and highest incline, they dash down the other side by their own gravitation. If the length of the track is properly proportioned, with not too many humps put into it, the car will complete the circuit of the track and return to the position of the "pick-up" belt or chain at the base of the incline. This pick-up chain acts as a feeder for that passing up the incline—the same as in the large-size scenic railway.

It may be found that the cars will have to be weighted with some lead in order to make them heavy enough to stay on the track as they speed down the incline and around over the circular track. The front of each car has a piece of tin secured or riveted to it so as to hang downward in order to be engaged by the clips or lugs on the moving chain. A chain in this case is used instead of a flat belt.

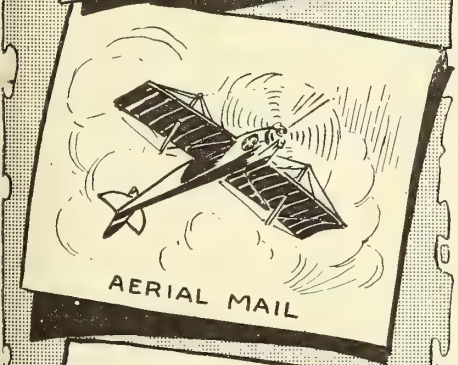
LEARN WIRELESS At Home By Mail













Calls Coming In Steadily For National Radio Institute Graduates. Big Concerns in Need of Operators.

MANY attractive positions are now open in Commercial Land Radio Service Merchant Marine, Radio Supply Factories, Lake and Ocean Steamship Lines, Telegraph Companies, and U. S. Shipping Board. We are continually receiving requests for more National Radio Institute Graduates than we can furnish.

Salaries up to $3,500 a Year

Exceptional opportunity for ambitious men for promotion to the higher branches of Radio. You can learn Wireless the National Radio Institute way, quickly and easily, by mail right in your own home in your spare time. No previous experience or training is necessary. With our help you can quickly qualify for a First Grade Government License, and a good position. Our graduates are qualified as Senior Operators and start with a salary of $125 a month, besides Room and Board, which when totaled and added to salary, means more than $200 a month. One of our recent graduates is getting $6,000 a year.

U. S. Department of Commerce Recognizes N. R. I. Graduates

and allows them a credit of 5 to 10 points when taking examination for First Grade Government License. This school heads the printed list of reputable Wireless Schools recommended by the U. S. Shipping Board.

Travel without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs, Wireless offers you the chance of a lifetime. On shipboard you are rated as an officer, living and eating with the officers. However, you are not obliged to travel, if you secure a position at one of the land radio offices which are steadily increasing in number.

Pay as You Learn

Our plans of payment place a Wireless education within the reach of anyone who desires to learn A small payment down, and the small payments made during the course, make it possible for you to earn the cost of your tuition while actually learning to be a Wireless operator.

Instruments Furnished Free

In addition to all necessary text books and other equipment with which we supply you, we furnish FREE to every student our new automatic Natrometer, which transmits Wireless messages in 600 different combinations. You receive the instrument after your enrollment; it becomes your personal property upon completion of our course.

The Natrometer automatically sends you messages in International Code, just as though they were coming to you through the air from a station a thousand miles away! The instrument is operated entirely without the use of aerials and can be regulated to any speed from 1 to 30 words a minute.

FREE. In addition to our complete course in Radio Telegraphy, every student is given our complete course in modern Radio Telephony. These combined courses enable our students to fill positions requiring a knowledge of both Radio Telegraphy and Telephony.

Send the following coupon today for our FREE BOOK containing all particulars.

MAIL THIS COUPON TODAY

NATIONAL RADIO INSTITUTE,
Dept. 385, Washington, D. C.

Send me your FREE book, "Wireless The Opportunity of Today." Tell me about your Home Study Course in Wireless Telegraphy and Telephony—the free post-graduate course—and your Special Instrument offer.

Name.....

Address.....

City..... State.....



Voice Thrower 10c

Learn to throw your voice into a TRUNK, under the bed, out in the hall or anywhere. Lots of FUN fooling the Teacher, Janitor, Policeman, Parents, Neighbors, or Friends.

THE VENTRILO

is a little instrument that fits into the mouth out of sight. BOYS or GIRLS can use it in conjunction with the above for imitating birds and animals. Never fails. A 32-page book on Ventriloquism sent with the Ventrilo for 10 cents.

NEW FORD JOKE BOOK 1920

All the latest jokes on the Ford auto. Hundreds of them, and all good ones. Spring a new one on your neighbors.

Large book with cover by mail, 10c



ROGEN X-RAY



Price 12 cents

HERE, BOYS, is just what you want. With this instrument you can apparently see the bones in your fingers. Think of the fun you can have with it. Sample by mail, **TWELVE CENTS.**



SKULL RING

Here is a handsome, up-to-date Ring, representing a Skull and Cross-bones. Has stones in the eyes and looks something frightful. Women won't like it, but for men or boys it is a great novelty. **Sample, by mail, 20c.**



Gee! What a Wad!

This is STAGE MONEY

Looks like the GENUINE STUFF. Some Green backs and some Yellow backs. Create a BIG sensation among your friends. The girls will all be after you when they see the wad. BIG roll of 15 pieces by mail, **10 cents.**



ENCHANTED BARREL

The Most Wonderful Pocket Trick Made

CHANGE A CENT INTO A DIME

Ask your friend to drop a dime in the barrel. When he takes it out, Behold! It is a CENT. You make 9 cents every time you fool them. Never fails. They cannot get on to it. Sample barrel, with directions, only.... **12c**

BIG VALUE for 10 Cts.



6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Baseball Book, giving rules for games; 1 Toy Maker Book; Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 5 Puzzles; 12 Games; 30 Verses for Autograph Albums. **All the above by mail for 10c.**

Any of the above Mailed with Catalog

ROYAL NOVELTY COMPANY
486 East Ave. South Norwalk, Conn.

DENINGER WILL SAVE YOU 25 TO 50 DOLLARS

$40

BIG MONEY SAVINGS FOR YOU

Used and rebuilt motorcycles; single and twins; $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog **Deninger Cycle Co., Rochester, N.Y.**

New 400 Candle Power Lamp

Gives a soft, brilliant, glowing light; restful to the eyes; an ideal illumination.

BURNS 96 PER CENT AIR

200 times brighter than kerosene lamps. Burns 96% air and 4% common gasoline. Lamps and Lanterns for every purpose. Clean--odorless--economical.

ABSOLUTELY SAFE

Can be carried anywhere--perfectly safe, even if tipped over.

LIGHTS WITH ONE MATCH

New patented twin mantle burner lights with **One Match** easily and quickly. Greatest improvement of the age.



SEND NO MONEY Write for Catalog, Special Agents' Offer, also Money-back Trial Offer. **Write today.**

AGENTS WANTED

THE AKRON LAMP CO. 1172 Lamp Bld. Akron, O.

Lamp Facts for the Householder

(*Continued from page 853*)

bulb is the governing factor, are these: The "S" or straight side bulb, having a hemispherical bowl and tapering, straight sides; the "G" or globular bulb, which is spherical; the "PS" or pear-shaped bulb of Mazda "C" lamps, similar in shape to the Bartlett pear; the flat-end bulb, used in flashlight lamps; the decorative flame bulb and the sweet-potato bulb.

Large Mazda "C" lamps are sometimes used for residence lighting, in which lower wattage Mazda "B" lamps should be used. And lower wattage Mazda "B" lamps are sometimes wrongly used in offices and factories where the larger Mazda "C" lamps ought to be employed.

Sometimes the particular problems peculiar to each specific case constitute a large factor in this tendency. But more commonly two misconceptions on the lighting question are the cause of such a situation. People do not realize the injury that is possible to the eyes under faulty lighting facilities. They also do not appreciate how economical it is to use the correct type of lamp.

THE LIFE OF AN INCANDESCENT LAMP.

There is an erroneous impression that a lamp possessing an extreme long life is the most desirable lamp to use. But when it is understood that the current consumed by a 25 watt lamp in one thousand hours is worth, at 10 cents per kilowatt hour, about $2.50, while the lamp itself is worth less than one-fifth of that sum, it will be seen that the cost of the lamp is a small item in the total cost of lighting. It will also be, at once, perceived that it is an expensive economy to sacrifice light, merely to prolong the life of the lamp.

The average life of the lamps most commonly used is *one thousand hours.* They are designed to give service for that number of hours. That amounts to about *eighteen months* of use in the case of a lamp in a residence, assuming that it is burned on an average of about two hours out of every twenty-four.

Mathematical calculations have set up the one-thousand hour period as the longest for efficiency and economy. It would be possible to make lamps at a low efficiency, thereby increasing the life of the lamp. But that would also increase the current consumed per candle-power. On the other hand, by increasing the efficiency of the lamp, a decrease is effected in its life and in the current consumed per candle-power.

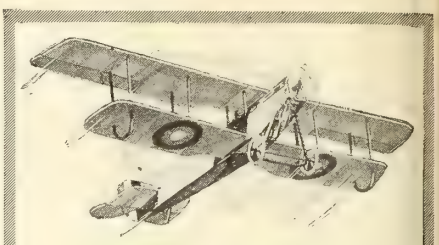
The most economical way of using incandescent lamps is, first, to install the smallest size of lamp that will give sufficient light for the purpose; and, second to operate the lamp at the voltage on the label, or even at a voltage slightly higher than that called for on the label.

As a 1 per cent increase in the voltage increases the watts consumed only 2 per cent, but increases the volume of light 5½ per cent, such an operation as that mentioned is "good business"—even tho it tends to shorten the life of the lamp.

POINTED PARAGRAPHS ON "LAMPOLOGY"

Speaking of the arithmetic of incandescent lamps and house lighting bills, there are a few points easily remembered by Mr. and Mrs. Householder, and the most important of these are cited below by the Editors:

To find the watts consumed by all the lamps in a house or other building, multiply the number of watts consumed by one lamp, by the number of lamps. Also, watts equals the volts multiplied by the amperes. Also, volts equals the resistance of the lamp multiplied by the current passing thru it; cur-



Building and Flying

Model Aeroplanes

Real Fun for Live Boys!

BUILDING a Model Aeroplane is very interesting work for any boy. It develops his mechanical ability, keeps him busy and fascinated, and shows him many things about Aeroplane construction. Any boy can be proud of a completed Model Aeroplane, and have an exciting time flying it. Building is easy for any handy boy. IDEAL Model Aeroplane Construction Outfits contain everything needed to build a Model Aeroplane that is an exact duplicate of a real machine; also Complete Plans and full instructions. IDEAL Model Aeroplanes are guaranteed to fly when correctly built. Complete Construction Outfits may be had for building any of these well-known Aeroplanes.

Curtiss JN4-D2 Training Plane, 3-ft. Model (shown above)	**$8.00**
De Havilland Battle Plane, 3-ft. Model.	**8.50**
NC-4 Naval—Curtiss Seaplane, 4½-ft. Model	**10.00**
Curtiss Military Tractor, 3-ft. Model...	**7.50**
Bleriot Monoplane, 3-ft. Model.....	**6.00**
Nieuport Monoplane, 3-ft. Model.....	**7.00**
Taube Monoplane, 3-ft. Model.....	**5.50**

West of Denver, Colo., and in Canada, 50c. extra for each Outfit

These Complete Construction Outfits are sold in sealed boxes by the Leading Toy, Sporting Goods and Department Stores. Ask for them at your store. If your store hasn't them, we will fill your order direct, postpaid, upon receipt of price above, and guarantee satisfaction or money back.

Plans for Modern Aeroplanes

Complete Plans, which include Scale Drawings and Building and Flying Instructions, for any of the above Model Aeroplanes will be sent by mail, postpaid, for 35 cents. These Plans show exactly what is required to build a Model Aeroplane, and how to build it.

Send 5 Cents for Aeroplane Book

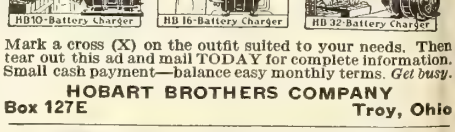
Gives full descriptions of all IDEAL Model Aeroplanes, Racing Aeroplanes and Flying Toys. Also lists hundreds of Model Aeroplane parts and supplies. It's a book every Amateur should have. Sent postpaid for 5 cents. Send for one today.



IDEAL AIRPLANE & SUPPLY COMPANY
159-161 Wooster Street, Corner W. Houston Street, New York City

BIG PROFITS for You in HB BATTERY CHARGING

Profits of $100 to $300 a month are easy—hundreds of HB users make that, and more. *You can, too.* Cost 4c to 12c per battery—customer pays 75c to $2.00. Start NOW—when winter brings biggest battery charging profits.



Mark a cross (X) on the outfit suited to your needs. Then tear out this ad and mail TODAY for complete information. Small cash payment—balance easy monthly terms. *Get busy.*

HOBART BROTHERS COMPANY
Box 127E Troy, Ohio



INSYDE TYRES

Inner Armor for auto tires. Prevent blowouts and punctures. Double tire mileage. Easily applied to any tire between casing and tube. Details free. Agents wanted. Liberal profits.
Amer. Access. Co. Dept. T-1972 Cincinnati, O

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

rent equals volts divided by the resistance; while resistance equals volts divided by current.

The practically obsolete carbon filament incandescent lamp consumes from 3.1 to 3.5 watts per candle-power (C.P.), while the highly efficient tungsten lamp of the present day, consumes approximately one watt per C.P. while nitrogen lamps consume from ¾ watt per C.P. in the smaller size of about 100 C.P. value, down to as low as .6 watt per C.P. in the larger size bulbs, such as the 1,000 C.P. unit.

The accompanying illustration shows several practical ideas of value to people who are striving to economize in their electric light bills. It may be said as a foreword, that it does not pay to reduce the candle-power down to too low a value, as this means a strain on the eyes, which condition, of course, none of us desire to create or work under, but there are many ways in which the candle-power and the resulting wattage consumed in a given house or room can be conserved. Of course, if you desire artistic effects such as placing high candle-powered lamps inside of darkly colored glass shades made to imitate a bunch of grapes, and what not, and providing you are quite willing to pay the extra cost for this artistic effect on your monthly lighting bill, then this does not apply to you.

The sectional view of a typical house and electric lighting layout with the lamp watts marked in each room, is shown in the illustration. Another figure shows an expensive and also an inexpensive method of lighting up porches, even large size ones. Another figure shows the cheap way and the H. C. L. way of lighting the dining room, no matter whether large or small. Indirect lighting is a fine thing for those who wish to pay for the extra watts consumed, which amounts to about double that required with plain lighting of the dome variety, using for example, with the average size dome—a 40, 60 or 80 watt tungsten lamp with a half-frosted bulb.

In parlor fixtures, many people endeavor to economize by using one large unit such as 100 C.P. lamp in one receptacle of a three outlet fixture. Generally speaking, it is far preferable to employ three low C.P. lamps, such as 25 C.P. units, instead of using the one high-powered lamp. Three 25-watt lamps give a total consumption for the fixture of about 75 watts, and the lighting effect is usually vastly more even and agreeable all around.

There are three principal types of economizers for users of incandescent lamps, all of which are shown in one of the accompanying figures. One of these economizer receptacles or attachments dims the lamp by means of a choke coil or rheostat, when a cord depending from the socket is pulled. Another one operates by pulling one of two depending cord switches, switching on either a small low C.P. filament or a large high C.P. filament. Still another employs a small two coil A.C. transformer in an attachment plug which fits into any standard socket, in the base of which a small A.C. night lamp may be screwed.

All of these devices will save considerable money indeed, for those who have to burn a light all night in children's rooms, etc., or for those who need a regulating lamp for a photographic dark room, etc.

BUYING RECORDS BY TELEPHONE.

"Call 1-4-9-2-5 from your home and ask to hear any record you like. The service is complimentary." This is the way a Los Angeles store interests the public in buying talking machine records, as told by N. D. Dunlea in *System*. When you can hear new records so easily it is a great inducement to buy.

This plan, which has been inaugurated some two months, has been a great help.

LEARN DRAFTING

At Home—In Spare Time
as you would in actual practice

Get into this constructive branch of industry where big salaries are paid. No previous training is necessary to become a capable draftsman with the help of the Columbia School of Drafting. You can master the practical lessons of our famous home study course, at home, in spare time. You will be personally coached and instructed, by mail, by Roy C. Claflin, president of the school, whose long experience as a draftsman and teacher, especially qualifies him to give you the training you need to become a successful Draftsman.





Draftsmen Get $35 to $100 a Week





Become a Specialist

We not only give you thorough and practical training in Mechanical Drafting, teaching you to make actual drawings as you would in any drafting room, but the additional benefit of a post-graduate course in some special branch of drafting. A big field of opportunity is thus opened to you as a trained specialist in this profession.

Draftsmen are needed in greater numbers, and receive better salaries than ever before.

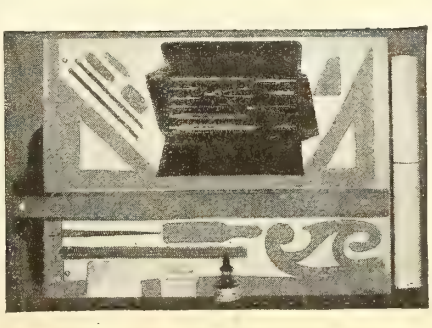
Because of the importance of his work the draftsman is paid a big salary and is always in line for advancement. The draftsman's pay is from $35 to $100 a week. A knowledge of drafting is the stepping stone to big technical positions in the industrial field paying as high as $50,000 a year.

How "Columbia" Students Succeed

Students of the Columbia School of Drafting often secure positions at $2,000 or more a year to start before completing the course. Hundreds of men and women with "Columbia" training are now making good with big concerns all over the country. Many more are needed for splendid positions now open. Here is what "Columbia" training is doing for some of our graduates: Laurence Johnston, over $5,000 a year; George Murray, $45 a week to start; G. Tangorra, $2,800 a year; A. L. Gash, $140 a month to start; W. S. Burfoot, $150 a month to start; T. R. Brown, $2,860 a year; R. Fowkes, $3,700 a year. These are only a few of a great number of similar cases.

This Complete Drafting Equipment Furnished

to students of our school. The instruments are of standard American make of the best quality, fully guaranteed, and become your property on completion of the course. Every instrument needed for the course is included.



Big Concerns Employ "Columbia" Graduates

The best concerns in America employ Columbia graduates in their drafting departments because of the thorough practical training we give which enables them to step right into important drafting positions. Our diploma is the entering wedge into big drafting rooms everywhere. As a Columbia graduate you are recognized as an experienced draftsman, not as a mere apprentice. Why be satisfied with a grinding, underpaid position when there are hundreds of promising positions open to you in the big field of Drafting. We are called upon to place trained draftsmen more rapidly than we can produce them.

Send This Coupon Today

Let us tell you the fascinating story of Drafting and how you can master this lucrative profession of big salaries and steady advancement through our help. Write today to

COLUMBIA SCHOOL OF DRAFTING
Roy C. Claflin, President
Dept. 1241, 14th & T Sts., N. W., Washington, D. C.

COLUMBIA SCHOOL OF DRAFTING,
Dept. 1241, 14th and T Sts., N. W.,
Washington, D. C.

Without obligation to me, please send me FREE your illustrated book of particulars, testimonials from students, rates and liberal terms.

Name .....

Age .....Address .....

City..... State.....

Be a Movie King



OH BOY! SOME SPORT

Surprise the Bunch—Have a Barrel O' Fun

Own a Genuine Moving Picture Machine

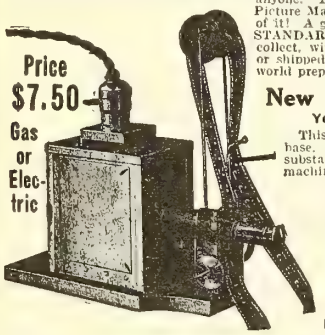
Here's what you've always wanted—a genuine MOVING PICTURE MACHINE—a machine that uses STANDARD FILM—like the Big theatres show—at a price you can easily afford to pay. This is the BIG opportunity—don't MISS it. Read every word, then act quick. Three swell models to select from. Each the best of its kind. All REAL moving picture machines—not toys or magic lanterns, but REAL Movie Machines, that show the pictures on the screen. The Films are supplied to us by the leading film companies in America, and the subjects include all the LEADING actors and actresses that you see and admire in all the big theatres. The "fellers" and girls and the grown-ups, too, will sit spellbound, or roar with laughter at the wonderful, lifelike, real movies you can show them.

Three-Reel Cinematograph

Here is an astonishing bargain. Our latest Model Cinematograph is a whirlwind value. At the price it has everything beat you ever heard of. Here is a genuine Moving Picture Machine, made entirely of metal, solidly constructed, and put together by expert workmen, that you can buy at a price that will simply astound you. It comes equipped with a SAFETY CARBIDE Gas Generator, and can be used to show moving pictures anywhere. The mechanism is so simple it can be operated by anyone. The greatest value in a Genuine Moving Picture Machine ever offered at the price. Think of it! A genuine Moving Picture Machine, using STANDARD FILMS, shipped by express, charges collect, with 3 REELS FREE, for ONLY $3.00; or shipped by parcel post to any address in the world prepaid for $3.25.



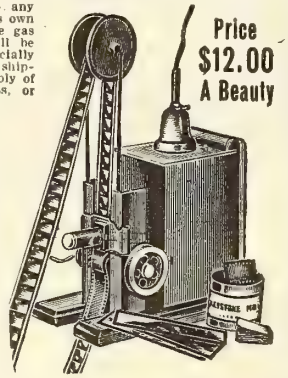
$3.00



New Model Movie Machine

Your Choice of Gas or Electric Light

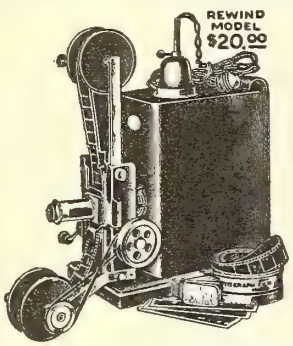
This is a beautiful, high-class Moving Picture Machine. Made of sheet iron with wood base. Finished in black or battleship grey with handsome red stripe trimmings. Solid and substantial construction. Size 12x7½x5½ in. Uses STANDARD FILM same as the big machines. TWO TYPES—Electric and Gas. The electric machine is equipped with plug and cord complete, ready to attach to any electric light socket. Gas machine has its own generator and makes its own light. The gas machine can be used anywhere and will be sent unless electric type machine is specially ordered. Sent securely packed in special shipping case with full instructions, film, supply of show tickets, etc., for $7.50, by express, or $8.00 if sent by prepaid parcel post.



Keystone Moviegraph

Moving Picture and Magic Lantern Combined

A regular beauty, all complete, ready for you to use the minute it arrives. Hang up a sheet, put on a reel, turn the crank, and you're off. That's all there is to it. Made of metal throughout, with heavy base casting. Finely adjusted mechanism, easily operated. Electric model only; simply screw in plug to your electric light socket and you are all ready for an exhibit. Equipped to show slides as well as Real Moving Pictures—just like the big machines. 12x9½x8 in. Comes with 3 EXTRA LONG STANDARD SIZED FILMS, 3 FINE LANTERN SLIDES, and admission tickets—all FREE. A machine you will be proud of. You can have endless fun and amusement, and MAKE MONEY with it. Sent by express, with full instructions and extra long cord and plug, securely packed, for $12.00; or by parcel post, to any address in the world, for 75c extra.



No. 2 Rewind Model

Largest and Most Powerful Model

This is the No. 2 Rewind Model, with equipment for unwinding and rewinding 100 to 200 feet of film. The size of the machine is 6¾ x 14 x 19 inches. It is constructed on a wooden base 6¾ x 11½ inches, which will not scratch the furniture. Electric model only, it operates from any electric lighting circuit. All you have to do is to screw in plug to any electric light socket. It has a regulator so that different sized lamps may be used—electric socket, plug and six feet electric lamp wire cord, and nickelled reflector. Also shows magic lantern slides. With this machine we furnish a can of 100 feet of film, three American-made Lantern Slides—subjects of which are Wilson, Pershing, Aeroplanes, Boy Scouts, Charlie Chaplin, Jiggs, Comics, etc., 100 Theatre Tickets, guarantee and full directions. PRICE $20.00, shipped by Express, or by prepaid parcel post to any address in the world for $1.00 extra.

Extra Films

EXTRA FILMS. For all our Machines. Big variety of subjects, including leading and best known movie actors and actresses. Standard size. Short Reels, Price 15 cents each. Extra Long (5 feet), Price 3 for $1.00. Special 100-feet reels $2.50 each. CHARLIE CHAPLIN FILMS, 25c each; 5-foot lengths, 60c each. All postpaid.

LANTERN SLIDES for Keystone Moviegraph, American made, 6 for 75 cents.

"U-MAK-EM" SLIDES. A special slide for use with the $12.00 and $20.00 machine or any other machine with Lantern Slide equipment, for showing on the screen announcements such as "Please Remove Your Hat," "No Smoking," "Intermission," "Goodnight," sporting results and even advertisements, etc. Can be used repeatedly. PRICE 3 for 50 cents postpaid.

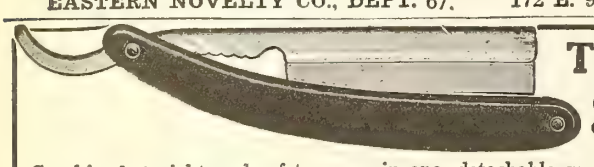
JOHNSON SMITH & CO., Dept. P.M.35 3224 N. HALSTED ST., CHICAGO

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.

Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. Guaranteed by the maker. Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness. Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.

EASTERN NOVELTY CO., DEPT. 67. 172 E. 93d STREET, NEW YORK.



The ACE RAZOR

$1.00 POSTPAID ANYWHERE

Combined straight and safety razor in one, detachable guard (not shown in cut) permits of use either as straight or safety. Neatly finished, black enamelled long handle, detachable blades of finest selected steel, good for 4 months' use. Instantly cleaned.

The old-fashioned clean shave and the new-fashioned safety shave in one. Send for yours today, postpaid, anywhere. Money refunded after 10 days if not satisfactory.

Raymond Farrell Co., Dept. 22, 3256 Third Avenue, New York

The First Practical A. C. Dynamo

(*Continued from page* 857)

and current capacity in the ratio of 1 to 4. At the opposite end of the armature from that shown, and beyond the connection board, is the commutator, consisting of four half circles arranged in two rings, one ring for each armature coil. On these the brushes rested and the two commutators were connected in series, commutating thus a biphase current, to obtain continuous current. The chief use of this dynamo was to run an arc light; and in so doing it probably absorbed about three horse power. The armature core, on account of the difficulty of getting sheet iron plates (by no means a small difficulty in those early days) was made by assembling a number of thin, soft castings.

The machine was capable of being used as an alternating current generator, giving bi-phase current or current displaced 90 degrees in phase, one alternating current coming from one of the armature coils, and the other coming from the coils at right angles thereto. Experiments were made with the alternating currents supplied by this early machine, and it is a noticeable fact in this connection that this machine was used to supply, early in 1879, from its alternating current side, transformers; and was shown supplying two shell-type transformers, the primaries or fine wire coils of which were connected in parallel to the source of line from the machine; and the secondaries were run individually as course wire secondaries working whatever might be at hand as a load, such as small vibrating arc lamps, resistance wires, etc. The question may arise: Why not have used incandescent lamps? Well, there were not any in those days. It was nearly a year before Edison had produced any of the carbonized paper filament lamps; and nothing of an equivalent character was available. The machine was first operated at the Franklin Institute building in Philadelphia, where there was, back of the lecture platform, a six-horse power engine of a single-cylinder, upright type. Power was by no means so easily obtained in those days as today. There were no such things as gasoline or oil engines, and even gas engines were somewhat rare. This historic and early American built dynamo is in the collection of the General Electric Company at the Lynn works, to which company we are indebted for the photograph and interesting diagram of circuits taken from the early personal notes of Prof. Elihu Thomson. This article was written by Prof. Thomson himself.

The Amateur Magician

By JOSEPH H. KRAUS

(*Continued from page* 870)

to one of these metal bands. The other band connects with a lead from the solenoid. The method of closing the circuit is identical with the roulette wheel described, I believe in my last discourse, and consists in making and breaking the circuit with a ring upon any finger. This arrangement is never noticed and does not generally allow meddlesome people to discover this secret.

"Is that clear?" I assured him that it was, and then asked, "But how about the wand when you gave it to me and how about the coins falling into the hat; surely there is some palmistry or some slight-of-hand work?"

"Not at all, was his answer. You see I simply held the cap or cover of the end in my hand and when I presented you with the wand, I transferred the wand from one hand into the other, slipping the cap in place. On the inside of this cap is soldered half of a snap cuff-link or similar snap fastener, in the wand proper is inserted the female part, and when the wand is given to any person, this simple snap holds the end in place quite securely, as you can readily see from the diagram."

"But the coins in the hat," I interrupted, "I am sure I heard them fall."

"I wouldn't swear to that if I were you," he added, "as the reason I asked for a high hat is because it makes plenty of noise and the effect of dropping a coin into the hat was obtained by merely snapping my finger against the brim."

"Oh!"—was all I could say.

After having recovered from the effects of this, I said "These tricks are wonderful, Professor, but haven't you anything in your encyclopedia which doesn't need the preparation or the instruments which you have employed thus far? Some simple trick for every reader to perform." "Well, let me see —I believe I have. Wait a few moments."

I busied myself with a magazine which he had lying on the table, when, a short time later he returned with colored bits of paper, the ends of each strip were glued together making a loop about 4 ft. long and ½ inch wide. Throwing these upon the table he drew out a pair of shears and said to me, "Are you a good tailor? Insert these scissors here and cut all around the loop." It was a tedious operation but soon finisht, and as a result I gave him *two* loops. Immediately he flared up. "What did you do that for. I told you to cut all around them but did not say to make two loops out of it. One was sufficient, and then you even separate the loops, you should be taught how to cut." I was quite amazed at this sudden turn of affairs and then gradually becoming more bold, I demanded that he do better. Picking another of the strips he commenced cutting it the same way I had done. "Now if you had coaxed it along, you might have done better or perhaps if you had spoken some magic word over it and made a pass,—thus a word like consologicaletcopitulationanthropohagenarianism, would have benefited your trick immensely." He had completed the cut and there were the two loops interlinked. Picking up another sheet of paper he said "Maybe I can do better this time," and when he had finisht cutting this, he had one loop left. Yes, to be sure I was not under the effects of no "half of no per cent liquor." He had actually cut a loop in half, and after cutting it showed me one loop *twice the size of the original one!*

"Now I'll try once more," he said, and picking up the last loop of paper started to cut this. This was completed in a few moments and there he was with a loop of paper which had a knot in it. Which of these two stunts were the more remarkable is more than I could tell, but there to be sure was the mute evidence lying in front of me.

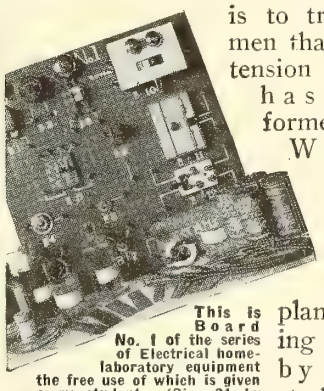
Hargrave laughed merrily at my chagrin, then gave me this secret. "You see old topper, the loop I gave you was unprepared. Those *I* had, I prepared and the preparation needed is very simple. The first loop is made so that it doesn't contain any twist in the paper. This you cut in half and try as hard as you will you cannot obtain anything but two separated loops from the paper. The second loop is made by gluing the two strips together but prior to gluing, the paper band is given a half twist, the third two half twists and the fourth loop three half twists. These twists are never noticed in a narrow long band of paper, and the surprise of the cutting doesn't abate sufficiently to allow the onlooker to notice the double twist or the triple twist described. Try it when you get home." With that he ushered me from the room.

Learn Electricity This Wonderful New Quick Way

At Home in Your Spare Time

EVERY year hundreds of young men from all over the world come to the residence school of the School of Engineering of Milwaukee to learn electricity in all its phases. Yet we know that there are thousands of ambitious men everywhere who aspire to big jobs in the great field of electricity, but who cannot conveniently leave their present work to attend a residence school. It is to train these men that this extension division has been formed.

Just Like Going to School



This is Board No. 1 of the series of Electrical home-laboratory equipment the free use of which is given every student. (Size 24 by 24 inches.)

We knew from our long experience that the ordinary plan of teaching electricity by home-study methods would not measure up to the high standards set by the School of Engineering of Milwaukee. And so, this unique, new plan of giving each student free use of a complete home-laboratory system of actual working electrical equipment was conceived. We know that it is the only practical way to learn electricity at home!

America's Greatest Electrical School Brought to Your Home!

On this plan you can now secure almost every advantage of America's Greatest Institution of Electrical Education right in your own home! In this way this famous school now gives the most thorough practical intensive home-study course in electricity ever offered! It is a specialized, graded course built up on the most advanced ideas of electrical instruction. Thorough, yet simple texts—graphically illustrated give the electrical principles which logically parallel the practical experience gained in using the instrument boards. This amazing new method of extension instruction quickly makes any ambitious man a high-salaried, electrical expert!

Free Use of This Fine Electrical Apparatus

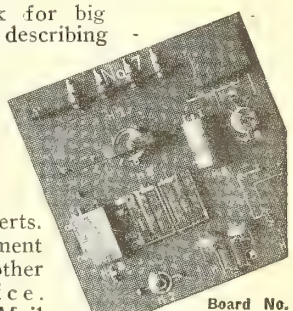
These wonderful, cleverly constructed instrument boards —equipped with actual, practical electrical apparatus—are furnished absolutely free to each student while studying. These laboratories are not toys—but include the same instruments and devices which the electrical man meets with in every day work.

You Can Fill One of These Big Pay Jobs

The field of opportunity for the well trained electrical man is practically unlimited. Billions of dollars are invested in this great industry. Thousands of men are employed in it—but the demand today is for men who are *trained specialists.* These men command handsome salaries—$2,500 to $6,000 and up to $10,000 a year and more. Why don't you get into this fascinating, highly paid field of work?

Write Quick for Big FREE Book

Write quick for big free book fully describing this astonishing new plan. Tells also about Consultation Privileges with our great staff of over 90 experts. Free Employment Bureau and other special service. Don't delay! Mail the coupon Now!



Board No. 7 of this wonderful new plan of studying electricity at home.

EXTENSION DIVISION

SCHOOL of ENGINEERING of Milwaukee

Dept. S-14, 373 Broadway, Milwaukee, Wisconsin

Extension Division
School of Engineering of Milwaukee,
Dept. S-14, 373 Broadway, Milwaukee, Wisconsin

Please send me free and without any obligation on my part full details of your special new home-study course in Practical Electricity.

Name .....

Address .....

City..... State.....

Age..... Education.....



Think Beyond Your Job!"

"There is not a man in power at the Bethlehem Steel Works today," says Charles M. Schwab, in the American Magazine, "who did not begin at the bottom and work his way up. Eight years ago Eugene Grace was switching engines. His ability to *out-think* his job, coupled with his sterling integrity, lifted him to the presidency of our corporation. Last year he earned more than a million dollars. . . . . Jimmie Ward, one of our vice-presidents, used to be a stenographer. The fifteen men in charge of the plants were selected, not because of some startling stroke of genius, but because day in and day out they were *thinking beyond their jobs.*"

If you want to be somebody, to climb to a position of responsibility, *get ready for it.* Do what you are doing *now* better than the men beside you, and *train for the job ahead.* You can do it—in spare time—through the International Correspondence Schools.

For 29 years men with ambition and I. C. S. help have been making spare hours the stepping-stones to successful careers. Last year more than 5,000 reported that their studies had won for them advancement and increased salaries. Over 150,000 men in offices, shops, stores, mines and mills and on railroads all over America are preparing in the I. C. S. way to take the next step upward.

Join them! All you need is just ordinary brains, the will to do, and the firm resolve to *think ahead of the job you now hold.* The I. C. S. are ready to make the rest easy. Make your start. Mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6171-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____



Send No Money

Snap this bargain up right now before it is too late. Only limited quantity. Amazing underwear bargain. Greatest offer ever made. **Two Guaranteed $4 Each, Wool Unionsuits $5.75.**

Save big money on your underwear. Send postcard or letter today—this very minute, for these 2 beautiful perfect fitting heavy weight gray elastic rib unionsuits. Full cut. Seams reinforced and overcast. **Send No Money**—pay only $5.75 on arrival, no more; we pay delivery charges.

We Guarantee to refund your money if you can match these 2 wonderful **wool** unionsuits for $8.00. Order this amazing bargain this minute before it is too late. Just give name, address and breast measure.

BERNARD-HEWITT & COMPANY
Dept. U-3912 900 W. Van Buren St. Chicago, Ill.

Heat for the Household

By H. WINFIELD SECOR

(*Continued from page* 864)

of comprest coal dust, charcoal, and there has recently been quite a flutter among the fuel producers by the introduction of briquettes made from comprest sawdust, mixed with coal dust.

There was recently shown in this journal, a photograph of a new British built stove which was intended to be used with briquettes, as a source of fuel and which burned for eight hours on one loading. Americans are probably most familiar with briquette heating thru the introduction a generation ago, of the famous Clarke carriage and automobile stoves which employed a non-smokeless slow-burning briquette made in a special manner. Small pocket stoves burning briquettes containing a nitrate to accelerate combustion, have also been made from time to time, both in this country and abroad.

Electric Fans Boost Fuel Efficiency

It sounds quite paradoxical to think of using electric fans in the winter time when we are hugging radiators and stoves in order to keep warm, and yelling at little Johnny and Sister Sue to close the door in a hurry, for fear some of the precious heat may be lost. However, the new generation has listened wisely to heating engineers and knows that an electric fan, judiciously employed, will help the circulation of heated air in a room or building.

The illustration at Fig. 6 shows how to construct a very good air deflector so as to re-direct the incoming cold air from the raised window sash, to the electric fan placed behind the radiator, thus causing a constant current of heated air to pass thru the room. It is usually best, especially in offices, to have the top sash of the windows lowered a little so that a perfect circulation of air can take place. The cold air going in at the bottom of the window is heated by the radiator, and then rising to the top of the room, eventually passes out thru the open top of the window.

Another good use for electric fans is in relation to the furnace; sometimes, the electric fan is placed before the draft door to provide a forced draft and in other cases, fans have been placed with excellent results in the cold air intake box as shown, so as to promote a steady and sufficient draft of cold air into the furnace. Those who have had experience with hot air furnaces know that one of the great troubles with this type is that in sluggish weather, when there is not much wind, it is often very difficult to get the heater to throw a sufficient amount of hot air into the rooms heated by it. This is due to the fact that there is not a sufficient amount of cold air taken in thru the cold air box and the object of using a fan in establishing this condition, will be at once apparent.

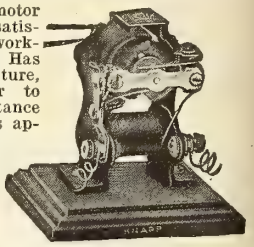
Saving Coal With Storm Sash

It is surprising how few people realize that they can *save as much as* 40 *per cent* on their winter fuel bill by the judicious installation of extra glass windows or storm sashes on the outside of the window frames. People who live in city apartments or in well settled localities where the houses are fitted in like building blocks, do not notice this, of course, so much as where a house is swept by the "four winds of heaven." Once you have tried storm sashes on your east, north, or west windows you will marvel at their efficiency.

DEPENDABLE **KNAPP** ELECTRIC SPECIALTIES

LITTLE HUSTLER MOTOR

With New Starting Switch $2.00



A powerful little motor that gives perfect satisfaction. Excellent workmanship throughout. Has a three-pole armature, causing the motor to start without assistance when the current is applied.

Equipped with pulley for running mechanical toys, models or driving a fan at high rate of speed.

AT ALL LIVE DEALERS

Insist on your dealer showing you the **KNAPP** line—**KNAPP** goods are best. If your dealer cannot supply you, order direct. Send for FREE illustrated catalogue showing a complete line of Electrical Motors and Novelties.

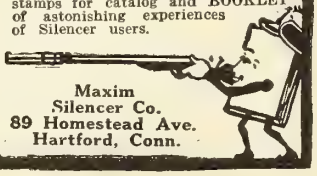
KNAPP ELECTRIC & NOVELTY CO.
523 West 51st Street, N. Y. City

Shoot Without Noise

Avoid disturbance, also flinching. Enjoy quiet shooting anywhere, any time. Use the new Model 1920

MAXIM SILENCER

Price, .22 cal., $7.00. Send 6c in stamps for catalog and BOOKLET of astonishing experiences of Silencer users.



Maxim Silencer Co.
89 Homestead Ave.
Hartford, Conn.

9 TOYS all for 2¢

TO introduce our new catalogue of a thousand tricks and jokes, toys and novelties, we make this big bargain offer. For only a two cent stamp we will send you prepaid, 9 toys; a game of anagrams, the 1921 joke book, genuine decalcomania transfer pictures, pictures to paint, a railroad cut-out (an engine, four cars, station signal and water tank), puzzle picture, checkerboard puzzle, the broken match trick and a mind reading trick. All yours for only a two cent stamp. Nothing more to pay.

Send 2c Today Write today and enclose a two cent stamp for 9 toys. We will send you our new catalog free. Write your name and address plainly.

JOHN PLAIN & CO., 200 South Peoria Street Dept. 1259, Chicago, Ill.

PROFITS for YOU Charging Batteries Making Electric Lights

With the HB Lighting and Battery Charging Set you can make your own electric lights for as low as 2c per KW, and make a profit from $100 to $150 per month on battery charging. Anyone can easily operate without experience. Sturdy, dependable, economical to operate from line-shaft or your engine. *Makes big, easy profits.*



Small Payments Put This Money-Maker in Your Shop

Balance on easy terms. Profits pay for outfit. Absolute Money-Back Guarantee. Ask our Service Department about proper size for your needs. Pin this ad to your letterhead and write TODAY for information.



HOBART BROTHERS COMPANY
Box 128E Troy, Ohio
Successful Manufacturers Since 1893

Model Electric Motor Boat



30 inches long. High power. Built like a real boat—$15.00

Send stamp for illustrated lists of working model boats, engines, etc.

BATHE MANUFACTURING COMPANY
Desk 2, 5214 Woodland Avenue, Philadelphia, Pa.

LEARN WIRELESS AT HOME

The Demand for Good Wireless Operators Far Exceeds the Supply

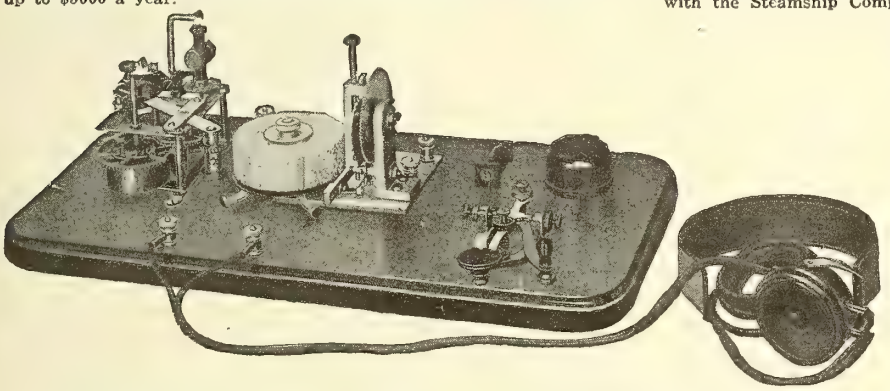
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, formerly Chief Radio Inspector, Bureau of Navigation, N. Y. He resigned last August to accept a position of still greater responsibility with one of the largest Commercial Radio Corporations in the United States. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course.

FREE Instruments and Text Books

We furnish free to all students, during the Course, *the wonderful receiving and sending set exactly as shown in the illustration.* **This set is not loaned, but *given* to all students completing the Course. One cell of dry battery all that is required. No additional wiring, aerials, etc., needed.**

The Transmitter shown is the celebrated **Omnigraph** used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the **Omnigraph,** place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the **Omnigraph**—the same model **Omnigraph** as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

Wireless Telephony Course

We have incorporated in our Institute an up-to-date and complete Course in Wireless Telephony, written by our Chief Instructor, Mr. L. R. Krumm. **This Course is also furnished free.**

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in New York City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

The Department of Commerce of the U. S. Government

recognizing the value of the instruction furnished by us, allows all of our graduates a five-point credit in their examination for first-grade license.

THE U. S. SHIPPING BOARD will also testify as to the value of this instruction.

America's Fastest Growing Wireless Institute

There Must Be a Good Reason. There Is—

The Best Course in Theory available.

The Best Instruments obtainable.

The Best Text Books and Diagrams on the market.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—**but do it today.**

NEW YORK WIRELESS INSTITUTE,

Dept. 77, 258 Broadway **New York City**

New York Wireless Institute

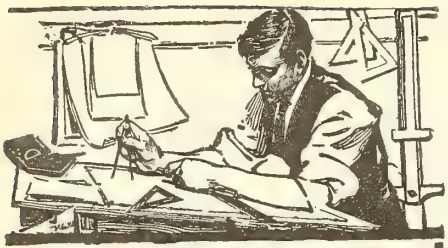
Dept. 77, 258 Broadway, N. Y. City.

Send me, free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your **Free Instrument offer.**

Name .....

Address .....

City or Town.....State.....



Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 6½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

75c a Week Only $3 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership **given free** with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-259 Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D-259
Chicago, U.S.A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $3 a month until $19.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....



A SPECIAL

Factory
Cut Price
U. S. Officer's Shoes

Hand sewed, first-grade factory cut-down price. Direct to you at only **$6.85** Made of the best Water-proof Mahogany calf leather. If these shoes are not just as we say, send them back. You do not lose a cent. Retail price of this shoe is $10.00. Built for work and dress at the same time. If you are sending money order or check do not include postage. Pay only for shoes. We pay postage.

U. S. Army Marching Shoes

First-grade factory, cut down-price. Direct to you at only $5.85. Retail price of these shoes is $8.00. Made of the best elkskin waterproof leather. Second grade $5.15

U. S. NATIONAL MUNSON ARMY SHOE CO., Inc.
Dept. 320
Westfield, Mass.

$50.00 the First Week



"I have averaged $500.00 a month ever since I started acting as your representative a year ago," writes Garrison. "$60.00 in one day," writes Lamar. Think of it. Thousands of agents all over the country are making big money representing us. You can too. Here is a bona-fide proposition. Absolutely guaranteed in every way. The biggest money making offer ever given. Write at once.

Raincoat FREE

Yes, we will give you a splendid gray worsted water-proof top coat in the latest style—of fine material. Snug, smart belt—roomy patch pockets. Write in at once if you want this wonderful coat free, but don't wait. This offer is only open for a limited time. Write in now to

GOODYEAR MFG. CO.
Dept. 5339 Goodyear Bldg., Kansas City, Mo.

"Movie" Models Show How Machines Work

By ESTHER LINDNER

(*Continued from page* 859)

a separate exposure of the motion picture camera to tell the story of the action. What appears on the screen to be steady action is in reality a series of different pictures, which, when run off by the projection machine, give the effect of consecutive movement.

The parts of the machine are moved by hand into each consecutive position that is a part of the movement of the original model, and for each movement a picture is made. If one part is moved a fraction of an inch, and this movement has a corresponding effect upon the other parts, these too must be moved to the exact position they would occupy if the actual machine were in operation—and each time that this is done a picture is made. All this must be perfectly timed so that the final action, as it appears on the screen, may be smooth and convincing—without any appearance of jerkiness.

For this reason it is necessary that the fashioner of the fibre-board duplicate superintend its photography as well. He alone has studied the problem, knows it by heart, and its making was his particular job. It is almost impossible to write directions for the photographing of such a contrivance.

The advantages of such an idea are innumerable, and their media for application many and varied. For instance, it is impossible to set up a motion picture camera inside of an automobile to secure bits of the mechanism—and yet it may be just such bits that will be of the greatest value and interest to persons interested in motors. Such an experiment is being tried at the present time—a "mechnigraph" has been made of the *vacuum gasoline-feed system* used on modern motor cars—and this has been animated on the screen.

Incidentally the flashes of the vacuum feed system occupy 150 feet of film space. At the rate of sixteen exposures to a foot of film, it was necessary to photograph the "mechnigraph" 2,400 times. The making of the replica and preparing it for the camera occupied two weeks. The man who made it spent years perfecting himself in this work, the photography alone consumed two days, and the working of the "mechnigraph" occupies the screen for just two minutes!—*Photos courtesy Harry Levey Service Corporation.*

What to Invent

By JAY G. HOBSON

(*Continued from page* 885)

an intensive state, as it is drawn from the burning end thru the paper wrapper and into the mouth and lungs. If this be true, and no doubt it is, a new cigarette holder with a special cooling feature should prove invaluable to the millions of puffers inhaling regularly, as most inveterate users of the mystic weed choose to do.

As shown, the construction of this holder sends the smoke indirectly thru the holder into the mouth, instead of straight thru the holder as the present kind does.

By causing the smoke to travel further, it makes for cooler smoking, and the larger surface of the holder coming in contact with the nicotine in the smoke, should have a tendency to retain some of it, thereby keeping it from the mouth and lungs where the damage to the health is done.

As an advertising article for a special brand of cigarettes and cigars, large quantities could be sold.

(Copyright 1920 by the Author)

Here's the reason I wanted The Auto-Wheel CONVERTIBLE Roadster

SEE how these sides work?—When I spread them out I have a hauling wagon. Just see how strong it is. Now suppose I want to coast, I push the sides towards the center. (They swing on pivots). Look at that roadster. Built just right. Wheels have real roller-bearings. No other wagon like it.

"And maybe you think it doesn't travel.—I'll challenge any boy on this street to a race."

The Perfect Christmas Gift

An *Auto-Wheel* wagon is a year-'round pal. You'll enjoy it throughout your boyhood. Besides the *Auto-Wheel Convertible Roadster,* we make the *Auto-Wheel Coaster,* the all-purpose wagon. Handsome booklet describes all sizes and models.

Set your heart on an *Auto-Wheel* for Christmas. Show this ad to Dad. Send us names of 3 coaster dealers, telling which ones handle the *Auto-Wheel.* We'll send Free for 6 months The *"Auto-Wheel Spokesman,"* our magazine telling about our BIG PRIZE CONTESTS and the *Auto-Wheel Clubs.* You may be able to win an *Auto-Wheel.* We'll also send the *Auto-Wheel* Coaster Dime Savings Bank.



The Auto-Wheel Coaster Co. Inc.
formerly
The Buffalo Sled Company
163 Schenck Street,
N. Tonawanda, N. Y.
In Canada: Preston, Ont.
Export Office: 365 W. 23rd
New York City

Auto-Wheel Spokesman FREE



Set in Solid Gold **Set in Solid Gold**

Send Us Your Name and We'll Send You a Lachnite

DON'T send a penny. Just say: "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will mail it prepaid right to your home. When it comes merely deposit $4.75 with the postman and wear the ring for 10 full days. **If you, or any of your friends can tell it from a diamond, send it back** and we will return your deposit. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.

Write Today Send your name now. Tell us which solid gold ring you wish (ladies' or men's). Be sure to send your finger size.

Harold Lachman Co., 204 So. Peoria St., Dept. 1259 Chicago

What a Dime Will bring You From the Nation's Capital

The little matter of **10 cts.** will bring you the Pathfinder **eight** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for all the Nation; an independent home paper that prints all the news of the world and tells the truth; now in its 28th year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, strongly, briefly—here it is. Send 10c to show that you might like such a paper, and we will send the Pathfinder on probation **eight** weeks. The 10c does not repay us, but we are glad to invest in new friends. Address:

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, 265 Langdon Sta., Washington, D. C.

Factory to Rider

Saves $15 to $25 on the model you select from **44 Styles,** colors and sizes of **Ranger** bicycles. Delivered free on approval direct from the Makers for **30 Days Free Trial.** We pay return charges if not satisfactory in every way.

12 Months to Pay Possession and use at once on our liberal year to pay plan. Any boy or girl can save the small monthly payments.

Tires wheels, chains, parts and equipment at half usual prices.

BIG RANGER CATALOG FREE, with marvelous new prices, 30 day trial offer and terms.

Mead Cycle Company Dept. B-107 Chicago Special Rider Agent plan to earn money.



Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page* 871)

found in their behavior toward heat. Some are very easily melted and oxidize or undergo combustion with great readiness, while others are exceedingly resistant.

Mount a piece of platinum wire two and one-half inches long in the end of a short piece of glass tubing by fusing the two together in the flame of a Bunsen burner. Note the bright silver lustre of the wire and its flexibility. Now place the wire in the oxidizing portion of the Bunsen flame, i.e., the hot outer part just above the tip of the inner cone. As you will observe, the wire becomes white hot and seems to expand in size. Remove the wire, allow it to cool and note that it has the same bright lustre and flexibility that it had originally. The wire in no way seems to have been changed. All its properties are still intact. Such changes we call physical because the composition of the substance remains the same.

Next, by means of tongs, hold a 2-inch piece of magnesium ribbon in the flame of the burner. A very vigorous action accompanied by a flash of blinding light follows with great rapidity When you have recovered your sight examine the white brittle residue that crumbles to a powder at the slightest touch. In no way does this new material resemble the original magnesium ribbon. The lustre, toughness and flexibility are all gone and it will not burn. Its properties have entirely changed and therefore we say that a chemical change has taken place and a new substance has formed. But since magnesium is an element it could have lost nothing in this change and, therefore, something must have been added to it. That something we shall see is *oxygen.*

Weight Change on Heating a Metal in the Air: That metals that undergo oxidation gain in weight when heated in the air can be very readily shown.

On one side of a horn-pan balance place a small porcelain crucible and fill it nearly full of granular tin, or "mossy" tin as it is called. Then just exactly counterpoise this with lead shot.

Arrange apparatus as shown in figure 1 placing the crucible of tin on the pipe-stem triangle. Using a small flame melt the tin and then gradually increase the heat. Continue the heating for about twenty minutes and stir the contents of the crucible frequently with an iron wire. You will observe a gray scum form on the surface of the molten tin and as you remove this with the iron wire the bright silver lustre immediately returns and as quickly vanishes. As you proceed the metallic tin disappears and a gray powder takes its place. When nearly all of the tin has been changed to this gray powder, turn off the burner and allow the crucible to cool without removing from the pipe-stem triangle. When it is cool enough so that you can handle it with perfect comfort again place the crucible and contents in the pan of the balance and note the weight change. Unless you have been very careless in your manipulation the balance will show a decided increase in weight.

What is true of tin is also true of other metals which oxidize when heated in the air. For many years in the early history of chemistry this simple fact was unknown and even for many years after its discovery the explanation of what had happened was a deep mystery. We now know *that oxygen from the air unites with the metal.*

Proof of the Oxidation of Copper: Cut a quantity of No. 24 copper wire into short

(*Continued on page* 920)



New Easy Way to Become An Artist

THIS wonderful new method makes it possible for *anyone* to learn Illustrating, Cartooning, or Commercial Art. Hundreds of our students are now making splendid incomes. And most of them never *touched* a drawing pencil before they studied with us.

The simplicity of this method will astound you. You will be amazed at your own rapid progress. You learn by mail—yet you receive *personal* instruction from one of America's foremost Commercial Artists—Will H. Chandlee. Get into this fascinating game, NOW. You can easily qualify. A few minutes' study each day is all that is needed.

Crying Demand for Trained Artists

Newspapers, advertising agencies, magazines, business concerns — all are looking for men and women to handle their art work. There are hundreds of vacancies right this minute! A trained commercial artist can command almost any salary he wants. Cartoonists and designers are at a premium. Dozens of our students started work at a high salary. Many earn more than the cost of the course while they are learning! YOU—with a little spare time study in your own home—can easily and quickly get one of these big-paying artists' jobs.

No Talent Needed

This amazing method has exploded the old idea that talent is an absolute necessity in art. Just as you have learned to write, this new method teaches you to draw. We start you with straight lines, then curves. Then you learn how to put them together. Now you begin making pictures. Shading, action, perspective, and all the rest follow in their right order, until you are making pictures that bring you from $50 to $500 or more! Many artists get as high as $1,000 for a single drawing!

Write for Interesting Free Book

Mail coupon now for this interesting free book "How to Become an Artist." Explains about this amazing method in detail. Tells of our students—and their wonderful progress — and how we can qualify you for a high-salaried artist's position. Also tells of our free artist's outfit and special low offer to a limited number of new students. Mail coupon NOW!

Washington School of Art

Room 1559, Marden Bldg., Washington, D. C.

FREE COUPON

WASHINGTON SCHOOL OF ART, Inc.,
Room 1559, Marden Bldg., Washington, D. C.

Please send me, without cost or obligation on my part, your free book, "How to Become an Artist."

Name .....

Address .....



CAPT G. F. CAMPBELL

Learn Commercial Aviation

Quickly At Home

Aviation is still in its infancy, but it is well past the trick stage. It is now a **billion dollar** industry needing thousands of trained men as pilots, mechanics, designers, salesmen, etc. You can enter this great new field of industry at a large salary after a few months of careful home study.

Course of Practical Aviation in National Aero Institute

will fit you for a big paying position in this giant industry. This nationally recognized course is directed by the famous **British birdman, Capt. Geo. Frederick Campbell, R. F. C.,** who personally supervises the work of every student.

It costs the U. S. Government $25,000.00 to fit a man for flying. Most of this training is ground work. Our course completely covers ground work and enables you to master the fundamentals of aviation in a short time. You want the **BIG MONEY** aviation offers. We show you how to get it. Fill in the coupon and let us tell you how you can enter this fascinating profession—**Now.**

NATIONAL AERO INSTITUTE

916 S. Michigan Ave., 744Z, Chicago, Ill.

National Aero Institute, Dept. 744-Z.
916 S. Michigan Ave., Chicago, Ill.

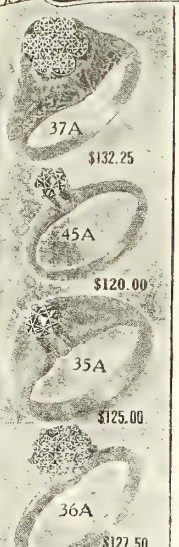
Gentlemen: Please send me without obligation, copy of "The Science of Aviation," also particulars of Mail Course in the Principles of Aviation.

Name .....

Address .....

Buy Your Xmas Gifts Now

Only a few cents a day



No Money Down

JUST send your name and address for our 128 page Christmas book of bargains in diamonds, watches and jewelry. Millions of dollars worth of jewelry from which to choose your Xmas gifts. Your selection sent on your simple request, *without a penny down.* If you don't think it is the biggest bargain you have ever seen, send it back at our expense. If you keep it you can pay at the rate of *only a few cents a day.*

8% Yearly Dividends

You are guaranteed an 8% yearly increase in value on all diamond exchanges. Also 5 per cent bonus privilege.

Write Today for Xmas Catalog

Send your name and address *now.* No obligation. Beautiful Xmas catalog comes free by return mail. Explains all about the Lyon Charge Account Plan. See this great collection of jewelry bargains now. *Send your name today to Dept.* 38-J

J·M·LYON & CO.

1 Maiden Lane, New York N.Y.

Play the Hawaiian Guitar

Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs, and other effects that make this instrument so delightful.



The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Your tuition fee includes a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 complete lessons and pieces of music. An ideal Christmas gift.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK

I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc., etc.

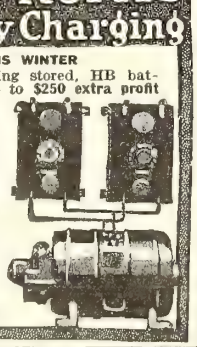
NAME .....
ADDRESS .....
TOWN .....
STATE .....E.E.

Please write name and address Clearly.

MAKE BIG PROFITS from HB Battery Charging

BIGGER PROFITS THIS WINTER

With winter here and cars being stored, HB battery charging can pay you $150 to $250 extra profit every month. Someone gets the business of charging those batteries—why not you? Start NOW—get a sturdy, dependable HB Charger with ample capacity to handle this profitable business.



THIS HB 16-BATTERY CHARGER Recharges 1 to 16 6-volt batteries or equivalent at once. Uses 2 or 3 phase city current cheapest and best. Current cost 4c to 12c each—owner pays 75c to $2.00. Quick, clean, permanent profits easily made.

Small Payment Puts This Money-Maker in Your Garage or Shop. Balance on easy monthly terms. Ten days' trial under HB Absolute Money-Back Guarantee. *Write*

HOBART BROTHERS COMPANY
Box 1210 E TROY, OHIO
Successful Manufacturers Since 1893

Be an Artist

Comics, Cartoons, Commercial, Newspaper and Magazine Illustrating, Pastel Crayon Portraits and Fashions. By Mail or Local Classes. Write for terms and List of successful students.

Associated Art Studios,
111 Flatiron Bldg. New York

A Prophet of Science

By JOHN DE QUER

(*Continued from page* 845)

metal, providing the radium is not in too close a proximity. From this I have conceived the idea that the Alpha rays of radio-active substances if properly applied, may have a stimulating effect upon cell growth, while the Gamma rays may be directly associated with function. In these experiments I do not concern myself with function, but only with growth. Some years ago, Dr. Alexis Carrel started this line of experimentation, and produced some wonderful results, and I believe if the proper light or electric stimulation to which each cell responds can be found, that these experiments will lead to an industrial development which will make the ocean water available as food for the human race. If this can be done, then we may smile at the gloomy forbodings of Malthus for another thousand generations.

"You see life originated in the ocean. Here the cell had its birth. It transformed sea water into its substance. The analysis of our bodies and that of sea water are very similar; they differ only in proportion. The cell is an aquatic creature; it has never left its original habitat. Our bodies are a cooperative commonwealth of cell colonies floating in a saline fluid. The small animals of our California deserts, which do not see water for years at a time, manufacture that fluid by chemical or electrical reactions going on in their intestinal tract from the starches in their food. The periods of gestation and other vital functions simulate the phenomena of the tides. Doubtlessly this is because the cell evolved in Paleozoic times under tidal conditions, and living things today, being nothing more than highly complex associations of cell groups, which differ from each other only because the media in which they develop differs in chemical composition, still responds to the conditions of its primitive home."

He removed the cap from the bottle, and took out the lungs which he now subjected to the galvanometer test demonstrating that the needle moved in the same way as in the test on the living dog. "After this cat has been dead two weeks its lungs still live," said he. At this point the dog on the table began to stir. He was coming out from under the anesthetic. "Poor pup," remarked the experimenter, "I have cut him up too much to save him. Dog Heaven is the place for him." So saying he took a sharp bistoury from his instrument case and with a deft movement of his hand, severed the spinal chord from the medulla. Respiration ceased immediately.

With his stethoscope he listened to the heart of the creature until that organ had ceased to beat. It took some time. "When the heart and lungs of an animal have ceased to function they are generally supposed to be dead," he explained. "But I will show you that the individual cells of this dog are not yet affected by its organic demise." With a few strokes of his knife he excised several of the creatures muscles. These he laid on a plate of glass and subjected them to the galvanometer test, with similar results to those obtained when they were part of the living dog.

"Now I will return the cat's lungs to their artificial nest, and make similar nests for 'Sports' running gears;" he purred as if to himself, "and two weeks from now I can assure you, they will be as alive and fresh as ever, no matter what becomes of the rest of the dog's anatomy.

"Rudolph Virchow has said that 'disease is resident in the cell.' He stated a partial

Send No Money

GENUINE $12 IMPORTED VELOUR HAT



Write quick for this amazing bargain. Only limited lo . Wonderful quality, imported velour, record-breaking cut price.

Just send address and size for this wonderful imported genuine black velour hat. Beautiful fedora style. Flexible brim. Can be turned up or down. Made of the finest quality, very silky, imported black velour. Fine wide grosgrain black silk ribbon band. Genuine leather, non-soilable sweat band. A hat you can wear, season after season, for years. **Don't Send a Penny**—Pay only $6.89 C. O. D. We pay delivery charges. **We Guarantee** to refund your money immediately, if you can match it for less than $12.00. **Write Today** before this astounding offer is withdrawn. Be sure to give size.

BERNARD-HEWITT & COMPANY
Dept. H-3912 900 W. Van Buren St., Chicago, Ill.



The Electric Safety Razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."
A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.

Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

VIBRATING ELECTRIC RAZOR CO.
Dept. 122, Council Bluffs, Iowa

NEW MOTOR BARGAIN

GENERAL ELECTRIC



1/4 HP Motor 110 V. A. C. 60 cycle single phase, 1750 Speed. Complete with Cord, Plug and Grooved Pulley.

Will operate **$23.50** Washing Machines, Sewing Machines, Small Lathes, Grinders, Bottle Washers, Etc. Satisfaction guaranteed or money refunded.

Illustrated catalog of motors and supplies FREE

HYRE ELECTRIC CO.
631 South Dearborn Street Chicago, Ill.

Learn the Sign-Show Card Business



Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.

EARN $25. TO $75. WEEKLY

You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.

DETROIT SCHOOL OF LETTERING, 632 D.S.L. Bldg., Detroit, Mich.

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**

truth. One phase of life manifests itself thru the cells, and disease means that the cell's transforming power is below par. Highly organized beings manifest two forms of energy. Let us call them the vegetative and the functional. The vegetative is energy manifesting itself as growth, and the functional is that energy used in the struggle for existence. Growth is due to a multiplication of the cell units, while functional energy is due to the circulating of the blood cells. These little workers add to their individual transforming power that of their mass movement. It is due to the cutting of the lines of force in the earth's field by the circulating blood that warm blooded animals are capable of such prolonged and intense exertion. The earth's magnetic field is the source of their dynamic energy.

"But what I especially want to call your attention to is the fact that the death of the individual and the death of its component cells are two separate and distinct phenomena. And in this fact lies the solution of some of the big problems which confront the human race today, and the solution of which will become imperative as the years roll on. But I am getting ahead of what I wish to say right here.

"As I have said animal life is due to the activity of harmoniously cooperating cell groups called organs, growing and functioning in a chain of media, each of slightly different chemical composition, according to the requirements of the cell forms they supply. It is my idea that the waste of one tissue alters the blood in such a way that it becomes a proper culture medium for the next, and so on until all organs have been supplied, when the unusuable waste is thrown out of the system by the organs of elimination. If this is true then health depends solely upon the perfection by which one set of tissues prepares the nutrition for the next. Tissues grow or suffer in direct proportion to the chemical sufficiency or insufficiency of the fluid on which they are fed. Of course there are other factors but these need not worry us now. What I am interested in is in the growth of tissue for human consumption apart from sentient organisms.

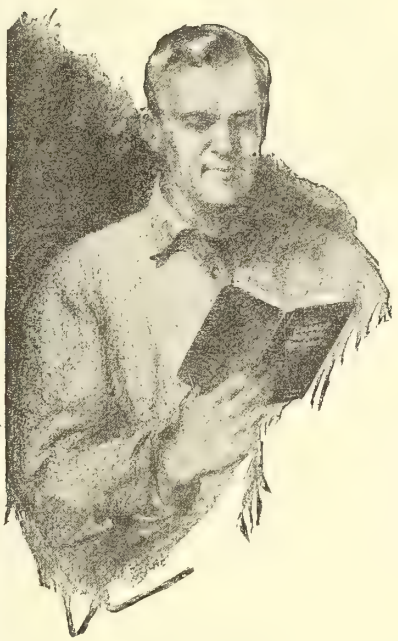
"Animals, and not their organs differ from such plants as the geranium, willow, or cotton-wood tree. These you may cut to pieces and each piece if suitably planted will make a complete plant or tree. They are comparatively simple organisms growing in a single medium, while an animal is a complex organism growing in a chain of media. Thus what is true of the geranium cutting is also true for our various organs, the difference being that while the geranium is planted in the soil, the organs are planted in different fluids, automatically supplied by the cooperative action, of their vegetative and functional activity.

"If I can succeed in demonstrating these facts beyond the peradventure of a doubt, they will prove to be of immense importance to science, especially to therapeutics. As yet we have no science of medicine. Medication is to a great extent guess-work and experimentation. Doctors still wince when some one quotes Voltaire's sarcasm, that Doctors put drugs of which they know little, into bodies of which they know less, for diseases of which they know nothing. How can we know very much concerning the processes of disease which is the approach of death as long as we do not understand the true nature of life, the perfection of which spells health? We have no right to hide behind a metaphysical bugbear which would make of life an impenetrable mystery. It is no more an impenetrable mystery than was the inland of Africa or the North Pole. I firmly believe that every phenomenon in the universe can be traced to a single cause, and that to this rule life is not exception; if it is, then the word 'universe' is a misnomer."

Starrett Books - Vol. I and II

75¢

If You are an Apprentice—



You take your problems to the STARRETT BOOK FOR MACHINISTS' APPRENTICES. It helps you to solve them.

But, if you've completed your time and are a MACHINIST—the old problems no longer puzzle you, but there are new ones that DO.

They're answered in Volume II of this series, THE STARRETT DATA BOOK FOR MACHINISTS.

Four editors, each an expert in his field, have selected its tables and formulas. Gear-cutting feeds, power transmissions data, strength of materials, etc.—you'll find these and many more in its 180 pages.

Bound in red Athol leather. Size 4½ x 7. Price 75c. Get either of them at your dealers, or order directly from us. Catalog No. 22 "LE" is a handy reference book. Sent free upon request.

THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Mfrs. of Hack Saws Unexcelled
ATHOL, MASS.

Use Starrett Tools

Does *ALL* Your Gasoline Explode?

OR does part of it just clog up the cylinders in the form of carbon — *through an inefficient spark?*

Put an Alsop-All-Spark on your car and your old, cracked, oil-soaked plugs will now give a hot, fat spark that explodes *every particle* of the gas. You will find unexpected power in your car and your carbon troubles will be gone forever. Government tests prove that an All-Spark actually will eliminate carbon—besides getting 100% power out of your engine.

You can try an All-Spark with no risk. It is fully guaranteed and your money will be refunded in full if you are not thoroughly satisfied. Incidentally, the saving in gasoline and new spark plugs alone will soon pay the cost of an All-Spark.

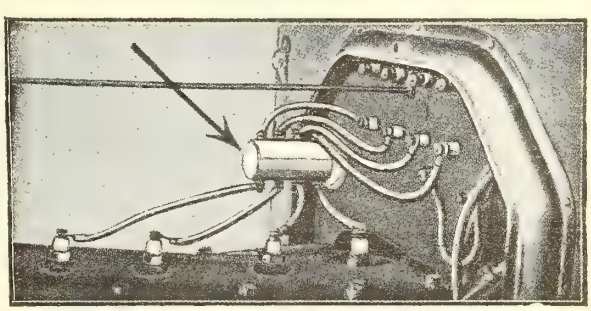
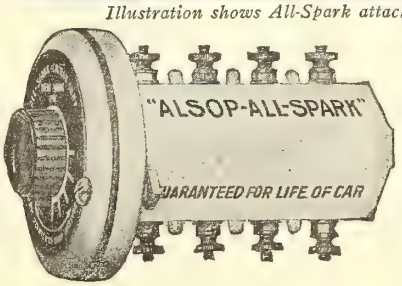


Illustration shows All-Spark attached to a Ford



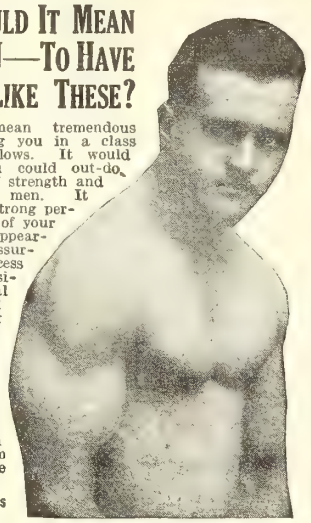
ALL-SPARK IGNITION COMPANY, Inc.
13-X Water Street, New York, N. Y.

ALL-SPARK IGNITION COMPANY
13-X Water Street,
New York, N. Y.

Gentlemen:
☐ Enclosed please find remittance for $7.50 for which please send me one Alsop-All-Spark Intensifier for a four cylinder engine together with full instructions for installing it in ten minutes.

Name.....
Address.....
City.....
State.....

WHAT WOULD IT MEAN —TO YOU—TO HAVE MUSCLES LIKE THESE?



It would mean tremendous strength, putting you in a class above your fellows. It would mean that you could out-do them in feats of strength and be a leader of men. It would mean a strong personality because of your commanding appearance, thereby assuring you of success in both the business and social world. It would mean added lung power, unlimited vitality and perfect health; removing all fears of indigestion and disorders which undermine the average man and make him old long before his time.

All These Things Are Yours

I absolutely guarantee to do all this and more for you. I have found the short cut to physical perfection and applied it on my own body, proving its results. I have personally trained many of the world's strongest men by this same method. Why waste your time and money with old-time worthless methods? If you are desirous of being a real robust man, follow the path of those who have already made a success. Come now, get busy, for every day counts.

EARLE LIEDERMAN
The Acme of Physical Perfection

Send for My New Book, "Muscular Development"

It tells the secret. Handsomely illustrated with 25 full-page photographs of myself and some of the world's best athletes whom I have trained. Also contains full particulars of my splendid offer to you. The valuable book and special offer will be sent on receipt of only 10c, stamps or coin, to cover cost of wrapping and mailing.

Don't miss this opportunity. Sit right down now and fill in the coupon. The sooner you get started on the road to health the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon to-day.

EARLE E. LIEDERMAN, Dept. 212, 309 Broadway, N. Y.

EARLE E. LIEDERMAN, Dept. 212, 309 Broadway, N. Y. City

Dear Sir:—I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development."

Name .....

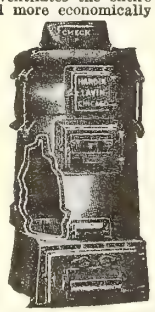
Address .....

City..... State.....



BURN LESS COAL

With an improved, all-cast pipeless furnace you can cut your coal bills in two. This efficient, basement installed heating plant heats and ventilates the entire home. It burns any grade of coal more economically than a stove. It needs no expensive piping or other equipment. Anyone can install it in a day. They are described at our wholesale prices in our Handy Man Book. Send for it.

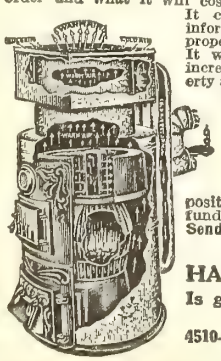


Do Your Own Plumbing and Heating by the Cut-to-Fit Method.

By our new plan anyone can install a complete plumbing or heating plant in his own home. Send us a rough sketch with measurements. Our Engineers will draw your plans, furnish information and see that the supplies you order come CUT-TO-FIT your needs. No waste of time, labor or unused material. Only a few simple tools necessary. **Send for**

The Handy Man Book

It will show you how. It will tell you just what to order and what it will cost at our wholesale prices. It contains plans and useful information for every builder, property owner or contractor. It will convince you. It will increase the value of your property 50%. You can do the work yourself.



We have spared no effort or expense in the preparation of this valuable book. To keep from sending it broadcast to uninterested persons we request a temporary deposit of 25c which will be refunded with your first order. **Send for it Today.**

The Service of
HARDIN-LAVIN CO.
Is guaranteed by 40 years' business at
4510-20R Cottage Grove Avenue
CHICAGO

He paused in his conversation—returned the carcass of the cat to the ice box—and called his negro servant to dispose of the remnant of the dog, after which he busied himself with the muscles he had excised and which lay still quivering on the plate of glass.

Taking one of the muscles, he attached it to one of three silver pipettes which were fixt in a large bottle stopper; from it he suspended the muscle in a bottle of similar dimensions to the one in which he kept the lungs of the cat. The pipette, from which the muscle was suspended, he attached to an oxygen tank by means of a soft rubber tube, while another was past thru a small hole in the bottom of the bottle in such a way that it protruded far enough so that its end would fall well below the hole provided for it in the shelf upon which the bottle was to rest. To the end of this pipette which fell below the shelf, he fastened a little safety valve, which he regulated so that it would keep the required gas pressure within the bottle. This tube was run up into the bottle to a point just above the fluid level, where, as the Doctor explained it could take up the carbon dioxid created by the metabolism of the muscle and expel it from the confines of the tissue. The other two pipettes in the stopper, he connected, one with the media tank, as he called it, and the other to an adjoining bottle in which was suspended a specimen of another tissue. There was some kind of pumping device which moved the media from one bottle into another at a definite rate of circulation. "The muscle cells take nourishment from the medium in which they are placed, they also excrete waste into it; hence we must provide for the circulation of the fluid. Fluid which has once been used by a tissue must not return to it again until it has been purified of all the excreta produced by the metabolism of that tissue. This, I have found, is best accomplished by the growth of other tissues. The only thing that makes different cell types in one organism possible is the fact that the morphological structure of the cell varies according to the media in which it finds itself. Thus the excreta of one set of tissues becomes the culture media for the next, and if we are to produce them artificially, with any degree of success, we must endeavor to imitate the requirements of nature as nearly as is humanly possible," he explained enthusiastically.

"But what is it you expect to gain from all this work? Where is the money in it?" I asked genuinely puzzled. The last question I felt sure would bring from him an excited flood of oratory, but in this I was disappointed. Nothing excited this dynamo except obscure phenomena; they, and they alone, set him to work.

"In the first place," said he, ignoring my reference to our modern god, "I am trying to discover what life is, and what are all the conditions on which it depends for its fullest and freest manifestations. The lack of such knowledge, fills our text-books on physiology with statements expressing doubt and uncertainty. Much of what the laity takes for truth is mere hypothesis. There are whole series of secretions, the nature of which we do not understand, and which, we therefore are as likely to hinder as to help with our medication.

"Society has intrusted us as doctors with the care of that highly complex mechanism we call the *human body,* the functional motive power of which we do not understand, not because that motive power is unknowable, but because science has just penetrated into that world of forces from which the material universe arises. We have always regarded life as a phenomenon of matter, we may have to come to the conclusion that matter is a phenomenon of life. Radio-activity and electricity are the beacon lights on the shores of the world of matter; they point the way into a sub-material universe, and it is in this universe that we



GLORIA SWANSON
Cecil B. DeMille Artcraft Player

WALLACE REID
Paramount Star

Hermo "Hair-Lustr"

(Keeps the Hair Dressed)

For Men, Women and Children

The hair will stay dressed after Hermo "HAIR-LUSTR" has been applied. No more mussy, untidy looking hair. Adds a charming sheen and luster, insuring the life and beauty of the hair. Dress it in any of the prevailing styles, and it will stay that way. Gives the hair that soft, glossy, well groomed appearance so becoming to the stars of the stage and screen. Guaranteed harmless, greaseless and stainless.

50c and $1 at Your Dealer

$1 size 3 times quantity of 50c size. If your dealer can't supply you we will send it prepaid upon receipt of price. **Remember your money back if dissatisfied.**

HERMO CO., 542 E. 63rd St., Dept. 1012, CHICAGO

A COMPLETE COURSE IN

COMIC DRAWING

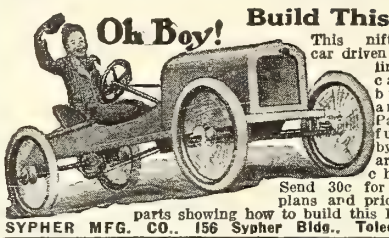
CARTOONING CARICATURING & LETTERING FOR ONLY $5



With this complete Course you can quickly learn to draw the COMICS, CARTOONS, CARICATURING, LETTERING, GIVE CHALK-TALKING EXHIBITIONS, etc., etc. Over 300 Illustrations. With our Modified Skeleton System you can easily learn to make original drawings. This course gives you all the "inside dope" and "short cuts." It explains the entire subject from A to Z. The Materials, General Instructions, Pen Lines, Enlarging, Reducing and Reversing Pictures, Lettering, How to draw the Head, Eyes, Ears, Nose, Mouth, Hair, Hats, Caps, etc., Anatomy, The Skeleton, Modified Figures, The Body, Action, Clothes, Wrinkles, The Hand in 80 different positions, The Foot, Shoes, Boots, Etc., Expression 18 different plates, Caricaturing, Portrait Drawing, Perspective, Foreshortening, Shading, Shadows, Composition, The Right and Wrong Way, Timely Remarks, How to Sign Your Name, Etc. Complete course printed on Drawing Paper and neatly bound in book form. Write your name plainly. Postpaid $5.



Ernie's School of Comic Art, Dept. O, Elyria, Ohio



Build This Car.

This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 30c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO., 156 Sypher Bldg., Toledo, Ohio

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only One Dollar Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah

WHY DONT YOU WRITE
THE WORDS FOR A SONG
WE'LL HELP YOU ALONG

By composing the music Free and publishing same. Send poems to-day.

D. N. LENOX CO., 271 W. 125th St., N. Y.

READ LOCOMA



—an interesting, instructive MAGAZINE, on personal subjects, such as Love, Marriage, Divorce, Eugenics, Birth Control, Sex Hygiene, etc. For Men and Women only. 15 cents a copy, $1.50 a year, 8 months' special trial 50c.

100 E.E. & M. Bldg., Farmington, Mich.

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 773 Bogue Bldg., Indianapolis

must seek for the ultimate cause of life's processes.

"But this field is comparatively new while medicine is old; it moves but slowly on these heretofore untrodden paths. Doctors are unaccustomed to think of life in terms of electro-magnetic lore; but they will have to come to it, if medicine is ever to become what it ought to be, a pure science. As it is now we are treating a highly complex generator as if it were an internal combustion engine, with the result that we not infrequently short-circuit the machine."

He walked over to the table which stood in the center of his laboratory and picked up several fairly large horseshoe magnets. These he clamped together with small brass clamps, fastened them to an upright in such a way that their open ends fitted over a copper disc, which he now set in motion with a fan motor. By means of the bare ends of an insulated wire he drew off from the swiftly rotating device a shower of sparks, explaining as he did so that it was the copper cutting the lines of magnetic force that produced the electricity. "Hemaglobin contains iron. Iron is affected by magnetism, from which I conclude that its circulation thru the vascular system must give rise to electrical phenomena, which I believe lie at the basis of the functional activities we behold in living organism," he explained.

"But cannot these be explained upon the well established laws of chemistry." I asked. "Is it really necessary to consider the body as a dynamo instead of an internal combustion engine in order to fathom the mysteries of life?"

"It would be all good and well to stay within the bounds of 'the established laws of chemistry' if we really knew them in the strict sense of the word," he replied quietly. "But you must not forget that much of what we considered 'well established' twenty years ago is today being shaken to its very foundation. The electronic theory of matter is going beyond the atomic theory. The search for the primal cause has past out of the hands of the chemist and into those of the physicist. Radio-activity has revealed to us a new continent in science which it is for us to explore. This continent stretches from the atom to the 'Prima Causa,' and in it lie the secrets of *electricity, magnetism, gravitation, repulsion, and life itself.* These are all pre-atomic forms of the one thing which composes this universe. As I have said, they are pre-atomic forms of energy. How then are you going to seek for them in what you are pleased to call 'the well established laws of chemistry.' These laws deal with the action of atoms on one another, while these pre-atomic forces give rise to the atoms themselves. Gravitation is only manifest to us thru the weight of material things. Electricity we know chiefly by its result. Heat is only manifest thru material media, and life is only recognized in animal or vegetable form."

He leaned against the table and ran his fingers thru his wavy blonde hair, while a whimsical smile played about his whip-like mouth. "Some day I will show the world, not only what life is, and upon what it depends, but also the rôle it plays in the formation of the so-called inorganic universe. It may sound terribly heterodox but I have a notion that not a few elements undergo transmutation in living organisms. Elements, like the organisms they compose, have their birth death and transformation period."

"Surely you do not hold this view seriously?" I asked. And then, in order to draw him out on this point, I added that I was under the impression that science had demonstrated beyond the peradventure of a doubt, that nothing could be found in organic beings that did not enter into them in molecular or atomic form from their environment. I was willing to concede that

Try These "Pay Raisers"
At our Expense ~ Order On 5 Day Trial
DRAKE'S PRACTICAL MECHANICAL BOOKS FOR HOME STUDY

These books will perfect you in your trade—pave the way to the big position. We will send any book postpaid. If not entirely satisfied return the book and your money will be refunded in full.



Modern Electrical Construction
By Horstmann & Tousley. A perfect guide for the beginner. Valuable to the journeyman. Of special value to the inspector. Explains in detail how good electrical work is installed. 440 pages. 263 illustrations.
Leatherette Binding **$1.75**

Easy Electrical Experiments and How to Make Them
By L. P. Dickinson. Equally valuable to the amateur or the practical electrician. Gives in plain language all the information you want about every kind of electrical apparatus. 220 pages, 110 illustrations. Cloth Binding.....**$1.25**

Telegraphy Self Taught
By Theodore A. Edison. Clearly and concisely written. Tells how to easily train the ear to receive messages by the audible alphabet system. 170 pages. Fully Illustrated. Cloth Binding.....**$1.25**

Electricians' Operating and Testing Manual
By Horstmann & Tousley. A practical handbook for working electricians. Covers installation, operation, testing, maintenance and repairs of all electrical apparatus. 361 pages. Illustrated.
Leatherette Binding **$1.75**

Operators' Wireless Telegraph and Telephone Handbook
By V. H. Laughter. Describes in detail the construction of a wireless set, the winding of spark coils and the tuning of a wireless station. Written in non-technical language. 210 Pages. Cloth Binding.....**$1.25**

Order Direct Today On Our Money-Back Plan
Over a hundred pay-raising books for every trade are listed in our big illustrated catalog. Write for free copy.
FREDERICK J. DRAKE & COMPANY, 1009 Michigan Ave., Chicago, Ill.
Drake Books are for sale at all book-stores.

Earn Big Money



Pack your grip today and come to the Sweeney School of Auto-Tractor & Aviation Mechanics. Strike out for the big money and a world wide opportunity.

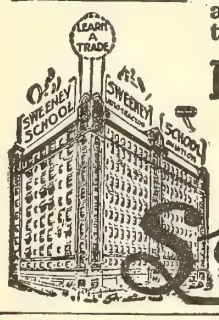
PICK YOUR JOB

Farm Mechs.	$125
Tire Men	150
Drivers	150
Repair Men	200
Taxi Drivers	175
Tractor Men	200
Garage Owner	400

Expert Mechanics Wanted The machine expert is the boss of creation today, whether on the farm or in the city. If you are mechanically inclined learn to make and repair autos, tractors, trucks, gas engines, auto tires, etc., **in Eight Weeks** by

The Sweeney System OF PRACTICAL EXPERIENCE

Learn as 35,000 other men have learned—**by tools, not books.** Learn power farming on my big Tractor farm—18 tractors. Learn to make a $30 tire from 45c worth of junk. Learn to fix any piece of machinery. You can't get this System anywhere else. Thousands of opportunities for experts trained in this **Million Dollar School—the greatest in the world.**



FREE Send today for my 72-page catalog, or simply say when you're coming and I will have classes arranged and your rooms ready. I guarantee railroad fare round trip if you find a single misrepresentation.

EMORY J. SWEENEY,
President

LEARN A TRADE—
Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
844 SWEENEY BLDG. KANSAS CITY, MO

The Million Dollar School
Sweeney
AUTOMOBILE and TRACTOR SCHOOL
The Largest in the World



$1 For This Guaranteed Fountain Pen

An extraordinary offer to introduce the Big Basch Diamond catalog. Diamonds listed as low as $97.50 per carat. Pen is a safety lever self-filler simplest and most practical fountain pen ever made. Barrel and cap of first quality Pararubber. Your name in gold free. Pen is 14K solid gold iridium tipped and hand tempered. Full size—6 1-2 in. long. Free repairs for two years guaranteed. Send $1.00 for pen today. Money returned if not satisfied, or ask for free diamond book. Free examination on everything. L. BASCH & CO., Dept. A3660 State & Quincy Sts., Chicago



General Manager at 28

How Mr. Rohrschneider Won Success as an Electrical Expert

GENERAL MANAGER of his company at 28 years of age! His own boss—owns his home—married and happy and prosperous—that's the remarkable success achieved by Wallace H. Rohrschneider, now General Manager, Secretary and Treasurer of the Hustisford Light, Power and Manufacturing Company of Hustisford, Wis.

Mr. Rohrschneider got his start toward his quick and brilliant success at School of Engineering of Milwaukee. There he received the practical, intensive and specialized training that enabled him to make good in a big way.

Why Don't You Get Into This Big Pay Field?

The same kind of training that put Mr. Rohrschneider into the ranks of the highly-paid Electrical Specialists will qualify you for brilliant success in this fascinating field of unlimited opportunities. **Come to America's Greatest Institution of Electrical Education.** Learn by actual practice in our big laboratories with their magnificent equipment, including motors, dynamos, switchboards, ignition and lighting systems, etc. **Over 90 recognized experts** give you personal instruction every step of the way.

Earn Your Way Through This Great College

You can earn money to help defray your expenses while you are learning. Our wonderful cooperative plan brings an Electrical Career within the reach of every ambitious man. Our Free Employment Department secures positions for those students who wish to earn part or all of their expenses. In addition, **the Department will help you get a good position in the Electrical industry when your training is completed.**

BIG BOOK FREE Mail the coupon today for our big new illustrated catalog. Check the course that interests you most and we will send you special information. Read about the wonderful method of training of this great Electrical School that trains men for **practical and quick success** See how easy it is for you to get the training that will enable you to step to a splendid position and a handsome income. Mail the coupon right NOW. No cost or obligation.

SCHOOL of ENGINEERING of Milwaukee

Dept. S-13, 373 Broadway **Milwaukee, Wisconsin**

Mail Coupon Now

SCHOOL OF ENGINEERING OF MILWAUKEE
Dept. S-13, 373 Broadway, Milwaukee, Wisconsin

Please send me, without any cost or obligation, full particulars of the electrical course I have checked and your big Free Book telling about your institution and how it will fit me for a big position in the electrical field. Also tell me about your Earn While You Learn plan.

(Check courses interested in.)

....**School of Practical Electricity**—1 year course. Complete general course, covering entire electrical field.
....**Institute of Electrotechnics**—12 to 36 months' course. Practical electrical training combined with thorough Academic education.
....**School of Electrical and Mechanical Drafting**—6 months' to 1 year course. A general drafting education. Prepares for good position as skilled draftsman.
....**School of Electrical Engineering**—3 years' course. Regular collegiate work granting B.S. Degree. 14 High School units or diploma from our Institute of Electrotechnics required for entrance.
....**School of Automotive Electrotechnics**—3 to 6 months. Covers all systems of starting, lighting, ignition and storage batteries for automobiles, tractors, air-craft, etc. Intensive practical course.
....**Armature Winding and Motor Generator Repair Course**—3 to 6 months' course. Brief, but intensely practical, leading to well-paying positions.

Name .....
Street .....
City ..... State.....
Age ..... Education.....

molecular rearrangement took place in both animal and plant structures, but that there was such a thing as *atomic transmutation consequent upon vital activity* seemed to me a dangerous heresy.

But my objections only brought a smile to the face of the earnest experimenter as he pursued his activity among the culture jars. Turning a stop cock here, and reading a dial there, testing the acidity of this fluid and the specific gravity of that, marking the results of his findings in his ever-ready note-book while he talked, as if he were thinking aloud,—he did not present any counter arguments to what I had said but just explained his views, and demonstrated his principles in a way that marked him as a unique man among my scientific acquaintances. He just talked, and his expressions are always interesting and unique. It is an education to listen to him. His philosophical deductions may not always be orthodox, and he may misinterpret the meaning of his experiments. I do not know. I only know that all those who have the privilege of his friendship will agree that his achievements are remarkable.

Dr. Pringle is always at work. He seldom busies his mind with abstract propositions. "Demonstration beats argument," is one of his favorite sayings. Whenever he makes a statement, he wants to work it out before your eyes. To be a teacher thru deeds seems to be the motive power of his life.

Thus while working he replied to my challenge of his scientific orthodoxy. He contended that science was always right but that scientists were frequently wrong. Said he: "Scientists fish for truth, with a generous share of fisherman's luck. When they do make a catch it is a big one, but they are of necessity few and far between. And the species of the specimens are not always certain. The trouble with us is, that we are inclined to stick to one side of the boat; and if some one suggests that we try the other side we are apt to call him irregular. That is why we persist in looking for the nature of life in atomic reactions; we have the habit. The idea that life may be itself an atom-forming power comes from the other side of the boat, and is therefore taboo. The idea that there are eighty distinct substances in the universe, is not only ridiculous but dead; it only survives as a scientific superstition, marring in no small degree our progress on the path of knowledge.

"Sir William Ramsay and others, have witnest the birth of helium from the death of radium, as well as its intermediate phenomena. Is it then too much to conceive, that what happens in Sir William's laboratory, may, I do not say does, happen in the infinitely more complex laboratory of the animal or vegetable body."

By this time he had finished checking up on his culture jars and he continued his conversation. "As sometimes happens in mathematics, when we invert the problem the truth drops out, so it is in biology and for that matter in all sciences. Many things remain unexplained because we approach them from the wrong side; that is why I have inverted the problem of life; and while I do not say that I will solve the mystery, I do say that I have approached nearer to the solution than ever did my preceptors.

"Some day I will take you out and show you the laboratory on my ranch by the sea. I am doing some interesting work on both animals and plants. Modern science has proven that there was more than a grain of truth in the idea of the ancient alchemists, that matter could be raised to higher values. In the case of radium at least we have discovered that elements can be stept down to lower values and by parity of reasoning, what can be stepped down can be stepped up. If atoms are condensations of electrons it may be a good guess that living organisms play a part in that conden-

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures but 4¼ Inches Long. Takes Regular .22 Calibre Cartridges

The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability.** It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard 22-calibre cartridge obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. The price of the Baby Revolver is only $6.50 sent by mail, p.p.d., to any address.

$6.50

JOHNSON SMITH & CO., Dept. PM35, 3224 N. Halsted Street, **CHICAGO**

AGENTS WANTED

Cut Your Own Hair WITH THIS **Only 50c** Extra Blades, 5c

SAFETY HAIR CUTTER Can cut your own hair with this marvelous invention. Cuts the hair any desired length, short or long. Does the job as nicely before your own mirror. You can cut the children's hair at home in a jiffy. Can be used as an ordinary razor to shave the face or finish around temple or neck. Sharpened like any razor. **Saves its cost first time used. 3 for 15 cents.**

JOHNSON SMITH & CO., Dept. PM 35, 3224 N. Halsted Street, **CHICAGO**

INVISIBLE INK

The most confidential messages can be written with this ink, for the writing **MAKES NO MARK.** Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private memorandums away from prying eyes. Great fun for playing practical jokes. **Only 25c Bottle.**

VANISHING INK

Writing written with this remarkable ink vanishes entirely in a few weeks (sooner if desired), leaving the paper QUITE BLANK. **25c ppd.**

Dissolving Ink

Writing appears or disappears at will. Secret with each bottle. Very remarkable. **25c.**

JOHNSON SMITH & CO., Dept. PM35, 3224 N. Halsted Street, **CHICAGO**

MAGIC FLUTE

Wonderfully Sweet Toned and Musical

The Magic Flute, or Humanatone, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a knack in playing it, which when once acquired after a little practice, will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is as charming as it is surprising. **25c ppd.**

Post Paid **25c**

Good Luck Ring

Quaint and Novel Design

A VERY striking and uncommon ring. Silver finish, skull and crossbone design, with two brilliant, flashing gems sparkling out of the eyes. Said by many to bring Good Luck to the wearer, hence its name, **Good Luck Ring.** Very unique ring that you will take a pride in wearing. **ONLY 25 CENTS.**

JOHNSON SMITH & CO., Dept. PM35, 3224 North Halsted Street, **CHICAGO**

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing the remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light, rendering it perfectly visible in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons of electric bells, plates of your electric meters, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. Small bottle, **price 25c** Larger sizes, **50c** and **$1** postpaid. Johnson Smith & Co.

Mystic Skeleton

A jointed figure of a skeleton 14 in. in height will dance to music and perform various gyrations and movements, while the operator may be some distance from it. **10c pd.**

Serpent's Eggs

Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most lifelike manner. **Price per box, 15c ppd.**

JOHNSON SMITH & CO., Dept. PM35, 3224 North Halsted Street, **CHICAGO**

All the Latest Surprising and Joke Novelties

"Chicken Inspector" Badge	15c	Luminous Skull	25c
Crying Cat in Bag	20c	Field Glasses	$10.00
Midget Bible (size of a pea)	25c	3 drawer Telescope	$1.75
Anarchist Bombs (Express only) 8 bxs for	$1.00	Invisible Ink (secret writing)	25c
Book on Boxing	35c	Vanishing Ink	25c
Thurston's wonderful Trk Cards	10c	Liar's License	15c
Box of 6 Wire Puzzles	35c	Fish Lure (catches fish)	25c
Conjurer's Casket of Magic Tricks	75c	Moving Picture Machines	$3.00, $7.50 and $12.00
Watch Camera	$3.50	Nail Klippers	35c
Films for Watch Camera	35c	Exploding Matches (Express only) 8 bxs for	$1.00
Exploding Cigarettes, box	50c	Stage Money, 50 bills	25c
Weather Cottage	$1.50	False Mustache	10c
Seebackroscope (see behind you)	25c	Inkless Pen, writes with water	15c
Amateur Electrician Book	15c	Exploding Fountain Pen	50c
Firecrackers (Express only) 10 pkts for	$1.00	X-Ray Novelty	15c

JOHNSON SMITH & CO., Dept. PM35, 3224 North Halsted Street, **CHICAGO**

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

SAVE OVER HALF

A few hours interesting work saves over half and gives you a machine to suit your ideas. We furnish motors, tone arms, case material, blue prints and full instructions Plays any record. Make fine profit building phonographs for your friends.

Write today for our Blue print offer. **FREE**

AGENTS wanted for Choraleon King Phonographs

Choraleon Phonograph Co.
1220 3rd St., Elkhart, Ind.

$4 AND $5 WILL BUY
A Standard, Guaranteed
TYPEWRITER
With Every Modern Writing Convenience

WRITE TODAY FOR ILLUSTRATED CIRCULAR
Explaining Try-Before-You-Buy Plan
HARRY A. SMITH. 738-218 North Wells St., Chicago, Ill.

Learn to Dance!

You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful **Peak System of Mail Instruction.**

New Diagram Method. Easily learned; no music needed: thousands taught successfully.

Write for Special Terms. Send *today* for FREE information and surprisingly low offer.

WILLIAM CHANDLER PEAK, M. B.
Room 239 , 821 Crescent Place—Chicago, Ill.

"EARN WHILE YOU LEARN"

STUDY ART

Learn to create illustrations, designs, posters or costume drawings. The business world demands them and offers big returns to trained artists.

We teach Composition, Perspective, Technique in pen-and-ink, water-color, etc., fascinating Design studies, Historic Ornament and Lettering, as well as Color.

Advanced classes are Costume Illustration, Advertising Art, Photo-Retouching.

Home Study and Resident instruction both given. Our catalogue on request.

COMMERCIAL ART SCHOOL
708, 116 S. Michigan Avenue

BLUE PRINT READING



Electricians, Carpenters, Bricklayers, Mechanics, Shipyard, Sheet Metal, Structural and Concrete Workers, Boiler Makers, Plumbers, Pipefitters and others can earn big money if they can read Blue Prints. Get into the big-pay class. By our simple method we train you in a short time. Write for Catalog 15-B, stating trade. Do it today.

BE A DRAFTSMAN
Earn $35-$150 a Week

Employers everywhere are looking for draftsmen. They are offering big salaries and good positions are always open. By our practical method we train you quickly in your spare time. Drawing outfit, books, etc., furnished FREE. We help you to obtain position when qualified. Write for Catalog 15-G. DO NOT DELAY.

COLUMBIA COR. SCHOOL
Dept. 1, Drexel Bldg., Phila.

Help Wanted

We require the services of an ambitious person to do some special advertising work right in your own locality. The work is pleasant and dignified. Pay is exceptionally large. No previous experience is required, as all that is necessary is a willingness on your part to carry out our instructions.
If you are at present employed, we can use your spare time in a way that will not interfere with your present employment—yet pay you well for your time.
If you are making less than $150 a month, the offer I am going to make will appeal to you. Your spare time will pay you well—your full time will bring you in a handsome income.
It costs nothing to investigate. Write me today and I will send you full particulars by return mail and place before you the facts so that you can decide for yourself.

ALBERT MILLS, Gen. Manager Employment Dept.
2714 American Bldg., CINCINNATI, OHIO

MEN

Intensely interesting booklet free.
Wonderful results.
H. Gyde Co., Washington, D. C.

Why continue to
STAMMER?

Send for (free) illustrated 200-page book. It tells how Stammering and Stuttering can be quickly cured by the most **Advanced Scientific Method** in the world.
THE LEWIS SCHOOL, 40 Adelaide, Detroit, Mich.

sation. With one of two exceptions the elements composing organic beings fall in the first two staffs of the periodic law. That is no coincidence. Living things seem to make special atoms of the proper weight and reactivity to carry on the functional activities of the body. If that is true, then we must learn to aid electronic condensation going on in the organism before we bother with chemical reactions, which are then secondary and not primary phenomena of life, if ever we are going to have a scientific system of therapeutics. In my laboratory out on the ranch I have for years investigated marine animals and plants, as well as land organisms, and I find that many of them contain elements which do not exist in their immediate environment. Transmutation of atoms must then take place, if in truth new atoms are not formed.

"Our food builds our frame-work and acts as catalyzers in the production of highly complex enzymes, the nature of which is almost wholly unknown to medical science. 'The well established laws of chemistry' have given to physicians little more than the requisite Latin terminology with which to hide their ignorance. The hope for our profession lies, in the new, electro-dynamics. The radio-activity of matter will be the lamp to guide our feet on the path of discovery and into the truth of life. Instead of seeking for mineral or bacterial ingredients with which to control disease processes, we must learn to use magnetism and heliotropism to regulate life processes. Until this is done we'll continue to operate where we ought to cure, and I might add that whenever we use the knife for anything but traumatic conditions, we reveal our helpless ignorance of the fundamental processes of life. But we need not despair. The dawn is breaking. We are on the road to the source of light. But this is a little beside the question.

"What I am trying to accomplish in this world, is to add if possible a few facts to this world's store of truth. A new fact discovered is of more importance to the human race than a million stomach-aches assauged or a million dollars amast. My researches carry me quite beyond the merely therapeutic; they tend to point the way to the solution of some of our greater social, I might say racial, problems. The culturing of flesh for instance from condensations of sea water, which will some day be perfected, will solve the protein food problem and that problem is very important if my butcher's bills are any indication. The fact is, that due to the highly efficient methods for the production of life's necessities, the human race is increasing by leaps and bounds. The increase of human numbers naturally decreases the animal range, yet increases the demand for animal food. There is only one way to solve it and that is along the line of my experiments.

"By the artificial culture method, flesh and fats could be produced free from disease taints and marketed locally in an absolutely fresh condition; that would do away with the deterioration going on in cold storage flesh which is so prolific a source of disease in modern society."

He showed me a bottle similar to the one in which he had planted the muscle of a dog; in it I saw a bright red mass afloat in a pale yellow fluid. "That is porterhouse," he explained. "I planted it a week ago, then it weighed one ounce, now it weighs three and one-half pounds and is pure meat; and what is more important to me, it grows unassociated with a highly sensitive organism. This idea of wholesale butchery, as carried on in our modern slaughter houses, is unesthetic to say the least."

As he referred to the brutalizing effect of killing, I could not help but remember the dog he was so industriously carving when I came in; but I made no comment.

10 Lessons in
PUBLIC SPEAKING
FREE

Write quick—for particulars of this extraordinary offer; an offer you will never forget if you take advantage of it. Ten lessons in Public Speaking absolutely free to those who act promptly. We make this extraordinary offer to introduce our wonderful course in localities where it is not already known.

We teach you, by mail, to become a powerful and convincing talker and speaker—to dominate and control the decisions of one listener or an audience of a thousand. We have trained hundreds and helped them to increase their earnings and their popularity. Learn in your spare time, at home, how to overcome "stage-fright" and conquer fear of others; how to enlarge your vocabulary; how to develop self-confidence and the qualities of leadership; how to RULE others by the power of your speech alone; how to train your memory. Our

New, Easy Method

perfected and taught by Prof. R. E. Pattison Kline, former dean of the Public Speaking Department of the Columbia College of Expression, can be learned in 15 minutes a day. Prof. Kline is one of the foremost authorities in the country on public speaking and mental development. Do not delay and miss this opportunity of a lifetime.

OFFER LIMITED SEND NO MONEY

This Special Offer of **ten lessons free** is made strictly for advertising purposes and will be withdrawn without notice. Write now, before it expires, and receive full particulars with enrollment blank by return mail. Just tear off and mail free coupon—or a postal.

NORTH AMERICAN INSTITUTE
9449—3601 Michigan Ave., Chicago

Send This
Free Lesson Coupon

NORTH AMERICAN INSTITUTE,
9449—3601 Michigan Ave., Chicago, Ill.
I am interested in your course in Effective Public Speaking and your offer of 10 lessons free. Please send full particulars. This request places me under no obligation of any kind.

Name.....
Street.....
City.....
State.....



"THE 100% WIRELESS MAGAZINE"

What "Radio News" Is:

RADIO NEWS now in its second year holds the field undisputably as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO NEWS leads all other wireless magazines. The November issue had 72 pages; there were seventy separate purely radio articles and 112 illustrations. *Over forty thousand copies were printed and circulated.*

Each issue of RADIO NEWS contains 74 pages (or more) and an artistic cover in two colors. The illustrations average 120 every month and there are from 60 to 80 up-to-date articles, some by our greatest radio scientists, in every issue.

20c The Copy
$2.00 A Year
Canada and Foreign $2.50 A Year

SEND 20c FOR SAMPLE COPY TODAY

$50.00
PRIZE CONTEST

See the November issue and our special cover. *$50.00 if you send in the best title for the picture.*

72 PAGES
120 ILLUSTRATIONS

SPECIAL OFFER

Gentlemen:
Please enter my subscription for RADIO NEWS for the term of one year for which I enclose herewith $2.00. As a special offer you will also send me for 25c extra your great Wireless Course containing 160 pages, 350 illustrations, size 6¾ x 10" with fine flexible cloth cover. I have written my name and address in margin at the left.

EXPERIMENTER PUB. CO.
231 Fulton St., New York City



Practical Chemical Experiments

(*Continued from page* 913)

pieces about a half-inch long. Put these in a 15-inch length of combustion tubing arranged as shown in figure 2 and connected with an oxygen generator. Under the tube place a 4-tube Bunsen burner. Heat the wire and at the same time pass over it a stream of oxygen from the generator. Bring the copper to a good heat before starting to heat the generator. Prepare the oxygen in the usual way by heating a mixture of potassium chlorat and manganese dioxid.

When the copper wire has turned to black copper oxid turn off the burners, disconnect the oxygen generator and allow the tube to cool. Remove a few pieces of the black wire and note their lack of lustre and flexibility. Break a piece and observe that the wire has become black and brittle thruout.

Now set up a hydrogen generator and connect it to the combustion tube containing the copper oxid as shown in figure 3. Upon the zinc in the hydrogen generator pour dilute sulfuric acid, and after all the air has been swept from the apparatus, light the four-tube burner under the combustion tube. As the stream of hydrogen passes over the hot copper oxid it unites with the oxygen in the oxid to form water, which escapes as steam, and there is left in the tube bright metallic copper.

Thus by heating copper in oxygen and reducing the product with hydrogen back to metallic copper, accompanied by the formation of water, we have proved that copper oxidizes. Incidentally we have also proved the composition of water.

Great Activity of some Metals: The two most active metals are potassium and sodium, the two least active are platinum and gold. The two former are so active that they will decompose water with the liberation of great energy and therefore must be kept under kerosene.

Buy an ounce of each of these two metals. They will probably come in small sealed containers. Before opening them have ready two small wide-mouthed bottles containing kerosene. Then upon removing the metals immediately immerse them in the kerosene.

Remove the potassium from the kerosene and with your knife blade cut off a very small piece. Note the softness of the metal and the bright lustre of the freshly cut surface. But also observe that this bright surface immediately tarnishes owing to the very great affinity of potassium metal for oxygen.

Now throw the small piece of potassium upon the surface of water in a small cup or beaker. So light is the metal that instead of sinking it floats, and so great is its activity that immediately it begins to liberate hydrogen from the water and both the hydrogen and potassium take fire. As you watch, a molten globule of shining metal skims about over the surface with a hissing sound and growing rapidly smaller is soon consumed.

To show that a new substance has formed in the water add to it a few drops of phenolphthalein indicator and a beautiful pink color showing the presence of a base appears.

Repeat the above operations with sodium and similar results will be obtained, except that the sodium will not take fire.

These were the two first metals to be discovered by means of the electric current and it is said that when Sir Humphrey Davy saw the bright globules of molten potassium separating at the cathode of his apparatus, his delight knew no bounds and he danced about his laboratory like a madman for sheer joy.

(*Continued on page* 939)



PATENT ADVICE

Edited by H. Gernsback

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

IMPORTANT NOTE TO CORRESPONDENTS

We receive from thirty to fifty letters requesting advice on patents every month. Due to lack of space, even tho condensing this department into the smallest type, we can only publish from eight to ten letters, with their answers, monthly. Obviously we are falling back further and further, and it looks as tho we will never be able to publish all the requests.

For this reason we would urge correspondents to avail themselves of our special service, as outlined above. In that case an immediate answer will be assured.

EDITOR.

GLASS BATTERY JARS

(427) W. G. Downie, Pomeroy, Ohio, writes: In my work with storage batteries I have often noticed how easily the rubber jars are broken; also by the action of the solution in batteries on the wood boxes I have noted how soon they fall to pieces. Now, the idea has come to me why not make the whole thing of glass; by this you would do away with the box, also the rubber jars, reducing the cost of a 3-cell battery from $6 to $8. Besides you can see at a glance thru the glass what is the trouble in the inside, whether the plates are touching or shorted by sediment in the bottom, positive plates crumbling, etc. I understand there is a glass made now that is very tough, besides the glass used on automobiles is hardly ever broken thru anything but accidents. I had started on getting a patent on same, but before I do so I would want your advice.

A. The idea which you have of all glass storage batteries is by no means a new one. Several companies manufacture all-glass storage batteries, but these are not satisfactory except for stationary purposes. Glass batteries have been used in Germany and France for many years and were manufactured complete with glass covers, etc., but the trouble with glass storage batteries always is that it is difficult to seal them, because the sealing wax or sealing compound does not stick as well to glass as to hard rubber, for instance. Then there is always the breakage, which is very high. The French and English have a much better battery for such purposes than we have, and they build these batteries out of transparent celluloid, which not only is light but transparent and tough as well.

AMPLIFIER

(428) Martin E. Truska, Brooklyn, N. Y., asks the following:

I would like to have your opinion as to the patentability and practicability of a telephone amplifying device, the drawing of which I enclose herewith. The drawing itself is almost self-explanatory.

The weak pulsating current from the line passes into electromagnets, causing the diaframs to vibrate. This action is transferred to the granulated carbon by means of carbon discs and rods which extend thru holes drilled in the cores of the electromagnets. This varying pressure on the granulated carbon causes more or less current to flow from the local battery into the receiver. The result is a reproduction and an amplification of the original impulses. This device could also be adapted to the amplification of radio signals, making it unnecessary to have the receivers held against the ears.

A. The idea which you have is a good one, altho the writer personally thinks that you do not gain very much by loading the diaframs as you do.

While of course an instrument of this kind is sensitive, there have been more sensitive ones designed on a slightly different basis, as for instance the Multiaudiphone. There is, however, a chance that you will get a patent on your device, but before doing so, we would strongly advise you to take up the matter with a patent attorney first, asking him to make a search for patentability. You will then be in a better position to obtain a patent when you know what different devices have been covered in the art heretofore.

RUBBER SHOE

(429) J. N. Roberts, Cleveland, Ohio, requests the following information:

I enclose sketch for half-sole rubber. This is to be made in such a manner so as to fit snug over the sole of the shoe with a small part of the rubber coming over the tip of the shoe and a band over the instep. Also a simple clamp under the arch of the shoe to keep it in place.

My idea of these half-sole rubbers is that they would not be as heavy and clumsy as the ordinary rubbers with heels, as there are days when a person needs just enough protection of the sole to keep the dampness away instead of wearing the full rubbers. Please pass judgment on the idea, and if it could be patented.

A. Your idea of the special rubber for shoes is a good one, and perhaps can be patented. The only thing that worries us is the attachment to hold the rubber on the shoe which you sketch roughly, but of which you have given no lengthy description. As you know, shoes all vary in width at the bottom, and we think you would have trouble to convince the manufacturer that he could make money by getting out such an attachment. The idea is sound, and as you probably know, there exist now women's rubbers made in a similar way except that the strap goes over the heel of the shoe. These rubbers are quite popular with women, and there seems to be a good demand for them.

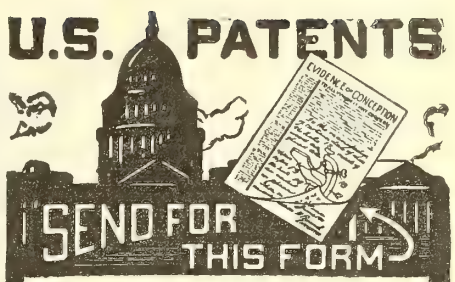
If the attachment in question is so designed that it will fit *every* shoe, then you ought to have a very good patent.

PHONO-PIANO

(430) John A. Hupf, Brooklyn, N. Y., asks:

I enclose a drawing on which I would like a little advice whether patentable, also how strong a patent can be obtained on same.

It is an instrument in the form of a regular piano, but in place of strings there is a series of disc records, one for each key on the piano key-



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St. San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... *Address*.....

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—**"Inventions and Trade Marks, Their Protection and Exploitation"** and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. **A postal will do—it is free.**

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE

In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c

board, each record fastened onto a sliding collar to be moved against the needle of a reproducer. By striking any key on the keyboard the rod on back end of key, which has a ball bearing at its end against the sliding collar, forces the collar holding the record against the needle.

Each record can contain at least six of the same notes played by the same amount of different instruments, thereby making it a rare novelty besides musical. These records can be replaced any time with little or no trouble. Power can be applied by either spring, foot or electric motor, or it can be fitted with self-playing mechanism. If my idea seems practical, kindly recommend a reliable patent attorney. Thanking you in advance, I remain.

A. We have carefully looked over your invention, which, to say the least, is quite ingenious. The only difficulty that we see is that it will be a very expensive proposition, and then there is also the matter of wearing out the records, which difficulty seems quite insurmountable. You know even the best records wear out quickly. What, then, will happen on the scheme which you propose?

We do not think it is possible to get the quick action necessary on a piano by means of your system. In other words, we are inclined to think that the lack of time element between the needle, the rotating element, and the diafram would be considerable. For instance such a thing as a "trill," which you can readily do on the piano, would seem impossible of accomplishment with this scheme. Then, there is also the complication and cost involved changing needles, records, etc.

ELECTRIC ALARM CLOCK

(431) Francis Michel, Brooklyn, N. Y., writes: Please let me know whether or not a patent can be obtained on an electric alarm clock which at the same time turns on the lights in the bedroom. If so, would there be much demand for such an article? Its use is obvious for people who have to get up while it is dark.

A. We do not think a patent can be obtained on the idea which you mention. It is not sufficiently original for patent purposes, as similar devices have been described in ours as well as other magazines many times in the past, and for this reason we are quite certain that you could not obtain a patent.

LOCK NUT

(432) H. H. Ellsworth, Racine, Wis., wishes to know:

I wish to take advantage of your patent advice section in regard to the practical and commercial side of the device, a diagram of which accompanies this letter.

As you can see this device consists of a nut so shaped and tapped that when tightened down upon a solid surface, the effect will be to bend the top of the bolt slightly, just enough to exceed the elastic limit of the steel. This will effectively prevent rattling or shaking loose and will in no wise injure the threads of bolt or nut nor hinder the removal of the nut by means of an ordinary wrench.

I had correspondence with a reliable attorney who is of the opinion that this can be patented, yet before investing in legal protection I should like the opinion of someone more versed in mechanics than myself in regard to the device.

A. Your idea, as far as we can see, is a good one. The all-important part that should interest you is, is the device practical, and will it work as you think it does? This looks all right to us on paper, but we are afraid you may have some obstacles when you come to actually manufacture the device.

We think it would be much better to make up a few samples and see if they work satisfactorily under all conditions. Then, if you find that this is so, we are quite certain that you will have no trouble in securing a patent.

ALCOHOL MAY TAKE THE PLACE OF "GAS."

Alcohol as a substitute for gasoline is being investigated by the British Government and tests are being made for the purpose of determining to what extent it can be used.

It is believed that the Board of Customs and Excise will shortly approve the denaturing of alcohol for power purposes. At the present time it can only be used with the addition of 5 per cent methyl—which adds at least twenty cents per gallon to its cost when used as fuel.

Tests have been made by the London General Omnibus Company, which corporation put out a small fleet of motor buses operating on alcohol mixed with benzol, to the exclusion of gasoline. The results of the tests are stated to have been most satisfactory.

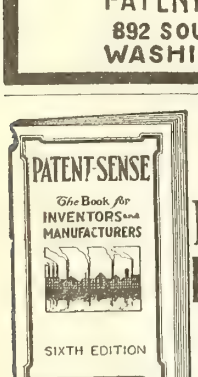
U.S. PATENTS

PROTECT YOUR RIGHTS



Write for "Record of Invention" containing forms establishing evidence of conception.
Send sketch and description for report upon patentable nature, and instructions. Preliminary service without charge.
PROMPT PERSONAL - SERVICE

J·REANEY·KELLY
PATENT ATTORNEY
892 SOUTHERN BLDG.
WASHINGTON D.C.



"The Book for Inventors and Manufacturers"
SIXTH EDITION
By return mail FREE. Write LACEY & LACEY
Dept K. Washington, D.C.

PATENTS
Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.



INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out? Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.
ELK MFG. CO., INC.
1926 Broadway, New York

PATENTS
Write for free INVENTOR'S RECORD form for establishing the date of your Invention, and INVENTOR'S BULLETIN Confidential Service
WM. H. MULLIGAN, PATENT LAWYER
110 Woodward Bldg. Washington, D. C.

PATENTS
Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.
MUNN & CO., 618 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 625 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

PATENTS
If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.
RANDOLPH & CO.
Dept. 172 Washington, D. C.

PATENTS & TRADE-MARKS
—FREE BOOKLET ON REQUEST—
MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES —
WARNER I. CUBBERLEY—PATENT ATTORNEY
22 NATIONAL UNION BUILDING
WASHINGTON D.C.

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney
"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.
OFFICES
364 University St. Montreal, Canada
919 F St., N. W. Washington, D. C.

PATENTS
C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.
Patents, Trade Marks, Copyrights, Patent Litigation
Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.
TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

"The Greatest Radio Catalog in the World—"

The Universal Verdict of Tens of Thousands of Radio Amateurs

DUCK'S No. 14 Big 200 Page Wireless Catalog

A VERITABLE Treasure House of Everything Worth While and Dependable in Radio. The largest, most comprehensive, artistic and educational wireless catalog published. The Beacon Light to guide you right in the selection of your radio purchases, and at prices that will command your attention. Every instrument guaranteed with privilege of return if not satisfied.

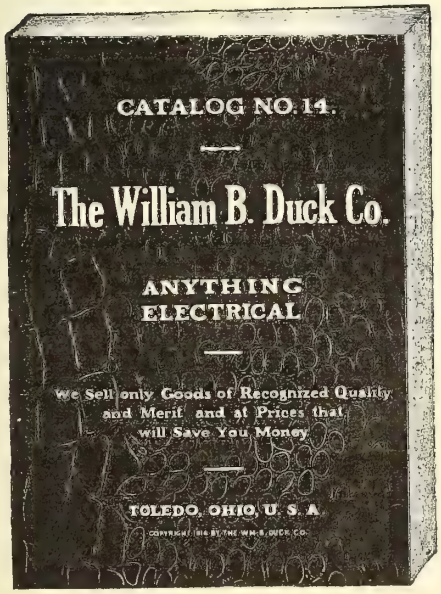
Mail 12c **in stamps or coin (*not sent otherwise*), which amount you are privileged to deduct on first dollar purchase. Revised price list to first edition of catalog, with prevailing prices, mailed on request.**

Announcing the Original "Duck" Service

Practically every order being shipped within 24 hours after receipt

Tremendous Christmas Stocks—

WITH a business of unprecedented volume ever since the close of the war. With nothing short of miserable service from our many sources of supply, and many other unusual conditions to contend with, we found it impossible, up to a comparatively short time ago, to give the service on orders for which we always enjoyed such a high reputation, and which was our pride. We deliberately curtailed our advertising, because we could not get catalogs printed fast enough and because we did not want a volume of business we could not expeditiously handle. We are now able to guarantee the wonderful service that our thousands of patrons received for many years before the commencement of the war.



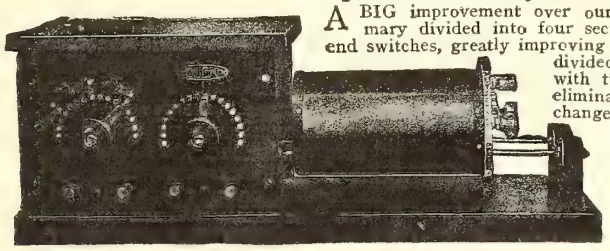
Send 12c for this wonderful catalog today. Revised price list to first edition of catalog No. 14 mailed on request.

3 Big Specials

November 15 to December 15

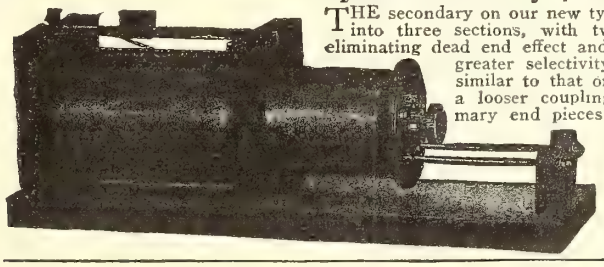
DURING the above period, planning on a terrific demand, we are placing truly remarkable prices on three of our most popular radio instruments. These low prices are possible only because of tremendous quantity production.

Model 5BB Navy Type Receiving Transformer, Regular price $27.50. Special Price only $21.95



A BIG improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model, both in appearance and performance.

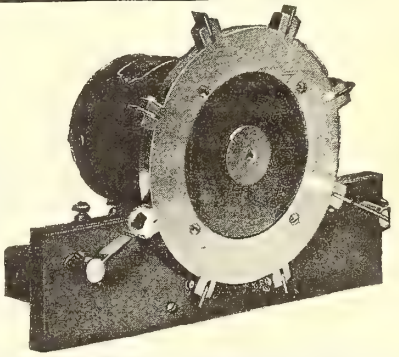
Improved Arlington Receiving Transformer, Regular price $15.00 Special Price only $11.95



THE secondary on our new type Arlington is divided into three sections, with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy, permitting a looser coupling. The base and primary end pieces have a spline to prevent warping or damage in transit. This feature is also on our Navy. It is a beautifully finished instrument.

Improved Type Sayville Rotary Gap

Embodies the latest and best features in Spark Gap Construction.



Our New Type Sayville Rotary Gap is, we believe, far in advance of any rotary gap on the market within a range even of twice the price. It is the final development of many different types made in our experimental Radio Laboratory. It fulfills every requirement of the ideal rotary gap. It is neat and attractive in appearance; simple and durable in construction; possesses a wonderful motor; has a cast aluminum rotary wheel, beautifully polished; every part is in perfect alignment; there is no wobbling of the rotor; produces and maintains a clear and pure 500-cycle note; is instantaneous in action; permits of no dragging of the spark; has contacts of tempered flat copper of proper length and width, easily and quickly removable, and inexpensively renewable; the stationary contacts are adjustable to any length. **Price $27.50**

No. 7721 Receiving Transformer, Regular price $9.00. Special Price $7.50

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio



HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competion is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

American School of Correspondence
Dept. H-926 Chicago, U. S. A.

American School of Correspondence,
Dept. H-926, Chicago, Ill.

I want job checked — tell me how to get it.

.....Architect $5,000 to $15,000	.....Lawyer $5,000 to $15,000
.....Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Photoplay Writer $2,000 to $10,000
.....Certified Public Accountant $7,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telephone Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....Telegraph Engineer $2,500 to $5,000
.....Electrical Engineer $4,000 to $10,000	.....High School Graduate In two years
.....General Education In one year	.....Fire Insurance Expert $3,000 to $10,000

Name.....

Address.....

The Light Ray Phonograph

(*Continued from page 851*)

the electric light ray it is bound to produce the same number of vibrations as the latter.

In the event that the claims which Mr. Lauste makes for his Electro-Phonograph come true, the machine will give a new impetus to the talking picture industry. The songs of the world's great artists will then be in great demand and it will be possible for those who live in obscure and faraway places on this globe to procure the treats which now are only afforded those who can listen to the singers in theaters, concert halls or operas. Of course, we have records of our famous singers, speakers, and orchestras, but as aforementioned, the present-day type of phonograph records do not give the full, natural reproduction of tones which are claimed for the records made by Mr. Lauste's instrument.

This new apparatus opens another field of great importance. Since the sound is collected by means of the microphone, which necessarily does not have to be attacht directly to the instrument, but can be located any distance away, the Electro-Phonograph can take the place of the dictograph in secretly obtaining a record of speech or conspiracy uttered by persons suspected of some crime. As a matter of illustration let us imagine a group of persons gathered together in a room planning some act of violence against society. It may be difficult for detectives to enter and obtain evidence while the men are in session. In such a case it would be only necessary to install a microphone, properly camouflaged, in some part of the room or rooms, while the suspects were absent, and then when the latter gathered to discuss their seditious plans, their speech could be recorded on a phonograph disc at police headquarters. Where the dictograph is used in cases like this, shorthand writers generally listen in and make notes of whatever conversation or talk is taking place. This method opens up great possibilities for eliminating errors, since there are times when it is difficult to hear all of the conversation. Something of importance might be mist by the shorthand writer.

This invention would also prove of immense benefit to newspapers in securing quickly and accurately news of the day. Speeches of conventions, important meetings, or court proceedings could be obtained very handily by means of the Electro-Phonograph. The latter would have its place in the room of the *city editor,* while the microphones in different parts of the city would carry to the instrument the proceedings as recorded in the places mentioned.

Mr. Lauste uses in the apparatus shown in the accompanying photograph, a very similar device now to that used in the ordinary motion picture studios, except that a phonographic disc is mounted in an upright position and the beam of light directed against a plate of special composition, fixt to the disc, literally melts the composition and in that way, due to the oscillating beam of light, cuts transverse grooves into the record in very sharp forms, and is thus able to secure, not alone the overtones, but more music on each record.

Not alone is Mr. Lauste working on this scheme, but there are several others equally if not more important. One of the features which he has worked upon for upward of 20 years, is talking motion pictures, and thru a simple comprest air amplifier, he has been able to reproduce sound from film with wonderful clarity and so loud that it could be heard thru several large rooms.

MAKE YOUR OWN MACHINE FOR TELEGRAPHING PICTURES



Something never offered before —secret, blue print and complete instructions for most marvelous invention of the age. Machines easily and inexpensively made from material and simple articles already in the hands of every experimenter. Will transmit pictures, maps, drawings and handwriting. This picture transmitted on set of these machines. Only $2. Send today.

L. J. LEISHMAN CO.
Dept. T Ogden, Utah

ALL MAKES



Underwoods, Monarchs, Remingtons, L. C. Smiths, Olivers, Royals, Coronas AT REDUCED PRICES. Prices as low as.... $20.00

Write for our Catalog No. 15

BERAN TYPEWRITER CO.
Dept. 21, 58 W. Washington Street, Chicago



"Lighting Fixtures"
Ready to Hang
(Direct from Manufacturers)
Completely wired, including glassware. New designs.
Send for catalog No. 20
ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

BUILD A WHITE FIREFLY $2.00



CARRIES FULL GROWN MAN

WHITE AIRCRAFT WKS.
Dept. 18, 425 Merchants Trust Bldg., Los Angeles, California.

World's lightest and simplest aeroplane. Designed by George D. White, America's foremost aeronautical engineer. Weight 150 pounds, length 15 ft. Needs 8-12 H.P. motorcycle engine. Lands and takes off at 24 miles per hour. Useful load 165 pounds. Can be built in a few weeks at home. Send $2 for complete working drawings, building instructions and price list of parts. SEND $2 NOW!

Price $1.10



Foreign $1.25

WHISPER INTO THIS!

and your voice will carry, clear and audible, to the other end of the line. This Marvelous New Standard Mouth-piece insures perfect results on any phone. If you want to reduce telephone troubles, get the magic

THERAPHONE

The effect is startling. Eliminates repetition, delay and grouch. A real energy saver. Check or C. O. D.

The EVOLUTION PHONE COMPANY, Inc.
488 Greenwich Avenue, New York City

GIVEN





Also your choice of many real valuable and useful presents, given for distributing a few packages of the wonderful **Majic Dye Soap Flakes at 10c.** It's a snap to get a present. Every woman wants these wonderful home dyes. It's so easy to distribute these wonderful home dyes—and we trust you fully and help you in every way. Send your name and address at once.

FREE SALES CO., Dept. 20 CHICAGO

MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE
Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.



FREE This REPAIR OUTFIT is given to you for selling only 40 packs "Quality Brand Garden Seeds" at 10c. per packet. Order today. SEND NO MONEY. WE TRUST YOU. When sold return $4.00 collected and the REPAIR OUTFIT is yours. Cash commission if preferred. Many other valuable presents. Catalogue with order.

NATIONAL SEED CO., Dept. 126, Lancaster, Pa.

5 Master Keys

Have a set of the most wonderful keys in the world, which open hundreds of different locks and replace hundreds of different keys. Used by locksmiths, janitors, and detectives. Set and novel key chain sent for $1.00. Master Key Company, 42 Manhattan Bldg., Milwaukee, Wis.

Learn to Write

I TEACH BY MAIL

WRITE FOR MY FREE BOOK "How to Become a Good Penman" and beautiful specimens Your name elegantly written on a card if you enclose stamp. Write for it today. F. W. TAMBLYN, 424 Meyer Bldg., Kansas City, Mo.

BE A BANKER

Prepare by mail in spare time for this attractive profession, in which there are great opportunities. Send at once for free book, "How to Become a Banker"
EDGAR G. ALCORN, *President*
American School of Banking, 114 McLene Bldg., Columbus, O.

RADIOTRONS VACUUM TUBES *for* Amateur or Experimental Use

THE facilities and resources of the world-famous RESEARCH LABORATORIES of the General Electric Company have been concentrated upon the development and design of a new series of VACUUM TUBES for Radio Detection and Amplification. The RADIO CORPORATION OF AMERICA now offers to the Wireless Experimenter two distinct types, each adapted to a particular field of usage.



LIST PRICE
$5.00

RADIOTRON U. V. 200, the first of the series, is a Detector and Audio Frequency Amplifier of unusual capabilities, which operates from a single standard plate battery. Best detector action occurs at plate voltages between 18 and 22½ volts, with a filament current of approximately 1 ampere, and with a grid condenser and grid leak. U. V. 200 is particularly adapted to amateur regenerative circuits. A trial in such circuits will be the most convincing.

NOTE—A special "A" or filament battery potentiometer for close adjustment of the plate voltage of U. V. 200 will shortly be placed on the market by the Radio Corporation.

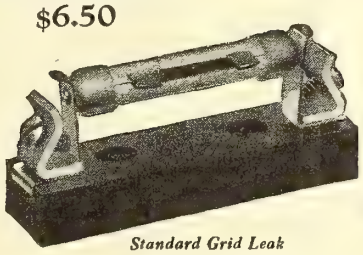


LIST PRICE
$6.50

RADIOTRON U. V. 201, the second of the series, is an unexcelled Amplifier of the PLIOTRON type, which may be used for Detection and for Radio or Audio Frequency Amplification. Normal plate voltage, 40 (two standard "B" batteries). Voltages up to 100 may be used on the plate with increasing amplification. Amplification constant, 6.5 to 8 at 40 volts on the plate, 8 to 10 at 100 volts on the plate.

Note to Amateurs, Dealers and Jobbers

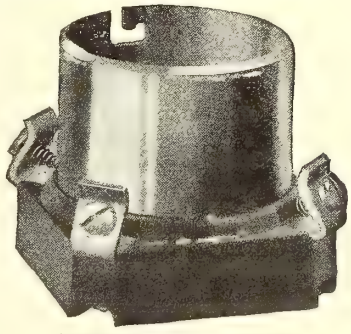
Radiotrons are manufactured by ultra-scientific methods laid down by America's foremost tube experts. No guess work—each tube bears the stamp of electrical manufacturers of world-wide reputation. A uniform product is assured. All tubes fitted with standard four-prong base. Filaments operate from 6 volt battery with rheostat.



Standard Grid Leak

LIST PRICES

Radiotron U. V. 200	$5.00
Radiotron U. V. 201	6.50
Standard Vacuum Tube Socket	1.00
Standard Grid Leak-Mounted 100,000 ohms to 6 megohms	1.25
Grid Leak Unit	.75
Grid Leak Mounting	.50
Audio Frequency Transformer	7.50



Standard Vacuum Tube Socket

A complete line or vacuum tube ACCESSORIES are now in manufacture and will shortly be available.

Dealers and Jobbers: We have an especially attractive proposition for you. Write us at once.

The Radio Corporation's tubes are covered by patents dated November 7th, 1905, January 15th, 1907, and February 18th, 1908, as well as by other patents issued and pending. Tubes licensed for amateur and experimental use only. Any other use will constitute an infringement.

Address all orders and enquiries to
SALES DIVISION
COMMERCIAL DEPARTMENT, Radio Corporation of America
233 Broadway, New York City

Positively Your Last Opportunity

to purchase the Original Tubular, Vacuum Detector, Amplifier, Oscillator so well known as the double-filament, double-life, hand-made

AUDIOTRON

In Constant Service Since 1915

AUDIOTRONS, recognized as the most sensitive detectors ever produced, are now free and clear of all patent difficulties. By agreements entered into with Radio Corporation of America, AUDIOTRONS are manufactured under the following patents: Nov. 7, 1905; Jan. 15, 1907; Feb. 18, 1908. Licensed only for amateur or experimental uses in Radio communication. Any other use will be an infringement of the above patents.

$6.00
Each. No increase in price

AUDIOTRONS are no longer limited to audio frequency and can now be used as detectors and oscillators as well as amplifiers.

See your dealer at once, or order direct. Be sure to benefit by this last opportunity to secure a *hand-made, super-sensitive, double-filament AudioTron Detector, Amplifier, Oscillator*. Insist on the name *AudioTron* on every tube you purchase. Fully guaranteed.

Dealers and Amateurs—Send at once for advance information on the NEW

AUDIOTRON AMPLITRON OSCILTRON
DETECTOR AMPLIFIER OSCILLATOR

mounted on the standard four-prong base. These NEW TUBES will be ready for delivery about October tenth. A valuable bulletin on these new fully licensed tubes is now being prepared. See your dealer today. If he cannot supply this Free Bulletin, send us his name and address and we will mail you an advance copy of Bulletin No. P170.

DEALERS, JOBBERS—If you are not on our mailing list, write us immediately

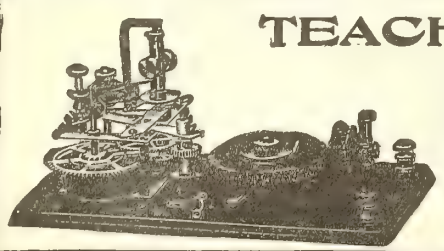
AUDIOTRON MANUFACTURING COMPANY

Dept. S, 35 Montgomery Street (Successors to The AUDIOTRON Sales Co.) **San Francisco, Calif.**

"THERE'S MONEY IN IT"

LEARN TELEGRAPHY AT HOME AT HOME
MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter. **THE OMNIGRAPH.** Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
26 L Cortlandt St. New York

Building Machines Accurately

By EARLE W. GAGE

(*Continued from page* 877)

and these limits, by the way, are far more exacting than are employed in the manufacture of many other machines.

Since it is impossible to make any two parts alike, the workmen steadily strive to make the parts with as slight difference as possible. Only slight variations, as small as the half-thousandth of an inch, are permitted in high-grade modern machines. This brings up the interesting subject of the various instruments employed in making the measurements determining the exact size of these parts.

It may have been determined that a certain part should be permitted to vary only two-thousandths of an inch from the standard. But if the means of measurement are another two-thousandths of an inch inaccurate, there may be a four-thousandths error in the part which, in close fitting, might prove a serious error. So having determined the variations permissible from the exact size, it is necessary to have instruments that actually measure accurately. It is necessary to measure inside and outside diameters, widths and lengths, and whether screw threads have the proper pitch. Close standards are worthless if measured by poor gages; so having set the policy of manufacturing close standards, modern manufacturers must also be equipt with accurate instruments for making the various necessary tests and measurements.

TESTING "HARDNESS" WITH PRECISION.

The *scleroscope*, for example, which tests the hardness of steel by the degree of rebound of a tiny ball of metal that is dropt from a fixt height to the surface of the metal, rebounding within a glass tube on which graduations are marked, the reading being made thru a magnifying glass. Every part of the machine in which hardness is essential is tested by the scleroscope and if it fails to pass the test is at once "rejected."

The dial gage is another interesting instrument which is used to determine whether or not a part supposed to be round is really round, the indicator registering fluctuations of a *thousandth of an inch* as the part is revolved. The registering arm of the device is set in contact with the part to be tested and the dial then turned so that the pointer stands at the zero mark. Movements of the pointer to right or to left indicate whether there are "hills" or "valleys" in the surface. A similar device is used to test cam shafts, the movement of the pointer indicating whether a cam has the proper *lift*.

The third gage is a two-way gage, providing a means of making both internal and external tests of threading. The external gage or templet is adjustable, so that it can be set to an exact corresponding fit with the internal gage. The external gage can then be used to check up on the accuracy of the threading of a bolt or stud, the internal gage being used to pass upon the threading of the corresponding hole. The end opposite the threaded end of the internal gage is ground and lapt to furnish the exact diameter at the top of the thread. A full stock of these thread gages is used by the inspectors for the various diameters and pitches of the threads they have occasion to test.

THE USE OF THE "PLUG" GAGE.

Plug gages in various sizes are used to test the accuracy of holes of small diameter. Each of these gages has one end .0005 (a half of one-thousandth) of an inch larger than the standard diameter, and the other end .0005 of an inch smaller. In order to pass inspection the holes must be of such size that the small end of the plug will go

(*Continued on page* 928)

-and here it is!

Licensed for use only in apparatus manufactured by the De Forest Radio Tel. & Tel. Co.



Equipped with the SHAW standard four-prong base. PRICE $7.50. Order from your dealer.

You have hoped for it. You have looked for it. You have asked for it. And here it is—a transmitting tube for telephone and telegraph C-W transmission, built right up to British and to French Government specifications. Capacity about 12.5 watts, and any number may be used in parallel—four, make telephone conversation possible over 25 miles, telegraph signals over 50 miles.

The plate of this transmitting tube is nickel, a special molybdenum grid is provided and the high vacuum permits operation on plate potentials of five hundred volts without breakdown.

By connecting the grid and plate together, the tube may be used as a rectifier for obtaining from an alternating current supply the high plate potential necessary for the generator tube.

Adopted by the De Forest Radio Tel. & Tel. Co. as the standard transmitting tube in all De Forest sets of less than ½ k.w. capacity. Licensed under the De Forest Audion and Fleming patents. Other patents applied for and pending.

Atlantic Radio Supplies Co.
8 Kirk Place, Newark, N. J.

Pacific Radio Supplies Co.
638 Mission St., San Francisco, Cal.

Distributors for Moorhead Laboratories, Inc., Manufacturers of

The A-P Transmitting Tube

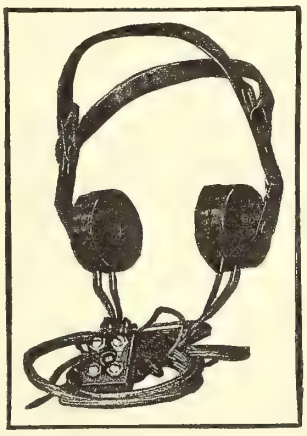
MURDOCK

No. 55

THE PRICES ARE UNUSUALLY LOW

2000 OHM DOUBLE SET

$4.50



THE QUALITY IS REMARKABLY HIGH

3000 OHM DOUBLE SET

$5.50

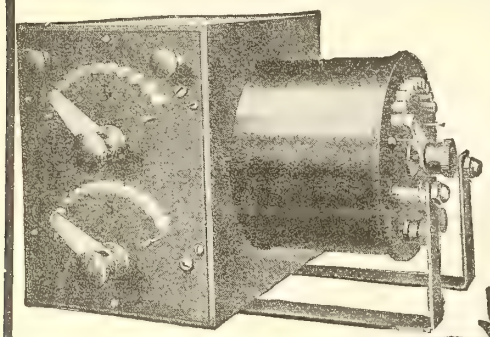
RIGHT IN PRICE AND IN PERFORMANCE

The substantial success earned by these receivers can be attributed to the instant recognition of their remarkable value by thousands of users. If, by chance, YOU are dubious regarding the possibility of securing really good 'phones at such prices, we suggest a trial, with the customary assurance of "satisfaction or money back." Ask your dealer for them.

BULLETIN No. 20 now ready for distribution. Send for your copy.

WM. J. MURDOCK CO. **55 Carter St., Chelsea, 50, Mass.**
509 Mission Street, San Francisco, Cal.

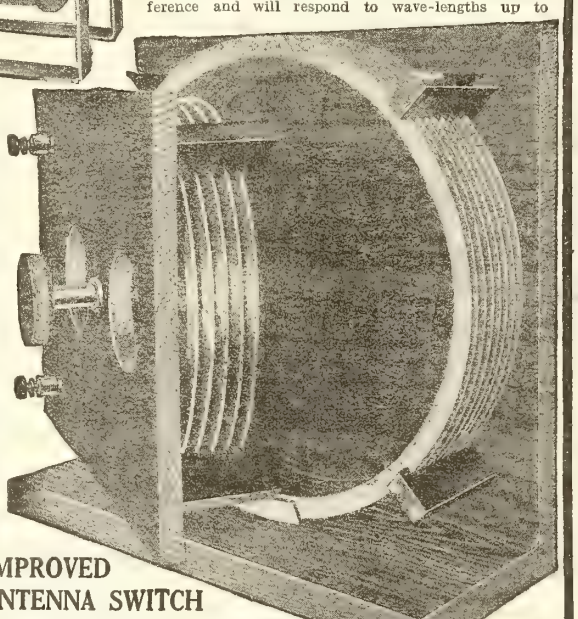
CLAPP-EASTHAM APPARATUS



RADION RECEIVING TRANSFORMER

The instrument is designed for those who prefer a tuner having conventional cylindrical coils rather than the rotary type. The disadvantage of most couplers of this type is the large table space necessary to accommodate them. This disadvantage has been eliminated to a large degree in this instrument by the use of banked windings. Both primary and secondary coils are provided with taps, eliminating all sliding contacts. The primary has two 10-point switches, one each for fine and coarse adjustments, while the secondary has one 10-point switch. Bakelite is used throughout for the panels, and the primary is completely enclosed in an oak cabinet. This instrument provides close adjustments with freedom from interference and will respond to wave-lengths up to 3000 meters with an average antenna. The completed tuner measures 6 in. deep by 5¼ in. high by 8 in. long.

List No.		Price
12054	Radion Receiving Transfor.	$14.00



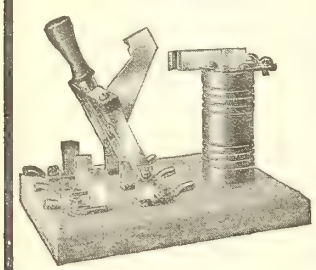
BLITZEN RADIOCOUPLER

Variable inductances of this type while commonly used in commercial practice have heretofore been beyond the reach of the experimenter, due to their high cost.

The Blitzen Radiocoupler is offered at a moderate cost, and provides all the advantages found in the more expensive types. The framework is of oak in dull black finish, the stationary frame carrying the secondary of eight turns of edgewise-wound copper strip 10¾ inches in diameter. The swinging member carries the primary of five turns of edgewise-wound copper strip 7½ inches inside diameter and both windings are supported by slotted uprights of Bakelite.

The primary is continuously adjustable by means of a projecting handle as shown in the illustration, while helix clips of the usual type are fitted to the secondary.

List No.		Price
252	Blitzen Radiocoupler	$22.00



IMPROVED ANTENNA SWITCH

The three-pole switch and Bakelite standard are mounted on a blue marble base six inches by nine inches, and terminals are sufficiently separated to provide protection to sets up to 1 K.W. When thrown to the upper or receiving position, the switch disconnects the antenna from the helix, connecting it to the receiving set and opening the power circuit so that damage to the receiving instruments through accidental pressure of the transmitting key is impossible. When in the down or sending position the antenna is disconnected from the receiving set and connected to the transmitter, the current supply is closed to the transmitter, the receiving set is short-circuited and grounded for protection and the right-hand switch blade closes the circuit to the motor of a rotary spark gap or closes any other circuit desired. Weight, 12 pounds.

List No.		Price
253	Improved Antenna Switch	$12.50

Get a Copy of Our 200 Page Manual of Wireless Telegraphy W12

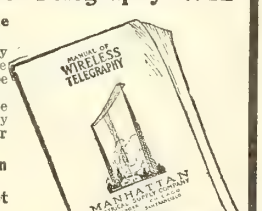
and Order All of Your RADIO MATERIAL from One Source of Supply and Save Trouble

You cannot get satisfaction from wireless instruments unless they are absolutely perfect. The slightest imperfection in construction destroys their efficiency. We offer for sale wireless apparatus only of the highest quality, guaranteed to be mechanically and electrically perfect.

Our combined Manual and Catalog illustrates and accurately describes the uses of standard radio instruments and should be of great assistance, not only to the amateur but to the professional user and experimenter in selecting proper radio material.

We Make a Charge of 25c. for this Manual, Issuing a Coupon Redeemable on an Order for $5.00 or More.

It is the Last Word in Wireless Catalogs. Send for a Copy Now. You Cannot Afford to be Without One When You Want to Buy.



MANHATTAN ELECTRICAL SUPPLY COMPANY, Inc.

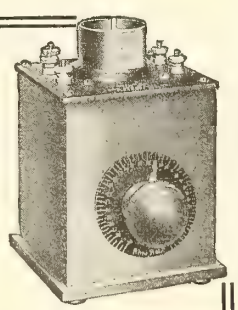
New York, 17 Park Place — **St. Louis, 1106 Pine St.**
Chicago, 114 So. Wells St. — **San Francisco, 604 Mission St.**

Detector Amplifier

A complete Detector (without tube) **$10.00**
A Single Stage Amplifier " " **13.00**

High Amplification at Low Cost

Write for Bulletins



ACME APPARATUS CO.

28 Windsor Street — **Cambridge, 39, Mass.**

TRANSFORMER AND RADIO ENGINEERS AND MANUFACTURERS

Building Machines Accurately

(*Continued from page* 926)

into the hole and the large end will not go into it. If both ends of the plug will pass thru the hole, it is too large. If neither end will pass thru, it is too small; thus a total variation of only a thousandth of an inch is permitted—half of a thousandth larger or a half of a thousandth smaller, than the exact size.

To speak of a hair's-breadth expresses the ultimate in the average person's conception of minute measurements; but a human hair might be split into ten or twenty parts and the micrometer could measure it—such small measurements are, in fact, employed commercially in our modern machine shops. These instruments are made in Sweden, C. E. Johansson being the maker. These are ordinary looking little blocks of steel, yet they are of various widths, varying from each other by tenths, hundredths, thousandths and ten thousandths of an inch, so that by combining various blocks any desired measurement, *to the ten-thousandth part of an inch,* can be obtained. In fact these instruments are guaranteed accurate to the *one-hundred-thousandth part of an inch.*

Let us pause and consider just what 1/100,000 of an inch is. If the human hair could be split into two hundred parts, each of these would be 1/100,000 of an inch in diameter. A silver quarter of a dollar, stood on edge, bears the same relation to the height of New York's tallest skyscraper that the 1/100,000 part of an inch bears to one inch.

But consider further what such accuracy means in a block of steel. It means that one edge must be substantially parallel to the other or the blocks could not give the same measurements at every point. It means that the surface must be absolutely plane or the unevenness in the surface would cause inaccuracies. It means that the surfaces must be perfectly flat so that the blocks can be properly combined to produce dimensions that are a sum of the several blocks in combination.

Accuracy has been secured to such a degree that a combination of the blocks will measure to within a hundred-thousandth of an inch of the sum of the widths of the several blocks. And when the blocks are so combined *they will stick together,* not by any force of magnetism or atmospheric pressure, but by some unknown force, presumably the same force that holds the molecules together in a single piece of steel. In support of this theory is the fact that the longer the blocks are left together, the tighter they hold, so that the user is advised to separate them at least once each day.

NEW VULCANIZING PROCESS.

Experiments conducted by the Manchester (England) College of Technology have led to the discovery of an important process for vulcanizing which is expected to have far-reaching effects on the rubber manufacturing industry. An official report states that in the new vulcanizing process two gases are used—sulfurated hydrogen and sulfur dioxid—which react on each other to produce water and free sulfur, which vulcanizes the rubber.

The importance of the discovery is said to lie in the fact that it makes cold vulcanizing possible. One claim is that the discovery will make possible the manufacture of one-piece boots without stitching, and that its use will extend to the manufacture of linoleum floorings, artificial leather upholstery and wall paper and probably affect the production of rubber tires.

Floating Sunken Ships

(*Continued from Page* 839)

the submerged ship, serve to force out the water thru the same holes by which it had entered the hull, while the water pressure from outside holds the patches tight to the hole in the ship's side.

The experts in charge of the work proceeded to have the rents closed up in a temporary yet secure fashion, and the S. S. *Royal George* was thus salvaged from her watery grave in the short space of six days. Comprest air had thus served as the genie by which the buoyancy of the vessel was quite restored, and the engineers were able not only actually to float the wreck, but to take the ship out to sea again without dry-docking.

How Coffer Dams and Submerged Electric Pumps Salvage Ships.

In a number of instances which are on record, something radically new even to salvage engineers has recently been brought out. This scheme consists in building large coffer dams of wood or steel directly over the larger hatchways in the vessel's deck or over other openings, and then proceeding to pump out all of the water embraced within the coffer dam and in the hull of the vessel by means of submerged electric pumps.

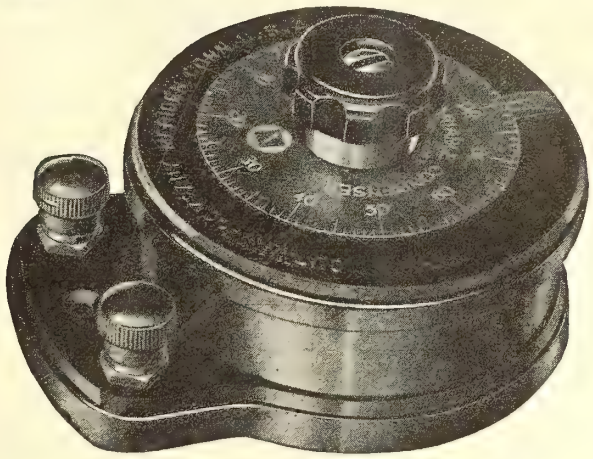
It is well known by those familiar with pumps in general, and particularly the large steam pumps generally used in modern salvaging, that this type of pump would raise water to a height of only 28 feet. But the latest electrically driven submergible pump, shown in lower right corner of accompanying illustration, can be lowered to a depth of 80 feet or more, from which depth it will shoot upward a veritable mountain of water in a remarkably short time owing for one thing to its high speed. As many of these electric submergible pump units as deemed necessary may be lowered down into the holds of the sunken ship. One excellent feature this pump possesses for salvaging undertakings, is that the electric current operating the pump motors is under instant control from the surface. Moreover these pumps do not have to be raised if for any reason the salvaging operations have to be discontinued for a day or more, owing to stormy weather, etc., but can be left right in place and the work resumed at the first opportunity.

The great mechanical superiority of this form of salvage pump will at once be evident, as the centrifugal pump secured to the motor sucks in the water to be raised right at the pump, and not thru a length of pipe as in the case of the steam pumps previously used; and once the powerful centrifugal pumps have sucked in this water, they proceed to hurl it toward the surface with tremendous power, from a depth of 80 feet or more.

There are several ways in which this system of coffer dams placed over the hatchways, and used in conjunction with electrical submergible pumps or other paraphernalia, may be successfully applied. One of the first considerations which the student of such affairs would be interested in, is of course, as to how the rents or holes, caused by torpedoes or collision, are to be taken care of; as it is evident in some cases particularly where these rents are large, say 20 by 30 feet or greater, the pumps cannot remove the water as fast as it enters the hole.

There are two principal methods followed in repairing the sunken vessel for this salvage operation: The first is to lower flexible patch blankets made of heavy woven rope, often reinforced with wooden beams

CONNECTICUT RADIO



An Amateur Copies POZ with the Connecticut Variable Condenser

An amateur in Southeastern New York says in a recent letter:

"I have purchased four of your Connecticut Variable Condensers and it is possible to get better results with them than with the multiplate type of Variable.

"I spent several weeks trying to get signals from the European stations. At first I was unsuccessful. I bought one Connecticut condenser for trial. It tuned the radio signals so sharply (and better than other variables) that I bought three others. Much to my expectation they did so remarkably well and I was soon copying POZ and other European stations without much difficulty.

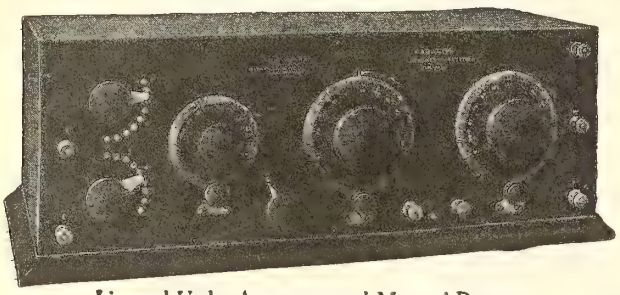
"Hereafter I will use Connecticut Variables in all my circuit as they are actually cheaper in the long run and are far more efficient for radio receiving sets."

Your set will be a better one with the Connecticut Condenser. The instrument is set at .001 mfds., adjustable either higher or lower.

There's a booklet with full information waiting for you. Send for your copy

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut

Paragon RA-TEN



Amplifying Short Wave Receiver

Licensed Under Armstrong and Marconi Patents

You'll Hear Stations You Never Heard Before
With this NEW Paragon!—

The original RA-Six was the acknowledged superior of any other set on the market. This NEW triumph of Adams Morgan Co. is as far ahead of the RA-Six as that was ahead of all others.

Here are a few outstanding features.

Wave length 160 to 1000 meters.
Amplification 100 times.
No dead end losses whatever.
Vernier attachments on all controls.

The Paragon RA-Ten covers amateur, commercial, and Navy wave-lengths. Advanced engineering design, combined with superior insulation and accurate controls, enables you to hear the weak station plainly and with proper selectivity, **that one station only.**

All amplification is obtained without change of spark tone. Objectionable effect of change of note is entirely eliminated. Coupling has scale of 180°.

The cabinet is of quartered oak; overall size 20⅝ x 8 x 7½". Fitted with genuine Bakelite panel, knobs and dials. White filled engravings. Truly an instrument to be proud of.

Every set sealed and guaranteed for two years.

PRICE EIGHTY-FIVE DOLLARS COMPLETE

Send for our special bulletin on the Paragon RA-Ten interesting and complete. Drop post card today

Our word of honor to you is our guarantee. Let us prove it.

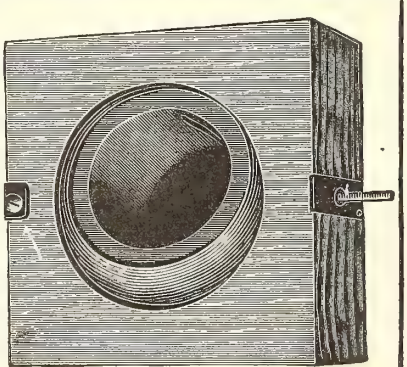
CONTINENTAL RADIO AND ELECTRIC CORP.

Sole Distributors of the New Paragon RA-TEN

J. DI BLASI, Secretary — J. STANTLEY, Treasurer

DEPT. A.1 — **6 WARREN STREET** — **NEW YORK**

Some More of Our Radio Mail Order Specialties



VARIOMETERS

As illustrated $4.50

Others at $6.00, $6.50, $7.00

REGENERATIVE SETS

Grebe $65.00
Signal $37.50
Mignon $60.00

All Instruments sold by us are manufactured by the most reliable Radio firms known. And our very complete stock gives us the opportunity of prompt service at reasonable prices.

Our new and most complete catalog will be ready for distribution shortly. Those having already sent 10c for it, will receive the new issue in a few days.

AMERICAN ELECTRO TECHNICAL APPLIANCE CO.

Dept. E. S.—235 Fulton Street — **New York**

Dependable Radio Apparatus

A new Tuner and a new Short Wave Set have joined the DEPENDABLE FAMILY

Catalogue Mailed for 10 Cents in Stamps

DORON BROTHERS ELECTRICAL COMPANY
Hamilton, Ohio

and steel plates or strips, into position against the side of the boat and maneuvered so as to cover the rent as tightly as possible by the aid of divers; while the second principal idea in the preliminary operation, and which has been successfully carried out in some instances, is to have divers descend down into the vessel and erect temporary bulkhead walls, cutting off the damaged sections of the hull, so that the parts to be eventually drained by the submerged pumps as afore described will be made as water-tight as possible.

Unless the vessel has been very severely damaged, and holes torn into her along the greater part of its length, the second procedure of cutting off the damaged section of the hull by means of bulkhead walls is usually successful; and sometimes a combination of the two methods described above is feasible.

It is necessary of course that divers supervise the placing of the bottom of the coffer dam over the hatchways on the vessel's deck, or over other openings, in order to see that they are correctly placed and also made as water-tight as possible.

The electrical energy for operating the submergible pump is supplied from a dynamo driven by a steam or gasoline engine on board the salvage vessel. When all is ready, the electric power is switched on, and the pumps start emptying the water thru the pipes attached to them in the manner shown in one of the illustrations herewith.

As the water is pumped out, the vessel slowly resumes its original buoyancy and finally after a few days pumping—the time required depending upon the size of the vessel—the deck and gradually the upper part of the hull rises above the surface of the water. After the vessel has been raised, it can then be towed to the nearest dry-dock in order to have its rents or holes properly repaired.

Raising Ships by Pontoons and Tides

The third method of raising sunken ships illustrated herewith, is that involving the aid of Mother Nature and large pontoons filled with air and possessing great buoyancy and lifting power. This method has been described sometime ago (in this journal), and the technique followed in this method is ingenious indeed. Simply explained, it involves the floating of a large number of steel pontoons to the position where the sunken craft lies, and to proceed with the aid of divers to place substantial ropes or steel cable slings around the hull of the vessel, which are afterward made fast to the pontoons.

It should be mentioned, in answer to the readers' anticipated question, that a new form of tackle or clamp has been developed for securing such cables to the pontoons in a flexible manner, so that a sudden rise or fall of the pontoons and other members, due to high seas, will not cause the cables to snap. The third illustration, which is shown in four stages, shows the procedure of raising vessels with the aid of the tide very clearly. The successive stages progress from left to right.

The tidal rise and fall, of course, is greatly exaggerated in this picture for the sake of illustration.

When the tide has reached its lowest point each day, the pontoon cables are tightened up, and then as the tide rises the vessel is raised a considerable distance or height, equivalent to the tidal rise. The vessel is then towed as far as possible until it strikes bottom again, and the salvaging crew then wait until the tide falls to its minimum point at this new location.

The pontoon cables are again tightened up and when the tide rises the vessel is raised again a certain number of feet. The pontoons and other submergible apparatus are then towed still further into shallow water and eventually the vessel is raised to the surface and is then ready to be dry-docked for repairs.

NEW INTERNATIONAL RADIO TELEGRAPH CO. STATION

The International Radio Telegraph Company announces that it opened its coast radio station at Siasconset, Nantucket Island, Mass. Radio call: WSC, on October 13th.

This island has long been the location of commercial and naval stations and because of its particularly advantageous location will undoubtedly be very generally used by incoming European ships in getting off their traffic on long waves and at long range. The station tax is twelve cents per word.

The station is now equipt to receive long waves, damped or undamped, with Heterodyne reception and for the present will utilize spark transmitters, but general enlargements are now contemplated.

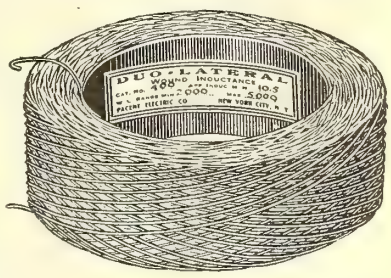
WESTINGHOUSE ENTERS THE RADIO FIELD

One of the important recent developments in electrical industry is the entrance of the Westinghouse Electric & Manufacturing Company into the wireless field. Though prior to the war this company was not commercially interested in wireless, it had devoted a great deal of attention to radio phenomena, and during the war it not only carried out extensive researches for the Government, but also manufactured a large amount of apparatus for military use.

The company has exclusive manufacturing and selling rights under the Fessenden patents for the Heterodyne method of reception, which is universally acknowledged to be among the best for undamped waves; and it also possesses licenses under many other important patents including the Poulsen arc converter system.

Your Duo-Lateral Wound Coils Are Ready

JUST a word of explanation: Our first advertisement caused such an upheaval in radio circles that we were swamped with inquiries. Indeed, one large manufacturer of radio apparatus immediately placed his contract with us, taking over our entire production. As a result we were obliged to turn down orders.



THAT was up till a short while ago. Now we have succeeded in doubling our productive capacity, and Duo-Lateral Coils are available to everyone in the radio field. We can make prompt shipments from stock. *Your DUO-LATERAL COILS are ready to be shipped the moment your order is received.*

REMEMBER, Duo-Lateral Coils are recognized for:

1. **Lower natural period.**
2. **Lower high frequency resistance.**
3. **Very low distributed capacity.**
4. **Lower direct current resistance.**
5. **Higher self-inductance.**
6. **Mechanically stronger.**

Bulletin P-1EX, containing valuable engineering data, constants and prices of numerous sizes of Duo-Lateral Coils, covering practically every wave-length used, is yours for the asking.

TO DEALERS: OUR DISCOUNTS ARE GENEROUS

PACENT ELECTRIC COMPANY, Inc.

Representing: A. H. Grebe & Co., Dubilier Condenser Co., Electrical Products Mfg. Co., Richter-Schottler Co., The Magnavox Company, The Rawson Electrical Instruments Co. and others.

150 Nassau Street **Telephone Beekman 5810** **New York City**

GREAT RESULTS—

"I have used your tuners, both for short and long waves, and they have always given me entire satisfaction." H. D. Titus, 24 Grove St., Auburn, N. Y. Send 2-cent stamp for Bulletin 111, showing new short and long wave tuners.

Colby's Telegraph School, Auburn, N. Y.

Five-Dial Omnigraphs Bought

at highest prices. Write for prices, stating what you have and how long it has been used. E.L.D., 1312 Belmont St. N.W., Washington, D.C.

DE FOREST

Christmas Suggestions for the Radio Amateur



Type P-200
Two-Step Amplifier

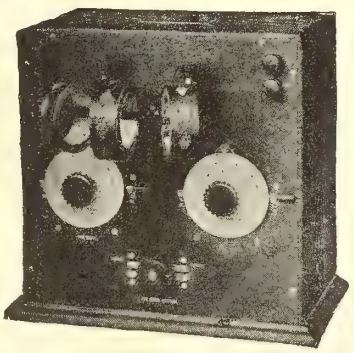
The newest development in Amplifier design, combining compactness and extreme efficiency in operation. Amplifies the power about 16 times. Panel quickly removable; all parts accessible. Cabinet size 12½ x 9⅜ x 7¾. Price (without tubes but including "B" battery) Each **$70.50**

PUT DeForest Radio Apparatus on your Christmas list. Get that new apparatus you need as a present. Here are three instruments of typical DeForest high quality which will make your station more modern and greatly increase its operating efficiency.

Our Catalogue "D" illustrates and describes a lot more apparatus you'll be glad to know about. Send 10 cents in stamps and get your copy now, in time to make your selection before Christmas.

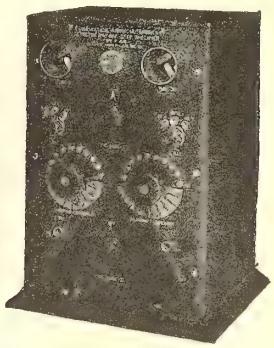
DE FOREST RADIO TEL. & TEL. CO.
Inventors and Manufacturers of High Grade Radio Apparatus
1401 Sedgwick Ave., New York City

LEE DE FOREST, Inc.
Western Distributors
451 Third St. San Francisco, Cal.



Type T-200
Multi-Wave Tuner

Responds to any wave length; 150 to 25,000 meters. Contains triple adjustable coil mountings; Vernier primary and secondary tuning condensers; primary condenser switch; all mounted on engraved Bakelite panel and in handsome cabinet, size 13 x 18 x 12¾. Price (without coils) **$85.00**



Type P-300 Combination Audion—UltrAudion and One-Step Amplifier

Specially designed to fill a real need for an instrument of this kind in the average amateur station. When used in connection with the T-200 Tuner shown here, it completes a receiver of unequaled efficiency. Cabinet size 12½ x 8¾ x 4¾. Price (without tubes) . . **$75.00**

DE FOREST

For Perfect Signals and Solid Comfort, Wear Brandes Matched Tone Receivers

WE were not satisfied when we accomplished the mechanical perfection of our receivers to such a high degree for we realized, and every professional knows, that lightness and comfort are almost as necessary as the perfectly matched tone for which Brandes Receivers are famous.

We have now equipped our receivers with an improved head band made to fit any size head and instantaneously adjustable. Checknuts hold the adjustment. The new head band is more durable and lighter in weight. It is made of Galvanized Piano Wire, covered with strongly woven Khaki. There are no metal parts which come in contact with the wearer's head, and the head band cannot catch the hair even when adjustments are made on the head. Other metal parts are nickel plated brass, making the head band absolutely rust proof. Our new head band is the strongest and lightest of its kind on the market.

Our receivers are now equipped with new style conducting cords which indicate the polarity of the receivers. This eliminates any danger of demagnetizing the receivers when used in connection with Vacuum Valve Detectors.



"Superior" 2,000 Ohms, weight 14 ozs. complete with head band and polarity indicating cord. Price $8.00.

Give yourself a Christmas present. Order any pair of our receivers, try them for 10 days in comparison with the phones you have now. If they aren't better receivers for clearness, sensitiveness, distance and comfort than what you are using, return them to us, and back comes your money immediately and without question.

Send 5c for catalogue E

C. BRANDES, Inc.
Room 814 32 Union Square
NEW YORK CITY
Wireless Receiver Specialists

Transmitting Photographs by Radio

By P. H. BOUCHERON

(*Continued from page* 883)

THE MARTIN METHOD.

In recent years several investigators have been at work developing systems of radio photography. Prominent among these have been Messrs. De Bernochi, Knudsen, Korn and Martin. To attempt to describe the histories and effectiveness of these systems is, of course, impossible here. For that reason we shall confine ourselves briefly to the method and manner of operation of one of the more modern and recent developments. We have in mind that of M. J. Martin of England, who, incidentally, has prepared some excellent data on the result of his efforts.* As this investigator freely admits, there is considerable room for the improvement of radio photographic systems, and at the present time there exists no entirely satisfactory method; the art being still in the experimental stage. The experiments of Professor Korn of Berlin, however, are prophetic of what may be expected in the future. This scientist has succeeded in sending photographs between Berlin and Paris—a distance of more than 700 miles!

Concerning the system of radio photography employed by Martin, which he has named the "Telephograph," the following advantages are claimed:

(a) A greatly improved method of transmitting and receiving over other systems.

(b) A simple method has been devised for regulating the speed of the driving motors and maintaining isochronism with a limit of error less than 1 in 800.

(c) An improved arrangement for synchronizing the two machines whereby transmission and reception begin simultaneously.

(d) Only one complete machine is used at each station.

* Wireless Transmission of Photographs, Wireless Press, London

TRANSMISSION.

In Fig. 1 is shown a schematic diagram of the apparatus and method of connection for a complete station; that is, transmitting and receiving combined. In the present case the problem is to prepare a photograph so that the light and dark shadings composing its make-up will be made to act upon a stylus at a more or less degree of pressure and length, the stylus, in turn, being made to operate a relay connected to a regular spark transmission system. These constantly broken up signals are in a like manner recorded at the receiving station in such a way that they will cause light and dark shadings to be imprest upon a sensitive photographic plate in the identical order of their original transmission.

In order to accomplish the above, the original photograph is first copied by means of a copying camera which, however, is furnished with a "cross" screen placed between the photographic plate and the lens.* The result is that the finished negative is composed of cross-sectioned lines. From this cross-section-lined negative a print is made upon a specially prepared sheet of metal. The result is that of an image composed of numerous cross-sections of *insulating* material corresponding to the characteristics of the illustration. Between each cross-section there are likewise spaces of *conducting* material. This prepared metallic print is then placed upon the transmitter drum, shown in the illustration, in such a manner that the stylus is progressively made

* See article "How Color Magazine Covers Are Made" in the November issue.

Do You Know A ACE E

that the ACE Type B 2-step Amplifier will give you 450 times amplification of signal? Price **$20.00,** ready to wire. Diagram furnished.

We manufacture and handle complete lines of Radio instruments and accessories.

Write for catalog.

"You may pay more—but you can't buy better."

THE PRECISION EQUIPMENT CO.
Dept. E, 2437 Gilbert Avenue
Cincinnati, Ohio

The Corwin Dials



are now used exclusively by the Radio Distributing Co. and all manufacturers whose apparatus is of a superior nature.

If you want indicating dials for superior performance, buy the Corwin Dials. Black composition, white filled engraving, beveled edge.

3" Dial.....$0.75. With Knob.....$1.30 Postpaid
3⅞" Dial..... 1.00. With Knob..... 1.70 Postpaid

We are distributors of the better class of radio apparatus and offer a superior service on products manufactured by Acme, A. R. Co., Murdock, Clapp Eastham, Moorhead, etc.

Send 10c. for latest catalog describing above dial and all Radio Apparatus.

A. H. CORWIN & CO.
4 W. Park St., Dept. E, 1, Newark, N. J.

Arnold Loose Couplers

Combination Loose Coupler Parts and accessories.

Send 3c stamp for literature which is sure to interest you.

J. F. ARNOLD 2082 Lexington Av. N.Y. Established 1910



SENT TO YOU FREE TO WEAR 10 DAYS

Just send your name for a beautiful Rosebrite ring. Wear this wonderful new sparkling stone ten days at our risk. All the dazzling fire and brilliance of a genuine diamond. Mounted in solid gold ring, men's or women's style.

Send No Money! Simply write today, stating style wanted and finger size. (Send strip of paper just long enough to meet over second joint of ring finger). Do not send a penny. When ring arrives deposit only $4.75 with postman. Wear it 10 days. **We guarantee to refund your deposit if you can tell this marvelous gem from a genuine diamond.** If you keep it send $3.00 a month for four months. Write today before this amazing, cut-price offer is withdrawn.

Rosebrite Diamond Co., 30 North Dearborn Street Dept. 5812 CHICAGO, ILL.

EARN-MORE-MONEY

Learn Sign Painting - Card Writing - Auto Painting Decorating - Paperhanging - Graining - Marbling.
Short terms - low cost - Catalog free
Chicago Painting School
146 W. AUSTIN AVE. Near Wells Street.



FREE $20

TENOR BANJO Ukulele, Hawaiian Guitar, Violin, Mandolin, Guitar, Cornet or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.
SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 41 - CHICAGO, ILL.

LITTLE GIANT DRILL PRESS



Just the thing for small shop and experimental work. Mechanically right and well made. Size 0 to $\frac{1}{4}$" drill. Weight 22 lbs. Price $15.00.

Send for circular

SYPHER MFG. CO.
Dept. "C" Toledo, Ohio

SAVE 25% to 60%



on slightly used
GRAFLEX-KODAKS

Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 10 days' Free Trial. Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.
CENTRAL CAMERA CO., Dept. 112 124 S. Wabash, Chicago

EASIEST SHORTHAND





Learn in 8 evenings home study; then acquire speed with K. I. Shorthand. Amazingly simple, easy. Approved by experts. Write dictation, messages, etc., rapidly as spoken, after brief pleasant practice. Favorite method for personal use; make notes at lectures, meetings; keep confidential diary. Big help in any profession or business; aid in your career. Used in Army, Navy, courts, commercial schools; by public and private stenographers, teachers. Slight cost. K. I. Shorthand—for busy people, including YOU. Proof Lessons. Guarantee and Brochure with Testimonials free, postpaid. Address:
KING INSTITUTE, EL-300—Station F, NEW YORK CITY

STUDENTS **ART MAGAZINE**

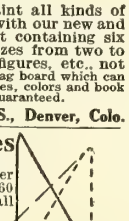


Publishes cash art assignments, lessons and articles on Cartooning, Designing, Illustrating, Lettering and Chalk-Talking. Criticises amateurs' work. Full of information for artists and art students. Satisfactory or money refunded.
20c a copy, $1 for 6.
Send $1 NOW. Thrift Stamps Taken
G. H. LOCKWOOD, Editor, Dept. 619, Kalamazoo, Mich.

A NEW AND EASY WAY TO PAINT
SIGNS AND SHOW CARDS
OUR PATTERNS DO THE WORK

No experience required. Any one can paint all kinds of signs, banners, cards, etc., on any surface with our new and easy system of lettering. Complete outfit containing six alphabets of letters, assorted styles and sizes from two to twelve inches high, also three sets of figures, etc., not printed but life size patterns cut out of durable tag board which can be used over and over again for years, also brushes, colors and book of instructions, PREPAID $10.00. Satisfaction guaranteed.
ACME SALES CO., Empire Bldg., Dept. S., Denver, Colo.

The Unversal Triangles



A 7", direct ruling Protractor with Vernier reading and secure adjustment, the 30x60 and the 45x90 transparent triangles—all in one.
The most practical and thoroughly satisfactory tool for draftsmen.
You cannot afford to be without it.
Ask for my SPECIAL OFFER to one draftsman in any school or shop.
EDWIN Z. LESH, Dayton, Ohio

Learn Watch Repairing



Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates.
Ask for our Free Book. It explains our system and terms.
THE DeSELMS WATCH SCHOOL
720 Perry St., ATTICA, IND.

TELEGRAPHY

(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.
DODGE'S INSTITUTE A Street, Valparaiso, Ind.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER LONGMONT, COLO.

to trace a path from one end of the print to the other. One end of the radio transmitter relay is connected to the stylus, while the other end is connected to the shaft attached to the metal drum. In this manner the various shadings of the print cause a short, long or no signal to be transmitted by means of the regular radio transmitter

In order to prevent possible sparking at the point of contact between the stylus and the specially prepared print, a condenser of 1 mfd. is placed across the circuit.

When the complete line print wrapt around the drum of the machine has past under the stylus the end of the shaft reaches the spring of the circuit-breaker, thereby breaking the clutch circuit and allowing the motor to run free.

RECEPTION

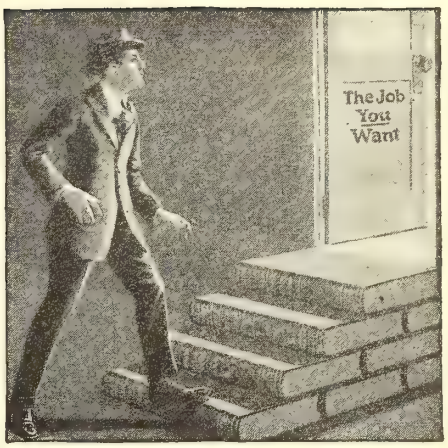
At the receiving end a regular radio receiver is employed, where the rectified current is made to pass thru a Brown telephone relay, from which it is directed to a special telephone receiver of extremely sensitive construction. To the diafram of this receiver is arranged a pivoted rod, on the end of which is the shutter placed between the two lenses, the opening and the closing of the shutter is, therefore, dependent upon the minute currents received by the sensitive receiver and where the following optical action takes place. By means of the Nernst Lamp and the condensing and focusing lenses a magnified shadow of the shutter is thrown upon the screen, having its small opening or "window" bored thru the center, and a certain amount of light from the lamp reaches the photographic film wrapt around the drum of the machine thru the medium of the above small hole. When, however, signals are transmitted, the magnified current from the telephone relay energizes the coil of the special telephone, thereby attracting the diafram and causing the above-mentioned movement of the pivoted rod. It is by means of this optical arrangement that a magnified movement, as well as a magnified image of the shutter, is thrown upon the screen in such a manner that this shadow of the shutter will cover the hole in the screen and prevent any light from reaching the film. Thus, when the stylus of the transmitter at the distant station traces over a conducting strip on the metal print, no light reaches the film of the receiving station, but when it is tracing over an insulating strip the shadow of the shutter on the screen rises and the light from the Nernst Lamp reaches the film. By this method a *positive* picture is received, which is of great advantage when photographs are required for immediate reproduction.

Static, of course, will make itself visible at the received station by irregular transparent marks on the film after development. These, however, can easily be eliminated by means of retouching.

The aluminum rod, as well as the optical parts mentioned here, are enclosed in a light-proof box in order to protect the film from outside light. In fact, the entire photographic end of the receiver must be enclosed within a dark room and observed only by means of a regular photographer's ruby lamp.

Some interesting devices connected with this system are the friction brake, which is designed to reduce the speed of the motor until the isochronizer indicates that the correct speed has been obtained. The isochronizer, on the other hand, is a device for insuring the correct speed regulation of the driving motors. The contact-breaker operates as soon as the transmitter sends out the first signal, whereupon the magnified current from the telephone relay actuates the polarized relay, which in turn completes the circuit.

The accurate performance of this system depends primarily upon the synchronizing



Step Up to a Better Job!

That better job and the bigger pay that goes with it—the job *you* want—is within your reach. It's only a step to the really big jobs from where you are. That step is simply "knowing how." The practical books for self-training described below will give you that "know how." They are the steps by which you can reach the job you want.

Some of the best authorities in the world wrote these books in plain, everyday language. Anyone who can read and write English can understand them. Thousands of pictures, diagrams, etc., make difficult points as plain as day. Over 1,000,000 volumes have been sold.

Pay-Raising Books at Greatly Reduced Prices

Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures.	Was $45.00 Now	$29.80
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures.	Was $37.50 Now	$24.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures.	Was $67.50 Now	$39.80
Accountancy and Business Management, 7 volumes, 2700 pages, 1000 pictures.	Was $52.50 Now	$29.80
Fire Prevention and Insurance, 4 volumes, 1500 pages, 600 pictures.	Was $30.00 Now	$19.80
Electrical Engineering, 8 volumes, 4100 pages, 3300 pictures.	Was $60.00 Now	$34.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures.	Was $45.00 Now	$29.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures.	Was $52.50 Now	$29.80
Law and Practice (with reading course), 13 volumes, 6000 pages, illustrated.	Was $97.50 Now	$49.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures.	Was $30.00 Now	$19.80
Sanitation, Heating and Ventilating, 4 volumes 1454 pages, 1400 pictures.	Was $30.00 Now	$18.80
Practical Accounting, 4 volumes, 1840 pages, 800 pictures, etc.	Was $20.00 Now	$14.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blueprints, etc.	Was $30.00 Now	$19.80

Send No Money
Shipped for 7 Days' Trial

Write the name of the books you want on the coupon and mail it today. We will send the books at once, express collect, and you can use them just as if they were your own for a whole week. If you decide you don't want to keep them, send them back at our expense.



75c a Week

If you like the books, as thousands of other men have after examination, just send us $2.80. You can send the balance of the special reduced price the same way—$3.00 each month, 75 cents a week.

Step up to a better job with bigger pay. MAIL THE COUPON NOW. It's your first step.

AMERICAN TECHNICAL SOCIETY
Chicago, U. S. A.

American Technical Society, Dept. X-259, Chicago, U.S.A.

Please send me set of .....

.....

for 7 DAYS' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3.00 each month until I have paid the special price of $..... If I decide not to keep the books I will return them at your expense within one week.

Name.....

Address.....

Reference.....

(Please fill out all lines.)

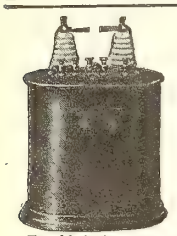
GET A
COMMERCIAL OPERATORS LICENSE

We train you in the shortest possible time for a first grade license

MODERN EQUIPMENT
BEST INSTRUCTORS
SHORT COURSE

New Federal Arc Set recently installed

EAST SIDE Y.M.C.A.
RADIO SCHOOL
152 East 86th Street, New York City



Packard

Owners of the 1-2 K. W. 13,200 high voltage type report distances of 450 to 900 miles. This cannot be equalled, using any other make of wireless transformer for amateurs. Adjustable power, large overload capacity and safety spark gap are but a few of the many good points.
With the *Packard* you will be leader of all operators in your district.

For this is the most powerful transformer that can be used for amateur purposes under Government regulations.

Write for our illustrated bulletin.

The Packard Electric Company Warren, Ohio

Wireless Transformers

Pure Copper Aerial Wire
14 GAUGE—2 ft. for One Cent
12 GAUGE—80c for 100 ft. Roll
Postage Must Accompany Order

Send 15c for our big illustrated Catalogue showing scores of bargains in radio apparatus. This may be deducted from your first order of $1.50 or over. High printing costs make free distribution impossible.

ELECTRICAL SPECIALTY COMPANY
Dept. E, 48-50 S. Front St., Columbus, Ohio
Dept. E, 20 N. 9th St., Philadelphia, Pa.



DEAFNESS IS MISERY
I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my sworn statement of how I recovered my hearing.
A. O. LEONARD
Suite 369, 70 5th Avenue -- New York City

SEX BOOKS
For Teachers, Students, Physicians, Nurses, Jurists, Lawyers, Social Workers, Clergymen, Priests, Professional and Advanced Adult Readers.
Send for List
THE MODERN BOOK SOCIETY
6 Hanson Place, Desk 55, Brooklyn, N. Y. City
"Books for Intelligent People"

and the isochronizing of the two stations and these are the most difficult problems encountered. As a matter of fact, both stations must be almost perfectly synchronized during operation, if an accurate photograph is to be produced.

Another important factor is the correct starting of the picture upon the receiving drum. Not only must the two machines revolve in perfect accord, but they must begin to transmit and record at exactly the same spot on the cylinders, so that the component parts of the received image shall occupy the same position on the photographic paper or film as they do on the metal print at the transmitter end. Otherwise, if the receiving cylinder is permitted to revolve slightly before reproduction has started, the final print would be entirely misplaced; the bottom part of the picture appearing at the top, or *vice versa,* as the case may be, thus ruining the resultant illustration.

The practical transmission and reception of illustrations thru the medium of *radio waves* is by no means a simple matter and requires the use of most sensitive receiving instruments as well as exacting patience in adjusting sender and receiver. However, it will not be many years before our transoceanic radio stations will devote part of their operating hours to the reception and transmission of photographs to accompany the text of the news items previously sent.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc., required by the Act of Congress of August 24, 1912; of ELECTRICAL EXPERIMENTER, published monthly, at New York, N. Y., for October 1, 1920.

State of New York, County of New York, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of the ELECTRICAL EXPERIMENTER and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Experimenter Publishing Co., 233 Fulton St., New York City; Editor, Hugo Gernsback, 233 Fulton St., New York City; Managing Editor, Harry Winfield Secor, 233 Fulton St., New York City; Business Manager, R. W. DeMott, 233 Fulton St., New York City.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) Experimenter Publishing Co., 233 Fulton St., New York City; Hugo Gernsback, 233 Fulton St., New York City; Sidney Gernsback, 233 Fulton St., New York City; Harry Winfield Secor, 233 Fulton St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, give the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

H. GERNSBACK.

Sworn to and subscribed before me this 13th day of October, 1920.

Beatrice K. Owen, Notary Public, New York County, New York; New York County No. 57; New York Register No. 1129. (My commission expires March 30, 1921.) (Seal.)

SKINDERVIKEN TRANSMITTER BUTTON



This famous button made in several styles for experimenters and wireless men. Supersensitive style for detectiphone work. Sends piano, violin and victrola music thruout the house. Common battery style for wireless telephone and amplifyer use. Capable of passing a greater amperage than most transmitters. Price with complete instructions for use $1.00.

Mechanical Stethoscope



Price $5.00

Detects knocks and trouble in all running machinery. Use it to test the motor of your automobile. Garages and Dealers stock up for Christmas.

Every automobile owner should have one. Send for list of experimental equipment, receivers, ringers, etc.

GENERAL SOUND TRANSMISSION CORPORATION
Room 507
2 Rector Street
New York

MEMORIZE CONTINENTAL CODE ALMOST INSTANTLY
Our method is THE short cut.
Successfully used by thousands.
"What They Say About It" Free. Master the Code and you overcome the only obstacle to quick success.
Chart and Instructions, 50 Cents
C. K. DODGE
Box 300 Mamaroneck, N. Y.

[RADIO] Mail Order SERVICE
A complete stock and prompt deliveries is a combination you can't beat. Any radio instrument mailed postpaid anywhere. Try our service.
Send 10 cents for catalog.
KELLY & PHILLIPS
312 Flatbush Ave., Brooklyn, N. Y.

RADIO CLUB PINS
Special folder of designs and prices in addition to regular School pin catalog free on request. Be sure to see these new numbers which will put new life in your club.
METAL ARTS CO.
Dept. 12 Rochester, N. Y.

LEARN WIRELESS
At the OLDEST, LARGEST and BEST EQUIPPED school of its kind in New England. Thousands of satisfied graduates all over the world. Splendid opportunities in the Merchant Marine. Day and Evening classes. Start any Monday. Illustrated Prospectus for the asking.
EASTERN RADIO INSTITUTE
899E Boylston St. Boston, Mass.



$12.50

NEW 1920 RED HEAD PHONES
We announce the new model of the famous Red Head Radio Receivers, greatly improved, 3200 ohms, $12.50 the pair.
THE NEWMAN-STERN CO.
Dept. E. E. Cleveland, Ohio
Distributors for DeForest, Murdock, Signal, Bunnell and other famous lines.

WIRELESS TELEGRAPHY
Make your own "Wireless," also Dynamos, Batteries, Motors, Telegraph, Telephone, Lights, Bells, Alarms, Coils, Current Reverser, Electric Engines, etc. Book with 75 Illustrations; by experts so anyone can understand it. With Catalog, All 10c, 3 for 25c pp
J. C. DORN, 705 S. DEARBORN STREET Dept. 22. CHICAGO, ILL.

"They WORK while you sleep"

Cascarets

Best Laxative for Men, Women and Children. 10, 25, 50c—drugstores.

STOMACH TROUBLE

Regulate your digestion so you can eat favorite foods without fear of

Indigestion
Flatulence
Gases
Acidity
Palpitation

A few tablets of Pape's Diapepsin correct acidity, thus regulating the stomach and giving almost instant relief. Large 60c case—drugstores.

PAPE'S DIAPEPSIN

Don't Wear a Truss



We Guarantee Your Comfort

with every Brooks' Appliance. New discovery. Wonderful. No obnoxious springs or pads. Automatic Air Cushions. **Binds and draws the broken parts together as you would a broken limb.** No salves. No plasters. No lies. Durable, cheap. Sent on trial to prove it. Full information and booklet free.

C. E. BROOKS
203D State St. Marshall, Mich.

Life or Death

By CHARLES S. WOLFE

(*Continued from page* 847)

"My picture," she said, coolly, "I believe that you newspaper people attach considerable value to photos. I had it ready for you."

"But—" I began, to be checked by a gesture.

"And now, Mr. Roberts, for your story." She settled herself comfortably in her chair. "For the last several months—a couple of years, to be more exact—I have been at work endeavoring to prove or disprove a theory that I had formulated. My work is about completed, I have been successful beyond my expectations, and I am ready to give my results to the world."

I nodded to show that I was following, and awaited further developments.

"You are thinking, perhaps, that such matter were best published in a medical journal. Well, undoubtedly, they will devote considerable space to me in the near future. But the treatment will be of such a technical nature that to the man on the street it will mean nothing, if, indeed, he gets a glimpse of the articles at all. My work is of such a revolutionary nature that I want every one to know of it, to realize what it means to each and every individual, and the best medium for such a widespread announcement is the daily press. I selected your paper as a starter. You will have what you call a scoop."

"Good night!" I thought, "our promising story dwindles to a doctor seeking sensational advertising for a pet cure. Some nerve! Wow!"

Then she puts over the knock-out punch. "I have conquered death," she said, quietly, coolly, confidently.

Believe me, I sat up quickly and began to look her over, hard, a fact that did not escape her keen eyes.

"I am not insane, Mr. Roberts, nor am I addicted to drugs or intoxicants. That statement startles you, of course, but can you think of any good reason why death should not be conquered, just as typhoid, for instance, has been mastered?"

I had no ready answer for that, but I was far from ready to believe her statement. "The thing is impossible, Doctor," I blurted. "You can make temporary repairs, and all that, but we all must die, and—"

"We always will," she finished, taking the words out of my mouth. "Yes, Mr. Roberts, that has been a foregone conclusion for ages, and for that reason more than any other, I suppose, few have ever dared tackle the problem of beating back the ancient enemy. Nevertheless, I say to you now that very few of us need die. What is more, I am prepared to prove my words. Do you think that this will make sensational enough reading for your subscribers?"

"If there was the remotest possibility of this thing being accomplished—or accomplishable, for that matter," I said, slowly, "it would be the story of the ages. The entire front page would be none too much space to devote to the subject. But—"

A mischievous gleam twinkled in her eyes. "I'll wager your Christian name is Thomas, Mr. Roberts," she laughed.

"What?" I asked, amazed, and then, catching her mood, I laughed too. "No, it's not," I retorted, "but I was born in Hannibal."

"Well," she replied, growing grave again, "I'll demonstrate, Missourian. Get

Are You A Reject?



—Like a damaged product of the factory?

Look in the glass. See if what you see there is a full fledged man, or a piece of damaged goods—a reject of society—nerves gone, vitality sapped, energy lacking, ambition lost—a weakened, trembling, hopeless, joyless mortal who feels that life is not worth living, and the world looks dark and gloomy.

The guilty man shudders at the spectacle he sees in the mirror. You know when you are face to face with yourself what has made you what you are, if you are of the guilty ones.

Don't Be a Half-Baked Misfit

You can brace up and be a real fellow—a wholesome looking, handsome, healthy chap—a man any employer would be glad to have around—a man every man and woman will instinctively take to right off. Yes, you can do it—if you will listen to a little common sense as it is taught by a man who made himself the best physical specimen in the world, then devoted himself to the rehabilitation of other men and women and so succeeded that thousands now acclaim him the wonder-worker of the age.



STRONGFORT
The Perfect Man

Strongfortism Will Put You on Your Feet

Strongfortism works miracles in men, yet it is easily adopted that, without interfering with any ordinary occupation, you can have health and vitality and vigor restored. If you are a sufferer from Nervous Disorders, Bad Habits, Excesses, Weaknesses, Catarrah, Indigestion, Rheumatism—or any other dread affliction, I urge you to learn what I can do for you. So wide-reaching is my system that I can remedy almost any physical fault by purely natural means **without the use of drugs or medicines.** It's great—you'll admit it as soon as you know anything about it. My Free Book tells all about it.

Send for My Free Book

I know I can confer upon you tremendous benefits—I know you'll thank me as other thousands have—that's why I want to give you an insight into my wonderful method by sending you my highly interesting and valuable book, **"Promotion and Conservation of Health, Strength and Mental Energy."** Don't lose a minute. Send a 10c piece for postage, etc., to my address. Tell me your ailment, I will reply promptly—you'll devour the truths found in my book and you will see at once that a new era of life is within your grasp.

LIONEL STRONGFORT
Physical and Health Specialist
Dept. 153 Newark, N. J.

FREE CONSULTATION COUPON
Absolutely Confidential

Mr. Lionel Strongfort—Dept. 153, Newark, N. J., Personal.—Please send me your book, "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY," for postage on which I enclose a 10c piece.
Send me special information on subjects marked X below, without in any way obligating me.

..Colds	..Stomach Disorders	..Skin Disorders
..Catarrh	..Constipation	..Impotency
..Hay Fever	..Biliousness	..Great Strength
..Asthma	..Torpid Liver	..Falling Hair
..Obesity	..Indigestion	..Weak Eyes
..Headache	..Nervousness	..Pimples
..Thinness	..Poor Memory	..Blackheads
..Rupture	..Rheumatism	..Round Shoulder
..Lumbago	..Gastritis	..Lung Troubles
..Neuritis	..Heart Weakness	..Female Disorders
..Neuralgia	..Poor Circulation	..Weak Back
..Flat Chest	..Increased Height	..Muscular Development
..Deformity (Describe)	..Successful Marriage	..Advanced Course
..Insomnia	..Easy Childbirth	..Healthy Children
..Vital Depletion	..Despondency	..Manhood Restored
..Youthful Errors		
..Short Wind		
..Flat Feet		

Here mention other subjects not listed above:

.....

Name .....

Age..... Occupation.....

Street .....

City..... State.....

S. & I.

RADIO APPARATUS

Distributors of Reliable Radio Apparatus for Experimenters in Every Branch of the Radio Field!

"Pittsco" the Sign of service!

PITTSCO

All we ask is a trial!

AMPLIFYING TRANSFORMERS

No. A-2 Acme, mounted	$7.00
No. A-2 Acme, semi-mounted	5.00
No. A-2 Acme, unmounted	4.50

VACUUM TUBES

Moorhead Electron Relay, detector	6.00
Moorhead Amplifier, oscillator	7.00
Moorhead Extra Hard, transmitting	7.50

B BATTERIES

No. 7623 Standard, 22.5 V. Small	1.50
No. 7625 Standard, 22.5 V. Large	2.65
No. 7650 Standard, 22.5 V. Variable	3.50

TELEPHONES (Pair)

No. 55 Murdock, 2,000 ohms	4.50
No. 55 Murdock, 3,000 ohms	5.50
Brandes Superior, 2,000 ohms	7.00
Baldwin's Type C Navy Standard	16.50
Baldwin's Type E Super-sensitive	20.00

"MANUAL" No. 22 Sent for 10 Cents in Stamps

F. D. PITTS CO. Inc.
12 Park Square, Dept. D, Boston, Mass., U.S.A.

No Seals-No Secrets —*But Service!*

Inspection of the interior of any Radio apparatus bearing the mark:

GREBE RADIO

reveals design and workmanship fully in keeping with its outward appearance.

GREBE RADIO apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service. Our interest in the purchaser does not terminate with the sale.

Ask your dealer to show you our line of super-grade apparatus. If he doesn't carry it, write us—mentioning his name—for catalogue.

A. H. GREBE & CO., Inc.,
70 Van Wyck Blvd., Richmond Hill, N.Y.

Materials and Parts

for that new set you are building, we have it.

Brass sheet, round and square rods, sheet aluminum, fibre, bakelite and hard rubber cut to size, machine and wood screws, binding points, switch points, knobs, insulators switches, all types; variable and fixed condensors, and card board tubing. Murdock, Acme, Tresco, Bunnell, Parkin, Morehead and Burgess products in stock, and we can give you the service you want. Our new catalogue sent for five cents, which will be refunded on first order for one dollar or over.

Try us on your next order.

Keystone Radio Co.
Drawer 307 Greenville, Pa.

CENTRAL RADIO

LEARN WIRELESS

at the largest radio school in the Central States. Modern complete equipment. Experienced instructors. Dormitory in connection. Students may earn expenses if necessary. Write today for catalogue and full information.

CENTRAL RADIO SCHOOL
Independence, Mo

your note-book, and I'll give you an outline."

Undecided as to whether I was up against mania, colossal nerve, or a practical joke, I complied, my mind striving desperately to read this riddle. I was getting a sensation all right.

She leaned back, rocking gently in the swivel-chair, placed her finger tips together, and began to speak, rather dreamily.

"Barring accident, of course, which is an artificial form of demise, due largely to our clumsy man-made mechanical contrivances, what is the primary cause of death?"

Sharpening my pencil, I replied rather flippantly, and certainly without any thought, "The heart ceasing to beat."

"Exactly," she cried, rousing. "The heart stops beating! That is the only cause of death. There may be any number of things, and numberless combinations of things, which act to produce this effect. But they are only instrumentalities. They are merely means to an end. There is no death until the heart ceases to function. Even if death be due to violence, this is true. You admit this?"

"Certainly," I answered, readily, "it is obvious."

"Very well. Then, if you are logical, you will admit also that we have only to find some means to prevent the heart from ceasing its working, and we have defeated death and dissolution."

"But—," I began, feeling that I had no adequate answer, yet with some big objection struggling within me for utterance.

"What you are going to say," she interrupted, "whatever form it takes, will simply amount to stating the fact that heretofore nothing has been found that will prevent the heart from stopping. That is true. But it is equally true that prior to the demonstration of the Wrights, no means had been found to sustain a machine heavier than air in flight. And that prior to Hertz's discoveries no means had been found to hurl energy thru miles of space with no tangible medium to aid the passage. And that, so far, no way has been found to bridge the void between planets. It does not say that in the first instances it was not found, nor that in the last that it will not be found. It seems incredible, as the others seemed incredible. In the light of what has already been accomplished, does not the future hold promise of things even more unbelievable than the statement that I have made to you this evening?"

"It at least earns for you a further hearing," I conceded, gracefully.

"Well," she resumed, "that was the theory upon which I began work. Realizing that death was a simple thing, depending only on that one condition, I began my quest for the cause of that condition, disregarding altogether the thousand and one forms in which the approach of the phenomenon heralded itself.

"After some research, I formulated the working hypothesis that the heart was overpowered by one thing only, and I then began a quest for an active principle, whose presence in some quantity in the heart would cause it to cease its beating."

I ventured a question. "Why just one cause?" I queried. "I am not up in these lines, but it seems to me that it might be stopt by any one of a dozen causes. In the case of old age, for instance, it might just simply wear out."

"That same statement has been made by many a medical man," she answered, "but I invite you to consider a very significant fact. Regardless of the cause of death, the heart undergoes no material change. It simply stops, that's all. It does not shrink. It does not disintegrate. It does not change its form. A shoe, for a concrete instance, in wearing out shows visible signs

GENUINE ASPIRIN

Name "Bayer" means genuine
Say "Bayer"—Insist!

BAYER

Say "Bayer" when buying Aspirin. Then you are sure of getting true "Bayer Tablets of Aspirin"—genuine Aspirin proved safe by millions and prescribed by physicians for over twenty years. Accept only an unbroken "Bayer package" which contains proper directions. Handy tin boxes of 12 tablets cost few cents. Druggists also sell larger "Bayer packages."

BAYER-TABLETS of ASPIRIN

Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid

Used by 4,000,000 People Annually

Prepared with Predigested Organic Iron—Easily Assimilated by the Blood

NUXATED IRON



For Red Blood, Health and Strength

'FIBRE-LITE" LIMBS



Easy Payments—Do Nature's Work. AGENTS WANTED who wear leg. Good Pay. FREE Fibre Sample.
Describe Stump to
WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.

of the process. A limb, becoming paralyzed or useless, shrivels. In nearly everything which is reaching the end of its usefulness we find the evidence of change. Not so the heart. There is only one thing of which I can think, off-hand, which does not suffer to a great extent physical changes in reaching the end of its string."

"And that is—" I asked, interested deeply.

"A battery, more particularly a dry cell. If we disregard the attack on the zinc element, which is not so great, we find that its end is brought about for the reason that chemical reactions have taken place—it has polarized. I conducted my search for something that would—in effect—polarize the heart."

I looked up from my scribbling, struck by a thought which I hastened to voice. "Seems to me that in school we used to get a lot of stuff about anabolism and catabolism, and that sort of thing. I'm hazy on it at the present, but if I remember rightly the gist of it was that when the destructive process began to work faster than the constructive forces, the victim presented a pleasing aspect to the family undertaker."

Undaunted by my feeble attempt at humor, she countered. "Quite true, but the fact overlooked by many is that the destructive process cannot begin until the heart starts to waver under the first attack of this virulent principle of which I spoke. So long as the organ is functioning normally, construction keeps easily ahead of destruction. But at the first indication that the reverse is true, you may rest assured that there is beginning to collect within the heart this principle which I succeeded in isolating.

"Which brings us to the point. *I did succeed in isolating it.* Let me show you."

She swung to the desk again, to face about again with a half-ounce phial in her hand. She held it up to the light. It was of a peculiar, sickly green hue, and as the level of the fluid changed as she shifted the phial, I noted that it stuck to the sides of the bottle in oily drops.

"What is that stuff?" I asked, regarding it disapprovingly. It was, for some reason, repugnant.

"I have not given it a name as yet," she said, calmly. "But let me tell you this. All known poisons pale into insignificance in comparison to this. In fact, it is the real active principle in every poison. A poison is only a poison because it contains this principle in sufficient proportion to completely *polarize* the heart, if I may use that expression.

"Further, I have made exhaustive tests of its power. I was amazed at the truly minute quantity of this liquid which would produce death. Science has found ways to measure the infinitely small, but I had to devise several entirely new instruments to measure the dose necessary for fatal results. There is enough in this bottle to wipe out a nation."

"For Heaven's sake," I gasped, "what is a lethal dose of that stuff?"

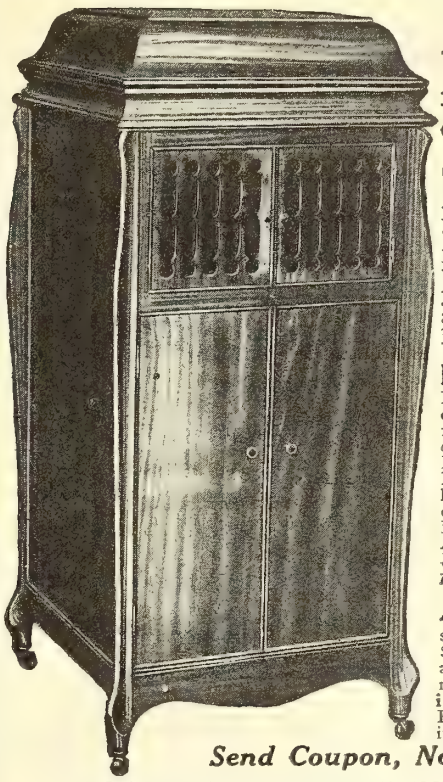
"As nearly as I can tell you, *an atom and a half,*" she replied.

"An atom and a half," I echoed. "That would be small, wouldn't it?"

She smiled. "Quite," she said, dryly. "To resume, and to be brief, my next logical step was to find an antidote for this terrible poison that I had discovered. This I have done. And that is why I sent for you. I am prepared to demonstrate that I have an antidote for death itself. Let me give you a convincing demonstration."

From under the desk she brought to light a small cage, and a series of squeals betrayed the fact that it contained some living animals. In a moment these proved to be white rats.

YOU Can *Easily* BUILD This PHONOGRAPH



TREMENDOUS SAVING IN COST

You don't need to be a cabinet maker. We have made it an easy and pleasant job with

Our Simplified Plans We furnish blue prints, diagrams, motor, ready-built horn, cabinet pieces and all metal parts complete. You do the assembling, **6 models to choose from.** A few hours' work, and you will have as fine a type of phonograph as any produced, and at a price away below what you would pay in a store.

KEEP THE SAVINGS IN YOUR POCKET

Machines play all records, have a wonderful tonal quality, excelled by none. No need now for any family to be without a phonograph because of the cost. THE MAKAFONE solves the problem. BUILD IT YOURSELF AT LESS THAN ONE-FOURTH REGULAR COST, but equal to the high-priced cabinet machines. Free Records with each outfit. SEND TODAY FOR FREE CATALOG and full particulars of our wonderful offer. *Many a manufacturer got his start in this way. Why not you? Build machines and sell to your friends.*

Agents Attention You can make and sell *these* machines from our plans at a profit of $50 to $75 each. Others are selling two and three a week. Here is your opportunity to make big money and become independent. Pleasant and profitable work.

Send Coupon, Now—To-day

MODERN PHONOGRAPH SUPPLY CO.
393 Springer Bldg., 313 So. Clinton Street, Chicago.

Modern Phonograph Supply Co.
393 Springer Bldg.
313 So. Clinton St., Chicago, Ill.

Gentlemen: Please send me full particulars of your Makafone proposition, without obligation to me.

Name .....

Address..... State.....

The Third Edition of the— **Consolidated Radio Call Book**

Officially lists all the radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world will be represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control and their new calls.

All Amateur Calls Also Listed
Order Your Copy NOW!

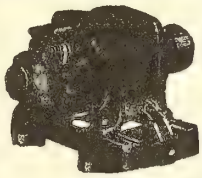
Each of the two preceding editions were immediately exhausted. By placing your order **now** you are assured one of the first copies off the press.

Price $1.50

For sale at all leading dealers or order from us direct.

CONSOLIDATED RADIO CALL BOOK CO., 41 Park Row, New York City

NEW MOTORS FACTORY GUARANTEED ALL SIZES PROMPT DELIVERY



Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

8 v. 10 amp.	$19.50
15 v., 10 amp.	$26.50
40 v. 6 amp.	$31.50
110 v, 2½ amp.	$31.50
110 v, 5 amp.	$52.50
40 v, 12 amp.	$52.50
110 v, 9½ amp.	$67.50
40 v, 25 amp.	$67.50
110 v, 18 amp.	$116.50
40 v., 50 amp.	$116.50
110 v, 26 amp.	$156.50
110 v, 50 amp.	$238.50
Moving Picture Arc Generator 60 v., 35 a.	$116.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., Complete with base and pulley.

½ H.P.	$46.50
1 H.P.	$66.50
2 H.P.	$86.50
3 H.P.	$98.50
5 H.P.	$116.50
1 H. P. Special Grinding and Buffing Motor	$106.50

Direct Current Motors
110 or 220 volts, D. C., shunt wound, 1750 R. P. M. With base pulley and starting box.

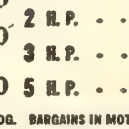
¼ H. P. Washing Machine Motor	$28.50
¼ H. P., 32 v. Washing Machine Motor	$28.50
½ H.P.	$58.50
1 H.P.	$82.50
2 H.P.	$124.50
3 H.P.	$142.50
5 H.P.	$218.50

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

¼ H. P., 220 v. induction Washing Machine Motor	$28.50
¼ H. P., 110 v. grinding buffing motor	$28.50
½ H. P. induction, full load start	$46.50
½ H. P. repulsion induction For compressor service	$54.50
1 H. P. repulsion induction, Special Garage Motor	$74.50
2 H. P. repulsion induction with sliding base	$126.50
3 H. P. repulsion induction with sliding base	$146.50
5 H. P. repulsion induction with sliding base	$188.50

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL ¼ H.P. 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley



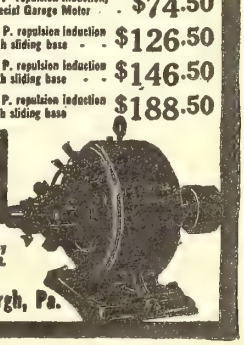
WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $26.50 Each Reg. Val. $34.50

MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 12, West End, Pittsburgh, Pa.



AMATEURS

Get the whole efficiency out of your set by installing a combination of the MOORHEAD A-P ELECTRON RELAY as a detector and one or more A-P V. T.'s as amplifiers.

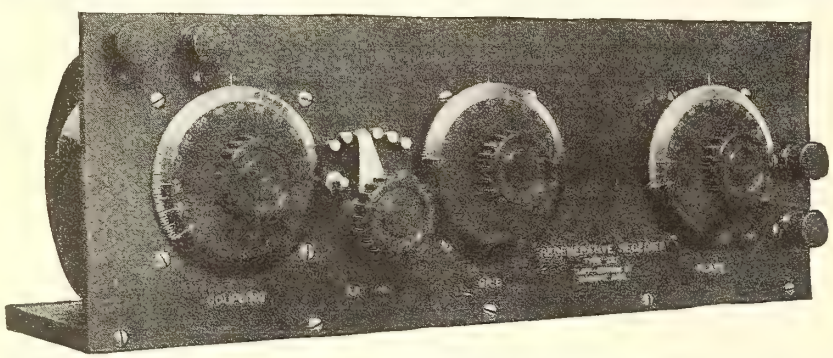
Electron Relay - - $6.00 *Amplifier - - $7.00*

SPECIAL FOR THIS MONTH ONLY—We will give free with every tube sold 15 nickel contact points.

WHITALL ELECTRIC COMPANY
42 Main Street **Westerly, R. I.**
Call Letters 1. I. A. P.

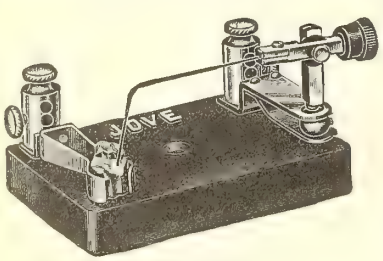
WRITE FOR SPECIAL PRICE FOR MORE THAN ONE BULB—YOU CAN SAVE MONEY

TYPE Z.R.F. REGENERATIVE RECEIVER



WE invite your comparison with any set of similar type for performance or quality. Range 175 to 600 meters. Price complete, $38.00. Variometer, only $6.50.
Our Radio Products have been established in their leadership for thirteen years, are carried in stock by discriminating dealers and are manufactured at 139 Main Street, Cambridge, Mass., by

CLAPP-EASTHAM COMPANY
Catalogs mailed for 6c stamps



(GHEGAN PATENT)

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

Send stamp for new edition 42E Catalog.

J. H. BUNNELL & CO., 32 Park Place, New York

SUCCESS OPPORTUNITY
UTTMARK'S
NAUTICAL ACADEMY
RADIO SCHOOL

8 State St., New York, N.Y.
Phone Bowling Green 8079
Complete instruction in radio operating in all branches for Merchant Marine, Ocean Steamships, Telegram Service. Special course in Vacuum Tubes and Radio Telegraphy. Preparing for Government Examinations.
Elementary and Advanced Classes
Day and Evening Classes
Write for Circular.

Coolly she went about her preparations. An ordinary hypodermic syringe was produced, and a tumbler of a liquid which may have been, and probably was, water. Uncorking the terrible green bottle, she seemed to me to merely waive it over the tumbler. Certainly there was no perceptible coloring of the fluid. The amount added had indeed been minute. From the tumbler she filled her syringe. Deftly she drew one of the rats from the cage, and quickly administered the injection.

For an instant the rat seemed to sit motionless on the desk-top. Then a convulsive shiver shook its frame, and it seemed to stiffen imperceptibly.

"Dead!" said Doctor Weeks, glancing at me significantly. "Heart failure."

From a pigeon-hole of the desk she drew a second phial, this time filled with a black solution. "The antidote," she said.

Another rat was drawn squirming from its cage. Holding and soothing it, she faced me. "And now, Mr. Roberts," she said, "you will see how completely my antidote overcomes the Master Poison. I propose to inoculate this rat with the same syringe that caused the death of the first one. We will even let apparent death ensue. Then we will use the antidote. Watch closely, please."

I bent forward, tensely, in my chair. The deadly hypodermic was administered. Doctor Weeks placed the syringe upon the desk-top, and gazed down quizzically as the second rat gave the convulsive movement that had marked the passing of his predecessor.

"And now—" she cried, seizing a fresh syringe and the antidote bottle, leaning forward to give the saving injection. It was never given. There arose a terrible hoarse cry. She jerked erect, the antidote phial and syringe crashing from her hand. I shall never forget the imploring look she gave me in that brief second, never. Instantly I realized what had happened. She had lunged forward and struck that impregnated needle with her bare arm. And as I struggled to my feet she crumpled to the rug.

In her fall, the uncorked antidote bottle which she held in one hand, and which might have saved her, had emptied on the rug, spilling every drop of the precious liquid.

I called loudly for her servant stooping frantically over her. The servant rushed into the room. "Telephone for the nearest doctor," I ordered, "and tell him to come quickly!"

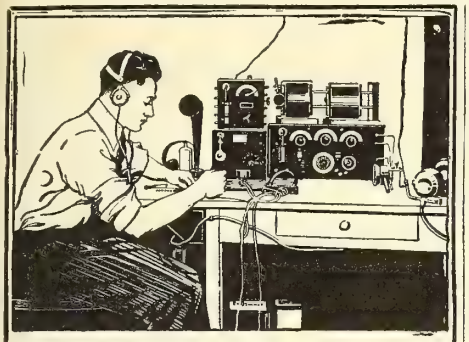
All my efforts to revive her were in vain. I bethought me of the antidote. Quickly, desperately, I picked up the phial from the floor where it had fallen. It was empty, every drop having been absorbed by the rug.

I continued my efforts until the summoned physician arrived. He bent over the prostrate form, an exploratory hand seeking the breast. Finally he straightened up with the customary deprecatory shrug of the medical man faced by a hopeless task. "Heart failure," he said, briefly.

Sorrowfully I carried my tale back to the city editor. We couldn't use it, of course. But now, a year later, it dawns on me that possibly some other medical student might attempt the search again—that is, if he thinks Doctor Weeks was sane.

MAKING THE SAFFIRE BLUSH.

The existence of the electric furnace makes it possible to create diamonds that are the veritable stone, and to fuse chippings and fragments of ruby into one complete jewel. Now arrives a report that with the aid of radium successful transformations have been made in the appearance, if not in the nature, of certain precious stones. A saffire, it is said, has been turned into a glorious ruby by long exposure to the effect of radium.



IT will pay you to learn Radio by our new and comprehensive method in a few months of evening study. We prepare you to meet all the new requirements for first grade commercial license, and obtain position paying $125.00 a month and expenses. Moderate tuition fee.

Write for Booklet B

Y. M. C. A. RADIO SCHOOL

Marcy Avenue, Near Broadway
Brooklyn, N. Y.
Telephone Williamsburg 3800

The
WIRELESS EQUIPMENT COMPANY, Inc.

Furnishes all kinds of reliable radio apparatus at lowest prices. Send for latest bulletin No. 151C on new apparatus.

188-190 Greenwich St. New York

$10 Brings This Latest Model L. C. Smith or a Remington TYPEWRITER



Thoroughly rebuilt in our factory by the famous "Young Process." Fully guaranteed. Easy terms. No interest. FREE TRIAL. We handle all standard makes. Write for details.
YOUNG TYPEWRITER CO., Dept. 44, Chicago

Audion Control Unit $15.00

Type A1, absolutely reliable, can be used with every known circuit. Cabinet size 8½x6¼x6½". Mahogany finish, contains Vacuum tube socket, filament rheostat, grid condenser, grid leak and filament switch. Whole back of cabinet swings open, giving ready access to interior.

At your dealer or from us.

K. & G. WIRELESS SUPPLY CO.
Dept. 15A 152 Chambers St., N. Y.

YOU Can Double Your Ability to Earn Money! Hold Friends! Win Love and Happiness! Our System of Personal Efficiency tells you **how**! Success Studygram and Personality Sketch for 10c and birth date. Thomson-Heywood Company, Dept. 350, Chronicle Building, San Francisco.

DOLLARS IN HARES



We supply garanteed high grade stock and buy back all you raise at $7.00 to $18.50 and up a pair, and pay express charges. Big Profits. Use back yard, barn, cellar, attic. Contract and Illustrated Catalog Free.
STANDARD FOOD & FUR ASSOCIATION
409Z Broadway - New York

BE AN EXPERT
Penman
Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. Complete outline FREE. Write C. J. Ozment, Dept. 44. St. Louis, Mo.



Wrestling Book FREE
Be an expert wrestler. Learn at home by mail. Wonderful lessons prepared by world's champions Farmer Burns and Frank Gotch. Free book tells you how. Secret holds, blocks and tricks revealed. Don't delay. Be strong, healthy. Handle big men with ease. Write for free book. State age. Farmer Burns, 1259 Ramge Bldg., Omaha, Neb.

Practical Chemical Experiments

(*Continued from page* 920)

Order of Activity of the Metals: Chemists arrange the metals according to their relative degrees of activity. The order is such that any metal in this table will replace from its solution any metal that follows it and will itself be replaced from solution by any metal that precedes it. This chemical fact is stated in another way as follows: Any meal in the table is negative with respect to any metal that follows it and positive with respect to any metal that precedes it. Very important chemical facts result from this simple relationship.

Replacement of one Metal by another: In separate test tubes place solutions of lead nitrat, copper sulfate, silver nitrat and mercury nitrat. Label the test tubes so that you will be able to identify them and drop into each a strip of sheet zinc about 10 cm. long and 1 cm. wide.

In another set of test tubes containing solutions of lead nitrat, silver nitrat, zinc nitrat and mercury nitrat place strips of copper.

Allow these test tubes to stand undisturbed for about fifteen minutes. Then observe what has happened. In the first set of test tubes there seems to be a deposit in each case except that of the mercury. But remove the zinc strip from the mercury solution and rub it. It immediately assumes a bright silvery lustre. Break the zinc strip and, unlike the original zinc, you will find it very brittle and the bright lustre seems to extend clear thru the metal. The zinc has replaced the mercury in the solution and since mercury amalgamates with many metals it has penetrated the zinc and alloyed with it.

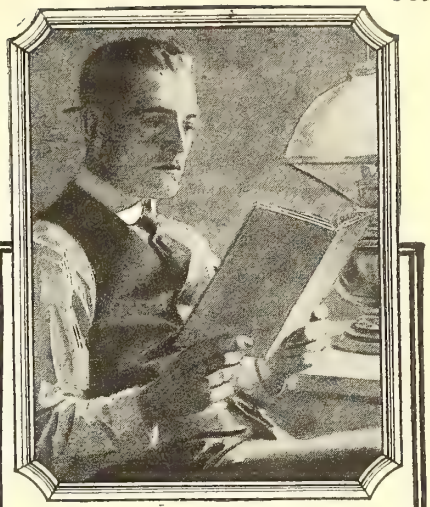
If allowed to stand the copper sulfate solution will lose its blue color because all of the copper will have been driven from solution. The lead appears as a spongy grayish deposit, while the silver has a very peculiar appearance totally unlike the familiar white metal. If the strip of copper placed in the silver nitrat is allowed to remain for some time, a distinct bluish tinge will be seen upon looking down into the test tube showing that the copper has gone into solution. Remove this strip of copper and carefully scrape off some of the spongy deposit. Place it on a square of glass and rub it with the end of a glass rod. The bright white lustre of silver will at once appear.

In will be noted that, altho zinc replaces copper, the copper does not replace zinc.

Applications of the above Facts: Because zinc is negative with respect to copper we use these two metals in the making of electric cells. If strips of zinc and copper are placed in a solution of dilute sulfuric acid and connected in external circuit, the zinc having greater activity than copper goes into solution, driving positive hydrogen ions over to the copper and causing it to become positively charged while the zinc itself remains negatively charged.

Local action in a cell is caused from the fact that zinc is negative with respect to the little impurities of carbon that it contains, and therefore a multitude of tiny electric cells are set up over the surface of the zinc, causing it to go into solution. Copper is electro-positive with respect to iron and therefore copper rivets cannot be used on iron sheeting, especially if it is to be used in salt water. If they are the iron will immediately be eaten away.

Zinc is an excellent coating for iron because, being negative with respect to it, the zinc must oxidize entirely away before any of the iron will rust. And since zinc oxidizes very slowly the iron is preserved for a long time.



$95 An Hour!

"Every hour I spent on my I. C. S. Course has been worth $95 to me! My position, my $5,000 a year income, my home, my family's happiness—I owe it all to my spare time training with the International Correspondence Schools!"

Every mail brings letters from some of the two million I. C. S. students telling of promotions or increases in salary as the rewards of spare time study.

What are *you* doing with the hours after supper? Can you afford to let them slip by unimproved when you can easily make them mean so much? One hour a day spent with the I. C. S. will prepare you for the position you want in the work you like best. Yes, it will! Put it up to *us* to prove it. Mark and mail this coupon *now!*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6173-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE
Sheet Metal Worker	Poultry Raising
Navigator	Automobiles
	Spanish
	French
	Italian

Name
Present Occupation
Street and No.
City State

7-26-19



Send No Money

Free Trial

We will send you any of the new Pathe Phonographs with your own selection of Pathe Records without a penny down. Test them for 10 full days. If you decide to buy, pay the lowest cash price in small monthly amounts. If it fails to please, send it back at our expense.

Easy Terms

Pathe Phonographs are known and loved by millions on two continents. It is the acknowledged standard of the world. In its library are over 75,000 selections—and it plays *all* other records, too. No needles to change. It costs no more than the ordinary phonograph.

Pathé Book Free

Send name and address today. No obligations.

The Standard Phonograph Co.
202 South Peoria Street
Dept. 1259 Chicago, Ill.

Pathé
Standard of the World

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section ten cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the February issue must reach us not later than December 22.

The Circulation of Science and Invention is over 140,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York City, N. Y.

Auto Accessories

Battery charger for garage or service station. Terms if desired. HB Company, Troy, Ohio.

Autoists. "Saviorgas" made at home. More power. Less carbon. Recipe 10c. Hawthorne Recipe Co., Roslyn, Wash.

Tire Agents. Exclusive representatives to use and sell the new Mellinger Extra-Ply Tires. (No seconds.) Guarantee Bond 8,000 miles. Wholesale prices. Sample sections furnished. Mellinger Tire Co., 980 O k, Kansas City, Mo.

Auto Motor Supplies—Buick, Michigan, Stoddard-Dayton, Cadillac-Overland, E. M. F. Continental and Buda Motors, all types, $50 each and up. Special high-tension, 2 and 4 cylinder magnetos $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Save money on accessories. Any kind. We wholesale to consumers. 25% less than retail. Write your wants and get our prices. Guaranteed Auto Parts Co., 105 W. Monroe, Chicago, Ill.

Blueprints. Automobile Armatures. See ad under "Electrical." Charles Chittenden.

Fords start easy in cold weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene, using our 1920 carburetors. Increased power; styles for all motors; can attach them yourself. Big profits to agents; money back guarantee; 30 days trial; Air Friction Carburetor Co., 1511 Madison St., Dayton, Ohio.

Motor Engines and Dynamos

Small motors and generators: ¼ hp. AC $26.50; ½ hp., $38.50; ¾ hp. AC $67.50. Battery charging sets; charging lighting and moving picture arc generators; motors for all phases of current. Prompt delivery; wholesale prices. Write for late catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Motors, generators, battery chargers, prompt deliveries. Easy terms. Write Hobartsons, Troy, Ohio.

Motorcycles—Bicycles

$25.00 up, guaranteed rebuilt motorcycles, Henderson, Excelsior, Indian, Harley-Davidson. Bicycles $5.00 up. Tires and accessories at wholesale. Illustrated Bulletin A free. Ash Motor Corporation, 162 N. Clinton Ave., Rochester, N. Y.

Aeronautics

Blueprints. Most elaborate sets of prints ever published for building a Ford or motorcycle motored biplane. Ford consists of 36 large sheets, motorcycle 28 sheets, all chuck full of valuable details designed by America's Oldest and best Aeronautical Engineers. Price, either set $20.00. Send $5.00, balance after you are convinced. Heath Airplane Co., Chicago.

Boys make a model aeroplane that will fly. Easily made at small cost. Write for circular. Aero Shop, 658½ Hurlbut Ave., Detroit, Michigan.

Heath Propellers represent the most efficient method for all Aerial drive. Each propeller individually designed for the particular work to be done, as laid out by America's Oldest Aeronautical engineers. Propeller Catalog 4c. Heath Airplane Co., Chicago.

Propellers for aeroplane propulsion, small propellers for motorcycle driven snow and ice sleds, road speedsters and hydroplanes. 5 ft. diameter $12, others in proportion. Hub mountings, bearings, sprockets, and countershafts complete. Have full scale blue prints for building Ford and Motorcycle driven sleighs. Crawford Motor and Aeroplane Mfgr., 142 South Rampart St., New Orleans, La.

Heath Airplane Co.'s "Supply Catalog" is the most complete booklet ever published on aeronautical needs. 15c in stamps. Get our pamphlet on Ford and Motorcycle engine-driven airplane, 4c. Heath Airplane Co., Chicago.

Aviation-Motor 30-40 HP, 2 cyl. opposed air cooled, weight 128 lbs. ideal motor for light aeroplanes, motor sleds, wind wagons, hydroplanes, etc. Price only $325, complete with propeller ready to run. Aircraft Inc., 338 Coney Island Ave., Brooklyn, N. Y.

Short Stories, Manuscripts Wanted

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Short Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 165 Hannibal, Missouri.

Stamping Names

Make $19 a hundred stamping names on keychecks. Send 25c. for sample and particulars. Ex Keytag Co., Cohoes, N. Y.

Agents Wanted

Earn $2.00 an hour. Cleaning, renovating and refinishing old floors. Complete instructions and formulas. Price $1.00. C.C. Box 775, Chicago, Ill.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Agents make big money because sales may be made in every home. Our modern aids to home sanitation have an appeal that cannot be resisted. A brush, mop or duster for every need. Liberal commissions and good territory. North Ridge Brush Company, 127 Clark St., Freeport, Ill.

Make and sell your own goods. Formulas by Expert Chemists. Manufacturing Processes and Trade Secrets. Write for Formula Catalog. Chapin Mystic Company, Washington, D. C.

$6000.00 a year is your profit from 4 sales a day. Davidson sold 96 one week. No experience needed. The Aladdin light is a sensation wherever introduced. 5 times as bright as electric. Won Gold Metal. Farmers have the money, they need this light and 9 out of 10 will buy. Also big opportunity in small towns and suburbs. Excellent spare time and evening seller. No capital required. Sample on free trial. Write for agency proposition while territory still open. Mantle Lamp Company, 507 Aladdin Bldg., Chicago.

Agents—$40-$100 week; free samples; gold sign letters; anyone can put on store windows; big demand; liberal offer to general agents. Metallic Letter Co., 433-Z, N. Clark, Chicago.

Agents. Sell our accident and sickness policies in your spare time. Pay $5,000 death. $25 weekly benefit. Premium $10 yearly. Permanent income from renewals. Easy seller. Liberal commissions. Insurance Co., Dept. N-3, Newark, N. J.

Agents—Our soap and toilet article plan is a wonder; get our free sample case offer. Ho-Ro-Co., 138 Locust, St. Louis.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Men, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 759, Chicago.

350% profit. Quick Seller, Klean-Rite Magic Washing Compound. Washes clothes without rubbing. Sells 25c. You make 19c. Samples free. Bestever Products Co., 3253-E, Belleplaine, Chicago.

Insyde Tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts; quickly applied; cost little; demand tremendous; profits unlimited. Details free. American Automobile Accessories Co., Dept. T-1992, Cincinnati, Ohio.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Agents wanted to sell hosiery. Everybody wears. Samples and instructions free. Hosiery House, Tappan, N. Y.

Agents go into permanent business. No capital required. Should net $2500 to $5000 first year. Guaranteed products needed in every home. Repeat sales—big profits. Old established concern whose products are known everywhere. Many make sales of $40 to $75 per day. Practical sales helps, advertising matter furnished. Sample outfit free. Write today. W. T. Rawleigh Co., 309 Liberty St., Freeport, Ill.

Help Wanted

Men, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 760, Chicago.

You are wanted as U. S. Government Postal Clerks. $135-$195 month. Men—women over 17. List positions open—free. Franklin Institute, Dept. E 25, Rochester, N. Y.

Wanted, bright young men desirous of getting into aeroplane work. Good future; advancement monthly $2.00 per day while learning. Heath Airplane Co., Chicago.

Money In Mirrors. Tells how to cash in big. All or spare time making and resilvering mirrors. Our formula best on market. Booklet free. Wear Mirror Works, Excelsior Springs, Missouri.

Wanted. Picture play writers. Big pay. Experience unnecessary. Best course how to write and sell plays. Prepaid $1.00. Address Studios, 856 Carpenter Ave., Oak Park, Ill.

Stop daily grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 48, Marion, Indiana.

Firemen, Brakemen, Baggagemen, $140-$200, Colored porters by railroads everywhere. Experience unnecessary. 897 Ry. Bureau, East St. Louis, Ill.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Men—Boys. Become Automobile experts. $45 week. Learn while earning. Write Franklin Institute, Dept. E806, Rochester, N. Y.

Men Wanted. I want a few men to train as draftsmen. Experience not necessary. Draftsmen earn $150 to $300 per month and more. Big demand. Splendid opportunities. Learn quickly at home. Let me send you Free Lesson. No charge. Address: Charles W. Morey, Director, 2278 Chicago Tech. Bldg., Chicago, Ill.

Be a Mirror Expert. $3 to 10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Get a Business College Course at Home. Prepare to earn $100 to $200 month. Graduates placed in good positions. Details free. Brown's Home Study School, 310-R, Peoria, Ill.

Detectives earn big money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write, American Detective System, 1968 Broadway, N. Y.

Be a Detective. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. Write American School of Criminology, Dept. B, Detroit, Mich.

Armature Winders make big money. We will train you for this interesting profession in 3 to 6 months, and will find you a good paying job while you are learning, so that you can earn your way. Write for special proposition. State age and education. School of Engineering, Dept. R-32, 373 Broadway, Milwaukee, Wis

American Made Toys

An opportunity for Home Workers on small scale and manufacturers on large scale to make American Metal Toys. Army, navy, machine guns, cannons, warships, Indians, cowboys, wild animals, whistles, bird-whistles, religious designs and other toys and novelties. Greatest chance for industrious people to have an independent business. Enormous demand for cheap toys offers unlimited field and great future all over United States and foreign countries. Experience or tools not necessary. Hundreds and more made complete per hour. Casting forms, complete outfit from $3 up. We buy these goods, paying fixed prices. Attractive prices offered for painted goods. A strictly business proposition. No one need apply unless he means business. Booklet and information furnished free. We have no sales agents and we warn against worthless and cheap imitations. Toy Soldier Manufacturing Co., 32 Union Square, New York.

Volume VIII.
Whole No. 93

Science and Invention

H. GERNSBACK – EDITOR
H.W. SECOR – ASSOCIATE EDITOR

JANUARY
1921
No. 9

Eliminating Danger from X-Ray Machines

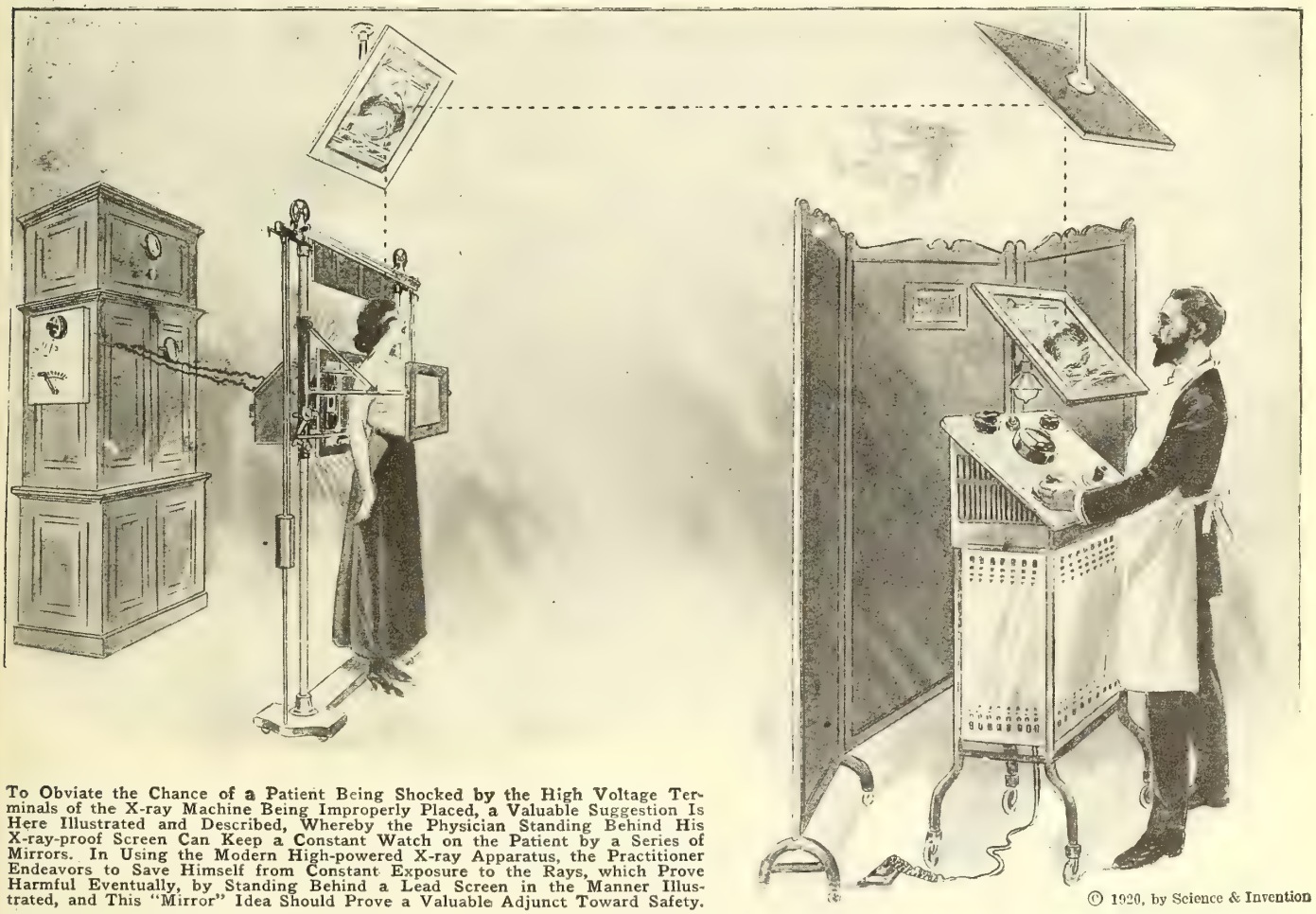
IN the old days of the X-ray, when induction-coils were used before the advent of the modern high powered machines, which invariably use alternating current high-voltage transformers instead of such induction coils, there was very little chance of a patient being electrocuted or killed, even if a wire had come near enough to the body to permit a spark to jump. This was due to the fact that the spark discharge, even from large induction coils, is of such a peculiar nature that rarely, if ever, has it proven fatal to human life.

The writer knows of one case where an electrician was testing a large spark coil capable of giving an 8-inch discharge, when the primary was accidentally closed, while the inspector's head was approximately between the two discharge balls, with the consequence that a spark jumped from each ball to his head with only a momentary, altho severe shocking effect.

Recently a patient was electrocuted in the office of a physician at Newark, N. J., while the physician's son-in-law, who claimed to be an expert in the operation of the X-ray machine, was in the act of taking skiagraphs of the patient's jaw and teeth. The coroner finally came to the conclusion that it was not the fault of the doctor or his assistant that the patient succumbed, even tho a part of the electrical wires or X-ray tube stand had come close enough to the body to admit of a spark jumping to the patient's body, and causing his death,—but that the patient whose medical history was known, suffered from a weak heart, gastritis, and other ailments conducive to a weak condition of the cardiac system.

The accompanying illustration shows an idea suggested by Mr. H. Gernsback, employing a system of mirrors. The first or viewing mirror, is placed directly over the patient, so that the X-ray operative can at all times note just what is going on all around the patient's body and be sure that the wires connecting to the X-ray tube and other parts of the machine are sufficiently distant from the body, and that no sparking takes place, which may indicate the improper arrangement of the apparatus.

As in the case of the Newark physician where the fatality occurred, it is the usual practise for those owning a large size and extremely powerful X-ray machine, to step behind a lead screen as here shown in order to protect themselves from the X-rays as much as possible, owing to their frequent daily exposure to the rays which eventually are liable to prove harmful. These screens are invariably fitted with a small lead-glass window which cuts off the X-rays.



To Obviate the Chance of a Patient Being Shocked by the High Voltage Terminals of the X-ray Machine Being Improperly Placed, a Valuable Suggestion Is Here Illustrated and Described, Whereby the Physician Standing Behind His X-ray-proof Screen Can Keep a Constant Watch on the Patient by a Series of Mirrors. In Using the Modern High-powered X-ray Apparatus, the Practitioner Endeavors to Save Himself from Constant Exposure to the Rays, which Prove Harmful Eventually, by Standing Behind a Lead Screen in the Manner Illustrated, and This "Mirror" Idea Should Prove a Valuable Adjunct Toward Safety.

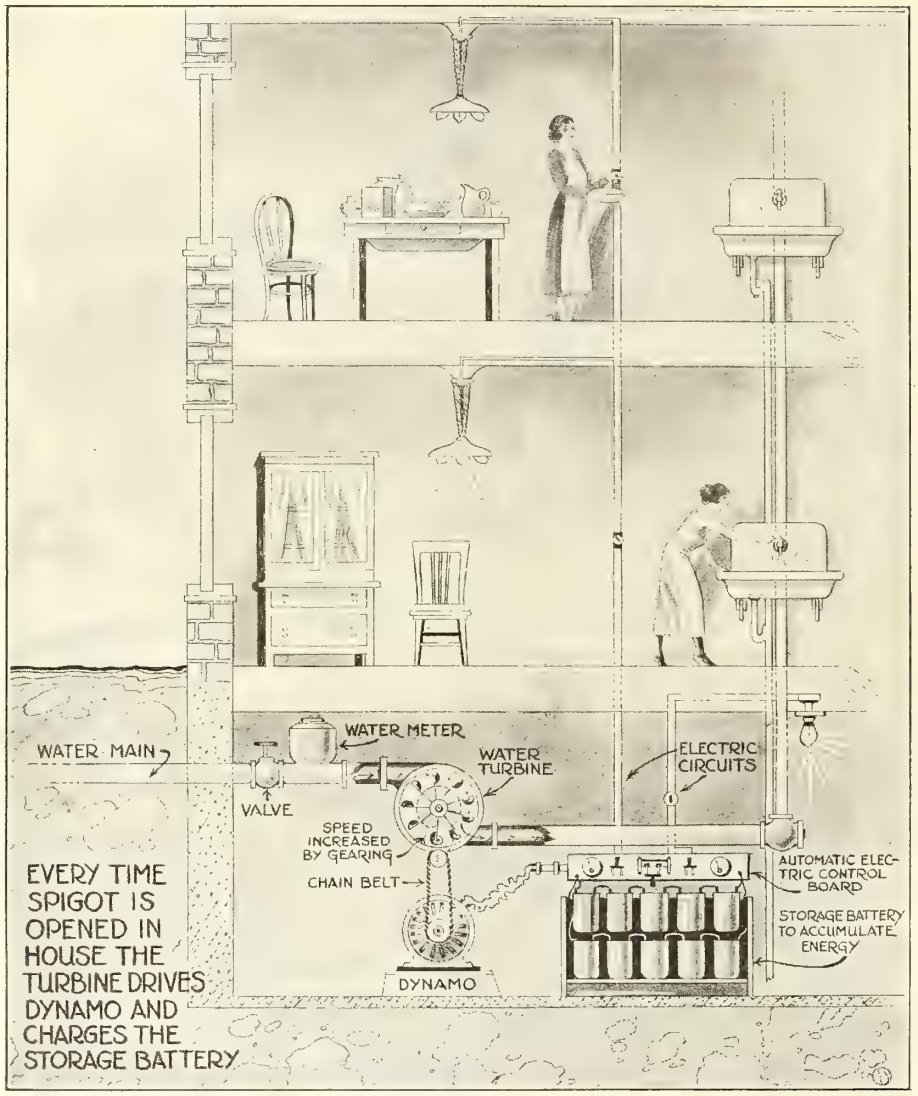
© 1920, by Science & Invention

Electric Lights From Spigots

EVERY house with its own electric generating installation is the dream which M. E. Colardeau, French scientist, expounded before the French Academy of Sciences recently. "We Waste Too Much Energy," was his text, and he proceeded to show how scandalous was *waste*.

Wind power was wasted wholesale, but even more culpable was the waste of waterpower within one's own house. "The force of every kitchen and bathroom tap is wasted," he declared, and he put forward a scheme which he believes can be made practicable to utilize the force from the water that runs from every kitchen tap, which Paris derives from a reservoir 200 feet above the city.

This is where M. Colardeau's invention comes in. In his own house he has fixt on his supply pipe a high speed water turbine, geared directly to a dynamo, with a little battery of accumulators or storage battery. Every time that the taps are turned on the little generating station works and the batteries accumulate the energy from the water. With his own installation the scientist claims he can light 1 500-candlepower lamp, or 20 lamps of from 15 to 20-candlepower.



A French Scientist Has Successfully Tried Out and Demonstrated in His Own House That It Is Possible to Operate Your Electric Lights at No Cost Whatever, Providing You Have City Water or Water Under Pressure Distributed Thru Spigots in the Usual Manner. This Scientist Has Fitted a High-Speed Water Turbine on His Water Supply Pipe, in a Manner Like That Shown Above—This Turbine Drives a Dynamo Which Charges a Storage Battery. It Is Simply Utilizing Energy Wasted Every Day, Declares This Genius.

Our illustration herewith shows a home-generating plant installed in a building housing several families. To take advantage of the various spigot openings when in use at different times, the water turbine is placed in the cellar near to the water meter. The turbine is geared up to the main driving shaft, which is connected mechanically to the dynamo with a link belt or chain. Automatic cut-outs or circuit breakers open the dynamo circuit whenever the speed and consequently the voltage of the latter fall below that necessary to pass current into the battery.

In his house he uses no other installation, and it never gives out and never costs him anything. In the country places M. Colardeau would use the wind to pump water up to the required heights, and so transfer the wind energy into water energy, which would be transformed into electric energy.

"When we've done that," he concluded, "we needn't any longer worry about the exhaustion of our coal stocks."

Helium

By John T. Bushby

THE recent announcement by the United States Geological Survey of unlimited supplies of helium gas in the vast oil reservoirs of Texas, does not surprise the devotees of science, simply because the phenomenal of yesterday is the commonplace of today. Coupled with this, the statement of Professor McLennan, the distinguished Canadian scientist, on the floor of the House of Commons, Ottawa, a few weeks ago, excited little comment when he said that the city of Calgary alone has been wasting fifty million dollars' worth of helium daily during the war, along with its natural gases.

The Canadian West is remarkably prolific in natural gas. A few years ago Rudyard Kipling, while on a visit to the town of Medicine Hat, called it "the city that was born lucky," because natural gas produced all the heat, light and power in the place, including that used in the big central machine shops of the Canadian Pacific railway. Every street lamp in town was lit by natural gas which burned all day because it was cheaper to keep the lamps lit, than to pay for matches to relight them. Thus the quantity of mixed helium that went up the flue will never be known. More inefficiency.

The economic value of helium centers in the fact that it is the ideal gas for dirigible air-ships. It is slightly heavier than hydrogen, but unlike hydrogen it is absolutely non-inflammable, *ergo* had the big Goodyear dirigible been filled with helium instead of hydrogen, the recent appalling holocaust in Chicago would have been averted.

The spectrum of helium was observed not only in the sun, but also in many of the stars; and in some classes of stars now known as helium stars the spectrum of helium predominates. Helium, which was named by Lockyer, has a well marked complex spectrum of bright lines, of which the most noticeable is a bright yellow line close to the minutely separated sodium lines.

No evidence of the existence of helium on earth was discovered until 1895. Hillebrande of the U. S. Geological Survey no doubt found it on analysis of radio-active rocks found near Glastonbury, Conn. He thought it was nitrogen, altho it differed in behavior from ordinary nitrogen. The mineral clevite gave off large quantities of gas when heated or dissolved. Ramsay procured some of this mineral in order to see if it might be argon, which he had previously discovered. On examination of the gas liberated from clevite into a vacuum tube, he found a spectrum entirely different from argon. The spectrum was carefully examined by Lockyer and found to be identical with that of the element helium, previously observed by him in the sun.

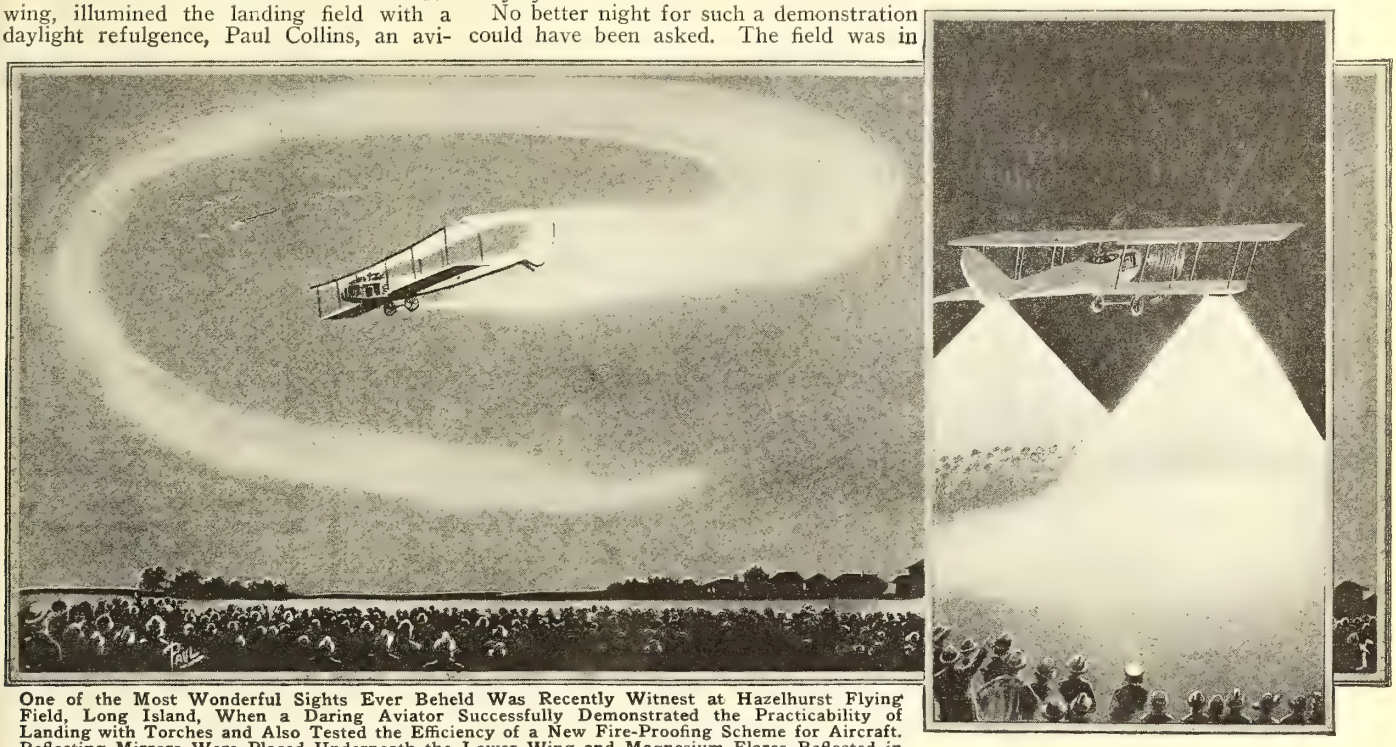
Thus, after a lapse of 27 years since its discovery in the sun, helium had at last been found to exist on the earth. Ramsay and Soddy, in 1903 discovered that helium seems to be continuously produced from radium and other radio-active substances; but this phase includes a literature of its own, too extensive for description here. Suffice to say, that two more elements, coronium and nebulum, are known to exist in the sun, which have not yet been found on earth. But there are gaps in Mendelejeff's table of periodicity waiting for the computation of their atomic weights.

Who will be the lucky prospector to locate them? Perhaps some electrical experimenter or radio bug, tinkering in garret or woodshed, and now unknown to fame!

Torch-Lit Plane Lands at Night

WINGING his way to earth from a height of 5,000 feet in an airplane ablaze with flaming torches, which, reflecting on a series of mirrors attached to the under wing, illumined the landing field with a daylight refulgence, Paul Collins, an aviator, thrilled a crowd of spectators at Hazelhurst Field, near Garden City, N. Y., recently when he demonstrated the practicability of landing in the darkness and of fireproofing aircraft. In the glide to the ground the swiftly moving plane resembled a comet with its long-drawn-out tail of fire. The plane used in the test was a Curtiss, to which had been attached more than a dozen reflecting mirrors underneath the lower wing. On the tips of the wings magnesium flares had been placed connected to the pilot's seat by electric wire, by which they were set off. On other parts of the airplane torches such as are used on Fourth of July were tied.

No better night for such a demonstration could have been asked. The field was in total darkness when Collins "took off" with only his green and red head and tail lights showing. Ascending to a height of about a 1,000 feet, when the sight of the plane was lost to the spectators in the darkness, Collins touched off the torches on either side of the fuselage. In an instant the whole plane was bathed in a flood of fire, and residents of Garden City, who during the war had frequently seen ill-fated aviators falling in a mass of flames when the wings took fire, must have thought that a recurrence of that type of accident had happened. Around and around the plane sped at a rate of eighty miles an hour, ascending until a height of 5,000 feet was reached. In the upward and onward flight the flaming tail seemed to be at least a hundred feet long. When at a height of about 1,000 feet he touched off the magnesium torches which reflected on the mirrors. The whole field, hitherto dark, became as broad daylight. An examination of the wing fabric and woodwork of the airplane showed that it was none the worse for having been subjected to the fire from the flares.



One of the Most Wonderful Sights Ever Beheld Was Recently Witnest at Hazelhurst Flying Field, Long Island, When a Daring Aviator Successfully Demonstrated the Practicability of Landing with Torches and Also Tested the Efficiency of a New Fire-Proofing Scheme for Aircraft. Reflecting Mirrors Were Placed Underneath the Lower Wing and Magnesium Flares Reflected in the Mirrors When These Were Lighted; These Flares Illuminated the Whole Field Which Became as Bright as in Broad Daylight.

Wonders of "Jack Frost"

By JEROME LACHENBRUCH

WHEN you rise, shivering, on a cold winter morning and your window panes are covered with frost, do you ever stop to think of the wondrous beauty that has come to your room during the night?

If your eyes had the magnifying power of the common house fly, you would see a variety of designs on your window that would startle you with the exquisiteness of their forms. Frost crystals may take various forms. The most common is that of the fern leaf, which it resembles not only in shape, but also with a suggestion of texture. Sometimes, frost crystals form in imitation of the animal kingdom, when they shape themselves in a series of intertwined ostrich feathers. And again, they may follow the suggestion of the ocean world by taking the form of a fan-shaped coral.

The accompanying photographs were taken under a microscope and have been transferred by a unique process to the motion picture screen. They will be shown in educational and other institutions thruout the United States.—*Courtesy Bray Studios.*



1 2 3

Some True Wonders of "Jack Frost": Illustration at Left Shows Frost on Window Pane Resembling Intertwined Ostrich Feathers. Again Jack Frost May Follow the Suggestion of the Animal Kingdom by Taking the Form of a Fan-Shaped Coral (Center). The Most Common Frost Design Found on Window Panes Is That of the Fern Leaf Shown Very Beautifully at Right.

A Fairyland of Bubbles

By JOSEPH H. KRAUS

PROBABLY there is no one who has ever played with soap bubbles who has not often wondered at the beautiful colors and entrancing effects obtained by these soap films. Incidentally, each one of us has felt a desire, during some period of such experimentation, to obtain a permanent film which would preserve for us the gorgeous effects so often noted.

Many of us have also been present at lectures in which the operator dexterously manipulated soap films so as to present to us spectacular effects which we had never dreamt of. Wire frames immersed in soap solutions produce the most fantastic and unique impressions. The writer has experimented with films of this nature for quite a time, the object being to produce a film which when formed, would last indefinitely.

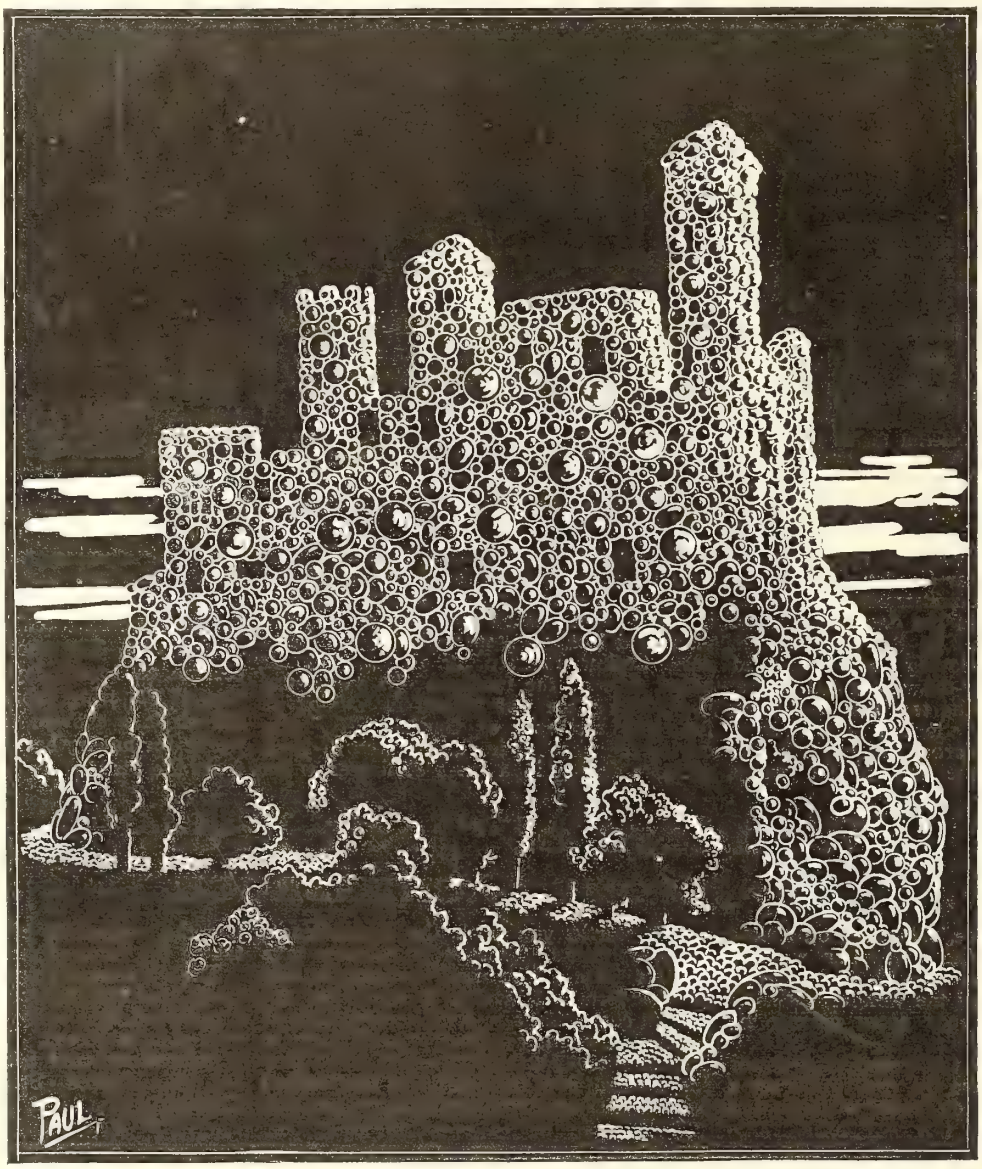
At first, the experiments were rather discouraging, but finally the film was floated on water so that the delicate tissue could be lifted up on a wire frame. Here, after allowing it to stand for one week, it developed the most exquisite refraction effects imaginable, and the interference colors developed seemed to improve even upon Nature.

Making the Solution

This effect can readily be produced with a little care by any experimenter in the following simple manner: Three ounces of amyl acetate are purchased from the local druggist and placed in a four-ounce vial. Ordinary celluloid which may be obtained by immersing pieces of camera film in boiling hot water to remove the emulsion, is then cut up into narrow strips and introduced into the vial, until the height of the liquid therein comes up to the neck of the bottle.

It is allowed to stand for twenty-four hours at room temperature with the bottle corked and then the supernatant liquid which is of quite a heavy consistency is poured into another bottle and is ready for use. The mode of procedure is to make a loop or circle three inches across by twisting a piece of copper wire together, leaving about eight inches of wire to act as a handle. This handle is then bent into such a shape that it will not interfere with the removal of the film.

A good way to do this is to place the circle upon a table and bend the handle downward over the edge of the table. This curve is then changed by twisting it outward and then upward as shown in our diagram. The wire circle is afterward immersed in a bowl of water and a single drop of the amyl acetate and celluloid solution is allowed to fall into the water; the drop instantly spreads over the surface of the water and forms a film and floats on the water. It will be seen that at first very pretty iridescent colors form near the edge of the film. These colors gradually spread, which spreading can be forced by blowing at the surface of the film.



Altho It May Sound Quite Impossible, a Wonderful Castle Such as the One Here Shown, May Be Constructed Entirely of Permanent, Colored Soap Bubbles After the Manner Described in the Accompanying Text. The Art of Blowing Permanent Soap Bubbles Which Will Last a Year or More, Opens Up an Entirely New Field of Experimentation for Those Interested in Scientific Matters. By Flashing Colored Lights on to the Bubble Structure, Either from Behind or in Front, Very Beautiful Effects Are Readily Produced.

Removing the Bubble Films

After a short period, the surface becomes serrated and the serrations become more prominent as the experiment proceeds. Finally, when the largest of these serrations has become about one-half an inch long, the wire frame is centered under the film and lifted carefully, in this way removing the film intact.

It will be found quite difficult to succeed at first, and it is best to start with smaller frames, but after a while quite large films can be removed without difficulty. These are suspended in some location free of dust and within a week the film will develop a very interesting interference effect which can be projected thru an ordinary stereopticon upon the screen.

The tension of this film can be demonstrated by the fact that if the blunt end of a pencil is held in an upright position in contact with the film, considerable force will be required to puncture the surface, the film easily taking care of the weight of the pencil, and not allowing it to penetrate unless prest upon.

Another way of demonstrating the tension of the film is to tie a piece of thread to the wire circle. The free end of the thread is tied into a loop about an inch across. The thread is held out of the water and the film is produced as just described. Then the loop on the thread is placed upon the floating film. The film is lifted as described and a hole is punctured thru the center of the loop; the loop flies open into a perfect circle and the tension of the film is demonstrated.

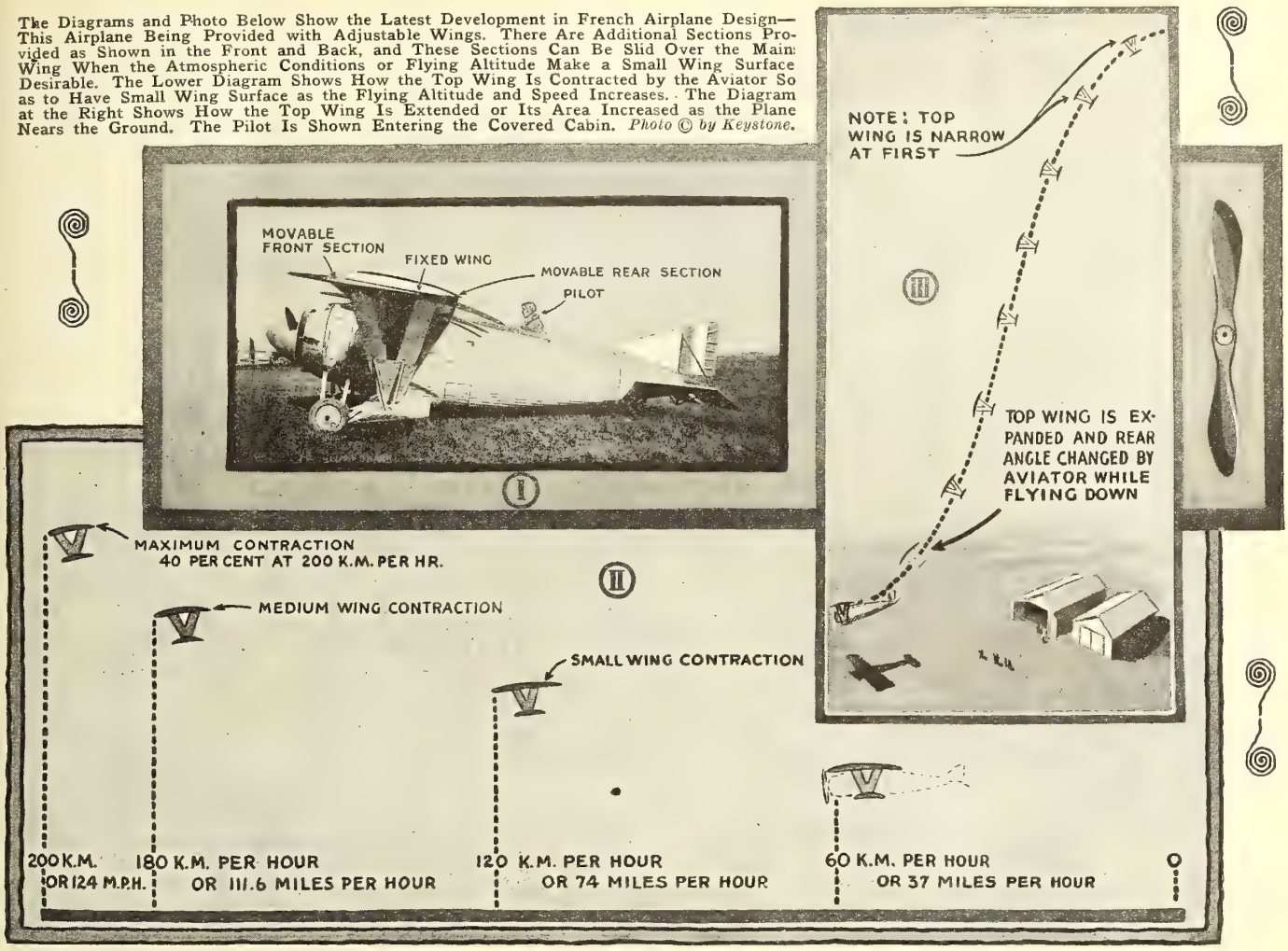
A hole punctured in the film with a sharp needle also gives a very clever demonstration of the film tension. So much for films of this nature, which must, of course, be made in the flat form altho they are capable of assisting in the regular experiments in surface tension. It has been found that a film of this form, if sprinkled with lycopodium or some other light powder, will show definite zones whenever a musical instrument is played in its vicinity, giving a Chladin plate effect. These areas are differently marked with each sound.

Now we come to the more difficult object,

(*Continued on page* 1024)

Airplane Varies Wing Spread in Flight

The Diagrams and Photo Below Show the Latest Development in French Airplane Design—This Airplane Being Provided with Adjustable Wings. There Are Additional Sections Provided as Shown in the Front and Back, and These Sections Can Be Slid Over the Main Wing When the Atmospheric Conditions or Flying Altitude Make a Small Wing Surface Desirable. The Lower Diagram Shows How the Top Wing Is Contracted by the Aviator So as to Have Small Wing Surface as the Flying Altitude and Speed Increases. The Diagram at the Right Shows How the Top Wing Is Extended or Its Area Increased as the Plane Nears the Ground. The Pilot Is Shown Entering the Covered Cabin. *Photo © by Keystone.*



BEFORE the Military Commission at Etamps (France) a successful demonstration was recently made with an airplane of which the wing surface can be increased or diminished during flight and the speed proportionately varied. The plane was designed by Levavasseur and Gastambode and flown by the aviator, Grandjean, after whose demonstration of its capabilities it was officially accepted by the commission.

The machine is a 250-horse power biplane in which a new mechanism enables the pilot to vary the wing surface from thirty to fifty square meters and alter his speed from 60 to 200 kilometers an hour. The surface variation is made in the upper plane, which is constructed in three parts. One of these is fixt, but the two others are movable, one gliding forward and the other backward. The centre of pressure is kept invariable by giving the forward and rear wings a different displacement.

The pilot starting out with the wings at full stretch rose to a considerable height. Then wishing to increase his speed he began contracting the wings' surface. The operation took about a minute, during which time the plane gathered speed until it was flying at 200 kilometers an hour.

When he wished to land, the airman again increased the surface and glided down gently at 60 kilometers an hour and made a perfect landing. The arrangement of the rear wing of the upper plane enables the pilot, at the same time as he expands it, to alter the curvature or angle at which it is set and so present a greater or less resistance to the air. The landing, under the circumstances, resembles almost exactly that of a bird, which at the same time that it decreases the speed bends its wings to a different angle to break the force with which it touches the ground.

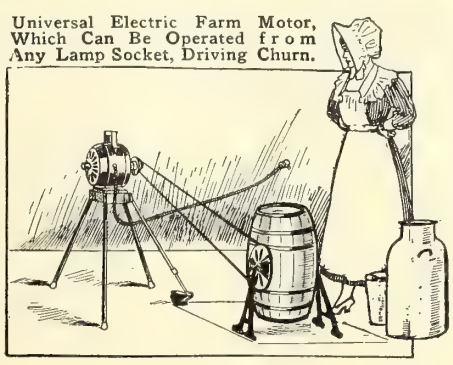
Military experts who saw the exhibition declare themselves well satisfied that a great step is made by the invention toward securing safety in the landing of an airplane which can at the same time be capable of great speed. The mechanism is both simple and strong and the trials carried out showed not the slightest fault.

Universal Electric Farm Motor

Wherever electric central station lines are extended into rural districts or private lighting plants are installed, there is felt an immediate need for a small portable motor which may be available for operating the miscellaneous light machinery always to be found about the country home and farm.

The small electric motor here illustrated is furnisht especially for this apparatus and is supplied to operate on 60-cycle, single phase, 110 volt or other potential, circuits from central station service, or else 32 volt direct current service as supplied by the average farm lighting plant, driven by water-wheel or gasoline engine.

Universal Electric Farm Motor, Which Can Be Operated from Any Lamp Socket, Driving Churn.



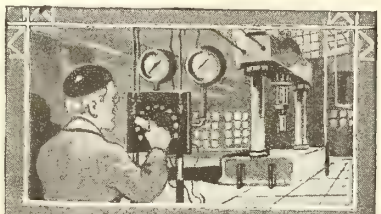
The motor is mounted on a steel tripod base provided with a brace rod and clamp for maintenance of proper belt tension. The motor is equipt with a back gear which reduces the pulley speed to 285 r.p.m., a speed suitable for driving the butter-churn, washing machine, grind-stone, pump and other devices of this class without making it necessary to equip them with pulleys of large and small diameter, which of course entails considerable complication where a small motor only is used for operating the machine.

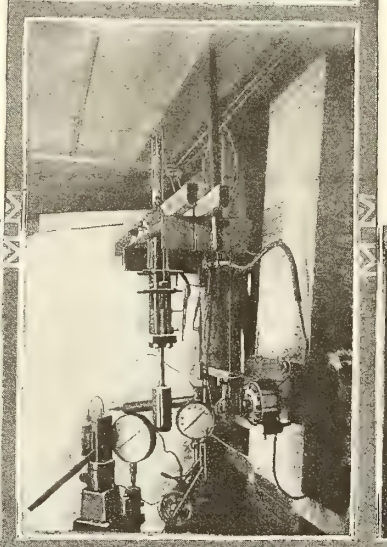
A third special pulley is supplied as shown, with two spaces for round belts and one for flat belts.

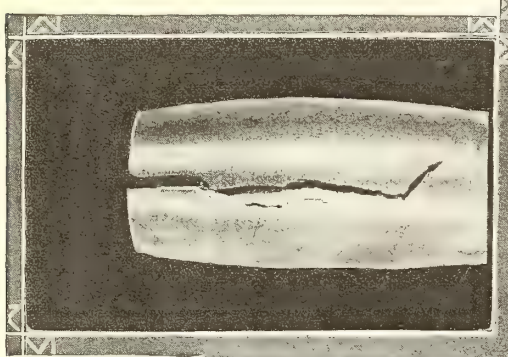
Wonderful Experiments in High Pressure

As rate of motion is specified as distance covered in a unit of time, pressure is usually rated in weight per unit area. This brings about very curious results. If the blades of two penknives are crossed with the edges at right angles, the area of contact is so extremely small that a few pounds pressure produces an enormous rate of pressure figured at pounds per square inch. This of course is only a striking way of illustrating high pressure.

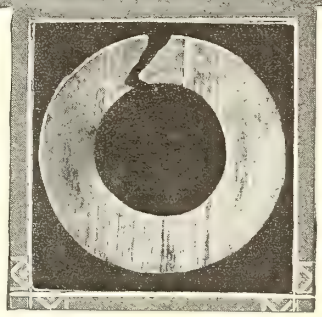
Recent investigations into high pressure by Dr. P. W. Bridgman have led to some of the most interesting results; and such experiments are being carried on in the Jefferson Physical Laboratory of Harvard University.





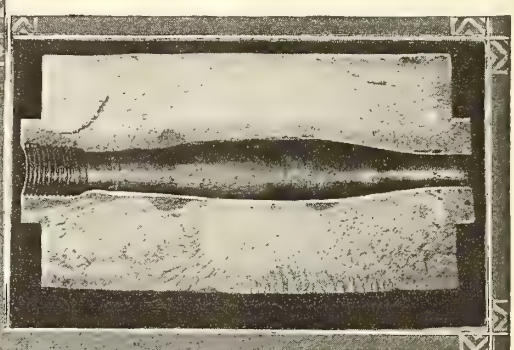


Half a Million Pounds Pressure per Square Inch Results in Strains in Metals Never Before Realized. Photo Above Shows a Cylinder Cracked by High Internal Pressure.



Cross-section of Shell Ruptured by the Application of High Internal Pressure. The Inner Hole Was Stretched from ½" to 1⅜".

View of One of the High-Pressure Cylinders, Gages and Other Paraphernalia Used in the Jefferson Physical Laboratory at Harvard University by Dr. P. W. Bridgman. In the Famous High Pressure Experiments Conducted by Dr. Bridgman, Pressures Were Carried Up to Ten Times the Firing Pressure of Smokeless Powder in Large Guns; in Other Words, Pressures of 300,000 Pounds per Sq. In. Were Obtained, and New Kinds of Ice Heavier Than Water Were Discovered.



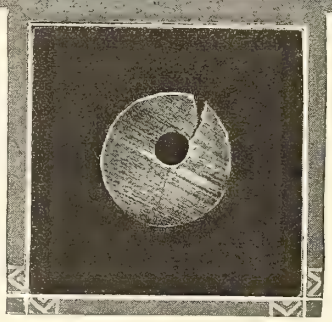


Photo Above Shows One of the Halves of a Cylinder of Tool Steel Split by the Application of High Internal Pressure. The Inner Hole Was Stretched from 1/2" to 1 1/5". The Maximum Pressure Withstood Was 30,000 Atmos.

Section Cut from a Copper Cylinder Split by the Action of High Pressure.

In the Bridgman experiments pressures were carried up to ten times the firing pressure of smokeless powder in large guns. A pressure of 20,000 atmospheres, or in round numbers 300,000 pounds to the square inch, or 150 tons, was attained; this represents the pressure which would be exerted at the bottom of a body of water 120 miles deep. It would take a column of rock some fifty miles high to exert this pressure on its base.

The pressure was produced in a cylinder provided with a piston packed with packing which grew tighter with the pressure. The piston has to stand a strain of compression and for it the best material was found to be hard tool steel. It was found that it could sustain a pressure of from 600,000 to 750,000 pounds per square inch, a surprisingly high figure. When it came to the cylinder it became a question of tensile strength. It was found that the best treatment was to apply to the unfinished cylinder a higher pressure than it was intended to sustain. This stretched the interior. It was then put on the boring engine and brought to its final diameter. It will be observed this represents the condition attained by a gun over whose inner tube the great hoops and jackets are shrunk on. When a strain is applied to said cylinder by high pressure in its interior, a state of uniform tension approximately is produced thruout the metal of the cylinder. This state is the one which gun constructors strive to reach in the building-up or wire-winding process. Chrome vanadium steel, oil hardened, was found the best for the cylinder.

Most extraordinary results were reached. A cylinder half an inch in internal diameter was stretched to over an inch in diameter before breaking, and the break, when the cylinder was ruptured, started at the outside. Of course the object was to use the cylinders without breaking them, and the stretching and peculiarity of fracture noted are side issues only.

Paraffin Wax More Rigid Than Steel!

Substances ordinarily soft and pliable were found to increase in rigidity under pressure. Paraffin wax at 20,000 atmospheres becomes more rigid than soft steel. A piece of soft steel bedded in paraffin which is made to flow under this pressure will go with the stream and become bent and distorted with the wax now harder than itself.

Soft India rubber becomes so brittle that it ill crack like glass, and becomes harder than soft steel, so that irregularities on its surface can be imprest upon the surface of the metal.

A pressure gage of the simplest possible description, which consisted of a small diameter barrel with a piston moving freely yet fitting tightly, was found to measure high pressure with an accuracy of one-tenth of one per cent. This was treated as a master gage and with it electrical resistance gages were calibrated. Such gages consisted of coils of manganin wire, whose electric resistance changes in proportion to the change in pressure to which it is subjected.

Water Comprest Twenty Per Cent.

Water is generally considered almost incompressible, but under a pressure of 12,000 atmospheres the astonishing decrease of volume of twenty per cent was produced. Certain irregularities in the behavior of the water induced the experimenter to believe that he was sometimes measuring liquid water and sometimes ice. Of course it was not easy to tell what was going on inside of the heavy steel cylinder.

Under these pressures when water freezes to ice it decreases in volume and the pressure falls; and when ice melts to water the volume increases and the pressure rises. Sudden changes of pressure were taken as indicating the formation of ice or of water. For every temperature the pressure at which water freezes becomes different. It is a sort of case of critical temperatures and pressures.

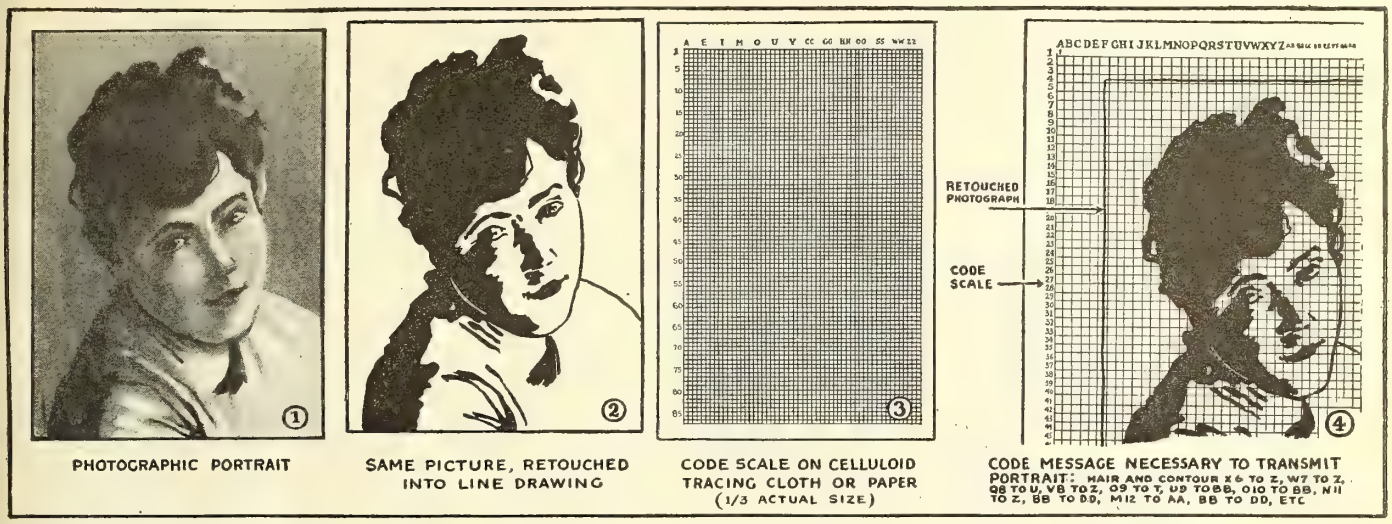
New Kinds of Ice Discovered!

From the work of a previous experimenter, it was known that there are two distinct varieties of ice produced under the condition of high pressure. Two additional ones were found in these last experiments, so that we know of five different kinds of ice, four of them of higher specific gravity than water.

In some cases, on high compression, ice changes into another kind with such suddenness as to suggest an explosion. In other cases, the change would sometimes take hours before its completion; the lower the temperature as a rule, the slower was the change from one ice into the other.

(*Continued on page* 1008)

Telegraphing Photos by Code



The Above Pictures Show Successive Stages in a New Method Evolved for the Transmission of Photographs or Other Pictures by Code, Over Telegraph or Telephone Circuits, as Well as by Radio or Cable. The Original Photograph at Left Was First Retouched or Redrawn So as to Resemble a Line-Cut, as Shown at Fig. 2. A Transparent Code Scale (3) is Then Placed Over the Line Cut as at 4, and the Black and White Portions of the Picture Coded by Noting the Lines Which the Black Portions Intersect.

THERE has been evidenced of late an unusual interest, especially by the lay public, in the frequent reports from Europe that certain inventors, notably Belin and Andersen, have been successful in transmitting pictures over a telegraph or telephone wire.

The Belin system was described at length in the November issue of this journal, and M. Belin is now in this country making preparations for transmitting photographs and drawings, as well as writing, over an ordinary telephone circuit, by means of his rapid transmitting and recording instrument which he has perfected to a high degree.

Before discussing the new Andersen system recently demonstrated in London, by invitation of the London *Daily Express,* which method involves the coding and decoding of a given picture, drawing or script, by means of numbers, let us glance at Fig. 1-A, which shows a highly magnified half-tone picture of a man's head. This represents an enlargement of a plate made for printing in a magazine such as SCIENCE AND INVENTION or any other periodical, and in the original of which the dots constituting the picture were so small, that they could hardly be distinguished by the naked eye.

Now to show the correctness of the dot or point theory of picture construction as employed in the half-tone process, all you have to do is to place this magnified dot picture of the man's face about six feet away, when you will be surprised by the result; the dots all merge into one another in a very mystical way, and yet in a manner well-understood by photo-engravers, to form a natural likeness of the subject.

The numerous inventors who are developing systems for transmission and reproduction of photographs, etc., are almost invariably working along these lines, utilizing the fact that with fairly fine points or dots, or in some cases lines, a satisfactory picture can be reconstructed at the receiving end of the circuit. This fact can be demonstrated in the manner just explained in connection with viewing the cut at Fig. 1-A, at a considerable distance. In the event that the cut should be reconstructed by the receiving instrument or by decoding a cablegram or telegraph message composed of numbers indicating the positions of the various dots, lines, etc., of the original picture in a coarse manner or by large dots, the picture can be suitably reduced so as to give a faithful reproduction of the photo or picture in question.



This Picture of a Man Demonstrates Vividly How Accurately a Picture Can be Constructed, Solely from Black Dots. Hold This Picture at Arm's Length and the Features of the Man Will Begin to Form; Look at It from a Distance of 8 to 10 Feet, and You Will be Astonished at Seeing the Features Fully Developed. Figure 1-A.

Changing Photos to Line Cuts for Transmission by Code

It is reported in a recent dispatch from London that the young Danish inventor, Thorvald Andersen, has devised an entirely new system of transmitting and reproducing photographs over long distances, which system has great promise.

His arrangement of the details, it is said, makes it possible to telegraph, telephone or radio a photograph as far as either of the electrical circuits his system employs may extend, which means, of course, across the ocean, or across the U. S.

The London *Daily Express,* who invited the young Danish inventor to demonstrate his system in England, recently publisht three photographs cabled from Denmark across the North Sea to the London office of that paper. These three pictures were those of King George, Lloyd George and Irene Vanbrugh, the well-known English actress.

A unique feature of this demonstration of the Andersen system was the fact that the three photographs selected by the editor of the London *Daily Express* were picked out from a number of photographs after the inventor had started on the journey from Copenhagen to London, and were transmitted via the Andersen system by his brother in Denmark. When the inventor arrived in London, the three cablegrams in code from his brother awaited him

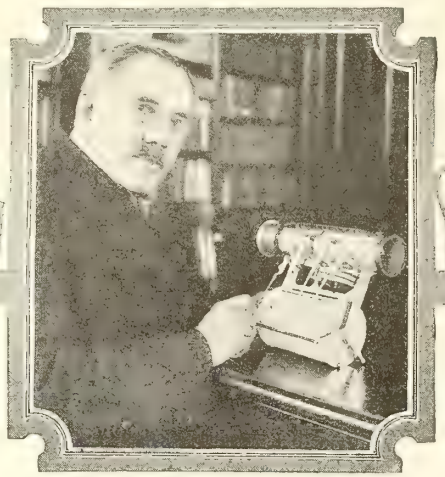
(*Continued on page* 1010)

Science and the Weather Man

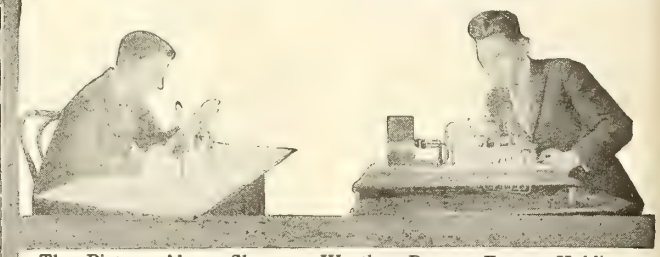
How Rain, Sun and Wind Are Accurately Measured

IN the days of the past and bygone generations our forefathers looked at the weather-cock to determine the direction of the wind, scanned the sky knowingly morning and evening, and exchanged comments as to what their ideas of the weather during the following twenty-four hours would be. Some farmers today still cling to the old-fashioned way of telling the weather by placing a miniature doll's house on their porches and they believe that when the doll in pink appears at the door of the house the weather will be fair, but if the doll in blue should be seen—then rainy weather is in store for us.





Two Important Factors in Forecasting the Weather Scientifically are "Air Pressure" and "Wind Velocity." The Barograph and Anemometer Feel and Record These Quantities. The Four Cups of the Wind Speed Indicator and Recorder Rotate in the Breeze.



The Picture Above Shows a Weather Bureau Expert Holding a Glass Tube Device Known as the "Sunshine Recorder."

At Left: Prof. C. F. Marvin, Chief of the U. S. Weather Bureau, With His New Self-recording Weather Observation Instrument. It Has Been Successfully Tested by Attaching It to a Box Kite.

Photo at Extreme Right Shows Weather-recording Meteorograph or Triple Register, Which Electrically Records the Direction and Velocity of the Wind, the Amount of Rainfall and the Sunshine.

The United States Weather Bureau was founded by a resolution approved February 9, 1870. Today there are 200 branches of the Weather Bureau in the United States. Besides these there are 4,500 cooperating stations. Every main branch of the Weather Bureau is supposed to be able to predict for an area of 1,500 square miles.

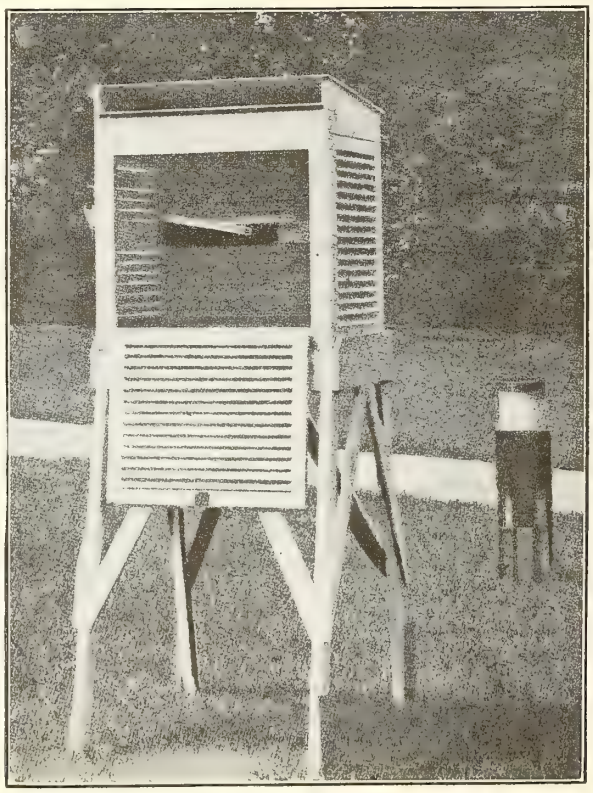
Variations in the pressure of the atmosphere are recorded by the barographs, highly accurate instruments placed in the office of the Weather Bureau. The automatic instruments are so arranged that they mechanically register in the Weather Bureau below the roof. The visual readings are taken twice in every twenty-four hours, at 8 o'clock in the morning and at 8 at night.

Temperature, pressure of air, precipitation, direction of wind, current, wind velocity, clouds and maximum and minimum temperatures are factors which go toward making up the day's weather report.

Measuring Temperature and Where to Place Thermometers

As specified in the publications giving instruction for official weather-observing conditions, thermometers in meteorological stations must, whenever possible, be placed in a perfectly open space where the circulation of air is entirely unobstructed. It will not do, however, to place the thermometers simply in the open air, exposed freely to the sky and to the direct rays of the sun. The sunshine would cause the thermometers to register too high, and even if not exposed directly to the sun, it could not be depended upon to register the true air temperature either day or night.

To overcome these difficulties, the Weather Bureau experts or those contemplating taking scientific weather observations, employ for the purpose a special *thermometer shelter* or housing, constructed in the fashion shown in one of the accompanying illustrations. This shelter comprises a box with slatted or louvered sides, constructed in such a manner that the air can move thru all sides with the greatest possible freedom. The object of this shelter is to screen off the direct and reflected sunshine and the radiation to and from the sky, as well as to keep the thermometers dry.



Approved Style of Housing, Provided With Venetian Blinds, for Supporting the Maximum and Minimum Official Thermometers. The Instrument in the Background Is a Standard Type Rain Gage.

The thermometer shelter should be placed in the open air on a house top where the circulation of air is as free as possible. When it cannot be placed on the top of the building it may be placed on the north side of the building. The building itself should be free from vibration so as not to interfere with the readings of the thermometer.

In one of the accompanying photographs, a rain gage of a simple type is shown just behind the thermometer shelter. In actual practise, the rain gage should be placed at least fifteen to twenty feet away from the shelter and in the open. In all cases, the position of the thermometer house must be such that the door opens to the *north*. Maximum and minimum thermometers are generally placed in the shelter.

The highest and lowest temperatures since the preceding readings are taken by *maximum* and *minimum* thermometers exposed in shuttered shelters on the roof. One curious fact which the weather man points out is that a person rarely feels as hot as the day really is. Usually there is between 10 and 15 degrees difference in the actual and sensible, or human body's temperature. Only in time of heavy fog or storm is it the same.

To measure wind velocity, a rotating windmill-like instrument called the *anemometer* is spun by the wind—the higher the wind velocity, the faster the instrument spins. This self-registers so as to make a continuous automatic record of the wind, showing the rate and time of occurrence of all winds. A *thermograph* writes the temperatures unceasingly by clock time, and the moisture is measured by the hygrograph.

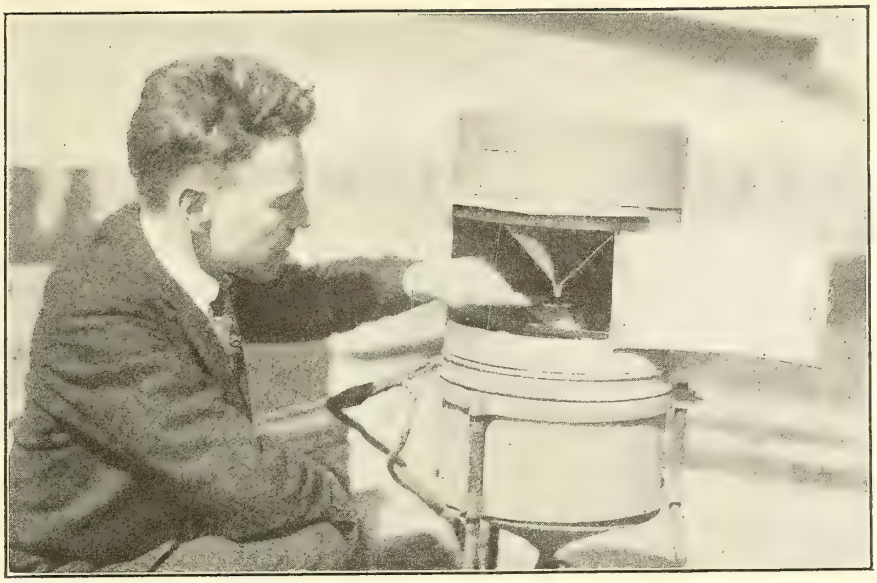
Perhaps the most important piece of scientific machinery in Uncle Sam's weather bureau outfit is the meteorograph or triple register. Three things are recorded on this scientific invention, the direction and velocity of the wind, the rain and sunshine.

Recording Sunshine

Sunshine is the last element which enters into the weather report. It may be noted by the naked eye, but for fear the weather man might err, a *sunshine recorder* has been devised. The sunshine recorder comprises a glass bulb partly filled with mercury and exposed to the sun in

such a manner that the light rays are registered by the electrical wires which extend from the sunshine recorder on the roof to the meteorograph or triple register in the office below.

Therefore the weather prophet reads his various barometers, thermometers, hygrometers and anemometers and takes the figures from them all. These he uses in his semi-daily computations, and by comparing them, by noting just what the wind, rain and sunshine have been doing for the last 12 hours, he can forecast the weather for his vicinity for the next 12 hours, even for a longer period, once he has received the telegraphic reports from other communities of weather conditions.



This Tipping Bucket Rain Gage—as the Delicately Balanced Bucket Shown at the End of the Operator's Finger Periodically Fills and Empties, Causes a Record to be Made on a Recording Drum. The Bucket Tips in One Direction or the Other, When Filled With a Quantity of Water Representing .01 Inch of Rainfall.

Details of the Simplest "Rain Gage"

The standard rain gage of the simplest form consists of the following parts: the receiver A; the overflow attachment B and the measuring tube C. The top cylindrical portion of the receiver, marked *a* in the figure, is exactly 8 inches in diameter, inside, and is provided with a funnel-shaped bottom, which conducts all the rain caught in the receiver into the tall, cylindrical measuring tube C, the total height of which, inside, is exactly 20 inches. The diameter of this tube is much smaller than the large receiving tube *a*, being only 2.53 inches. In consequence of this a small amount of rain falling into the receiver and flowing into C, fills the latter to a depth *greater* than the actual rainfall, in proportion as the area of the receiver is greater than the area of the measuring tube. In the standard gages of the U. S. Weather Bureau, the depth of the rainfall, in accordance with this principle, is *magnified just 10 (ten) times.* The receiver A has a sleeve, *d* (see figure) which slips over the tube, C, and very effectually prevents any loss of rainfall. Again, when the rainfall is very heavy the tube C may overflow. In this case, to prevent loss, an opening, shown at *e,* (see below) is made in the sleeve *d* just on a level with the top of the tube C. The excess of rainfall escapes thru this opening, and is retained in the large overflow attachment, B, and can be measured afterward, as will be described later. The opening *e* is omitted in the latest forms of gages, as the water easily flows between the sleeve and the tube C, which fit each other loosely. The inside diameter of the overflow attachment is just 8 inches, and this portion of the instrument can be used as a snow gage, as will be explained hereafter.

How Rainfall and Snowfall Are Measured

Rudyard Kipling in his story of the flooded mine, called "At Twenty-Two," states that an inch of water on an acre of ground weighs one hundred tons. This, like most of Kipling's technical points in his stories, is substantially correct, giving a character of accuracy to his imaginative topic.

Rainfall.—The *measuring stick* of the rain gage is graduated into *inches* and *tenths* of inches. Remembering that the actual depth of the rainfall is *magnified ten times,* as explained above, it is plain that if we find the water 10 inches deep in the measuring tube, then the actual rainfall must have been only 1 *inch;* or if the water in the tube is only one-tenth inch (or written as a decimal, 0.1 inch), then the rainfall must have been only one-hundredth inch (or written as a decimal, 0.01 inch).

The depth of the water is measured by inserting the measuring stick into the gage thru the small hole in the funnel. When the stick reaches the bottom of the measuring tube, it should be held there for one or two seconds, and then quickly withdrawn and examined to see at what division of the graduation the top of the wet portion comes. The numbering of this division, as stamped on the stick, gives, as has just been explained, the actual depth of rainfall, and in making out records and reports observers always use the decimal expressions.

After measuring and recording in this way the precipitation found in the gage, the top should be removed, the measuring tube should be emptied and drained, and the gage put in position again.

Snowfall.—During the winter season, especially in those climates where the precipitation is nearly all in the form of snow, the overflow attachment only of the rain gage should be exposed in the support as a *snow gage.* The receiver and measuring tube are taken out, as these parts cannot be used for measuring snow, and even if rain should occur it is very apt to be frozen while in the measuring tube, generally bursting it and rendering it worthless or highly inaccurate.

The first method for measuring snow is as follows: The snowfall collected in the overflow attachment is measured after placing the vessel in a warm room until the snow is *melted. The water is then carefully poured into the measuring tube, and measured just as tho it were rainfall.*

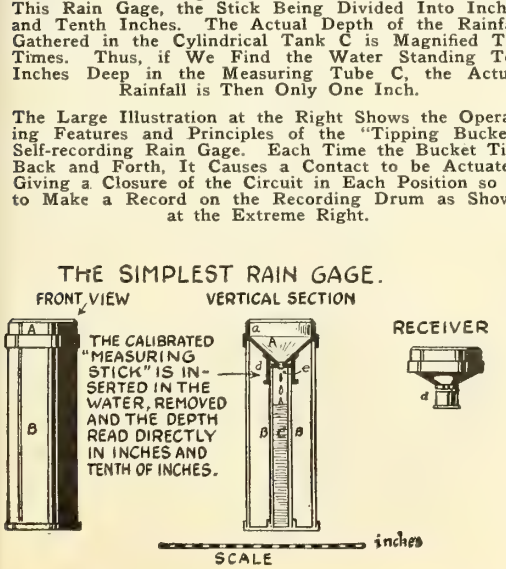
The Tipping Bucket Rain Gage, with Automatic Recorder

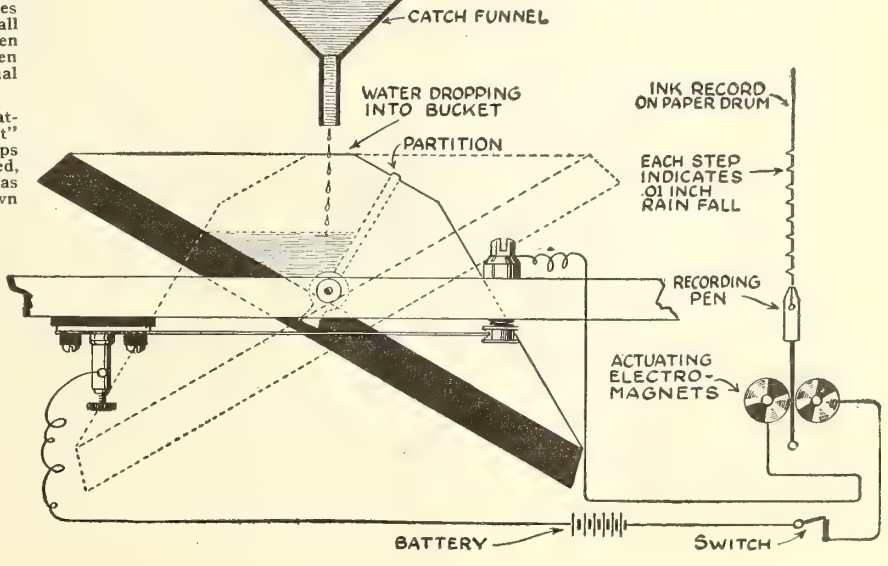
The top section of this gage, called the receiver or collector, is made of a sharp-edged brass rim, 12 inches in diameter, inside, and provided with a funnel-shaped

(*Continued on page* 1012)

The Simplest Rain Gage is Shown in the Illustration Below. A Measuring Stick is Used in Connection With This Rain Gage, the Stick Being Divided Into Inches and Tenth Inches. The Actual Depth of the Rainfall Gathered in the Cylindrical Tank C is Magnified Ten Times. Thus, if We Find the Water Standing Ten Inches Deep in the Measuring Tube C, the Actual Rainfall is Then Only One Inch.

The Large Illustration at the Right Shows the Operating Features and Principles of the "Tipping Bucket" Self-recording Rain Gage. Each Time the Bucket Tips Back and Forth, It Causes a Contact to be Actuated, Giving a Closure of the Circuit in Each Position so as to Make a Record on the Recording Drum as Shown at the Extreme Right.





Snow and Ice Melters

By H. GERNSBACK

WE know that every year our cities lying in the northern latitudes will be covered with snow and ice as regularly as clock work. For every "open" winter there are at least nine that are far from "open," and every once in a while when one or more good-sized blizzards visit our large centers traffic comes to a halt for days and sometimes for weeks. Shoveling the snow away —an archaic and antiquated method—helps but little. This was shown again forcefully last year in New York, where the snow could not be removed fast enough, and the puny efforts that were made only served to pack the snow down more and more until it finally turned to ice. This of course stopt all street railway traffic effectively, and as a matter of fact the street cars in New York were out of commission for the longest term in the history of the city, for they did not run in some instances for two months. This condition was created mostly by snow turning into ice and packing down on the level of the street for several inches, burying the rails entirely. Whatever traffic there was jogged along at a snail's pace because the unevenness of the packed ice made it dangerous for any vehicle to go at a fast pace.

This year the city administration will try military tank snow removers, but it is not quite clear how these will remove ice once it is packed down. They probably will remove snow if they start in immediately while the snow is still falling, and providing there are enough tanks in use to keep the streets open. If not, the tanks will fail just as ignominiously as did the street cleaners with their ridiculous shovels.

What we need is simply an imitation of nature. In the end the streets are always cleared well by nature due to thaw and warm weather. It is the only effective method of clearing away snow and ice, and if we cannot, have a natural thaw, we can at least have it an artificial one.

The writer proposes several methods, all of which have been tried in an experimental way, if not under actual conditions. There is no reason why any of these ideas cannot be used, not only by our traction companies, but by any city government which wishes to clear the streets of snow and ice, even tho there are no street cars on the streets in question; in this instance the apparatus would of course have to be mounted on some sort of vehicle, and not all the methods shown in our illustrations could be used.

One of the most effective means to clear not only snow but the more difficult ice is depicted in Fig. 1. Probably the hottest source of heat we have at our disposal and which can be used economically on any street car is the electric arc. Our illustration, as well as our front cover, shows how it can be used to dig any street car line out of its difficulties no matter how thick the ice.

On the front of the car as shown is rigged a sort of fender which carries a number of arc lights all pointing downward. They reach within one or two inches from the ground. The arcs between the rails are of the two-carbon variety, and the arcs are struck between the carbons themselves. There is enough heat generated near these arcs to melt anything for a distance of several inches.

In the back and staggered to the first row we find several more arcs which are to complete the work that the first row did not finish.

LAST year several of our eastern cities were visited by blizzards of extraordinary violence. Traffic was stopt for weeks at a time, and the cities suffered damages that have been computed to run up to $60,000,000 for the period, not to mention inconveniences to every one of the citizens, accidents, delays that could never be made up, etc. The writer of this article proposes several simple and very effective means to quickly clear the street of snow and ice, and we hope to see some of the methods tried out with success this year.

An interesting idea devised by the writer is that several of the arcs directly over the rails have only one large carbon electrode, and *the arc here is struck between the carbon electrode and the street rail.* No matter how much ice is packed on the rail, the electric arc will melt it like butter in no time.

It will occur at once to the reader that this would immediately melt the rail itself due to the tremendous heat of the arc. This would be true if the street car were standing stationary all of the time. But this is not the case. The car moves, even if it only moves at the rate of a few inches a minute—it still moves. Besides, as experiments of the writer have shown, as long as the rails have been covered with snow and ice, it is quite impossible to melt the steel underneath. *The ice and the resulting water must first clear away before the steel rail can be damaged to the slightest degree.* Any experimenter can readily convince himself of this. If by reason of the street being blocked the car should have to stop after the snow and ice had actually been melted, the motorman naturally would turn off the arcs until the car was ready to move on again.

In New York and Washington, where the third rail is underground, additional trouble is created by the slot thru which the trolley passes. The slot then becomes clogged as well and freezes up at times. This happened last year. By the method outlined above the melted hot water flowing down into the slot will clear the latter from snow and ice.

Another system is shown in illustration No. 2 where live steam is brought to play upon the packed snow and ice, the steam being generated electrically by heating the water while passing the current thru it. The current of course is furnished by the trolley car itself from the overhead wire. Live steam then issues from the steam nozzles in front, and by running the car along very slowly, either back or forward, or forward only, good progress can be made, and the line can be thawed out in a few hours.

Another method is shown in Fig. 3, where a hot air blast is used. The car is provided with powerful electric heaters; the hot air is then drawn over these heaters by means of air blowers. The hot blast in this way will act the same as the steam melters shown under Fig. 2. This hot air method, however, we do not think is as good as either the methods shown in Fig. 1 or Fig. 2, because hot air does not give the same degree of effectiveness as steam.

In Fig. 4 is shown another melter whereby a cage is equipt with powerful electric heaters, and which may melt a thin coating of snow and ice, but would never be effective in case there was a foot of snow on the ground.

In Fig. 5 we see an apparatus whereby live steam is generated by means of an ordinary coal-fired boiler, similar in results to the electrical method shown in Fig. 2. For quick and effective work perhaps this method would be preferable to the use of the electrically heated boiler; it is probably possible to generate steam quicker and better than by an electrically operated boiler. The method shown in Fig. 5 also has the additional advantage that it does not necessarily have to be used on a street car, but can be used on trucks, automobiles, etc., and on streets where there are no street cars.

We finally come to Fig. 6, where a street car is shown using an oil tank with comprest air to throw liquid flames on the rails. This method was tried out indeed last year in an experimental manner by using some army liquid flame throwers carried and operated by men. The results were certainly astonishing.

We predict that a few cars with a multiplicity of nozzles directed downward would certainly melt the thickest and toughest layer of snow and ice imaginable, and it certainly would be worth while to try any of the methods suggested. None of them are very expensive, and each of them may save our large cities millions of dollars.

Some February Articles

The Paris Radium Institute. The Wonderful Work of Madame Curie and Staff. Special Feature Article Written Especially for This Journal. Wonderful Photos. Don't Miss It!

Colloidal Fuel—Piping Fuel From the Coal Regions. By Professor T. O'Conor Sloane, Ph.D., LL.D..

Is Electrocution Humane? What Scientific Investigation Discloses.

A "Radiogenes"—An Unusual Wireless Tale. By Charles S. Wolfe.

The Fastest Things in the World. By H. Winfield Secor, E.E.

Can We Make Ourselves Invisible? A Peek into the Science of To-morrow. Illustrated. Written by H. Gernsback, Member of American Physical Society.

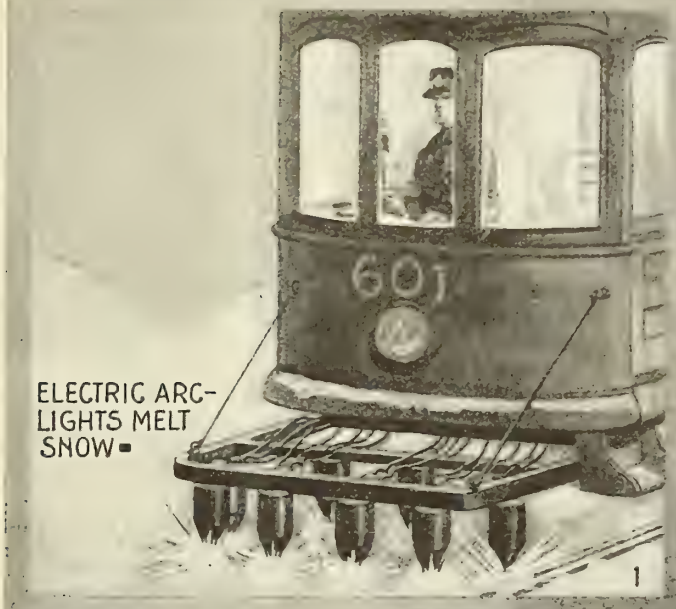
A Stage Scene Formed of Soap Bubbles—A Remarkable New York Stage Production. By Joseph H. Kraus.

How Do Crystals Form? The Great Riddle of Modern Chemistry. By William M. Butterfield.

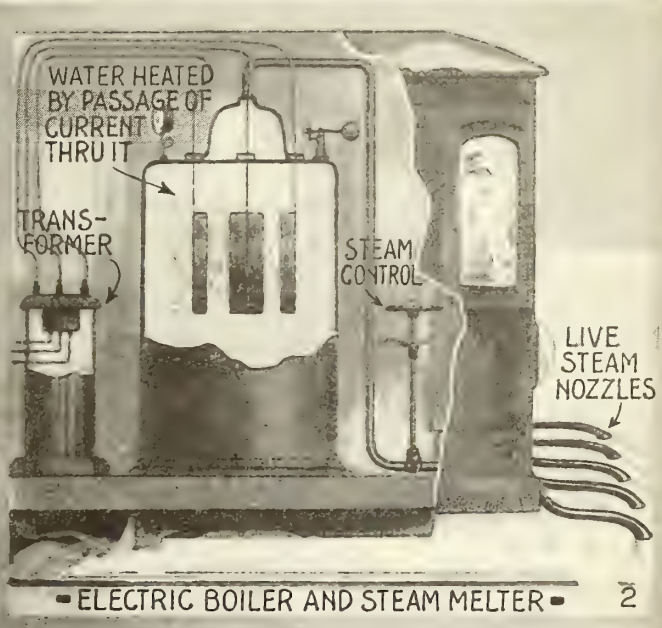
"Home Electrics"—Reading Your Electric Light Meter—Thoroly and Clearly Explained. By G. L. Hoadley, M.E.

The Gyroscope—Its Mystery and Its Uses. Described in Simple English and Illustrated. By Professor Floyd L. Darrow.

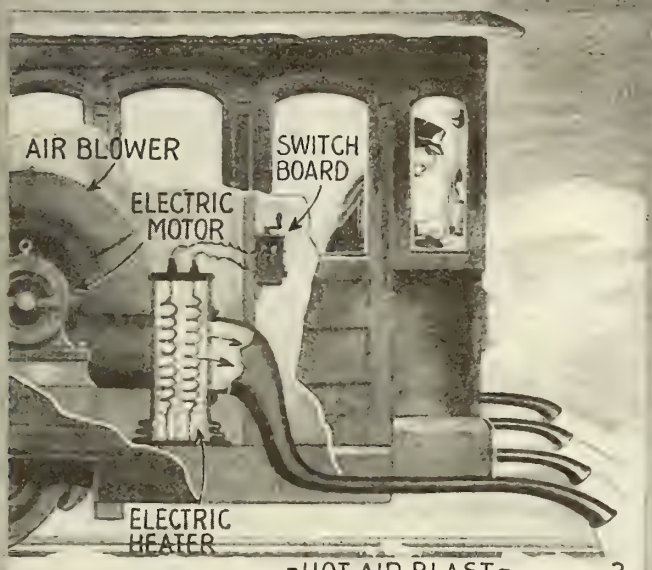
SNOW AND ICE MELTERS



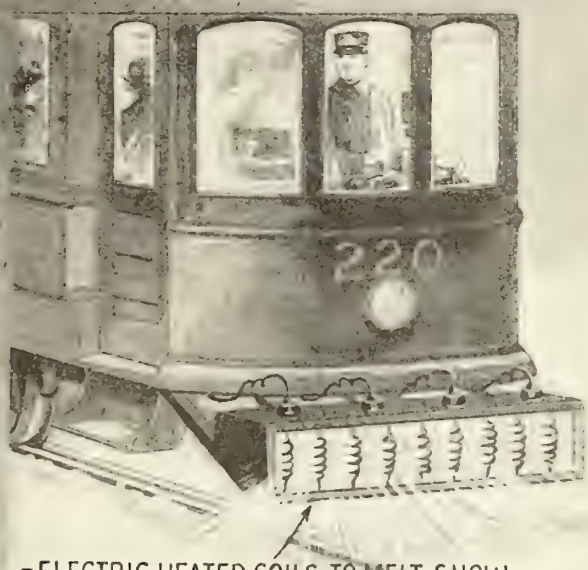
1



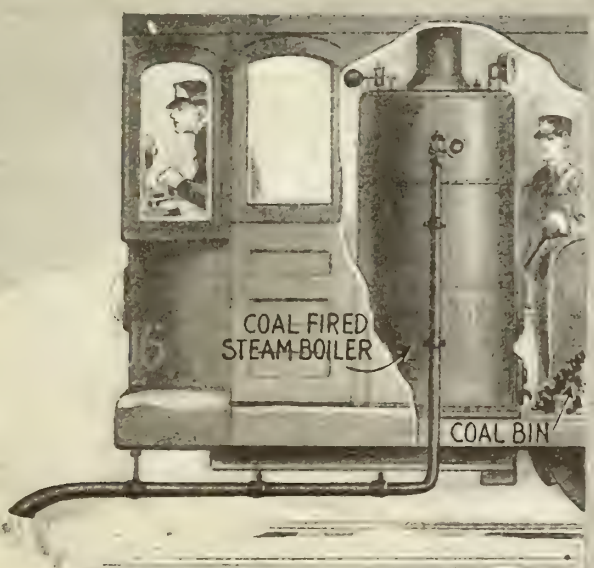
ELECTRIC BOILER AND STEAM MELTER 2



HOT AIR BLAST 3



ELECTRIC HEATED COILS TO MELT SNOW 4



LIVE STEAM MELTS SNOW 5

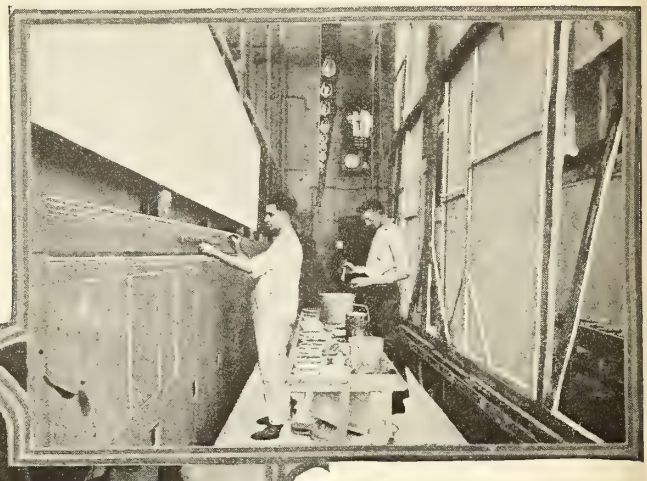


LIQUID FLAME THROWERS MOUNTED ON CAR 6

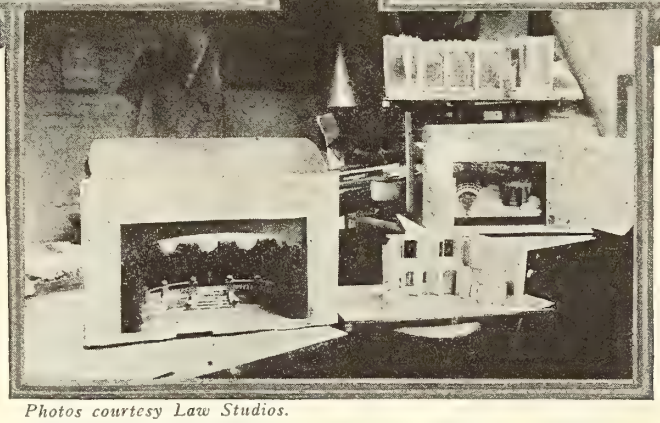
The Magic Art of Scene-Painting



Painting a Huge "Moon" on Canvas Back Drop From a Scene Painters' Bridge 40 Feet Above the Stage. The Various Bowls Containing Colors Are Seen on the Table in the Foreground.



Scene Painter Laying Out Perspective Lines on Back Drop Which Will Eventually Represent a Shoe Store. Real Shoe Boxes Will Be Placed in the Openings Seen in the Curtain.



Photos courtesy Law Studios.

This Shows How Stage Settings Are First Made in Miniature—Perfect Down to the Smallest Detail, Even to Vases, Clocks, Footstools, and Other Furniture. Colored Lights Are Thrown on the Miniature Settings to Obtain the Correct Data to Guide the Electrician in Lighting the Full Size Stage Production.

UNDOUBTEDLY, both the master mind and hand behind our greatest stage productions are those possest by the scene-painter,—several glimpses of a well-known New York scene-painter being shown in the accompanying views. One of the views shows a scene-painter preparing a "moon" scene, this moon being specially treated with metallic paint so as to make it luminous when lighted up in a special manner. It will be noted that the artist had to don a mask in order to avoid breathing in the fine metallic particles which float in the air while this particular scene is being painted, and which are injurious if inhaled in any great quantity.

Another photo shows several miniature stage settings; these act as the missing links, as it were, between the original scene as conceived by the artist or designer and the finisht full-size setting as finally painted for a theatrical production. If you have ever stopt to think about it, you have undoubtedly often wondered how the large scenes of buildings, streets, Venetian canals, *et cetera,* were actually painted so as to preserve the true perspective and relative proportion in size of each part with relation to the entire scene.

It would be almost impossible, it would seem, for the average artist to stand in front of a canvas as high as a stage-drop measuring, say, 40 feet by 30 feet, and paint a scene in its true perspective and always have it in correct proportion.

As in many other branches of the fine arts, science has been gradually lending more and more a helping hand, and the scenic artist of today has to be quite a fair mathematician, as he must lay out the perspective lines on the scene and also the full-size scene has to be accurately *scaled* off from the miniature stage setting or painting constructed like those shown in one of the photographs.

These miniature settings would surely fascinate any boy or girl, if he or she happened to see one of them, for every little detail is accurately and faultlessly constructed and colored in exact proportion and harmony. The details include such small items as vases, footstools, all kinds of furniture, window and door details in room scenes and even a clock on the mantel and pictures on the wall.

These model sets are frequently provided with colored celluloid screens or else with colored miniature lamps, so that the scene can be lighted up in the studio and the proper lighting schedules as to colors, etc., specified for the stage electrician to follow in the actual stage production.

The third photograph shows a scene being painted of the interior of a shoe store. The shoe boxes are mostly painted in the scene, but at periodic intervals a hole is left in the screen for an actual shoe box in order that the actor-salesman will be enabled to take out a shoe box so as to make the appearance and action of the scene very realistic.

As will be seen from the illustrations herewith, modern scene-painting represents, indeed, a great work, as it incorporates many branches of art and science which the average artist never encounters. The matter of properly mixing paints and gums to enable the rolling of big canvases is truly an art in itself, as any scene-painter will tell you.

Mr. and Mrs. Scene-Painter (yes, there are women who follow this work, too) must possess a first-class bodily equilibrium, as most of the painting is done on the canvas while it is suspended above the stage, the scene-painter standing on a bridge about 40 feet above the stage floor. The canvas can be readily raised or lowered by pulling on a rope. Some of the painting is also done from ladders. There are no rails on the bridge, as will be seen, as this would interfere with the freedom of laying out the scene projection line with the scale sticks, which measure 8 to 10 feet and even more in length. And here is where your bodily balance comes in. If you fall between the scene and the bridge, it's a 40-foot drop to the stage at least.

Micro-Organisms Seem Deathless

Most extraordinary living micro-organisms have been discovered in paper. These harmless entities possess remarkable resistance to heat and to time. They survive for hundreds, even thousands, of years, and then, under certain circumstances regain their activity. The Paris correspondent of the Journal of the American Medical Association writes of a communication on these organisms which Dr. Galippe presented recently before the French Academy of Sciences.

"However little one may know about the process of manufacture, it is not surprising that paper contains many micro-organisms," writes the correspondent, and continues: "But it was generally supposed that these were destroyed in the course of the many operations which are undergone in the stages from pulp to paper. Now, according to the researches of Galippe, this is not the case, and all papers in use harbor living and cultivable micro-organisms. What is more, these organisms offer considerable resistance to heat, since filter paper may be subjected for half an hour to a temperature of 120 C. in an autoclave without the least effect on them.

"Galippe was able to study a fragment of papyrus of the Ptolemaic epoch, that is, dating back to about 200 B. C. The structural elements of the papyrus were unchanged and the vegetable cells and fibers of which it was built up were found intact. The cells had not only preserved their form and reciprocal relations, but in some of them were found some perfectly distinguishable micro-organisms. After three hours' contact with sterile water these micro-organisms, immobile for centuries, regained their activity and showed themselves capable of motion. More than that, when placed in a favorable culture medium they multiplied, and their development and different phases of their evolution could readily be studied."

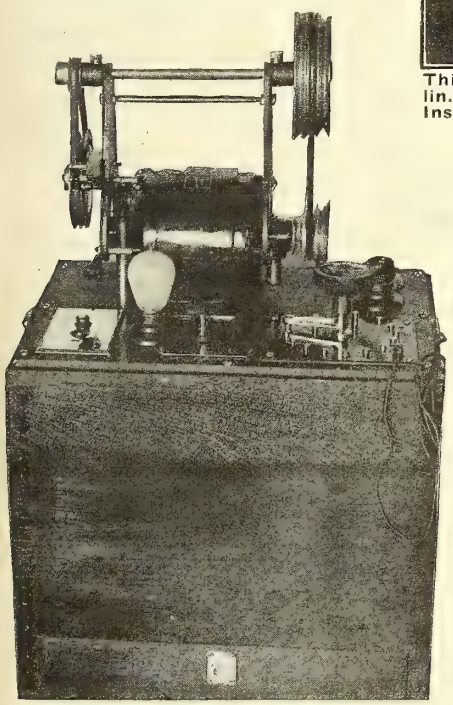
Everyday Science

OPERATING BY ELECTRICITY.

Specific drugs possess a like vibratory rate as the diseases for which they are effective.

These like vibratory rates (homovibrations) of drugs owe their efficiency to their inherent radio activity. Thus, an obsolete drug like *gamboge* painted on the chest in incipient tuberculosis will effect a symptomatic cure within a few weeks. Gamboge possesses the same vibratory rate as tuberculosis. Our conception that drug action is dependent on direct cellular contact is thus demolished. One must recall that *wave motion is one of nature's general methods for transforming energy.*

All forms of energy whether derived from heat, electricity or magnetism may be made to yield different rates of vibration, and these rates corresponding to the diseases are utilized for their destruction. It has been found empirically that the greater the potentiality (voltage) of the energy, the more effective are the results.



This Machine Nullifies Your Sense of Feeling, so That Physicians Can Operate Without Administering Ether or Chloroform—Thanks to Electricity!

We have learned that energy may be utilized to *increase* or *decrease* the activity of an organ and that with definite vibratory rates of energy *one may duplicate the action of a drug,* says Dr. Albert Abrams, in a recent report on his newest invention, the "Oscilloclast." No sensation of any kind is perceived by the use of the current from the oscilloclast, and it is *absolutely innocuous.* This is in decided contrast to the accidents associated with Radiotherapy which despite protecting devices make such protection illusory. The action of the oscilloclast is based on the fact that every object has a certain natural period of vibration and, if we approach an object with a source of vibration of the same vibratory rate as itself, the object will be set in vibration.

Operations have been performed painlessly by its aid.



This Is the Way They Cut Hair by Electricity in Berlin. We Presume the Kaiser Also Has One of These Installed in His Holland Castle, Altho He Got a Very Close Shave "a Short Time Ago."

HAIR CUTTING BY ELECTRICITY.

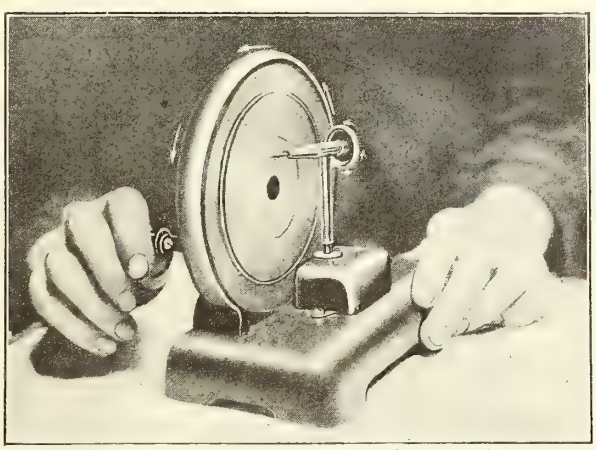
No, gentle reader, this is not as serious a matter as it looks, and this patron in a German tonsorial parlor is not having his hair removed by an electrocution process,—but instead by a very efficient motor-operated clipper, which removes it in lightning fashion.

This is said to be one of the latest Teutonic inventions.

NEEDLE REPOINTING MACHINE.

A needle is a small thing, but the world is made up of small things. A needle makes all of our clothes and, among other things, reproduces the music on our talking-machine records which are today so universally used that the waste of steel in these alone is quite considerable, as the requirements are so exacting and the pressure on the point so relatively great that even in the hardest of steel they are rendered useless after one playing over the 300 feet of the record groove.

With this clever little device a needle may be repointed many times. It is wonderfully simple, yet possesses some very interesting points.



Why Throw Away Thousands of Phonograph Needles When, with the Machine Illustrated, They Can Be Sharpened in a Jiffy, Just as Good as New—Not Forgetting Sewing Needles.

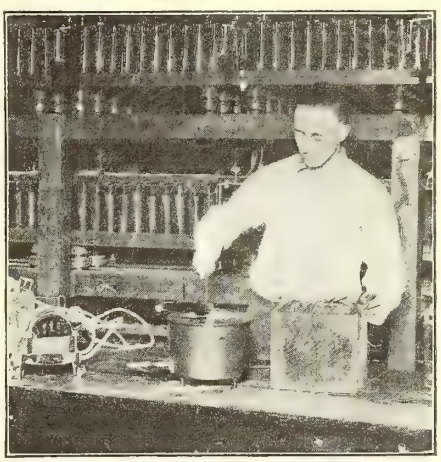
NEW ELECTRIC "MELTING POT."

There has recently been developed an electrically heated compound melting pot for melting battery compound and other compositions of like nature which should interest garage and repair-shop owners, as well as all others whose business includes the manufacturing and repair of electric batteries. To such men the inconveniences and risks of the gas-flame method of melting compounds are the cause of considerable annoyance, due to the loss of time, waste of material and the increased fire risk.

The gas flame is a method of heating practicaly impossible to regulate with any degree of flexibility. It fails to give an even distribution of heat, and is unreliable. This, together with the haphazard sort of containers generally in use, necessitates the constant attention of the operator. If he is called away and forgets to turn down the flame the compound, owing to its inflammable nature, will soon catch fire, resulting oftentimes in considerable financial loss. Or, if the flame is turned down enough for safety, the compound will probably cool so as to necessitate its being remelted; hence, waste of time.

The new electric compound pot is made in four-quart size, and is solidly built with a bail to facilitate handling. It is provided with flange around the top, so that if it is desired, it can be lowered into a hole to bring the top flush with the table. This flange extends over the inside so that the compound cannot boil over the edge, this often being the case when old compound is desired to be remelted, inasmuch as old compound is often impregnated with acids. The inner flange also acts as a lip for scraping the compound from the ladle, thus preventing waste.

The heat is provided by a three-heat unit of the well-known cartridge type, which is inserted in a slot at the bottom of the pot. This unit is regulated by a three-point plug switch for obtaining three heats. The unit is reliable and does not require any attention of the operator. Many of these units are in use daily and are operating with entire satisfaction. *Photo courtesy General Electric Co.*

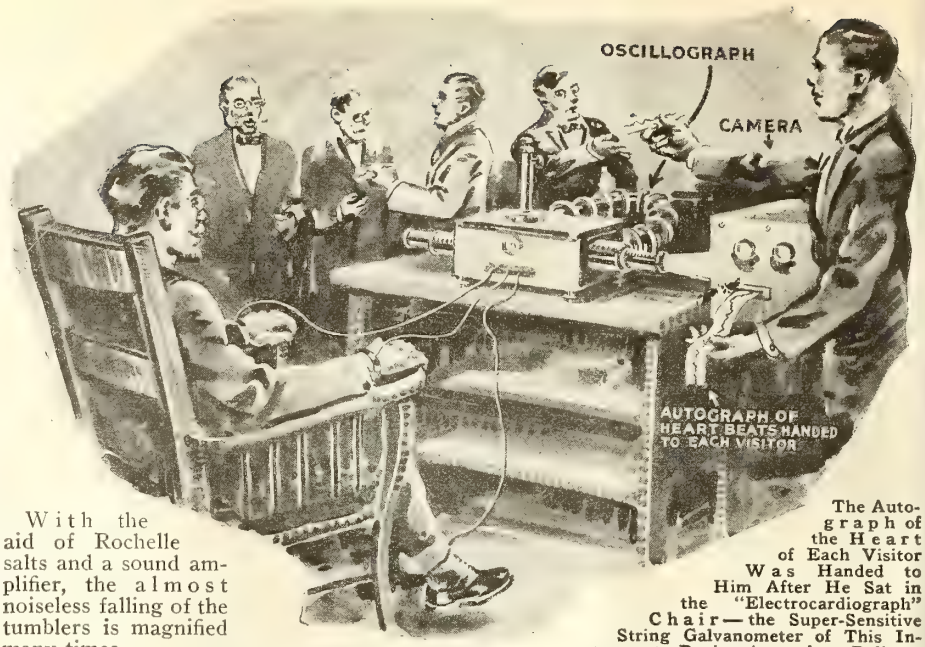


One of the Very Latest Electric Melting-Pot Devices, Suitable for Compounds, Wax Mixtures, Etc. It Is Shown Here in Use for Filling Storage Battery Tops.

Electrical Marvels Startle Delegates

THE British, French, Italian, and Japanese delegates to the International Communications Conference left New York recently one morning for Washington to resume their preliminary session after a week's tour of American electrical industrial plants, which recently concluded with an inspection of the laboratories of the American Telephone and Telegraph and the Western Electric Companies.

When Dr. F. B. Jewett, chief engineer of the Western Electric Company, opened every secret door to them in his thirteen-story research laboratory at 463 West Street, where 3,500 engineers and employees are engaged in training volts, amperes, watts, and coulombs to do impossible things, they were overwhelmed with astonishment.



The Autograph of the Heart of Each Visitor Was Handed to Him After He Sat in the "Electrocardiograph" Chair—the Super-Sensitive String Galvanometer of This Instrument Registering the Delicate Heart Beat Currents on a Photographic Paper Strip. Modern Hospitals Employ This New Instrument of Science for Studying the Form of Heart Beat of Each Patient.

Piezo-electricity

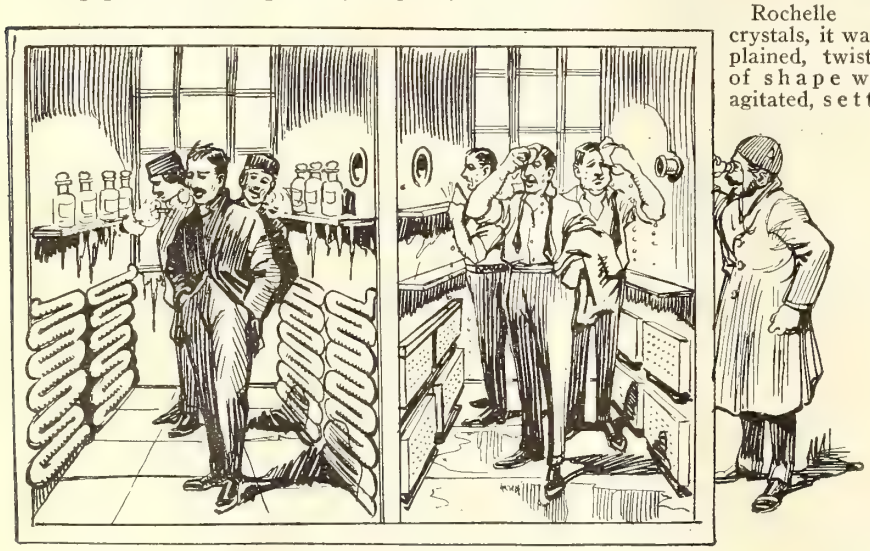
The first surprise was a demonstration with Rochelle salt crystals. "When it comes to gymnastics," explained the engineer in charge, "no one has anything on the Rochelle salt crystals." And every one agreed.

It was shown that when these crystals are twisted or pressed an electric current flows from them, is squeezed from them, as the engineer put it. And conversely, when a current flows into them they wiggle and wabble in a most capricious fashion. There was a phonograph with the ordinary reproducer replaced by a salt crystal. From this crystal wires were led to another crystal placed in a phonographic horn and when the phonograph was turned on the first crystal wriggled, producing currents which made the second crystal wiggle so violently that rich music poured from the horn.

Rochelle Salts Opens a Safe

How to open a safe without knowing the combination or wrecking the strong box was next demonstrated.

With the aid of Rochelle salts and a sound amplifier, the almost noiseless falling of the tumblers is magnified many times.



And Finally the Visitors Thought They Had Been Transported Suddenly to First the North Pole and Then to the Equator. Those Who Cared to, Were Allowed to Visit the "Hot" and "Cold" Rooms in Which Telephone Engineers Test Their Cables, Wires and Insulating Materials to Stand All Sorts of Rigorous Climatic Conditions. The Air Can Be Made as Damp as Desired in These "Bug" Rooms, as the Engineers Call Them.

Rochelle salt crystals, it was explained, twist out of shape when agitated, setting up an electromotive force. When connected with the safe lock, the vibration of the falling tumblers is enough to throw the salt into spasms. The whispered moan of complaint is magnified in the amplifier, transmitted to another crystal and becomes a veritable shriek of agony.

In the Tropical and Arctic Rooms

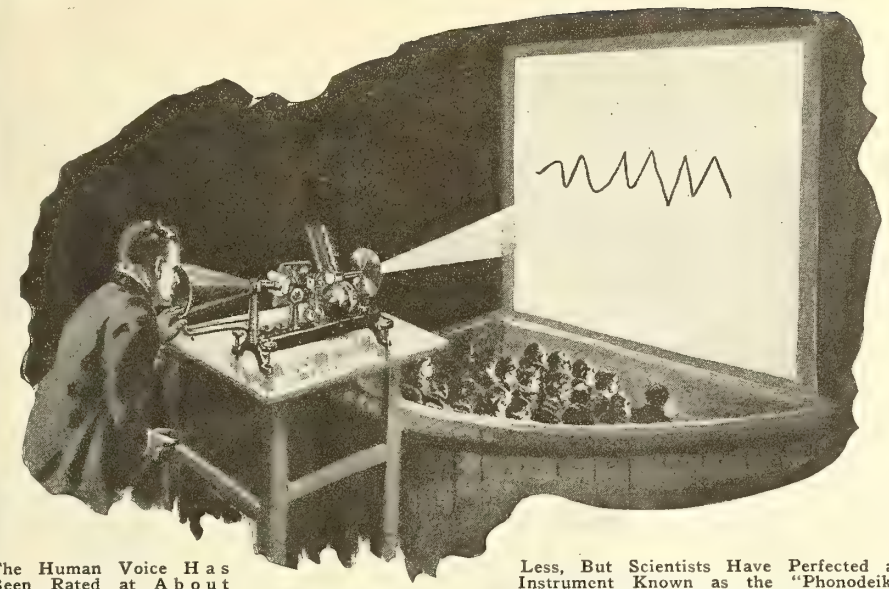
Then the visitors were led into the tropical room, where tropic conditions are reproduced for testing apparatus which is to be used in the equatorial regions. "Whew!" said Lieut. Gardiner of the British delegation, "everything here but mosquitoes and alligators."

And as they emerged in perspiration they were hurried into the arctic testing room, where the temperature was far below zero and the only realistic touch lacking was icebergs and the midnight sun.

"Do you know," asked an engineer in



An Interesting Experiment Demonstrating Vividly the Presence of an Electric Current in the Body. By Plunging Both Hands into Two Metal Dishes Containing Salt Water, the Extremely Minute Electric Potential Present Was Indicated on a Sensitive Electrical Measuring Instrument Known as a Micro-Voltmeter. A Micro-Ammeter Has Also Been Used for Indicating the Current.



The Human Voice Has Been Rated at About 1/200 H. P. and Even Less, But Scientists Have Perfected an Instrument Known as the "Phonodeik" Which When Spoken into, Magnifies the Voice Waves so That They Will Spread Across a Projection Screen Several Feet in Width as Shown in the Illustration Herewith. The "Phonodeik" Was Perfected by Professor Dayton C. Miller of Cleveland, Ohio, the Eminent American Authority on the Science of Sound.

another laboratory, "that every time your heart beats one-thousandth of a volt is produced from your finger tips?"

They didn't. But when they dropt their fingers into two shallow dishes of saltwater the pointer of a small instrument before them flickered back and forth, registering their heart action. "Perhaps there's something in this talk of magnetic personality and magnetic handclasp, after all," they said.

Telephone Talk from Ocean to Ocean

One of the demonstrations arranged was the setting up of communication by wires and wireless between the Catalina Islands in the Pacific Ocean and a ship in the Atlantic Ocean off the New Jersey Coast. The Catalina operator talked to the skipper of the Gloucester over 4,000 miles of telephone wires and radio distances of about 100 miles, while the guests listened in from a dining room in the Waldorf here where a dinner was given for them recently by the American Telephone and Telegraph Company.

After the Catalina operator had told the skipper of the Gloucester, who was riding a heavy sea in the Atlantic Ocean's darkness of 11 o'clock, that the sun was just setting off California, Colonel John J. Carty, vice-president of the telephone company, cut in with:

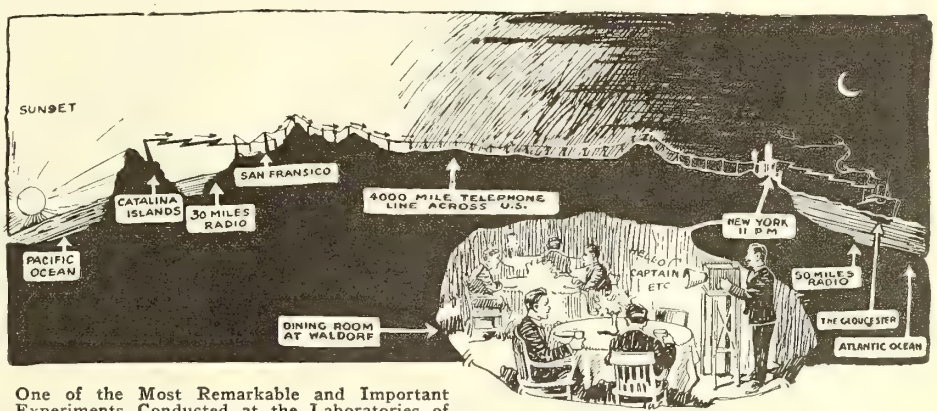
"You, Captain Nichols on the Gloucester, and Operator Spiker on the Catalina Islands, are taking part in an epochal event in wireless telephony. You are the first men to talk to each other from the Atlantic to the Pacific, across the waters of both oceans and the stretches of the continent."

The two men talked for about four minutes, and then Operator Spiker closed up his apparatus to go to supper and Captain Nichols to go to bed. Their conversation had been hampered somewhat by amateur operators, who insisted upon tuning up their radio apparatus to listen in both on the Atlantic and Pacific coasts. Static interference prevented the Gloucester from hearing well, but Catalina was able to hear every word with ease.

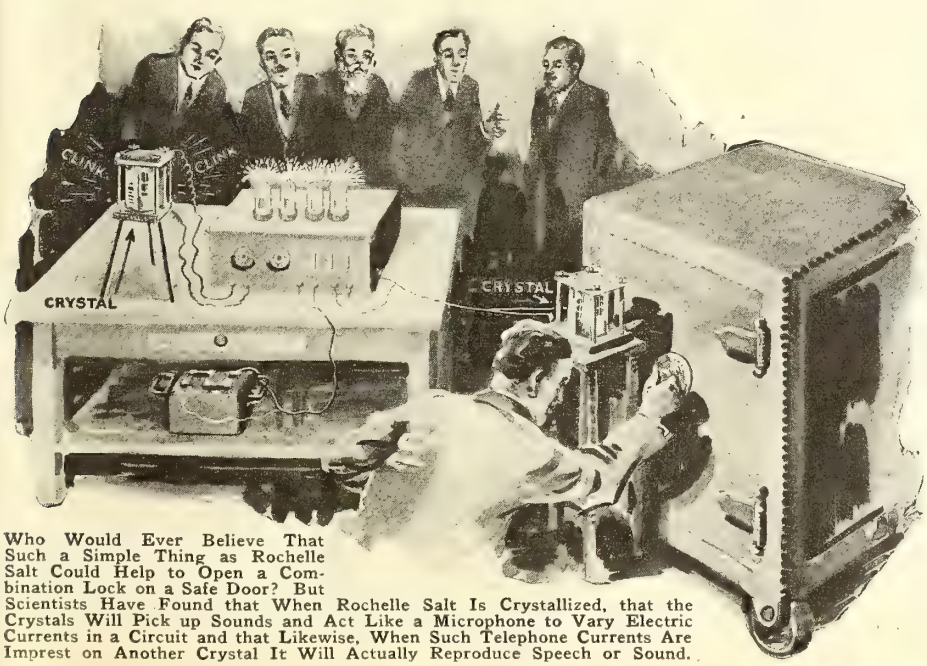
By automatic devices of American invention, the conversation was taken off the ends of the land wires and transmitted by radio to the ocean stations. The wireless distance on the Pacific was about thirty miles between wires' ends and the Catalina Island Station. The distance between the wires' end at New Brunswick, N. J., and the Gloucester was more than fifty miles.

Carrier-Current Phone Circuit

At 195 Broadway the visitors saw the demonstration of a carrier-current telephone circuit in operation from New York via Harrisburg to Chicago, a distance of 700 miles. This is not yet in commercial use, but will be shortly. Between Harrisburg and Chicago over each circuit of one wire twelve telegraph and one telephone



One of the Most Remarkable and Important Experiments Conducted at the Laboratories of a Large American Electrical Company for the Benefit of Visiting Radio Experts Was the "Stunt" Illustrated Above. By a Special Arrangement on Overland Telephone and Radio Systems the Visitors While at Dinner in the Waldorf-Astoria Hotel, New York City, Had the Unusual Experience of Hearing a Radio Operator on the Catalina Islands Talk to the Mainland Via Radio, Thence Across the United States Via Telephone, and Finally by Radio Once More to the Steamship "Gloucester" in the Atlantic Ocean. It Was Sunset in San Francisco and 11 P. M. at Night on the Atlantic, When This Remarkable Combination Radio and Telephone Conversation Took Place.



Who Would Ever Believe That Such a Simple Thing as Rochelle Salt Could Help to Open a Combination Lock on a Safe Door? But Scientists Have Found that When Rochelle Salt Is Crystallized, that the Crystals Will Pick up Sounds and Act Like a Microphone to Vary Electric Currents in a Circuit and that Likewise, When Such Telephone Currents Are Imprest on Another Crystal It Will Actually Reproduce Speech or Sound.

messages could be sent simultaneously. In the demonstration five and a half telephone circuits and two duplex telegraph circuits were used without interference in conversations between the foreign visitors in the Broadway building and the company's representatives in the downtown district of Chicago.

What seemed to impress many of the delegates as the most interesting demonstration was one of cipher printing by telegraph. This has not yet gone into commercial use and has been one of the wartime secrets of the American Government and the American Telephone and Telegraph Company. Major Gen. Squiers, Chief of American Army Communications, and other military and naval officers present were not surprised at what took place because several months before the armistice this newly developed cipher printing telegraph system was in daily use between the War Department at Washington and its port of embarkation at Hoboken.

The cipher message was sent over a fifty-mile circuit from New York to Cliffwood, N. J., half of this route being by radio and the balance over return land wires. During the demonstration the delegates saw messages ciphered and then transmitted and

(*Continued on page* 1020)

The Limitations of Sight

By WILLIAM M. BUTTERFIELD

THE microscope and telescope have revealed many *invisible* living and inanimate objects, the microphotographic and telephotographic camera have given man a knowledge of still smaller or more difficult subjects than those shown by either one of the visual apparatus first mentioned, yet man is dissatisfied. He wants to see atoms, invisible stars and still other things of which he knows nothing as yet. Can he do it?

It now seems impossible that he will ever be able to see these lesser things, for two reasons. The first of course, is the nature of the limitations of the eye, and the next the insurmountable obstacles met with in the construction and use of artificial optical instruments, which after all is said and done, provide nothing more than optical assistance for the human eye with the adjunct, however, of the photographic plate.

Vision is limited in the eye by the qualities and action of a double convex lens whose faces change their radii of curvature or degrees of convexity under the action of adaptation muscles; next, by the iris with its sphincter muscle, that regulates the diameter of the opening of the pupil, constituting what the photographer calls his *diafram*—and finally by the size, shape and physiological qualities of the eye-ball with its retinal lining. If the eye is adequately studied, it will be found to be an exceedingly complicated structure, and the section of the retina shown in the cut, is a good example. *A* and *B* are what is known as the cones; between them are the rods. The eye-ball is practically unchanging in shape. The convex lens of the eye, independent of any particular effects of the diaframming effected by the iris, may be taken as determining the angle of vision, as shown in Fig. 1.

The reflected, emitted or transmitted rays of light from an object pass into the eye by way of the convex lens, adapted to the distance by the action of the adaptation muscles and diaframmed for clear vision by the iris and produce upon the retina, the inverted focal image of the object. The angle of vision may be observed by closing one eye and noting how distant objects are affected and to what extremes, right and left and up and down the vision extends.

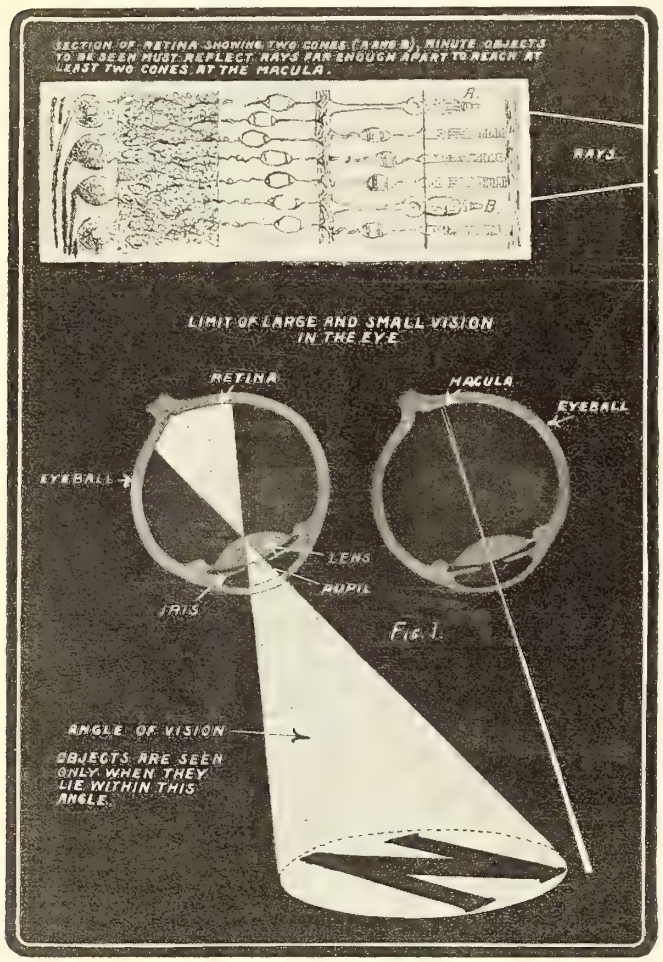
The iris opens in obscure light and closes in strong light, so that the reader can study or observe for himself what effect, if any, the change of opening of the iris has upon the field of vision.

These different movements which are very briefly and inadequately described, are known as accommodation and the accommodation system is in constant action, when the eye is in use on objects at various distances or is affected by varying light. The accommodation reduces itself to the reception of parallel, or converging and diverging rays. As distant objects give virtually parallel rays, it is merely a question of the sensitiveness of the retina, as defined by the size of the focal image falling upon it, that limits the distance at which any specific object can be seen. But where we come to objects so near that the rays from them cease to be parallel, then it is a question of adaption of lens and iris.

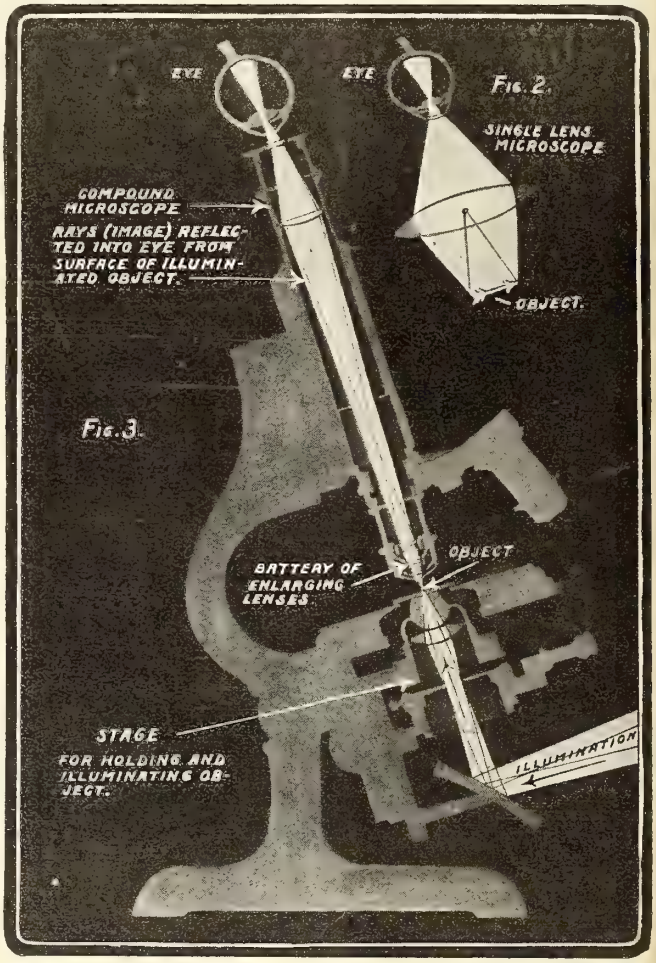
In normal eyes, an object appears to be a mere point when the rays of light from it subtend an angle of 60 seconds. On the most sensitive part of the retina, the macula, the cones lie close together (.002 mm.) but in the outer part of the field of vision, the cones are farther apart, so that vision there is less perfect. Approximately back of the lens on the surface of the retina is a spot which is unaffected by light rays and is called the *punctum caecum,* quite the reverse of the *macula,* altho a near neighbor thereto.

The microscope and telescope operate to increase the apparent size of objects. In the last resort, this resolves itself into causing the rays from the object to enter the eye at an advantageous angle, so as to cover a larger portion of the retina than they otherwise would. This of course cuts down the illumination and in the micro-

(*Continued on page* 1006)



Schematic Diagram Showing the Passage of a Ray of Light Thru the Lens of the Eye, and Demonstrating the Angle of Vision. Rays of Light Impinge on the Retina at the Rear of the Eye-ball and Form an Inverted Image of the Object. The Detailed Diagram Shows the Layers of Cells at the Rear of the Eye-ball, and Note Particularly the Rod and Cone Layer, Which Is the Most Important Part of the Structure Dealing with Sight.



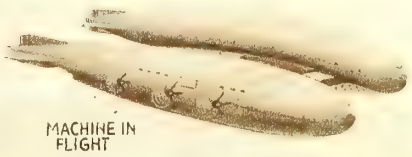
Comparison Between the Compound Microscope and the Single Lens Microscope. Both Are Practically Identical and Have Substantially the Same Effect Upon Vision, Except that in the Latter Only One Magnification Takes Place and the Rays of Light Do Not Cross. In Other Words, the Object Will Have to Be Upright in Order to Be Viewed in that Position. In the Former, the Rays of Light Cross, Due to a Battery of High-powered Lenses, and the Object Placed on the Stage Must Be Inverted in Order to View It in an Upright Position.

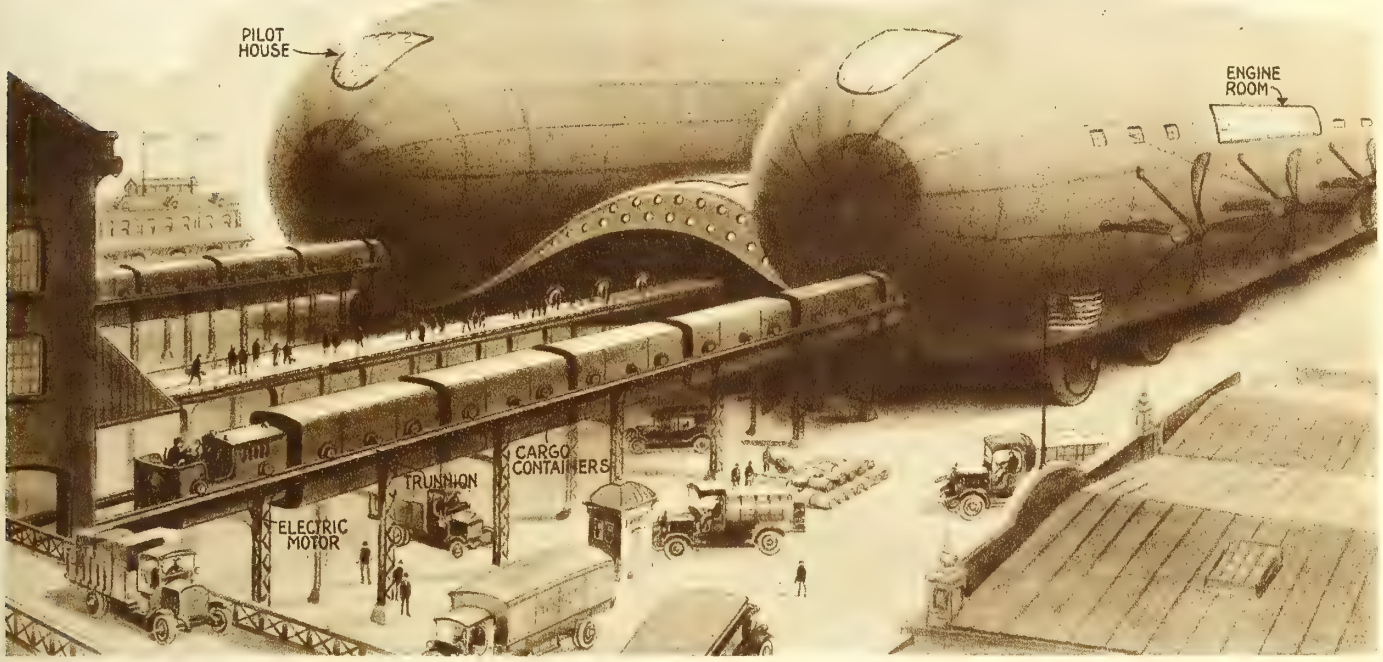
Freight Loader for Airships

By GEORGE WALL

(Illustration by the Author.)







© 1920 Science & Invention

When the Giant Airships of Tomorrow Arrive to Discharge and Take on Freight, Speed Will Be the Principal Desideratum. To Enable the Freight to Be Handled in the Shortest Time, So as to Keep the Ship in the Air, It Is Here Proposed to Pack the Freight in Metal Cars—These Cars Being Run in or Out with an Electric Locomotive as Shown.

As commercial aircraft routes continue to develop, one of the promising and important features of this method of transportation is that of carrying freight and express shipments, aside from that of passengers. We know that a large number of passengers may be quickly taken on board an airplane or Zeppelin type airship, but it is another problem altogether, when we come to consider the loading of a number of these large airships with freight in the near future, when aircraft will be as common a sight as the ocean steamships of today. The writer of this article has given considerable thought to this phase of the subject, and illustrates herewith an idea which he believes quite feasible, not to mention necessary, in rapidly loading such giant freight-carrying aircraft, so as to keep them flying the greatest amount of time possible.

It requires several days to load some of the large ocean steamships at the present day, even with the highly developed loading and unloading machinery which has been installed at several of our large sea and lake ports. The scheme shown in the illustration will certainly serve to load one of these giant aerial Leviathans much more rapidly than is possible or has proven possible so far in the case of steamships.

The principal idea in this arrangement is to have the freight placed or packed into suitable steel carriers or cars, each one to contain a given number of tons of freight.

The freight can thus be gotten ready to load into the airship long before the actual shipping time, and when the ship arrives, her shipment of freight could be pulled out with electric locomotives, running along the rails as shown in the picture, and the return shipment stowed away in her cavernous maw, all within a few hours.

Incidentally, the writer shows in his illustration herewith a new idea in dirigible or lighter-than-air aircraft design, *viz.*, this type of airship comprising two individual gas bags joined together by a more or less shallow central compartment, which can be made of sufficient height to form a passenger-carrying compartment with staterooms, etc., for the accommodation of passengers.

It would seem a very good plan to provide two pilot rooms in the nose of each dirigible as shown, which had best be equipt with suitable controls, in duplicate, for steering and handling the giant aircraft, so that in the event that one set of controls should become defective, the other set could be immediately brought into play.

This type of duplex airship should operate very successfully in the air and should not prove any more difficult to handle than a single gas bag dirigible.

One of the reasons for suggesting this invention in the design of lighter-than-air machines, has been prompted by the belief in the fact that the maximum size of single gas bag machine has been about reached in the giant craft built by the British, such as the R-34, which made a successful trip across the Atlantic Ocean, and return.

To carry more freight than the R-34, for example, it would be necessary to build a longer ship, as the diameter could not, of course, be very much increased, for the length already adopted in the design of the R-34. Hence, the present suggestion that two such gas bags be combined and rigidly fastened together in the manner shown, resulting in a ship of moderate length and easier steering and handling qualities.

Several other ideas which the writer has had in mind for the freight-carrying airships of tomorrow, are the following:

It has been found difficult to successfully repair gasoline engines used for driving the propellers of such aircraft when the engines are placed external to the gas envelope or cabins of the ship, and therefore it would certainly seem the best practice to place the driving motors inside the airship, grouping the engines as far as possible along a given axis so that the engineer crew could take care of the motors by passing from one engine room to the other quickly.

It is proposed to drive the propellers thru shafting and gears or they could of course be driven electrically by motors supplied with electrical energy from a central dynamo and gasoline engine plant, installed at a suitable location in the airship.

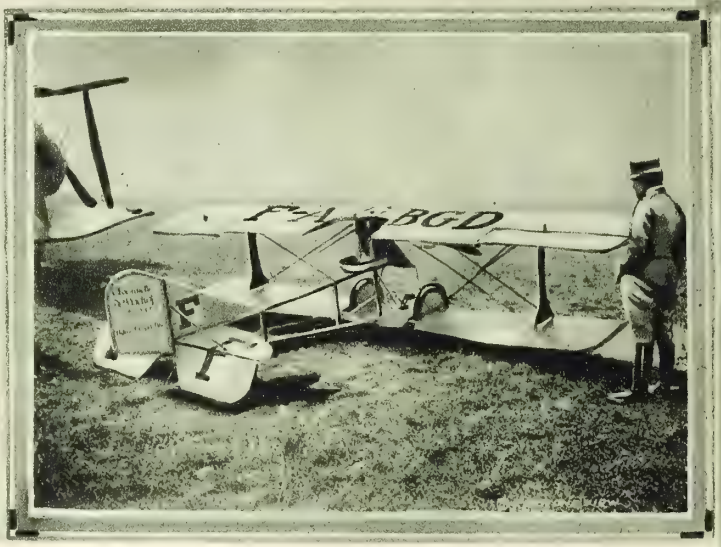
With this arrangement, the complete control of the airship is greatly improved and enables the centralization or focusing of all the engine power and other controls in the pilot's cabin.

The aircraft of tomorrow will duplicate, if not surpass, the large steamships of today in conveniences for the passengers Wireless telegraphy and telephony apparatus will be carried, as well as all of the usual appointments.

SCIENCE



A "Water-Merry-Go-Round" Is Making the Task of Learning How to Swim a Pleasant One for About 6,000 Boys and Girls in Cincinnati. This Novel Invention Takes All Fear of Being Accidentally Submerged Out of Learning How to Swim and the Youngsters Give Their Undivided Attention to the Instructor, Easily Keeping Their Place in the Procession of Young Swimmers. An Oval Track Fastened to the Ceiling Above the Pool From Which Are Suspended Stout Ropes on Pulleys Running on the Track, Keep the Swimmers on the Surface of the Water.—Photo from J. R. Schmidt.



The New Pishoff Aeroplane Photographed at the French Aviation Meet at Buc, France, Where It Attracted Much Attention. It Is Small and Known as an "Avionette." Note the Position of Pilot's Seat and the Wings. It Gets Its Name from the French Inventor, M. Pishoff. Compare With Man at Right.



A Knotty Radish. No, There Is No Trick to This Radish. Just as You See It Is the Way It Came From Mother Earth. How It Came to Take This Turn in Life Is Unknown. Perhaps You Can Figure It Out. The Radish From Which the Photo Was Made Is in the Possession of Mr. S. G. Gill, of Wooster, Ohio, Who So Kindly Loaned It for Photographing. He Keeps It in Alcohol.
Photo from W. F. Mellot.

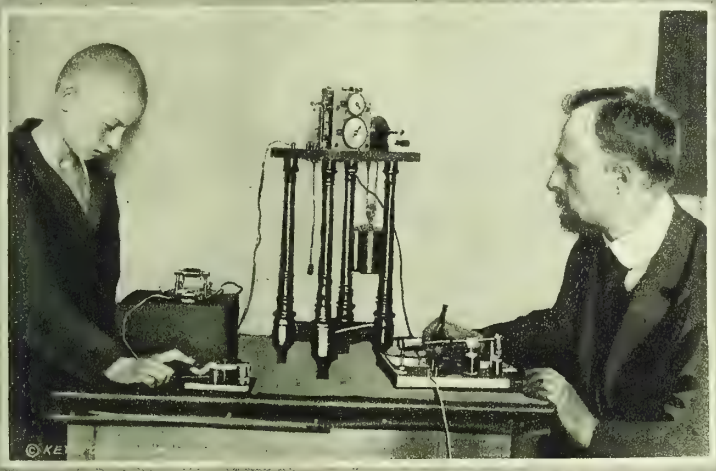


A Recent Photograph Taken of Thomas A. Edison, the Famous American Inventor, in His Laboratory at West Orange, N. J. Mr. Edison Spends a Great Part of His Time in One of His Several Laboratories Where He Works on Experiments in Electricity and Chemistry, in an Endeavor to Extract New Secrets from Dame Nature. Among His Great Contributions to the Welfare and Happiness of Mankind, Are the Phonograph, or Talking Machine, the Moving Picture, the Electric Light, Pioneer Development of the Electric Railway, Besides Developments in the Manufacture and Distribution of Cement, the Perfection of Nickel-Plated Moulds for Pouring Concrete Houses in One Operation—Including Stairs, Fireplace and Other Decorations, the Nickel-Iron Alkaline Storage Battery, an Instrument for Automatically Recording Telephone Calls in the Absence of the Subscriber, Etc.



No, This Is Not an Iceberg from the North Pole, but One Made by Man. More Than 20,000 Blocks of Ice Are in This Land Iceberg, Comprising Over 6,000,000 Pounds of Ice. This Sight, Never Seen Before, Is in Covington, Ky., near Cincinnati, Where an Ice Plant Was Wrecked by an Ammonia Gas Explosion. The Force of the Explosion Was So Great That It Blew Away the Walls of the Building and Left the Ice Within Exposed to the Elements.

IN PHOTOS



Testing Boys to Find Their Qualifications Before They Are Apprenticed to a Trade Above:——Examining the Boy's Sense of Feeling. He Is Depressing a Morse Telegraph Key, at Regular Intervals, While the Little Watch at the Side Registers 1/1000 Seconds and Is Connected With the Key. It Indicates Whether the Same Amount of Exertion Has Been Used and How Evenly It Has Been Done. Below:—This Young Man Intends Being an Artist and Is Being Examined for His Ability to Test Colors.





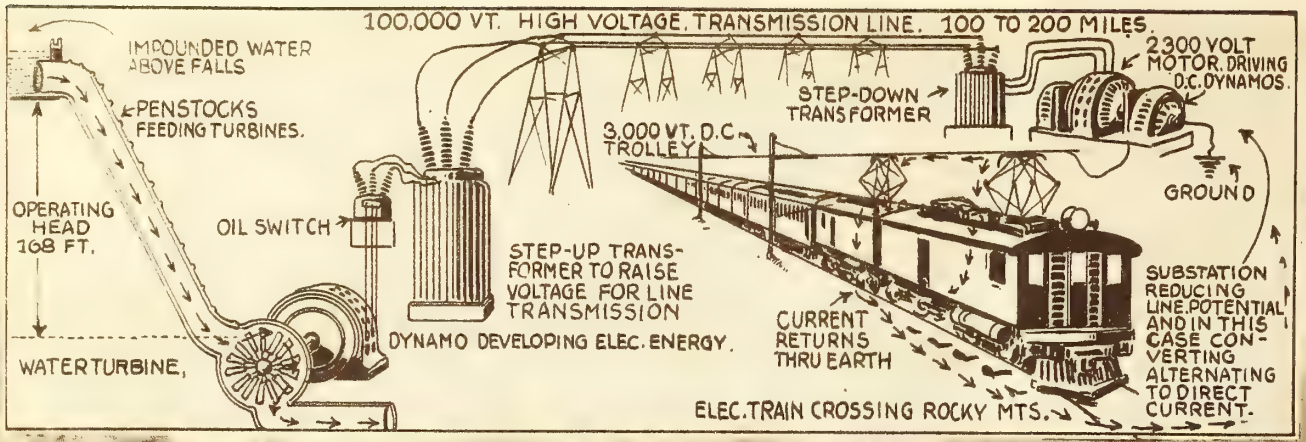
One of New York's Marvelous Electric Signs. The Butterfly and Rose, Are All Shown in Their True-to-Nature Colors. The Various Groups of Lamps Are Winked On and Off Rapidly by an Automatic Motor-Driven Switch So as to Give the Effect of the Butterfly Flapping Its Wings as It Alights on the Flower.—Photo © Kadel & Herbert.



New Automobile Direction Indicator. A New Device Which Is Attached to the Rear Left Fender or Body of the Car. The Diameter of the Face of the Indicator Is 10 Inches. The Four Signals "Right", "Left", "Stop" and "Back" Are Operated by Four Push Buttons Set in Switch Which May Be Attached to the Steering Post or Instrument Board. By Pressing the Button, the Correspondence Signal Is Brought Into View, and the Small Gong on the Face of the Indicator Rings in Order to Apprise the Other Automobiles and the Traffic Policeman of the Change in Indication. At Night the Signal Is Illuminated From Within.



No, This Is Not a Giant Mouse Trap, but One of the World's Great Wonders—a Giant Water Wheel or Series of Water Wheels Joined to One Shaft and Constructed Entirely of Bamboo. Several Months Work and Thousands of Pieces of Bamboo and Rope Lashings Were Necessary in Constructing This Giant Prime Mover. The Water Wheel Was Photographed in Operation on the River Song, in Indo-China.





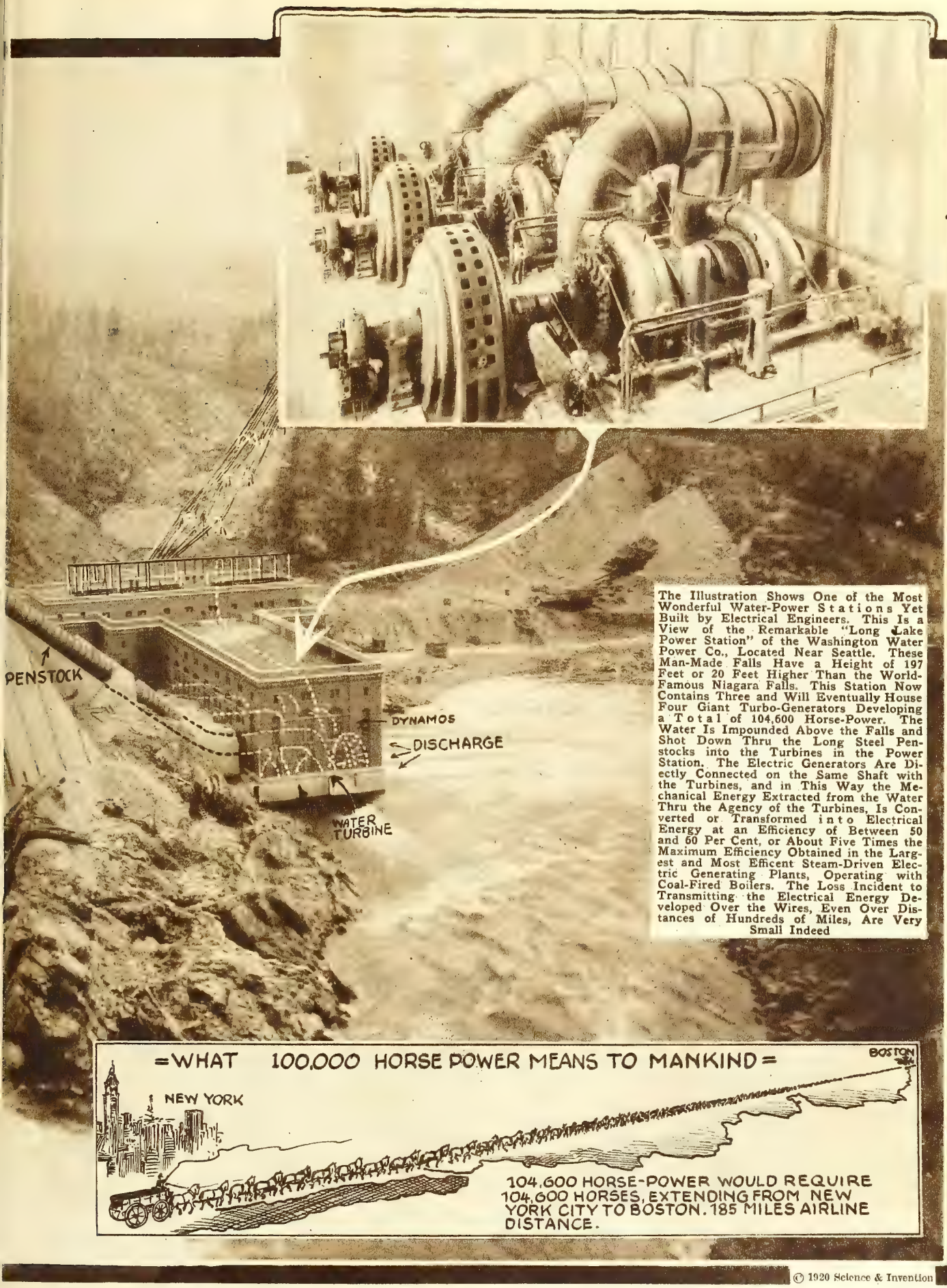
Man-Made Falls Develop 100,000 H. P.

Long Lake Power Station Falls Higher Than Niagara

THIS article, dealing with the possibility of hydro-electric development, or the generation of electricity from water-falls and running streams, is a most timely one; not only for the reason that coal, oil and other fuels are gradually and surely rising in first cost, and the sources of these fuels, in some cases, diminishing, but it is almost a criminal offense to the engineering fraternity to see thousands of miles of water streams, rivers and other bodies of water undeveloped and simply wasting their energy, so far as the every-day requirements of mankind are concerned.

The electrical engineer would not rob Nature of her beauty by stopping the flow of a river stream, but he would simply extract the latent power in the stream as it wends its way towards the sea. Many gigantic hydro-electric developments, which have been completed in the last ten years, attest to this fact.

One of the latest water-power developments for generating electricity to help haul



The Illustration Shows One of the Most Wonderful Water-Power Stations Yet Built by Electrical Engineers. This Is a View of the Remarkable "Long Lake Power Station" of the Washington Water Power Co., Located Near Seattle. These Man-Made Falls Have a Height of 197 Feet or 20 Feet Higher Than the World-Famous Niagara Falls. This Station Now Contains Three and Will Eventually House Four Giant Turbo-Generators Developing a Total of 104,600 Horse-Power. The Water Is Impounded Above the Falls and Shot Down Thru the Long Steel Penstocks into the Turbines in the Power Station. The Electric Generators Are Directly Connected on the Same Shaft with the Turbines, and in This Way the Mechanical Energy Extracted from the Water Thru the Agency of the Turbines, Is Converted or Transformed into Electrical Energy at an Efficiency of Between 50 and 60 Per Cent, or About Five Times the Maximum Efficiency Obtained in the Largest and Most Efficent Steam-Driven Electric Generating Plants, Operating with Coal-Fired Boilers. The Loss Incident to Transmitting the Electrical Energy Developed Over the Wires, Even Over Distances of Hundreds of Miles, Are Very Small Indeed

© 1920 Science & Invention

the trains of the great Chicago, Milwaukee and St. Paul Railway system over the Rocky Mountains, is that at the Long Lake Power Station, near Seattle, Washington, which station is shown in the accompanying illustration. This water-fall is remarkable for one thing, as it falls from a total height of 197 feet or twenty feet higher than the world-famous Niagara Falls, and it is all man-made.

The present plans called for the installation of four giant turbo-generators developing a total of 19,500 kilowatts each at unity power factor—or a total of 104,600 horse-power. Three sets of turbines and generators are now installed and the fourth is to follow. These turbines operate under

(*Continued on page* 1042)

The Elixir of Life

By H. L. JOHNSTONE

FOR the tenth time in the last half hour, Billie Hoyt looked at the office clock. At last it was five o'clock. With a sigh of relief he tossed his pen at the rack, closed the heavy ledger, dashed into his street clothes, and rushed out of the office.

Billie, as a rule, was not a clock-watcher, as it is understood in a busy office. Tonight, however, the clock had been dragging slower than ever before. There was a reason. He was going to take a run out into the quiet suburbs of Los Angeles to see Marie, the only daughter of Professor Straus, who spent most of his time dabbling in the mysteries of science. This was not the only reason, either, for Billie was going to ask the old Professor for Marie's hand. He did not think that there would be much objection raised on the Professor's part, for Billie had been a welcome friend for many months past. Neither did he figure that the question of money would cut much ice, for he knew that Professor Straus had been so busy during the declining years of his life trying to discover some wonderful elixir or other, that he had let his business run itself with the result that a thousand dollars or so were all that remained of a once good-sized fortune.

Billie spent a half-hour in tonsorial effort, and then, taking a hurried glance at the mirror, left his little room, and caught a trolley for Marie's.

It was only a half-hour's ride from the busy section of town and he soon found himself at the front door.

He pushed a button. The door opened, and Marie sprang to meet him.

"Oh, Billie! Won't Father be surprised when we break our secret to him?" she exclaimed as she gave him a bear-hug and a kiss."

"May be. Then, perhaps he will surprise me," replied Billie. "Let's go and see him right away."

"I think not. You would spoil every chance you ever did have if you bothered him now. He's working in that old stuffy laboratory and won't be bothered. I wish that he'd get done puttering and mussing all over the place with those nasty smelly chemicals. Come on in, and let's have some supper. I've tried to coax him up three times and the last time I went down stairs he pushed me out of the place and locked the door."

"Must have found something new, eh?"

"Guess so, from the way he acts lately."

Marie bustled around the little kitchen, putting the finishing touches to a savory meal, which she had spread out on a snowy white cloth. As she worked, she flashed Billie a glance from pretty brown eyes, that made him catch his breath.

The meal had started, and was progressing wonderfully for two young folks in love, when hurried steps were heard on the stairway leading from the laboratory. The kitchen door flew open and Professor Straus stood viewing the two.

He was excited.

"Hello, Billie. Just in time. Come on, you two, with me to the laboratory—I've found it at last!"

"Found what?" asked Marie. "I hope whatever you've found will give you time to eat your supper. Come on, Father, and eat now; or you'll be ill."

The Professor looked disappointed.

"The supper can go, child. Come on. Hurry up! This is too important a matter to wait! I've found it at last! *The Elixir of Life!*"

Half protesting at being disturbed, Billie and Marie bustled from the kitchen, down a flight of stairs and into the little smelly laboratory.

The Professor led them to a table, where lay upon a cushion, fast asleep, the worst-looking specimen of tom-cat Billie had ever beheld.

There was a rack of test tubes on the table with the cat, one of the tubes containing a dark green fluid. Picking out this particular tube, the Professor motioned Billie and Marie to chairs close to the table.

"Sit down, children, while I tell you what is in this tube. Marie knows that ever since the death of her dear mother, ten years ago, I have devoted my entire time to searching for the Elixir of Life. People have laughed at me, and said that I was crazy, still I kept everlastingly at it, and now I am rewarded. This little tube contains one ounce of the Elixir of Life. I am going to show you what it will do. See this cat asleep on the table? I judge him to be about ten years old. He is a hard-looking character and from his appearance has been in many battles. He is minus an ear and a part of his tail. Now I have found that each drop of this fluid turns the hands of time back just five years. It is given like medicine through the mouth. Whoever takes a drop finds himself just five years younger. Now I said that this cat is about ten years old. If I give him two drops, he will grow ten years younger."

"Impossible," blurted the impulsive Billie.

"Eh? How's that? Young man, what do you know about it? What do you mean by standing there and making such an asser-

(*Continued on page* 1030)



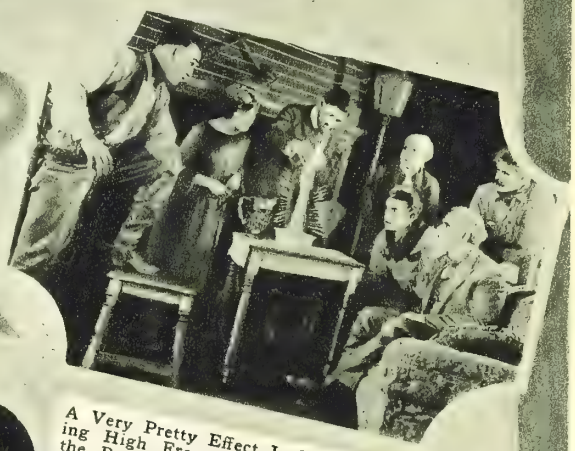
. . . . . The Tail Grew Out Slick and Shiny. In Her Excitement, Forgetting the Warning to Keep Quiet, Marie Gurgled Out: "Oh, the Cute Little Darling. Let Me Hold It, Father."

© 1920 Science & Invention

MYSTICAL MOVIES



In a New Vitagraph Serial, "Hidden Dangers," in Which Joe Ryan and Jean Paige Co-Star, Many New and Startling Effects Are Obtained. Above We Find Joe Ryan Assisting in Cutting Open the Top of a Gas Reservoir with an Oxy-Acetylene Flame.



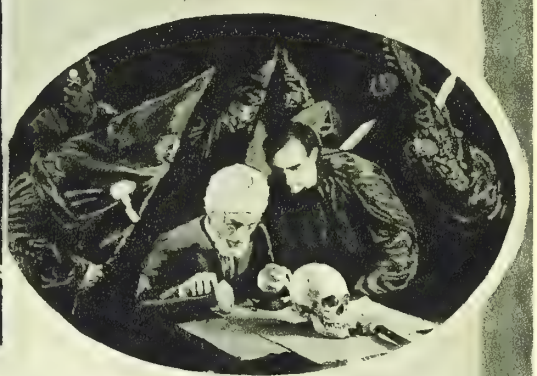
A Very Pretty Effect Is Produced by Allowing High Frequency Current to Pass Thru the Body to a Drinking Glass Held in the Hand; the Stream of Sparks Filling the Air-Gap Between a Dish of Water and the Glass.



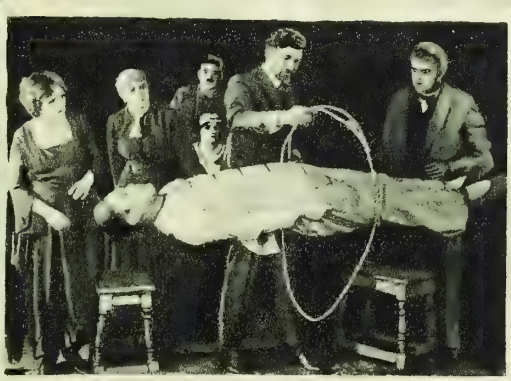
Lighting Candles with a High Frequency Spark from the Finger. Joe Ryan Is Supposed to Have a Contraption Strapt Around His Body, Whereupon by Pressing Certain Buttons, Various Mystical Effects Are Produced.



A Typical Portable High Frequency Apparatus for Producing Long Streamers of Sparks and Even This Is "Movified" for Effect, Rather Than for Actual Work.—Photo Courtesy Universal Films.

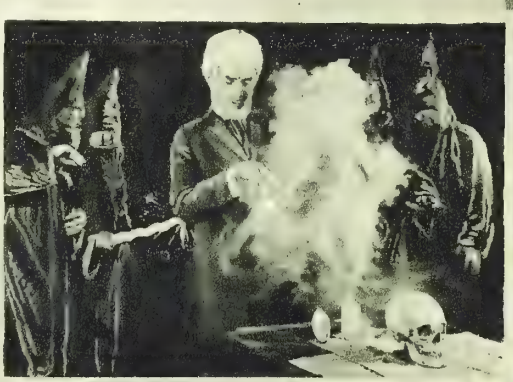


So Weird Is the "Hidden Dangers" Photoplay, That Even the Realms of the "Crystal Gazer" and the Masked Societies Are Encroached Upon. The Art of "Crystal Gazing" Is Pictured in This Strange Photoplay with Startling Reality and Effect on the Audience.



A Very Smple "Magic" Stunt Is that of Elevating the Body, or Levitation, as the Magicians Call It; but When Used in a Movie Thriller, It Produces a Far Different Effect Than When Demonstrated by the Professional Prestidigitator. The Magician Is Passing a Hoop Over the Body.



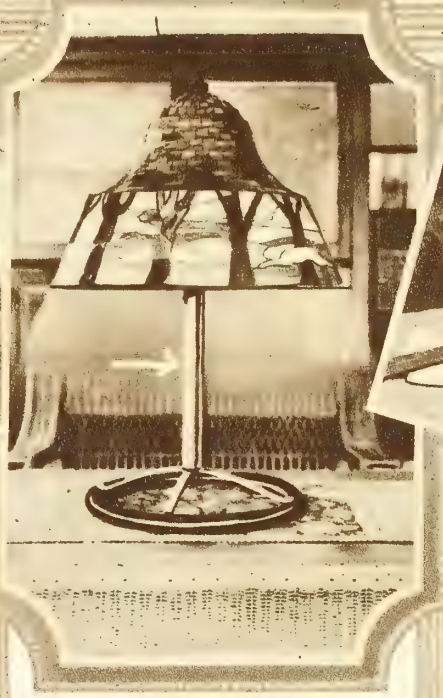


Volumes of Smoke Pouring from the Mouth of a Little Bottle Is Produced in Still Another of the Vitagraph Photoplays. Note the Spark Shooting to the Elbow of the Hindoo. The Smoke, of Course, Is Due to the Chemical Reaction of Two Substances in the Flask.

USING OLD "AUTO" PARTS



Why Not Use the Old Plain Glass Lens or Windows From the Head Lamps for Framing Pictures, After You Have Installed Those New Non-Glare Ones on Your Car? Circular Pictures Can Also Be Made Attractive With the Glass Discs From Discarded Head Lamps.



We'll Say This Is Some Novel as Well as Attractive Table Lamp. It Was Constructed With an Old Steering Wheel. The Wheel Itself Can be Either Re-Nickeled or Else Painted, and the Lamp Made Attractive With an Ornate Silk Shade.



And Who Said That Old Worn-Out Pistons Could Perform No Further Service After Being Discarded From the Engine? Here We See a Discarded Piston Acting as a Paper Weight, a Pen Holder, and Last, but Not Least, a Cigarette Holder.



If You Have an Old Fireplace That Needs a Little Dressing Up, Here Is Where a Discarded Gear Shift Lever Comes in as a Poker; Real Colonial Looking, Is It Not? Many Other Uses for Discarded Auto Parts Will Readily Suggest Themselves.



As a Fireside Stool, the Old Tonneau Seat From a Discarded Automobile Can Hardly Be Excelled. It Is Exceedingly Comfortable and Can Be Placed in Any Odd Corner or Spot Desired. The Excellent Springs in Automobile Seats Provide Wonderful Comfort.



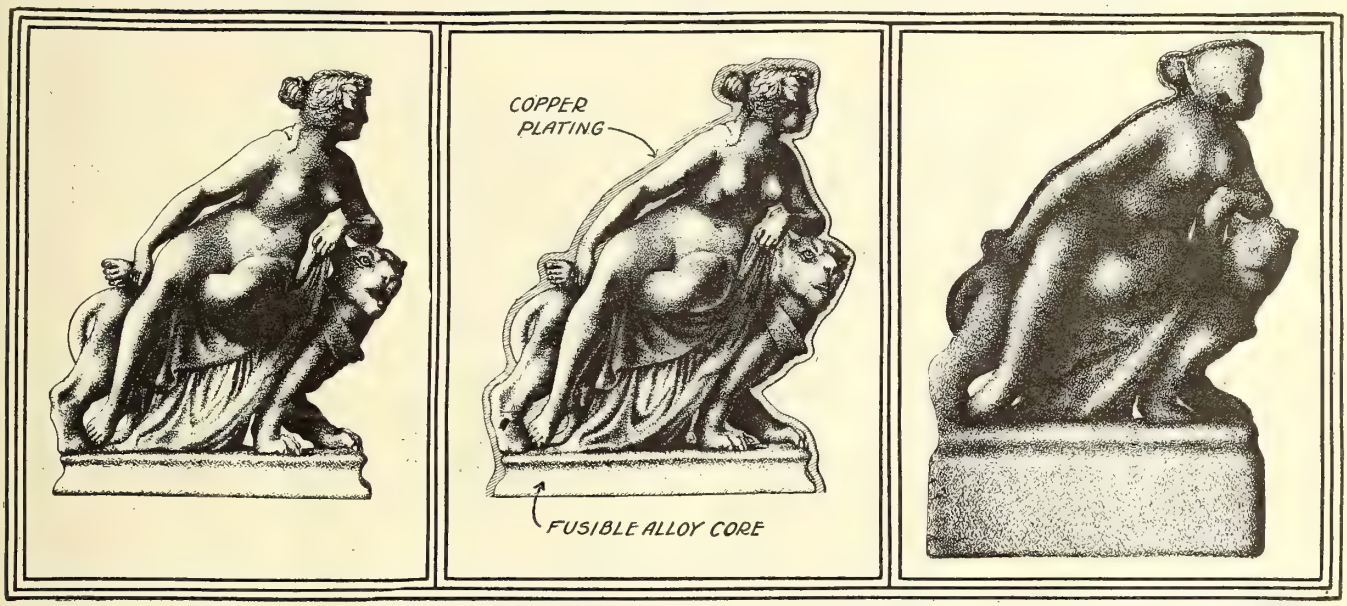
Speaking of Typewriter Lamps—What's the Matter With This One Constructed From an Old Speedometer Shaft? This Shaft Is Thoroly Flexible Permitting of Adjustment of the Lamp to Different Heights and Angles.





The Making of Copper Articles by Electrolysis

By SAMUEL WEIN



Various Stages in the Reproduction of Statues or Other Objects by the Method of Electrolysis or by the Deposition of Pure Metallic Copper on a Mold of the Object, Which Mold is Formed of a Special, Fusible Alloy Which Can Afterward be Melted Out. Any Thickness of Copper Deposit Desired Can be Easily Obtained.

THERE are a number of methods of manufactuing copper articles, but the electrolytic process is in many cases, the simplest and most inexpensive. Very little is known by the public concerning this process, inasmuch as the method is carefully guarded by those practising it; the reason for this being that the results are far superior in many cases to those given by processes in common use, and the profits realized in commodities made thus are surprisingly great.

In the electrolytic process, there are two distinct methods in use, and these are:

1. A mould is made of wax or similar material, and this in turn is rendered conductive with either grafite, bronze powder or by precipitation of metallic salts, as by chemical reaction, and this is made the cathode for the deposition of copper from its sulfate or solution of some other salt.

2. A mould is made of a *fusible alloy*, and this is electroplated as above and the alloy is removed by fusion or melting.

The first process is not so good as the second, because the conducting surface of the grafite or other materials, at their best, are very poor, and great care must be exercised to give this a "flash" of copper and a considerable time is needed to deposit this layer of copper. The wax mould is quite soft, and does not well withstand the great pressure it is subjected to, in the process of electrolysis; therefore, the thickness of the deposited copper is limited.

The second process is more adaptable for commercial purposes, as the conductivity of the mould is greater and therefore much heavier deposits are possible in less time, than with the wax mould. Furthermore, finer details can be brought out better than by any other process.

Here are some of the commodities these concerns are actually making: automobile radiators and manifolds, head-light reflectors, seamless tubing, condensers for chemical purposes, phonographic tone-arms, honor rolls or tablets, etc. The number of commodities are legion, and would necessitate quite a long list, but the possibilities are obvious to many branches of manufacturing enterprises.

Method of Moulding.

A wooden pattern is made of the article in question and a matrix is made in plaster-of-Paris. After the plaster has "set" and is thoroly dried, a duplicate is made by pouring the alloy into or on (as the case may be) the plaster negative. After the metal is cold, the plaster negative is removed and the metallic core is prepared for the copper plating solution, this being done by steeping it in a solution of caustic soda for a few minutes, and washing in running water. A copper wire is attached to the metallic core at any convenient place, which is to serve as one of the conductors.

In some cases, the article is prest into the molten fusible alloy (which is poured into a shallow pan) and the alloy is suddenly cooled or chilled.

Fusible Alloys.

Many years ago, chemists discovered that by adding tin and bismuth to lead, the resultant melting point of the alloy would be very low and in fact some of these alloys are readily plastic in hot water. Here are several typical fusible alloys that have been found to give good results for the purposes covered in the present paper. Quite a large amount of these have been compiled and their general characteristics given in the Physico-Chemical Tables. Volume 1, page 394 to 397.

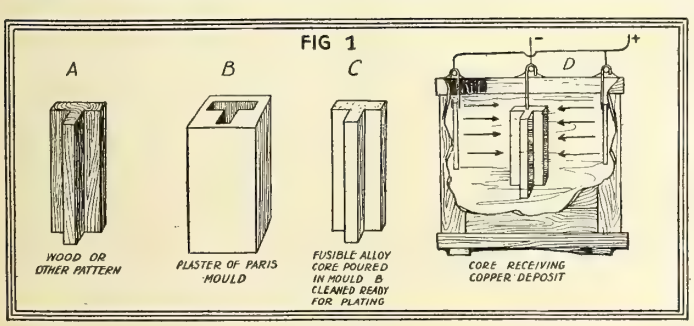
Lead	Tin	Bismuth	Mercury	Fusing Point. Degrees Fah.
2	3	5	..	212
5	3	8	..	183
2	2	5	1	158
5	3	5	2	127.5

The metals are melted in an iron pot in the usual manner, and about a pound of rosin is added to every hundred pounds of the alloy, this acting as a flux and keeping the alloy clean. The dross is then skimmed off with a ladle and it is ready for use.

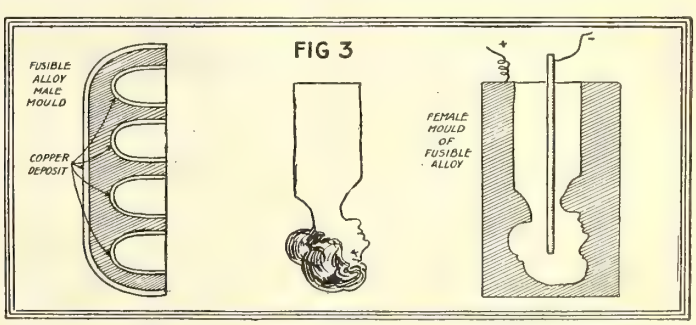
The Copper Plating Solution.

The composition of this solution usually consists of a five per cent up to a

(*Continued on page* 1008)



Clearly Showing Successive Stages From Making the Pattern to the Forming of the Copper Deposit on the Fusible Alloy Core.



At Left, an Automobile Engine Manifold, While the Center and Right Hand Views Show How a Two-Part Female Mold Is Plated from the Inside.

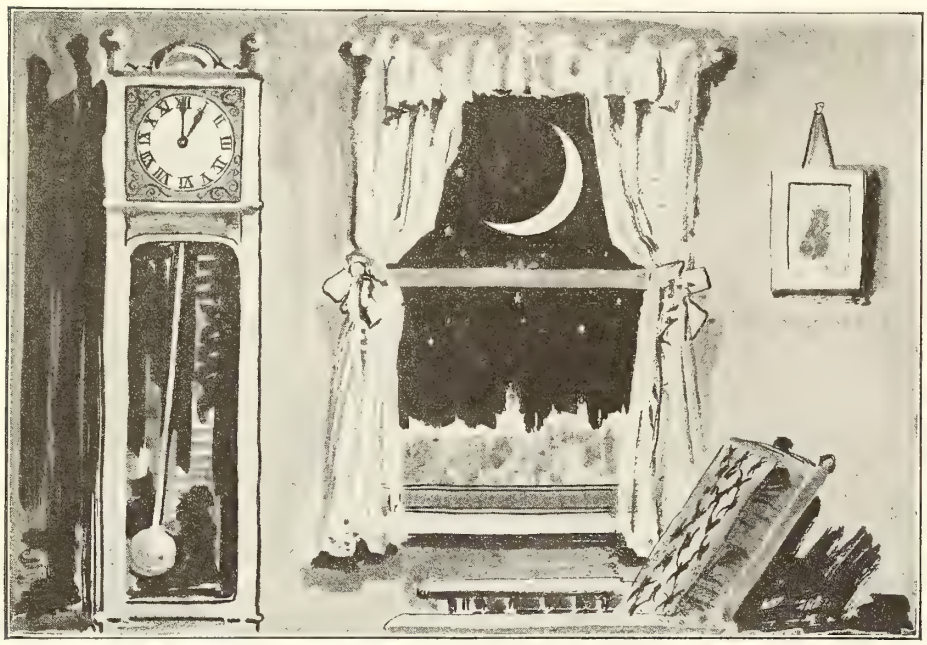
Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory

Keeping Track of the Moon

OF all celestial objects the nearest and most familiar and most troublesome is our satellite, the moon. It has probably caused the theoretical astronomer more work and worry than all the other members of the solar system combined, and he has still far from mastered the intricacies of the lunar motions, while the mistakes and blunders that an otherwise intelligent person makes when he ventures to refer to the various aspects and phases of the moon are quite unbelievable.



The Illustrations on This, as Well as on the Other Page, Show Some Impossible Moons. Often Artists Show Illustrations of Incorrect Moons of Which the Four Shown Here Are Good Examples. In This Illustration, We See a Crescent Moon at 1 A. M. High Above the Tree Tops. This Is Quite Impossible as a Crescent Moon Is Never So High Above the Horizon at This Time of the Night.

To be sure, nearly everyone knows that the moon is a solid body with no appreciable atmosphere, shining only by reflected light from the sun, and that its surface is rugged and mountainous and pitted with numberless "craters," also that it revolves around the earth in a month (approximately) keeping the same face always turned toward us, and that its various phases arise from the fact that we view the illuminated side from all different angles in the course of a month. Yet ask anyone of average intelligence when the moon rises before the sun and when after, or which limb, the eastern or western, is fully illuminated a day or so before or after full moon, knowledge that can be acquired by simple observations, or, again, why solar and lunar eclipses do not occur every month, and there are nine chances out of ten that he will not know. We all insist, tho, upon bringing the moon into poetry and fiction and we will continually depict in our drawings and paintings and our illustrated advertisements misunderstood and misrepresented moons.

It is well to bear in mind, if we are dealing with the moon, that there is but one place in the heavens where it can be found at a given time and that the lunar tables give that position whether it is in the year 2000 B. C. or the year 2000 A. D. or some year between these two dates, and it is exceedingly risky to venture to describe the appearance of the moon at some definite instant without first consulting an almanac.

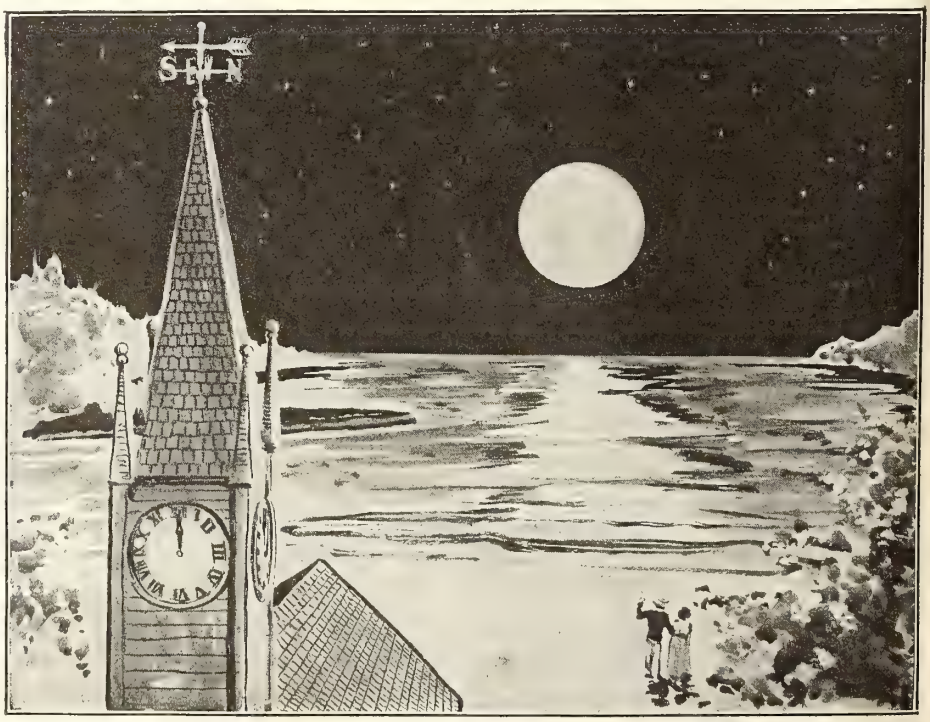
If you want to talk freely and safely about the aspect of the moon on a given date look it up in the almanac first unless you can trust your memory. Do not be like the man who was sure he had seen the Southern Cross from New Jersey and yet could not get us interested in its alleged appearance.

Who has not read in classics or in popular fiction of crescent moons riding high in midnight skies, of full moons rising above western cliffs or setting beyond eastern lakes? Who has not seen the moon drawn in impossible positions with horns pointing the way they should *not,* or a twinkling star shining thru an apparently transparent moon?

Careful observation of the moon thru its various phases and at different seasons is the best way to acquire a knowledge of the elementary fact regarding the motion of the moon thru the heavens from day to day, but that requires one to be up often after midnight and in the early hours preceding dawn and is probably one reason why we all feel so hazy as to what happens to the moon after it has passed the full.

A few fundamental rules can be easily acquired, however, and these will enable us to locate the moon in the right quarter of the heavens at any time of the day or night when we know its phase and the approximate position of the sun at the same instant, and thus we may avoid some of the most obvious blunders that are made in dealing with the general aspect of the moon at any given time.

As can be verified by direct observation the moon is always moving continually *eastward.* Since it makes a complete revolution around the earth from new moon back to new moon again in a little less than thirty days, it passes over about twelve degrees a day, (360° divided by 30) on the average, or one half a degree an hour which is the angular extent of its own diameter. Therefore every hour the moon moves eastward a distance equal to its own diameter. This is of course only *approximate* as the moon moves more rapidly in some parts of its orbit than in others. Observe the position of the moon with re-



Another Impossible Moon. It is Impossible to Have Such a Scene as This with a Full Moon in This Position at Midnight. The Correct Moon Would Have to Be Very Much Higher up in the Firmament.

spect to a near-by "fixed" star, then observe it again after an interval of two or three hours to satisfy yourself that it really is moving continually eastward.

In addition to its *real* eastward motion the moon shares the *apparent* daily *westward* motion of all celestial objects which is due to the daily rotation of the earth on its axis in the opposite direction. That is, the moon, as well as the sun, stars and planets, rise in the east and set in the west daily. On account of its continuous eastward motion, however, the moon rises later every night, on the average about fifty minutes, tho the amount of this retardation of moon-rise varies from less than half an hour to considerably over an hour at different seasons of the year and at different latitudes. In the course of a month then the moon has *risen* at all hours of the day and night and *set* at all hours of the day and night.

It might seem unnecessary to emphasize the fact that the moon always rises in the east were it not that the astronomer occasionally meets with the man who insists that he has *at times* seen the moon rise in the west.

What he has in mind is the new crescent moon which first becomes visible above the western horizon shortly after sunset tho it rises in the *east* the morning of the same day shortly after sunrise. As is also true of the sun the exact point on the horizon where the moon rises or sets varies from day to day and from season to season. *In one month the moon passes over very nearly the same path thru the heavens that the sun does in one year,* for the moon's path is inclined only five degrees to the ecliptic or apparent path of the sun thru the heavens. It can never pass more than 28½° (23½°+5°) south of the celestial equator nor more than 28½° north of it. It has a slightly greater range in altitude than the sun, therefore. North of 28½° North Latitude it always crosses the meridian *south* of the zenith and below 28½° South Latitude it crosses the meridian *north* of the zenith. In tropical regions the moon sometimes passes north of the zenith, sometimes south, or again directly thru the zenith.

Since the *full* moon is always diametrically opposite to the sun it traces out nearly the same path across the heavens that the sun traced six months before. In winter then when the sun is south of the equator the moon "rides high" at night north of the equator and, vice versa, in summer when the sun is north of the equator the full moon "rides low" south of the equator. In winter then we have more hours of moonlight than we have in summer. This may be of no great advantage in mid-latitudes but we can imagine what a boon it is in the Arctic and Antarctic regions to have the friendly moon above the horizon so continuously.

At time of "new" moon the moon lies directly between us and the sun but ordinarily passes just to the north or south of the sun since its orbit is inclined five degrees to the ecliptic. If the moon's path lay exactly in the ecliptic we would have an eclipse of the sun every month at new moon and an eclipse of the moon two weeks later at *full* moon. Now the moon crosses the ecliptic twice a month, the points of crossing being called the nodes of its orbit, but only twice a *year* is it nearly enough in line *with the sun* at the time it crosses to cause eclipses. Every year then there are two "eclipse seasons" separated by interval of six months when the moon is in line with the sun *at or close to the point where it crosses the ecliptic;* then and only then can solar and lunar eclipses occur. The solar eclipses of course, will occur when the moon is *new,* that is when the moon passes directly between the earth and the sun and throws its shadow over the earth; and the lunar eclipses two weeks later when the earth passes between the sun and moon and throws its shadow over and beyond the moon.



The Above Illustration Shows Three Glaring Mistakes.
1. It is Impossible to Have the Horns Directed Towards the Horizon. 2. A Star Cannot Appear in the Position Shown Because a Star Cannot Be Inside of the Dark Portion of the Moon. 3. The Horns Cannot Extend More Than 180 Degrees Along the Circumference.

It is doubtful if there is any astronomical subject that has been more generally misunderstood than that of solar and lunar eclipses. It is well to remember that solar eclipses can *only* occur at time of *new* moon and lunar eclipses *only* at the time of *full* moon and at the time of eclipses, whether lunar or solar, the moon is at or near its nodes, the points where its orbit crosses the ecliptic. There are always at least two solar eclipses every year and there may be as many as five. There are years when there are no *lunar* eclipses, tho ordinarily both solar and lunar eclipses occur every year, some partial others total.

The moon shines only by reflected sun light. It is of itself a solid, dark body with its day surface intensely hot and its night surface intensely cold, a world of extreme temperatures.

At new moon *all* of the night side of the moon is turned toward us, at full moon *all* of the day side. At other phases we see part of the day side and part of the night side and *the illuminated side of the moon is always the side that is towards the sun.* Failure to observe this simple rule leads to many grievous blunders in depicting the moon.

At the time of new moon the moon, moving continually eastward, passes north or south of the sun *from west to east* except when it passes directly in front of the sun causing eclipses. A day or so later the waxing crescent moon or the "new moon," as it is popularly called, becomes visible low in the west immediately after sunset. The moon is now east of the sun and will remain east of the sun until the time of full moon. During the period from new

(*Continued on page* 1021)



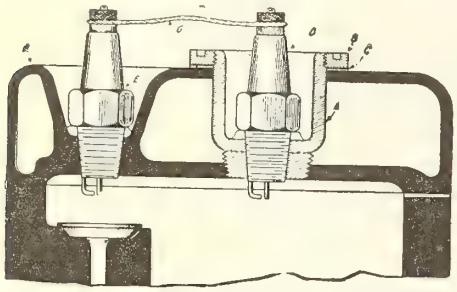
Still Another Impossible Moon. This Shows a Gibbous Moon, and It Is Impossible to Have It Thus on the Eastern Horizon. It Will Be Noted That the Wrong Limb Is Defective, and the Moon Is Below the Eastern Horizon at Sunset.

MOTOR HINTS

ADDING A SPARK PLUG TO THE FORD

First Prize $25.00

It is a well known fact today with the poorer grades of fuel that cars are compelled to operate on, that the burning of the charge in the cylinder can be accelerated by the use of greater ignition, or in other



This Diagram Shows the Mechanical Steps Necessary in Fitting in Extra Spark Plugs in the Ford or Other Automobile Engine. A Special Cast Iron or Mild Steel Bushing Is Made and Threaded into the Tapt Hole in the Inner Engine Wall. The Threaded Flange at the Top of the Bushing Makes the Water Jacket Tight. More Perfect Ignition and Combustion of the Mixture in the Cylinder Is Claimed for This Arrangement, Which Is Common in Racing Cars—Both Plugs Firing Simultaneously.

words more spark plugs. Unfortunately, however, the Ford engine is so arranged that an additional plug cannot be applied direct to the cylinder. The sketch herewith shows how a device can be made that will solve the problem and apply a plug directly over the center of the cylinder right where it performs the best. The addition of this extra plug to the Ford engine will greatly increase the power and will fire much weaker mixtures.

In the sketch (F) represents the section of the cylinder head and (E) the regular plug. (D) is the additional plug mounted in a simple cage (A). This is a very easily made part and can be turned up out of a piece of machine steel or of cast-iron; cast-iron having the same coefficient of expansion is assurance against leaks. This piece (A) is threaded with a 1-inch standard pipe thread where it goes thru the cylinder head, and at the top is threaded with a 1⅞-inch—20thd. U. S. form, at the top where the ring nut (B) clamps down on a gasket (C), thus making a water-tight joint. The walls of this cage are made ¼-inch thick and will stand the explosion force perfectly.

Care should be used to avoid any fractures in boring out the cylinder head to take this cage. If the amateur has not the right equipment for this he should take it to a good machine shop. The cost of boring the four holes will be in the neighborhood of $5. (D) is the additional spark plug and (G) the connecting wire. The whole device is inexpensive in relation to what it accomplishes and with a careful carburetor setting will give greater power on a leaner mixture and a greater mileage. In fact this stunt will allow the use of half gasoline and half kerosene. The results can be considerably improved by attention to the timer, if possible changing same to one having a positive make and break contact instead of the roller.

Contributed by
W. BURR BENNETT,
Member Society Automotive Engineers.

A HOME-MADE SPARK PLUG TESTER

Second Prize $15.00

Having had ignition trouble on a motorcycle, and as it was difficult to ascertain whether it was due to the magneto or

$50.00 IN PRIZES

Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

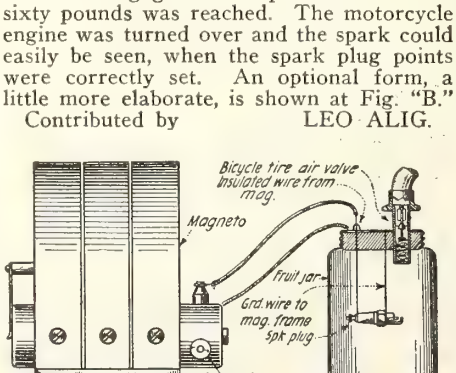
FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

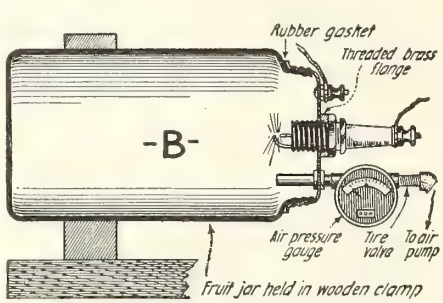
All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

spark plugs, I procured an ordinary fruit jar with a removable metal cap. I then drilled a hole thru the cap, and a bicycle air valve was taken from a tire and soldered to the top. Another hole was drilled thru the top and an insulated wire was drawn thru it; the jar was made air-tight with tin or gas-fitters' cement or sealing wax.

Next a ground wire was soldered on the inside and another one on the outside of the cap. The spark plug was attached to the wires on the inside of the cap, and the cap was tightly screwed on the fruit jar, placing a rubber washer between the cap and the jar. Air was then pumped into the jar and the air pressure tested with an automobile tire gage until a pressure of about sixty pounds was reached. The motorcycle engine was turned over and the spark could easily be seen, when the spark plug points were correctly set. An optional form, a little more elaborate, is shown at Fig. "B."

Contributed by LEO ALIG.





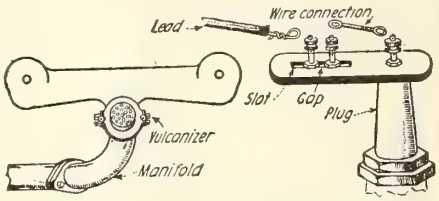
The Gap in the Spark Plug Is About 1/32 inch and the One-Half Inch Spark Given by the Ignition Apparatus Is Greatly Reduced by the Compression in the Cylinder. To Test Plugs Under Compression Conditions, the Plug Is Here Placed in a Glass Fruit Jar with the Top Made Air-Tight and Air Pumped in by Means of a Tire Valve, Together with a Foot or Hand Pump.

GAS INTAKE HEATER AND SPARK INTENSIFIER

Third Prize $10.00

I have tried a great many different devices of my own conception on my car, some of which have proven quite practical.

The *gas intake heater* here shown I have found works very well. A small tire and tube vulcanizer, such as the owner usually carries in the tool kit, is clampt to the intake manifold in such a position that it



Many Suggestions Have Been Given for Heating the Intake Manifold So as to Rapidly Vaporize the Gas from the Carburetor, in Cold Weather, But One of the Simplest Is That Shown Above, Utilizing the Ordinary Gasoline Inner Tube Vulcanizer. The Second Drawing Shows How a Simple Spark Intensifier in the Form of an Auxiliary Gap Can Be Readily Made.

will hold several teaspoonfuls of gasoline. This need not be removed when the motor is started, but may be left in place all winter, or until it is needed for other use. Two spoonfuls of gasoline should heat the manifold sufficiently to vaporize the gas and start the motor running.

A second idea is that of a *spark intensifier.* Instead of paying from one to two and a half dollars each for intensifiers, why not make them at a cost of only a few cents? All that is required is some sheet fibre (Bakelite best) and two dry cell terminals for each intensifier. A slot is cut in the fibre and two terminal binding posts are placed in same. One of the posts is connected to the plug electrode which comes up thru a small hole in the fibre, and the other is connected to the lead from the spark coils or magneto. The posts may be moved up or down the slot, thereby making the adjustment.

Contributed by
DENBY C. STEPHENSON.

HOW TO PULL IN IF YOUR GASOLINE VACUUM OR SUCTION FAILS.

I was in the country ten miles when my motor died with indications that gasoline was not reaching the carburetor, and upon investigation an air leak was discovered around the top of the *vacuum tank,* which stopt the suction of the gasoline from the reservoir. I saved myself from being towed in by removing gasoline from the reservoir and filling the vacuum tank, so that the gasoline would flow to the carburetor. There is a small plug in the center of the top of the vacuum tank which is easily removed to permit the insertion of gasoline. I used a small squirt gun to transfer the gasoline, but in the absence of a squirt gun a paper funnel can be devised, with which to pour gasoline into the vacuum chamber after it has been withdrawn from the reservoir or obtained from some other source. The vacuum holds enough gasoline to run six miles and two operations of a few minutes each enabled me to reach a garage without delay or expense. The point is to get to a garage; and the above stunt will enable you to do it if your vacuum system hangs you up.

Contributed by ALBERT A. JONES.

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

Air Shield for Window

IT would not be much of an exaggeration to say that there have been almost as many kinds of window air shields made as there were people who have used them, for each person has had an individual crotchet as to what a

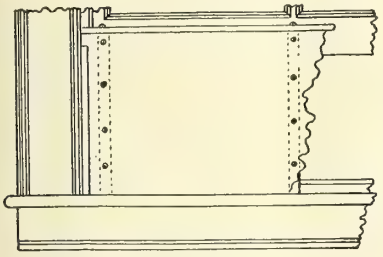
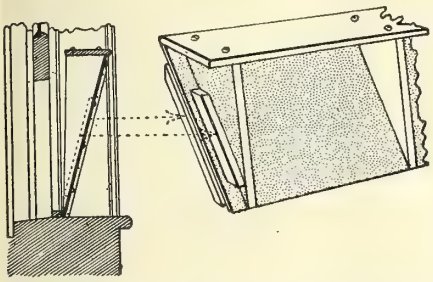


Plate 1.



Window Ventilating Board Constructed from a Few Light Pieces of Wood, Some Screws and a Length of Light Wood or Beaver Board. It Slides in Cleats Fastened to the Sides of the Window Frame.

shield should be; so the varieties are almost innumerable. Whether expensive and ornate or inexpensive and simple, the chief object of the apparatus is to keep a room supplied with fresh air, and at the same time prevent rain, snow or drafts from entering the apartment. Various efforts have been made to keep dust from entering as well, but this is asking almost too much of the shield, for to be effective at all, it must let the air come in freely—whether the air is laden with dust or not.

Our figure shows the simplest yet most effective form of shield ever made. It can be made as shown of wood and beaverboard without much trouble and at a very small cost. The whole attachment can then be painted or stained to match the window frame. It has the advantage of being instantly removable, only the cleats at the ends being permanently attached to the window frame. The shield is slid in and out of the cleats at will, for a daily brushing, or for washing the window glass. It can be constructed to fit any window, can be of any height and, if painted, will stand any kind of weather.

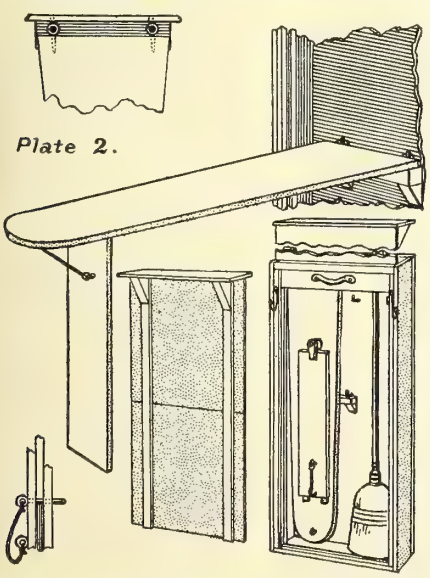


Plate 2.

Dustproof Cabinet, Easily Made by the Home Mechanic, to Accommodate the Family Broom and Ironing Board. A support for the Ironing Board Is Also Provided in This Design.

Broom and Ironing-Board Cabinet

Every woman's kitchen is clean—we know that—but there are a few things that every woman wants to keep extra clean—removed, as one may say, from the vapors of the kitchen; these are the ironing-board, broom, brushes used for dusting, etc.

The figure shows a cabinet that is devised to accommodate this desire. It is designed subject to alterations for individual requirements, but consists in all cases of a receptacle for the articles mentioned, and of a support for the ironing-board, as shown. An ordinary ironing-board is made usable with the device, simply by adding screw-eyes at the large end and a hinged board-rest at the rounded end; the attachment for the purpose is fully illustrated. The door slides, like a window, in a groove, and carries the top of the cabinet fastened to it. It is held open with metal pins, past thru holes in the groove cleats. Beaverboard is used for the door, held by wooden cleats, to which the cabinet top is also fastened. The cabinet back can also be made of beaverboard, but in this case the hooks that hold the ironing-board, its shelf and the hooks for the brushes will have to be secured by passing thru the beaverboard back and fastening in the wainscoting of the kitchen wall.

Stopping a Hole in Agateware

We have not all come to the point of discarding agateware cooking utensils for aluminum, and some, therefore, still use the former. Unfortunately, this kind of ware will develop holes in the most unaccountable way, thus putting an otherwise perfect pot or pan out of commission. There is only one safe, home-mechanical way of repairing an implement of this kind, and that is with solder. And fortunately in this instance the housewife can do the job quite as well as the "househusband."

The pictures shown in the illustration herewith give the method without much explanation being necessary. It is necessary, tho, to inform the lady tinker that solder will not adhere to agate surfaces, and that her repairs will be more in the nature of a riveting job than the common one of tinkering. She must for this reason have her solder cover enough of the surface of the outside and exterior to bind and stop the leak, otherwise the rivet will be useless. The procedure is as follows:

First remove grease or dirt from surfaces by scouring with sand, then make the hole at least an eighth of an inch in diameter so that the solder will run thru when melted. Next make a kind of putty by wetting flour or bread, shaping it, with the proper sized depression, as shown, for a mould to hold and shape the solder on the outside of the hole—also illustrated—this putty usually adhering to the agate sufficiently for the purpose. An iron spoon with a wooden handle will answer as the melting and pouring ladle, the solder being melted over a gas or coal fire. When the solder is cooled (say in fifteen minutes) remove the putty and try the vessel with water. If the leak is stopt no riveting is required; otherwise, rivet in the manner shown until it is stopt.

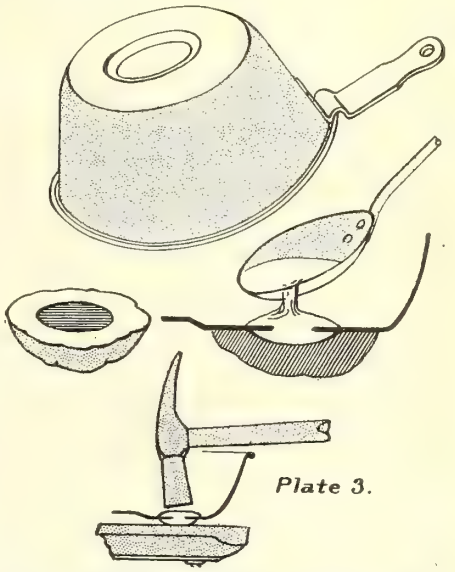


Plate 3.

Simple Method of Plugging a Hole in Agate or Similar Kitchen Wear. A Mold Is Made, Formed as Shown, and Hot Solder Poured into the Hole and Afterward Riveted with a Hammer.

Collar-Button Box

Here we show an interesting way of making a collar-button box, or one for containing similar articles. It is held together with wooden or metal pins, and lends itself to variations in size and shape which will make the construction of a number of these boxes, say for Christmas or birthday presents, very fascinating. The ever popular demand for the so-called "mission wood" in articles of this nature will cause them to be received with appreciative pleasure, while the inventive genius of the builder in creating new combinations or forms will be found equally attractive.

The principle of construction is to make the box of a single piece of wood, and

(*Continued on page* 1006)

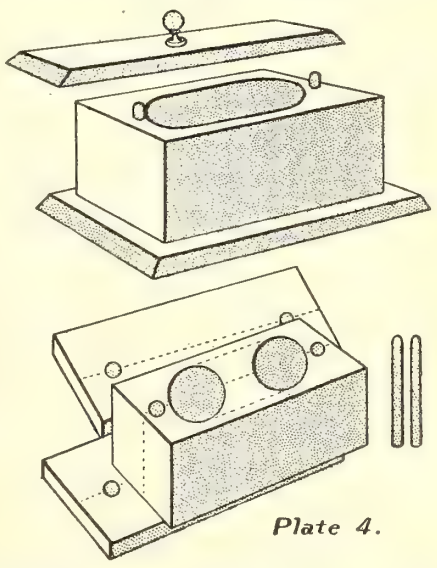


Plate 4.

Home-Made Collar Button or Jewelry Box Which Can Be Made Easily from Wood. If Constructed of Mahogany and Well Finished, It Will Present a Very Attractive Appearance. It May Also Be Gold Lacquered.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

METALS AND THEIR ALLOYS

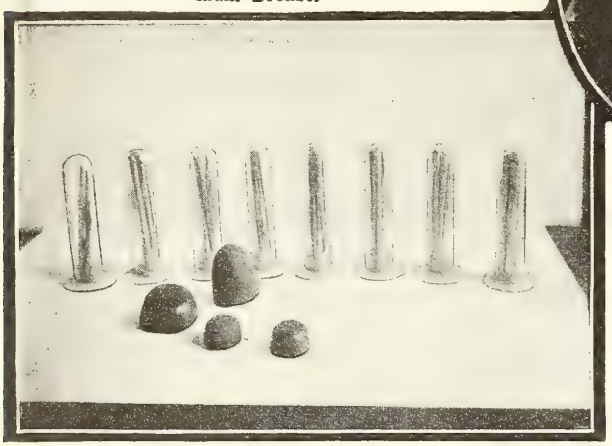
ONE of the earliest chemical facts to be discovered was the ease with which certain metals would alloy, or fuse together, when placed in the melting pot and subjected to heat. It was also early discovered that these new combinations of metals often possest properties which made them vastly superior for many purposes to the individual metals themselves. Thus, bronze, which was probably the first alloy to be made, was much harder and better adapted to fashioning weapons of warfare and domestic implements than either of its constituents, copper or tin. Bronze, too, was known long before primitive man had mastered the metallurgy of iron and steel and those early metal workers were actually able to temper this alloy and make it take a cutting edge—something that now seems to be one of the lost arts. With weapons and implements of bronze the cave men of Europe slew the savage beasts, fought their enemies and later felled the forests and tilled the soil. But following this first and tremendously important alloy has come a host of others, no less useful to the race. Indeed alloys are among the most valuable products of the metallurgist's art and some of the greatest triumphs of modern chemistry are associated with this work.

An alloy is a uniform mixture of several metals which have been melted together. The metals may be mixed in any desired proportions and are therefore not chemically combined. Each metal is present in the free state and yet such a combination of metals in some way, not well understood, modifies in a wonderful degree the physical properties of the constituents.

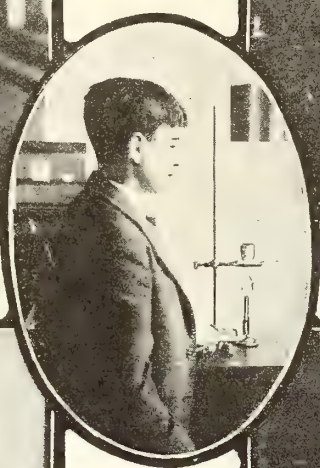
The preparation of alloys is an exceedingly simple process but an interesting one. For those alloys having a low melting point only a fire clay crucible, Bunsen burner and ring stand are required. For those of higher melting point either a forced draft or some form of electric furnace will be necessary.



Melting Wood's Metal in Hot Water.



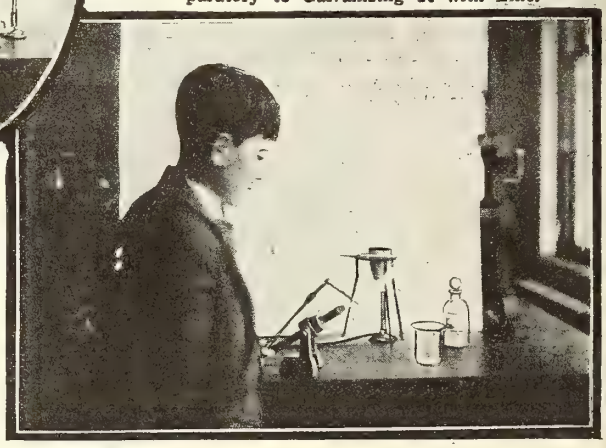
Samples of Alloys Made by Boys: Pewter, Solder, Type Metal, Wood's Metal, Bronze, Brass and Aluminum Bronze.



Below — Making Solder in the Chemical Laboratory. A Small Crucible Contains the Ingredients, Which Are Heated by Bunsen Gas Burner.



Removing the Crucible of Molten Brass from the Electric Furnace, Preparatory to Plunging It into a Jar of Cold Water.



Heating an Iron Nail in the Blast Lamp Flame, Preparatory to Galvanizing It with Zinc.

The Preparation of Solder

For our first alloy we will select one which has a low melting point and is easy to make. Arrange a ring stand, Bunsen burner and fire clay crucible as shown in Fig. 1. Into the crucible put equal parts by weight of lead and tin. Using a small flame at first, gradually increase the temperature until all of the metal has melted down into a uniform mixture.

For shaping the solder into sticks, have at hand a plaster of Paris mould. This can be made by mixing the plaster of Paris in a box cover and while still soft pressing into it two or three lead pencils. Into these depressions pour the molten metal and allow it to solidify.

The Pewter from which the tableware of early Colonial days was made consisted of an

(*Continued on page* 1016)

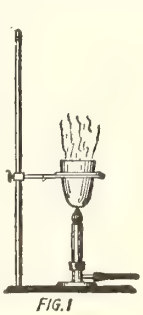


FIG. 1

Apparatus for Making Low Melting Point Alloys.



FIG. 2

Glass Specimen Tube for Mounting Preparations.

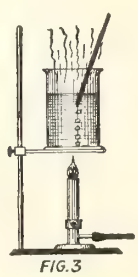


FIG. 3

Melting Wood's Metal in Hot Water.

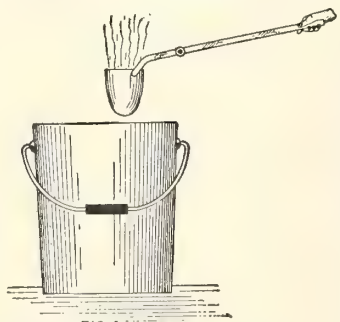
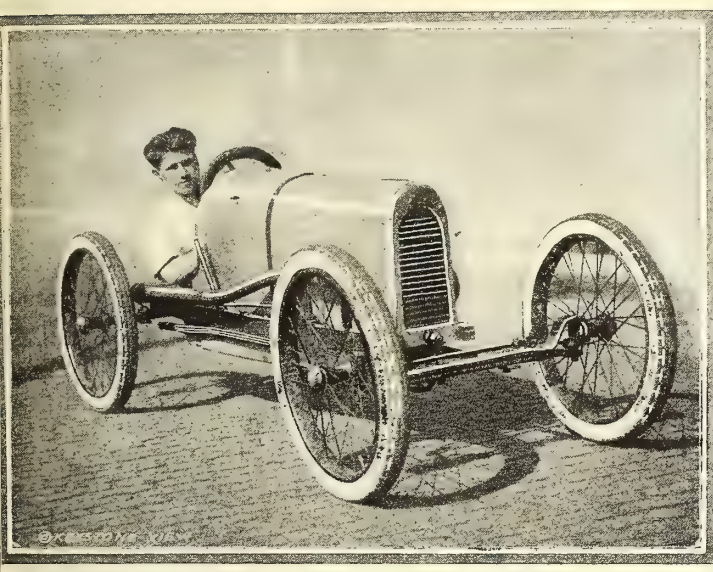


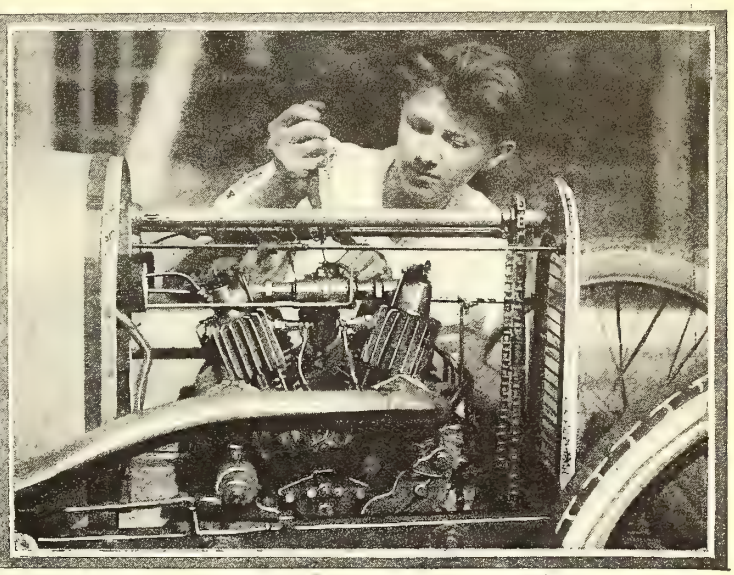
FIG. 4

Plunging Crucible of Molten Bronze into Pail of Water.

Building A Small Automobile

By H. Winfield Secor





The Two Photographs Above Show Master Harry Habig, a Youthful Automobile Builder Who Surprised Even Himself in the Speed Attainable with His Home-Made Motor Car. He Had Calculated that It Would Travel Along at About 30 Miles per Hour, but the Machine Developed Over 40 Miles an Hour. The Car Is Driven by a Motorcycle Engine.

IT took Harry Habig, a youthful automobile builder, a whole year to build the miniature automobile illustrated from parts of an old motorcycle, some from an old bicycle and still other parts which were original and which he had to make himself. But when it was finished it was no disappointment, for he figured right when he said it would go some better than 30 miles an hour. It developed over 40 miles an hour and Habig avers that, after he has substituted a chain drive for the present belt drive, his midget racer will travel 70 miles an hour!

The unique little racer has a six-foot wheel base. It is equipt with a two-cylinder motor, taken from a motorcycle, and contains a double ignition system. The springs were tensioned and bent by himself. He also installed in the machine a new idea in the steering system. The steering wheel shaft extends horizontally to the front of the machine and fastens into the top of the radiator where an endless driving chain taken from an old bicycle connects by means of sprockets to the steering mechanism of the front axle.

This miniature speedster weighs less than a thousand pounds and travels 42 miles on a measured gallon of gasoline.

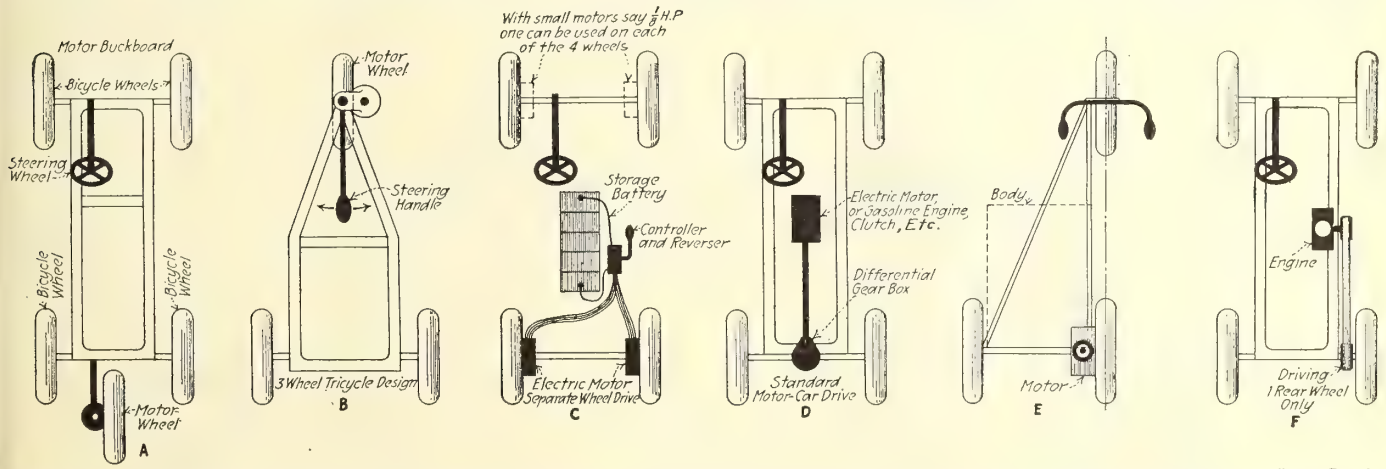
The youthful inventor and builder is only fifteen years old and is attending the first year class at the Ohio Mechanics Institute. He has built two model submarine chasers and several model airplanes which were on exhibition at the Institute.

A Small Home-Made Automobile

Youthful Master Habig started something when he built his miniature automobile—at least he influenced the Editor's ideas to the extent of preparing a short article on the subject and featuring some pertinent principles which can be easily worked out by the multitude of young motoring enthusiasts who may desire to build a small motor tricycle or runabout.

The great desire of almost everyone is to ride rather than walk, and while motorcycles are becoming more commonly known and employed every day, the commercial machines cost almost as much as a full-sized automobile, and therefore, many people cannot avail themselves of the privileges engendered by owning one of these machines.

A gasoline motor rated at 1½ to 2 horsepower such as employed in the Smith motor wheels as well as in several other motor drive attachments for introducing motors on bicycles, are sold on the open market at a very reasonable price, either



Figs. 1A to 1F, Inclusive, Shown Above, Illustrate the Principal Forms of Chassis Which Can Be Followed in Designing a Small Motor Car. In the Accompanying Article Details and Reasons for Using the Various Forms of Drive, Employing Both 3 and 4 Wheels, Are Thoroly Discust. The Simplest Machine, Employing No Differential Gear, Is the Three-Wheel or Tricycle Design Indicated at B and E.

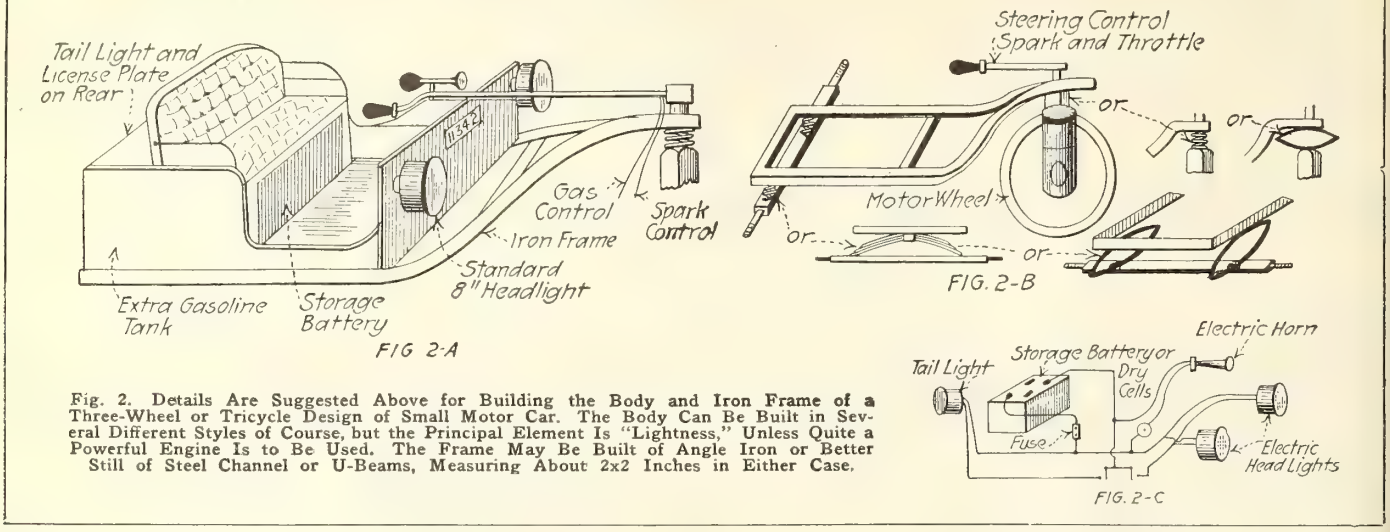


Fig. 2. Details Are Suggested Above for Building the Body and Iron Frame of a Three-Wheel or Tricycle Design of Small Motor Car. The Body Can Be Built in Several Different Styles of Course, but the Principal Element Is "Lightness," Unless Quite a Powerful Engine Is to Be Used. The Frame May Be Built of Angle Iron or Better Still of Steel Channel or U-Beams, Measuring About 2x2 Inches in Either Case.

new or second-hand, for constructing a small machine of the type outlined in the following description.

General Types of Small Automobiles

About the first important factor to be considered in designing or building a small motor tricycle or buckboard is the arrangement and disposal of the wheels and the power plant. At Fig. 1, there are shown the six principal methods which should be followed in propelling a small automobile.

Fig. *A* shows the design followed in building a small motor buckboard which the writer of this article had the pleasure of seeing in actual operation last summer. This machine measured about six feet in length between the axles and about three feet in width, and it contained two seats, often carrying a load of two adult passengers weighing about 135 pounds each.

The four wheels, numbered 1 to 4, in this case, are simply four bicycle wheels and may be used with or without ball bearings, the ball bearings causing the machine to run much more smoothly and easily, of course. The motor wheel, complete with engine, gasoline tank, etc., of a well-known type, was secured with an iron frame to the rear of the vehicle, in the manner shown.

The front wheels were turned to right or left by a steering wheel of the usual type. Resiliency to a fair extent is obtainable in these automobiles, by the use of springs placed between the body and axles, or by employing the buckboard principle. This involves the use of a number of slats or strips of some tough springy wood, such as hickory or spruce. The strips should usually measure about 2″ by ⅜″, and are bolted on top of the front and rear axles, or to a piece of channel iron attached to the axles. The spark and throttle control rods from the motor wheel are carried forward to the driver's seat, so as to be convenient.

One of the simplest and best designs, efficiency and other things considered, is the three-wheel disposition and drive shown at Fig. *B*. This is the famous tricycle principle so widely followed by the European builders of small motor vehicles, some of which carry three and four passengers with but a small engine.

The bugaboo that scares many of the would-be miniature auto builders, in most cases, is the complex machinery required in applying the driving power to the rear axle involving the well known compound gearing, known as the "differential," which device distributes the power from the main driving shaft to the two rear axles and wheels evenly, no matter at what angle the car may be turning.

The point should be kept in mind in the present argument that in turning a corner or a circle, the outer wheel of the car on the same axle should be able to rotate faster than the one on the inner or smaller part of the circle or curve. This is the principal reason for the differential gear found in the center of the rear axles of all modern cars. To eliminate this most expensive and important part of motor car machinery, has suggested to the minds of the builders of small motor vehicles, particularly of the European manufacturers, the employment of the well-known three-wheel tricycle, shown at Fig. *B*, and the writer has given herewith, several drawings and pointed out some of the simplest ways in which to build a machine of this type.

Before going further, we will consider several other methods of driving a motor vehicle. Fig. *C* shows an electric car for those who have or wish to build storage batteries and drive their machines by means of electric motors.

Electric vehicles have been built for several years, at least some types of them—without a differential on the rear axle and with the two rear wheels driven by separate motors in the manner shown at Fig. *C*. For a small machine of the buckboard or similar type, and light in weight, the two motors, if applied to the rear wheels, may develop about one-quarter to one-half horsepower each. Generally speaking, a small motor vehicle of this type, about six or seven feet long between axles, and utilizing bicycle or motorcycle wheels, will require about one-half horse-power at least, to drive the machine at a speed of eight or ten miles an hour.

Commercial machines have also been built, and are in present-day use, employing a relatively small electric motor applied to each of the four wheels. A condition may arise where the prospective motor car builder will have available four small motors rated at one-eighth to one-quarter horse-power each, let us say. These can be used in the manner shown at Fig. *C*, applying the motor thru a gear, one to each wheel. A pinion should be placed firmly on the shaft of an electric motor and a larger gear with about 10 to 15 times as many teeth as on the pinion is to be secured to the wheel.

(*Continued on page* 1020)

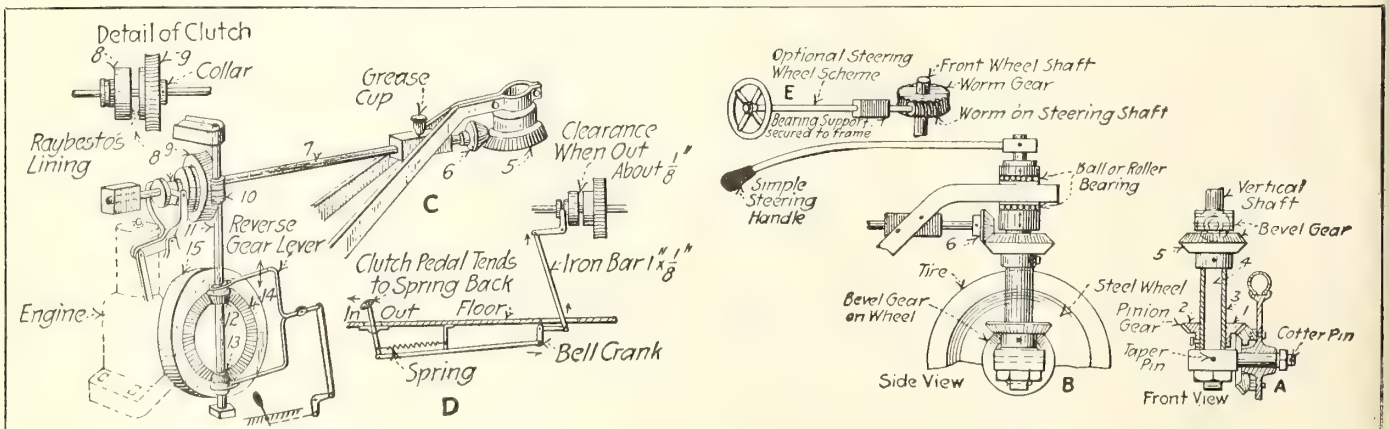


Fig. 3. For Those Desiring to Build a More Elaborate Tricycle Type of Motor Car with a Heavier Engine Than That Found on the Patented Motor-Wheel Units, a Special Design Is Illustrated Above Whereby Clutch and Reverse Mechanisms Are Included, Together with Provision for Using an Ordinary Gasoline Engine Rated at 1½ to 2 H. P. or More, the Power Being Transmitted to the Front Wheel of the Car by the Gearing Shown.

Bench Drill from Pipe Fittings

By R. E. NELSON

THE accompanying photograph shows a bench drill which the writer constructed from scrap pipe fittings and odds and ends about the shop. Cast fittings should be used as they add to the rigidity of the frame. The photograph shows the motor mounted on a box over the rear bearing but its position may be varied to suit the builder. A snap switch with fuse block mounted on the side of the box controls the motor. Five sixteenths or ⅜" round leather belting is large enough to drive the drill to full capacity.

Frame

For the frame the following pipe fittings are required:

One half of a 1½" Flange Union—"Y" fig. 2.
1 Nipple 1½" x 10½" E. H. Pipe—"Z" fig. 2.
1 Nipple 1" x 5" E. H. Pipe—"U" fig. 2.
1 Nipple ¾" x 4½" E. H. Pipe—"N" fig. 2.
1 Nipple ¾" x 4¾" E. H. Pipe—"N" fig. 2.
1 Cast Tee 1½" x 1½" x ¾"—"X" fig. 2.
1 Bushing 1½" x 1"—to fit top of "X."
2 Cast Tees ¾" x ¾" x ¾"—"C" and "C."
1 Cast Tee 1" x ¾" x ¾"—"Q" fig. 2.
1 Piece 2" x 8" x 24" Oak S4S for Base.

Cut and thread the nipples as per dimensions in figure 3 and assemble the frame. Bolt it to the oak base and test it for rigidity and alignment. Larger fittings can be used by bushing them down in case the above sizes are not obtainable. When in its lowest position the chuck is 4½" from the base and as no table has been provided for bringing the work toward the drill, a few wood blocks of various thicknesses should be provided for adjusting the work to the proper height.

Chuck and Spindle

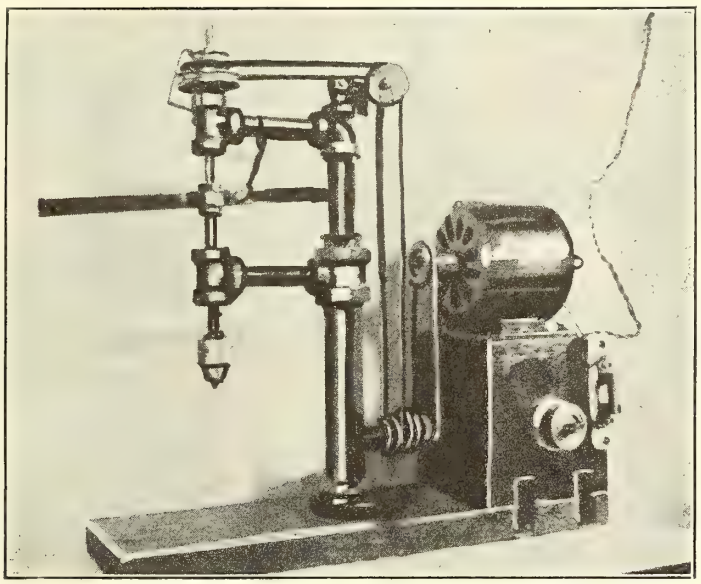
The chuck "A," figure 2 should be purchased as it is beyond the scope of the amateur. Get one that has a ½" shank which screws into the top of the chuck body and operates the jaws. This shank should be removed and the spindle threaded to fit in its place.

The spindle "B," figure 2, is turned from machine steel to dimensions shown in figure 3 and a keyway is cut in the upper end as shown. The spindle slides up and down thru the pulley "H" while the key "I" is relied upon to drive the spindle. The lower end of the spindle is threaded to fit the particular chuck purchased. The spindle pulley "H," figure 2, is shown in detail in figure 3. The best material to make it from is cast iron or brass. A 1/16" x ⅛" keyway is cut in the pulley to correspond with the one in the spindle. Make the key "I," figure 3, next and make it fit very tightly in the keyway of the pulley but have it fit loosely in the keyway in the spindle so that the spindle can be raised and lowered while the pulley "H" is driving it. As a further precaution to prevent the pulley "H" from rising when the spindle is raised make a small piece "G," figures 2 and 3, and fasten it to the upper tee with machine screws.

An easy way of cutting the keyways in the spindle and pulley is as follows: While the work is still between centers or in the chuck place a cutter with an ⅛" face sideways in an Armstrong holder or boring bar so that the cutting edge is toward the headstock. Run the carriage back and forth by hand and at the same time advance the cutter and a perfect keyway will be cut. Care must be taken to lock or clamp the headstock spindle so that it cannot rotate or shift its position even so much as a 1/100 of an inch or the keyway will be imperfect.

Feed Device

The easiest feed device to construct is a lever feed. It consists of the following parts: the lever "F," figures 2 and 3, which is hinged to the piece "P" by a stove bolt, two collars "D" and "D'" which are pinned to the spindle and the collar "E" which fits loosely between them but is not pinned to the spindle and does not rotate with it. Collar "E" has two projecting pins fastened to it (figure 3) which engage in the holes "O" and "O'" of the lever. The feed device operates as follows: When the lever is prest down, the two pins which are fastened to the collar "E" and which engage in the holes "O" and "O'" of the lever, cause the collar "E" to move down with the lever, but, the collar "E" bears against the collar "D" which is pinned to the spindle, and consequently the spindle is fed down with the lever. When the lever is raised collar "E" bears against the upper collar "D'" and the spindle is raised.



The Finished Bench Drill Constructed From Pipe Fittings.

Make the lever "F," figure 3, by riveting two pieces of ⅛" x ¾" strap iron together. The loop is made by bending the pieces around a 1¼" bar. The ¼" holes "O" and "O'" in which the pins and collar "E" engage are drilled on opposite sides of the loop as shown. Drill two ¼" holes in the end of the lever where it hinges to the piece "P" and file them out to form a slot. Unless this is done the holes "O" and "O'" will describe an arc and the spindle will bind. Make the anchor piece "P" from a piece of strap iron and fasten or clamp it to the nipple "U" with machine screws or a stove bolt. A stove bolt will do to hinge the lever on. A small spring keeps the spindle raised when the lever is released.

The two collars "D" and "D,'" figure 3, are similar and are turned from brass. They should fit the spindle very snugly. Turn up the collar "E" from brass also and have it fit loosely over the spindle. Drill a ¼" hole right through the collar edgewise and fit two pins in it letting them project about ½" to engage in the holes "O" and "O'" of the lever. To locate the position of the collars "D" and "D'" on the spindle proceed as follows: place the collar "D" on the spindle with its lower face 9" from the upper end of the spindle; and over it place a washer made from heavy paper. Next put the collar "E" in place and put another paper washer over it and then put collar "D'" on top. Clamp the three collars together and drill a ⅛" hole edgewise thru collar "D" and slip a pin in it to keep the assembly in place and then drill a similar hole in collar "D.'" Remove the clamp but do not remove the pins so that the location of the collars will not be disturbed until the spindle is finally put in place. If it becomes necessary to remove the collars for any purpose be sure to mark them with punch marks or otherwise so that they can be put back in the same position that they occupied before. It will, of course, be necessary to remove the paper washers before the drill is run.

Belt Tightener

The belt tightener and idler device consists of a plug "M," figure 2 and 3, threaded to fit the top of the tee "Q" and slotted as shown. In the slot is clamped the carrier "K" which holds the shaft "L" on which two pulleys, "J" and "J'" rotate in opposite directions. Make the plug "M" from brass or soft steel and thread it to fit the tee "Q." Cut a slot in it as shown in figure 3 and drill a hole for a clamping bolt. The carrier "K" is made from soft steel and slotted as shown in figure 3. A ⅜" hole is drilled at the large end for the shaft "L" which is a piece of ⅜" round soft steel polished up and threaded at each end for a nut. It should be driven into the ⅜" hole in the carrier "K" and pinned if necessary so that it will not rotate. The two pulleys "J" and "J'" are similar and should be made from brass, iron or hard babbitt. They should rotate freely on the shaft "L."

Drive Shaft

The drive or countershaft parts should next be constructed. There are five parts to these: a shaft "T," is supported at each end by the bearings "S" and "W" which are described in detail later on.

Turn up the shaft "T" from soft steel as per dimensions in figure 3. The three-step cone pulley should next be turned up from a piece of cast iron or brass or hard babbitt. The babbitt is just as good as the cast iron or brass and can be easily cast in the home work-shop. It is also very easy to machine. The detail dimensions are shown in figure 3. Hold the casting in a chuck or clamp it on a face plate and bore a 7/16" hole thru the center. With an inside boring tool bore out the diameter to a scant ½" or just enough so that the shaft "T" will fit very tightly in the hole. If this is done it will be unnecessary to use pins or set screws to fasten it to the shaft. Use the same method in turning up the pulley "V," or if desired, both pulleys may be turned in one piece.

(*Continued on page* 1004)

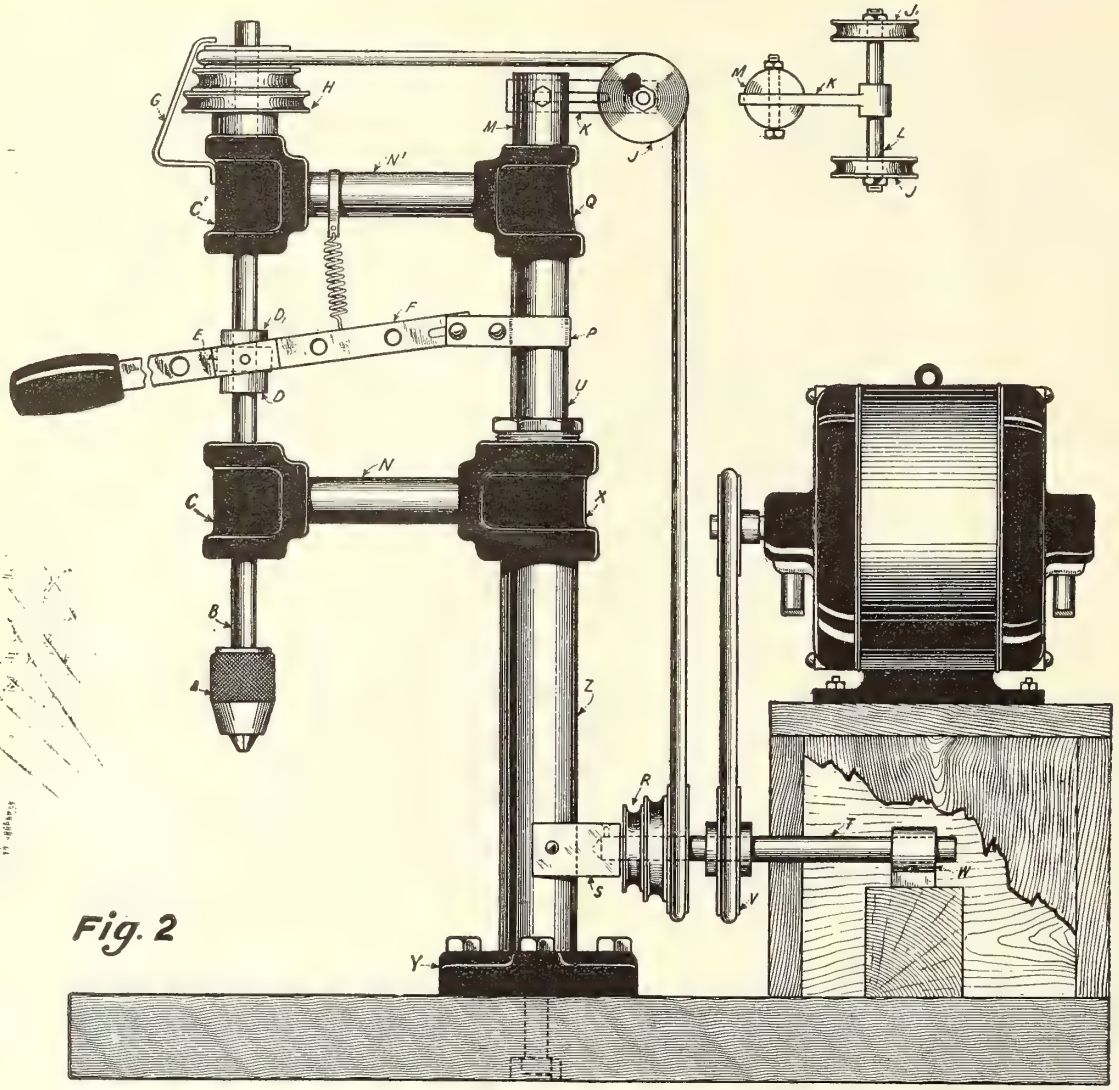


Fig. 2

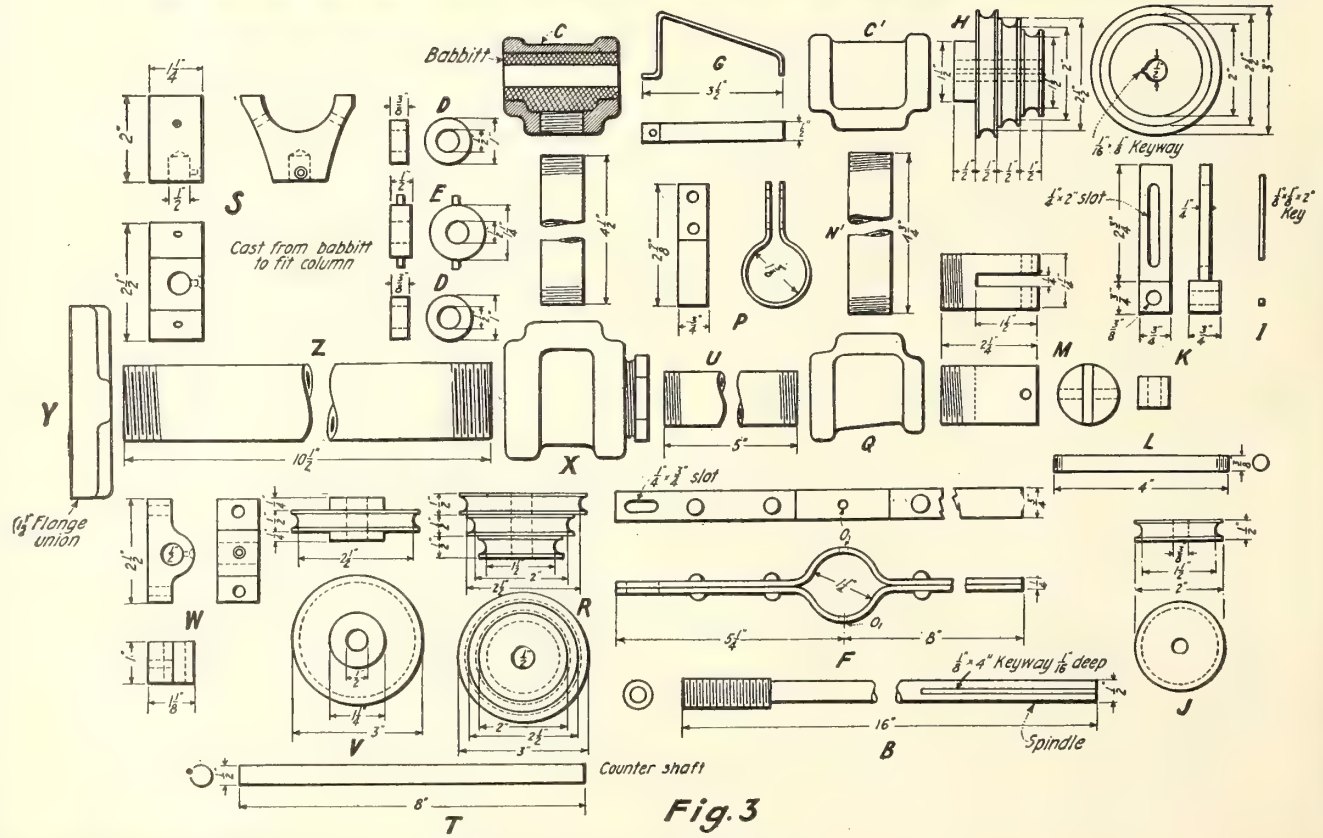


Fig. 3

Full Description on opposite page

Perpetual Motion Prize Winner

In the October, 1920, issue of SCIENCE AND INVENTION we publisht a special "Perpetual Motion" article submitted by Mr. d'Abro, who offered a ten-dollar ($10.00) prize for the best explanation as to why this machine (reproduced in the illustration herewith for the benefit of our readers who did not see the original article) would not successfully operate.

We received about 1,500 letters, the majority of the writers of which did not definitely explain why the machine would not operate perpetually, without committing themselves to a host of misstatements of the laws of physics, which automatically ruled them out.

These letters were examined by several scientific men of high repute, including among others Prof. T. O'Conor Sloane, Ph.D., LL.D., and the editors, H. Gernsback, E.E., and H. W. Secor, E.E.

The letter to which the $10.00 prize has been awarded, together with several of the next best letters, are publisht herewith.—The Editors.

[MR. d'ABRO'S ARTICLE REPRINTED BELOW.]

IN your February issue you publisht different answers to your "Perpetual Motion Prize Contest."

The first prize is allotted to Mr. Burgin, who claims that your first perpetual motion device will not work because of the buoyancy of the rubber chambers being the same on either side.

According to Boyle's law, this would mean that the pressure of the imprisoned air is the same whether the weight be crushing the rubber cylinder down or whether it be stretching it lengthwise.

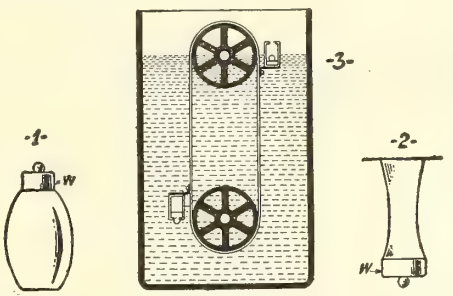
Surely this is incorrect. Assuming that the cylinders contain air at atmospheric pressure and are immersed in the atmosphere, when the weight presses down the top of the cylinder the walls bulge out and the cylinder assumes the form of a barrel—when a state of equilibrium is reached. (See Fig. 1.)

The pressure of the imprisoned air on the top surface of the cylinder is sufficient to counteract the push of the atmosphere, plus the push of the weight—thus the pressure of the imprisoned air is increased.

On the other hand, when the weight is suspended at the base of the cylinder the tendency is to lengthen the cylinder; thus increase the volume of the imprisoned air and decrease its pressure. (See Fig. 2.)

The outside atmosphere will push in the walls of the cylinder and create a waist. Finally when a state of equilibrium is reached, the interior push on the bottom of the cylinder will be equal to the atmospheric push on the bottom, minus the weight, thus the interior pressure is reduced.

I am assuming for simplicity's sake that the bottom and top of the cylinder are rigid and only the walls elastic.



Three Phases of the Recent Perpetual Motion "Water-Bucket Machine" Which Formed One of the Problems of the Prize Contest Some Months Ago. Mr. d'Abro Offers a Ten-Dollar Prize ($10) to Anyone Who Can Give a Successful Explanation to the Questions He Here Propounds. All Answers Must Be in the Editor's Office by October 15, 1920.

In short, according to Boyle's law, the buoyancy cannot be the same on both sides and the device must rotate—and yet, of course, it will not!

May I suggest a slight modification of your highly ingenious device? Instead of rubber pockets let us consider metallic cylinders in which pistons can run without friction, and let us fix the weights to these pistons and place rings at the extremities of the cylinders to prevent the pistons from slipping out. Let us suppose that the cylinders contain no air, and let us place the device in water.

When the weights press down the pistons toward the bases of the cylinder, the pistons will come in contact with the bases of the cylinders, since no air is interposed—when the weights pull the pistons down away from the bases of the cylinders the pistons will glide down to the other extremities of the cylinders until arrested by the rings. (See Fig. 3.) To obtain this result it will be necessary for the weights to be of sufficient magnitude to overcome the cumulative effect of the atmospheric pressure, plus the hydrostatic pressure—theoretically, at least, this is possible.

In this modified form the increase in volume and thus of buoyancy of the cylinders is manifest, and the device should undoubtedly rotate. If not, why not?

Could any of your readers explain the reason? I hereby offer a ten-dollar prize for the best answer.

(ED. NOTE.—*Mr. d'Abro has deposited the* $10.00 *prize money with us. Send all letters of explanation to Perpetual Motion Editor,* SCIENCE & INVENTION, 233 *Fulton St., New York City.*)

Prize Winner and Honorable Mention Awards

ERNEST K. CHAPIN

$10.00 Prize Winner

I herewith submit an explanation of why Mr. D'Abro's perpetual motion machine would not operate.

The upward force of buoyancy which is supposed to operate the machine is gained at the expense of the lowering of the weight in the cylinder which is rising. Additional energy must therefore be applied to the machine sometime during each cycle to boost this weight over the top for another trip. This fact will be seen clearly if one considers the lowering weight to have yielded all of its potential energy and to have reached the lowest point in the cycle. The rising weight will at this instant not be at the top but will have yet to travel a distance equal to the length of the cylinder. Where is this energy coming from?

ERNEST K. CHAPIN.
138 Merrill Ave., Muskegon, Mich.

First Honorable Mention

Assuming the conditions given are fulfilled, i. e., that the weight of the piston is of a magnitude greater than the combined weights of a water column and atmospheric column of equal horizontal area, and that the piston's motion within the cylinder is frictionless, and that as a result there is an unbalanced force sufficient to produce clockwise motion, as shown in Fig. 1, it is obvious that the very assumption we have made to get our piston into operating position is the thing which defeats our purpose for, there being no friction between the piston and cylinder walls, no force can be transmitted from one to the other and the piston will therefore *move up into the cylinder* until a condition of equilibrium is established.

Now let us suppose that the cylinder is equipt with a device which will lock the piston in position for upward motion, as in Fig. 1. Then there will be upward motion until a position is reached as shown in Fig. 2. At this point we have the weight of the cylinder and piston *in air* acting thru an equal lever arm against the weight of the cylinder and piston *in water* (which equals its weight in air minus the weight of water it displaces) and we will now find that the force tending to produce motion is in the *opposite direction* to that in Fig. 1, and we will therefore have no rotation.

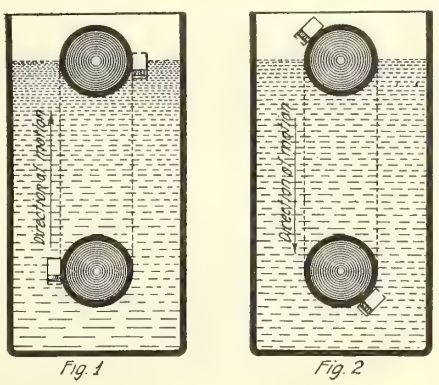


Diagram to Accompany "First Honorable Mention" Explanation of Perpetual Motion Problem.

EDWARD H. PRENTICE.
60½ North Street, Binghamton, N. Y.

Second Honorable Mention

The following is my answer to the perpetual motion scheme in the October SCIENCE AND INVENTION:

There is, it is true, a constant force acting upward on the left-hand side. This force is equal to the *weight of the water contained by one of the cylinders.* But we must remember that every time a weight drops toward the ring on the cylinders, a volume of water (equal in weight to that contained in the cylinders) is forced downward in the opposite direction to the supposed perpetual motion.

I think that even without a technical proof it is quite evident in a general way that these two forces offset each other, for they are in opposite directions, and equal (since they both equal the weight of the same volume of water).

LOUISE L. SLOAN.
Pembroke West, Bryn Mawr College, Bryn Mawr, Pa.

(*Continued on page* 1015)

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

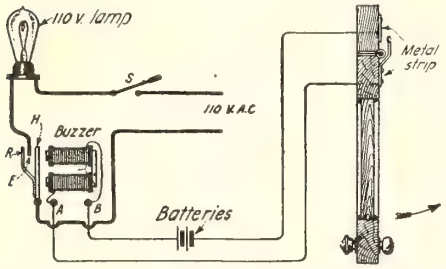
A DOOR ALARM.

The main apparatus of this alarm consists of a common buzzer used as a relay, which is arranged in the following fashion: The wire from binding-post A is joined to one magnet, and the wire leading to the other magnet connects to post B. This cuts out the circuit-breaker.

The strip R is bent about breaker E, so that it does not touch E unless the armature is attracted by the magnets. The action is as follows: When the door is opened, contact is made between the two metal strips, one on the door-jamb and the other on the door. Current from the batteries then flows thru the magnets drawing over the armature H, the contacts closing the circuit for a visual signal and announcing in this way that the door has been opened. The signal should be placed conspicuously.

The current from the 110-volt circuit then passes thru R to E and lights the lamp; a switch is provided at S to turn off the signal.

Contributed by C. R. WADGE.



A 110-Volt Lamp Signal, Controlled by a Relay Made from an Ordinary Buzzer, the Lamp Flashing on When the Door Is Opened.

WIRING COMPUTATION

Frequently electrical workers find themselves in the predicament of not having at hand a pocket reference book containing wire tables giving the different sizes of wire necessary to carry various currents over certain distances. The resistance of the circuit both ways equals the drop in volts in the circuit, divided by the current in amperes passing thru the circuit.

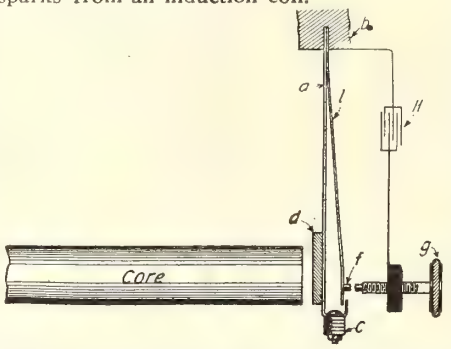
Suppose for example, we have a group of incandescent lamps requiring a total current of 10 amperes and that this lamp group is to be fed with current over a distance of 250 feet. This would mean that the length of the two wires would be 500 feet. The average potential drop allowable in a circuit of this type is 4 volts. Then we find the total resistance in the circuit, 500 feet of wire (exclusive of the resistance of the lamps) would be four divided by ten, or .4 ohm. This means that the resistance of the 500 feet of wire in the 250 foot run would be .4 ohm, or 1000 ft., of the wire would have a resistance of .8 ohm.

Looking this up in a standard B. and S. gage wire table, we find that No. 9 B. and S. gage copper wire corresponds to a resistance of .8 ohm per thousand feet.

SECOND PRIZE, $3.00

MECHANICAL INTERRUPTERS.

In the figure is shown a very efficient and simple mechanical interrupter that was designed especially for producing long sparks from an induction coil.



This Type of Interrupter Will Produce the Longest and Most Powerful Sparks from Induction Coils, Owing to the Long Make and Short Break Effect. "H" Is the Usual Condenser.

Referring to the figure, (a) is a stiff bronze spring fastened at (b) and weighted at (c) so as to give the desired frequency of vibration. This spring carries a soft iron armature (d) opposite the end of the core of the coil; (l) is a light spring of bronze, also fastened at (b), carrying a contact point (f) for making contact with the adjusting screw (g) thru the contact points.

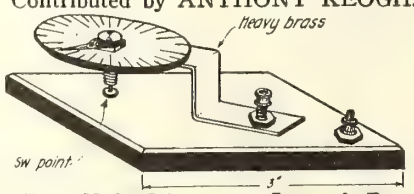
Both may be of platinum—iridium or silver. This spring normally rests against the screw, closing the battery circuit until spring (a) is attracted far enough so that the hook on spring (a) engages the end of spring (l) and opens the circuit. When this vibrator is properly adjusted spring (a) will vibrate very vigorously thru a wide arc, while spring (l) will close the battery circuit long enough to allow the core to become magnetically saturated, and then it will break the circuit very fast.

Contributed by PHILIP G. BERNHOLZ.

HOME-MADE MICROMETER

A necessary but seldom found tool in the average experimenter's "lab" is a micrometer. This instrument takes the place of one. The scale is graduated in thousandths of an inch, and may be used as a "mike" or a wire gage. If a bell and battery are connected in series with it, the bell will ring when the indicator is on the right spot. It may also be used as a key, if the brass arm is made springy enough. The arm is from a telegraph sounder, while the lower anvil is a switch point.

Contributed by ANTHONY KEOGH.



A Home-Made Micrometer Gage of Extreme Simplicity.

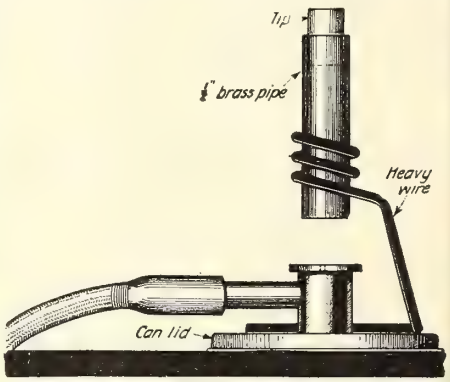
THIRD PRIZE, $2.00

THE CHEAPEST BUNSEN BURNER.

Herewith is a diagram of a Bunsen burner which can easily be made by the experimenter and will be found useful in the laboratory and shop.

A piece of half inch brass pipe (toilet supply pipe will do) 2⅛ inches long forms the barrel and a ¾-inch section of the same kind of pipe forms the gas tank. Wrap a piece of heavy copper wire around one end of the barrel and solder it, if you wish. Setting the barrel aside, obtain the lid of a syrup can for the base and solder the gas tank to it. The gas tank must previously have a section of ¼-inch pipe soldered to it, and a piece of thick brass with a 1/16-inch hole in the center soldered on one end.

Now bend the wire that is attached to the barrel so that it forms a semi-circle on the base and holds the bottom end of the barrel ½ inch from the gas tank. Solder it in place and you have only to make a tip for the burner out of a thin-walled piece of fixture-pipe or other piece of thin brass



A Bunsen Gas Burner Which Is Not Only Cheap and Readily Made from Scrap Parts Found about the Laboratory, but Which Is Also Adjustable.

and allow it to extend 3/16 inch above the barrel. It will probably need a little adjusting to suit the gas you use.

This is done by pulling the tip out a little farther or bending the end of it slightly inward. The distance between the gas tank and the barrel can also be adjusted by bending the heavy copper wire. Once adjusted, it requires no further attention.

Contributed by GEO. J. MELVILL.

CONVERTING TABLE.

The following is an approximate table for changing avoirdupois into metric weights:

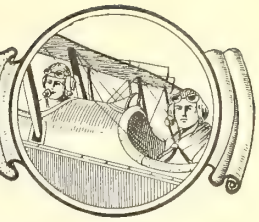
Avoirdupois.	Metric.
15 grains	1 gram
50 grains	3 1/3 grams
1 ounce	28½ grams
½ ounce	14 grams
¼ ounce	7 grams

With the above table it is possible to get almost any weight desired.

Contributed by FREDERICK REYNOLDS.



RADIO DEPARTMENT



The Geltow Radio Station

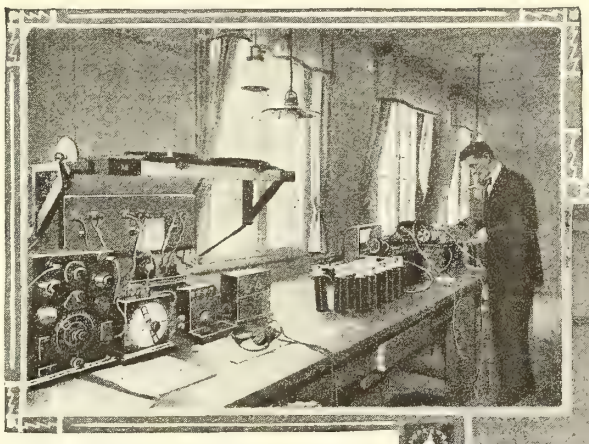
THE two accompanying photographs reproduced herewith show two very interesting views of the German radio station at Geltow, Brandenburg.

One of the photographs shows the incoming radio messages being received and amplified as well as recorded on a phonograph of the wax cylinder type, all simultaneously. The reader will note the small loop aerial or antenna in the picture. It is surprising what remarkably large distances can be covered with a small loop or coil aerial such as this when used in conjunction with the new multiple stage audion amplifiers.

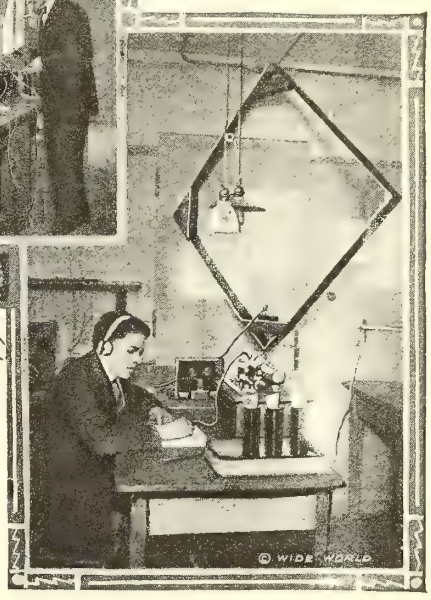
Trans-Atlantic messages have been picked up by some of the European stations with very small loop antennae, boosting the incoming signals to the requisite strength with audion amplifiers.

The second photo shows a more general view of the interior of the Geltow station. The large number of phonograph cylinder records containing messages, which have been recorded from distant stations, tell the story of the work of the station.

One of the principal features of phonographic reception of radio messages as followed out in this station, lies in the fact that messages can be recorded at very high speed—in fact a speed so high as to defy detection or interpretation by regular aural reception. These high-speed messages are afterward translated at a slower speed by running the phonograph at a slower rate than that employed when recording the signals. The phonograph has found a new rôle in radio station practise today, and serves its purpose particularly well in sending out wireless telephone messages, especially for tests and other specific purposes, where the message is of a fixt and predetermined nature.



View at Left Shows Interior of the Large German Station at Geltow, Brandenburg. At This Station the Incoming Messages Are Put on Phonograph Records, a Number of Which Are Plainly Visible in the Center of the Table.



View at Right Shows One of the Receiving Instrument Tables in the Geltow Radio Station, a Radio Message Being Transcribed from the Phonograph Record by the Operator. The Advantage of the Phonograph in Radio Transmission and Reception Is That the Signals Can Be Recorded at Very High Speed.

Fleet Hears Opera Singer Via Radiophone

Admiral Hugh Rodman in his cabin aboard the Pacific Fleet flagship U. S. S. *New Mexico*, is shown in one of the accompanying photos, together with his pet dog, "listening in" at the wireless telephone, while pretty Miss Mabelle Burch sang a song from the opera, the young *prima donna* being a coloratura-soprano singing with the Metropolitan Opera Quartette.

Miss Burch has a brother, Carleton Burch, who sails the seas on the U. S. Submarine F-2. Miss Burch recently asked permission to sing to her brother at sea, by wireless telephone. The request was quickly granted by Admiral Rodman of the Pacific Fleet and an order issued to all the vessels belonging to the fleet to "listen in" on the appointed evening.

Quadrupeds of the canine variety generally do not enjoy music of any kind and give vent to their untoward feelings by their emphatic howls, but Admiral Rodman's pet seems to be enjoying the wireless 'phone opera concert exceedingly. The second photo shows Miss Burch singing into the wireless telephone mouth-piece while the whole Pacific Fleet "listens in."

Those not familiar with the automatic telephone service, which is found in several American cities, will be interested in the type of instrument into which she is singing.

San Francisco has an automatic telephone service similar to that now being made ready for adoption in New York. With the automatic 'phone each subscriber calls his own number and does not obtain the desired party thru a central operator at the exchange. Automatic electrical switchboards operated by electro-magnets and motors effect all of the connections necessary in a few seconds.

As we go to press, a similar radio concert has just been successfully given for the benefit of naval ships within 500 miles of New York City, the soloist having been Mme. Louisa Tetrazzini. Mme Tetrazzini sang from her apartment in the Hotel McAlpin, New York City. Her selections were the "Polonaise" from "Mignon," "Rodono" from "La Sonnambula" in which she sent her high F sharp far out to sea, "Somewhere a Voice is Calling" and "I Milioni d'Arlecchino." After the songs, Mme. Tetrazzini talked with some of the radio men in the Whitehall Building and on the U. S. S. *Pennsylvania*, lying in the Brooklyn Navy Yard.





Miss Mabelle Burch Recently Sang Operatic Selections to the Pacific Fleet via Radio Telephone. Admiral Rodman's Pet Dog Also Enjoyed the Concert.

Locomotive Cab Radio Signal

THE State Railroad Administration of France has made quite extensive experiments with an audible cab signal controlled by Hertzian waves—a "repeater," as the French entitle it—to call the attention of the engineman when he passes a caution signal which is set against him; and the experiments have proven so satisfactory that the government plans to install the apparatus on long sections of its railroads and to equip a large number of locomotives, says a writer in the *Railway Signal Engineer*. This announcement of proposed extensive installations is not yet officially confirmed, but as the system is of interest on its own account and as the experiments have been continued over a series of months, we give herewith a brief description of the apparatus. The installation is on the line running from Paris, southwest, 48 miles, to Chartres. Nearly or quite all of the distant signals between Trappes and Maintenon, on this section, a distance of about 15 miles, are fitted with the wireless system.

The apparatus is the invention of a French engineer, Mr. Augereau, and the essential features are similar to those which were used for wireless communication by aviators during the war. At the roadside station, a Ruhmkorff or spark coil, energized by a small battery and acting by means of a spark gap, produces Hertzian waves which, by acting on a coherer on the locomotive, cause the sounding of a whistle in the cab. The antenna at the station and that on the locomotive are each about 4 feet above the level of the rail, and are of sufficient length, parallel to the track, to act satisfactorily in the case of trains moving at any speed.

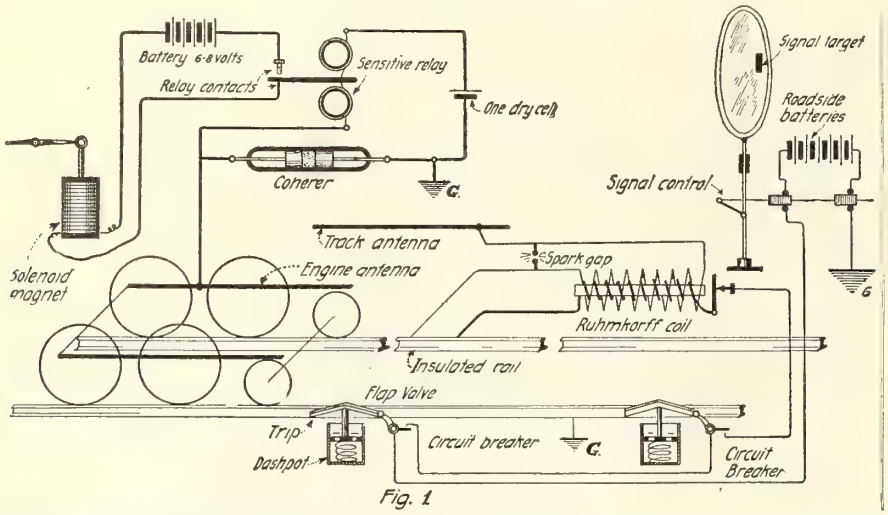


Fig. 1

Diagrams of Wireless Circuits Used Successfully in New French Locomotive Cab Signal Which Is Operated Automatically as the Train Speeds Along. The Coherer and Relay on the Locomotive Operate a Local Circuit Which in Turn Actuates an Audible Cab Signal, Warning the Engineer That He Has Past a Caution or Stop Signal. An Automatic Recorder Attached to the Receiving Circuit Keeps a Record of the Actions of the Engineer so That His Entire Performance Can be Checked Up Upon His Return to the Roundhouse.

The roadside battery is active only when the visual roadside signal is against the train, and only while a train is passing, track instruments being used to give the train this control.

The arrangement of circuits on the locomotive and roadside is illustrated in the diagram. The circuit from the battery energizes the solenoid sufficiently to lift its core whenever the coherer is traversed by the current coming from the antenna. The antenna consists of a copper tube on the side of the locomotive. (In France trains on double-track roads use the left-hand track, and therefore this antenna is on the left side of the engine; but to provide for running locomotives backward, antennae can be mounted on both sides.)

The induction coil at the roadside station, with a primary potential of 8 volts, is capable of producing a spark about one inch long. The secondary coil has one end connected to the ground and the other to a spark gap and to the roadside antenna, as shown. This antenna consists of a copper wire about 16 feet long.

The roadside battery has one pole grounded and the other is connected to a wire extending thru the induction coil to an insulated section of rail, as shown. The commutator placed between the battery and the ground is controlled by the visual signal, which makes or breaks the ground connection, the current flowing only when the signal is set against approaching trains. With the signal in the adverse position and the insulated rail grounded (by the presence of wheels upon it), the current from the battery traverses the primary coil; the induced current then leaps the spark gap, and the Hertzian waves are produced and sent out. As before stated, these latter continue only so long as the train is passing a signal.

On the engine, the resistance of the coherer normally opposes the passage of the current from the engine battery, but on passing the roadside antenna, this resistance diminishes and the current then lifts the core of the solenoid. This movement releases a lock, which is enclosed in a box fixed to the side of the speed recorder. This lock controls the valve of the cab-signal whistle (which is mounted in the front of the cab). The blast of the whistle continues until the engineman, by restoring a control lever to normal position, stops it.

A recording stylus is moved by the pushing of a lever to the right, and each operation of the wireless signal is recorded by means of a cam forming a part of the lock, which gives a slight movement of the stylus against the paper tape of the speed recorder. At the end of the run, the inspector at the engine-house finds this record in the form of a short, straight line cutting at right angles the speed record curve. This indicates that the whistle was in working order. When the engineman sees a signal set against him, it is his duty to give the stylus a movement in the other direction and the marks so made, different from those made by the roadside impulse, afford evidence that the engineman was attending to his duty.

Unique Portable Radio Set

Recently under direction of Postmaster General Giesberts in Königsberg the Portophone Service was added to the public utilities of the German Government. Electrical experts agree that this highly efficient instrument is destined to become widely used the world over on account of its practical and portable nature. The present portophone has one stage of radio amplification and two stages of audio amplification; one tube being used both as a radio- and audio-amplification stage. The instrument itself, without the horn, is twelve inches high and ten inches wide. The horn, of course, may be strapt to the case and carried along.

A desirable feature connected with the instrument is that it is simple to operate. The approximate range of the instrument in its present development is about 20 miles, but of course, this will eventually be considerably increased. This photo shows the opening of the Government service in Germany.



New Portable Wireless Telephone Being Tested by the Postmaster General of Germany. The Instrument is Capable of Talking Over a Distance of 20 Miles or More, and is Being Adopted Officially by the German Postal Service.

Girl Receives Election Returns by Radio

Miss Claire Horn "listening in" for the recent presidential election returns at the wireless station installed in the Hamilton Club in the City of Chicago, is shown in the accompanying illustration.

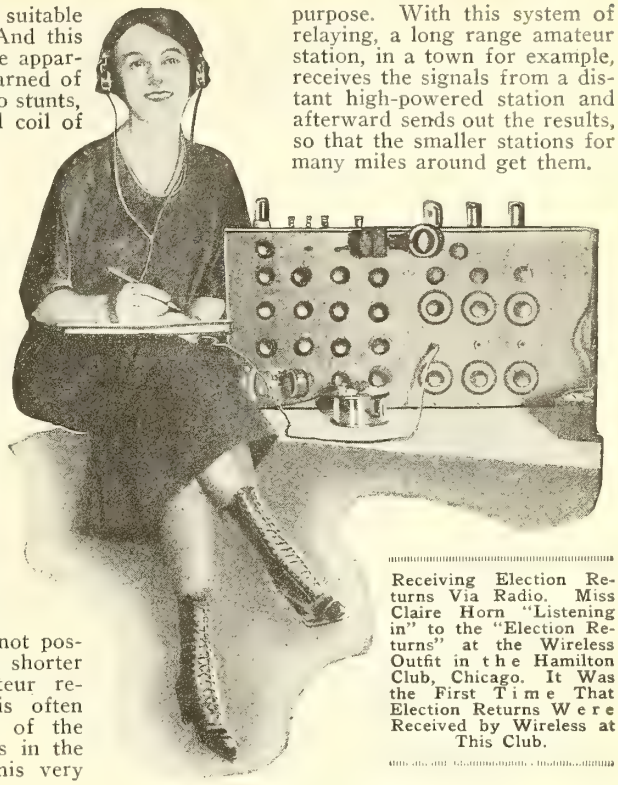
It was the first time that election returns were ever received by radio at this club, and the members found the innovation of unusual interest and convenience.

Thousands of radio amateurs this year, all over the country were listening intently at their radio receivers on election night to intercept the news of the returns as the messages were flashed to the four winds, from powerful radio stations in various parts of the country.

It used to be, and not so many years ago, that we had to wait several days or even several weeks in some parts of the country, to learn the facts about even such important events as a presidential election, and history records that in one of the early American wars, it was at least several days after peace had been declared that one army corps was still without news of this decision on the part of the commanders in chief of the opposing forces, and that this corps kept on fighting viciously, killing thereby many worthy soldiers whose lives could otherwise have been saved.

The time will undoubtedly come and in the very near future, when the speeches of the president-elect and other notables, given on inauguration day at Washington, will be heard broadcast over the country via radio-telephone by practically everyone, who may be equipt with a suitable radio receiving instrument. And this need not be such an elaborate apparatus, for we have recently learned of some remarkable French radio stunts, performed with a loop aerial coil of wire, the same size as a cigar box. With a practical loop antenna of these small dimensions and an audion amplifier, comprising several vacuum bulbs of French type, radio time signals from the Arlington station near Washington, D. C., were picked up at a small radio station in France.

Amateur radio stations have successfully picked up election returns in one of several ways. Those who live within 100 miles or so of large transmitting stations, are quite sure to receive the returns broadcasted by radio from some one of the powerful radio stations operated by commercial companies or by the Navy department. Where this is not possible owing to the relatively shorter range of the average amateur receiving station, the news is often obtained by relaying. One of the largest amateur organizations in the country was founded for this very purpose. With this system of relaying, a long range amateur station, in a town for example, receives the signals from a distant high-powered station and afterward sends out the results, so that the smaller stations for many miles around get them.



Receiving Election Returns Via Radio. Miss Claire Horn "Listening in" to the "Election Returns" at the Wireless Outfit in the Hamilton Club, Chicago. It Was the First Time That Election Returns Were Received by Wireless at This Club.

Turning Book Leaves Tunes Radio

Captain Hyde A. Donisthorpe of London, England, has recently perfected a very ingenious miniature receiving set for wireless telegraphy and telephony in book form, the wave length being varied by opening and shutting the book. Stations of different wave lengths are obtained by opening the book to different degrees; the further the book is opened, the longer the wave lengths and *vice-versa*.

The length of the aerial wire plays, of course, an important part as to the range in wave lengths over which the book will operate, but it has been so designed as to give a range of between 300 and 2,500 meters. Signals in London have been picked up by means of this pocket book from Paris, Berlin, Poldhu, all the local coast stations and ships.



Captain Hyde A. Donisthorpe, of London, England, Has Recently Perfected a Very Ingenious Radio Receiving Set in Book Form, the Wave-Length Being Varied by Opening and Shutting the Book. Stations of Different Wave-Lengths Are Obtained by Opening the Book to Different Degrees, the Further the Book Is Opened the Longer the Wave-Lengths and Vice Versa.

The photograph herewith shows the inventor operating his unique radio apparatus.

The clever pocket size radio set invented by Capt. Donisthorpe brings us face to face with the fact that we are slowly but surely evolving from the realms of large complicated radio receiving cabinets into a new realm of tabloid receiving sets.

Several builders of radio instruments have already shown developments along these lines and we prophesy that within another year or two, practically all of the large six to eight-foot loading coils, couplers and variometers, so beloved by the radio amateur of today and yesterday, will be relegated to the attic and that in their places we will have highly efficient radio receiving sets, which can be carried in the coat pocket.

The receiving set of tomorrow will approximate in size the average "best seller," or will be of about 7x7x1 inch dimensions and will have tuning inductances wound in the form of multiple-layer honeycomb coils. The variable condensers when used will be made in a very clever and compact manner as hinted at in some of the small radio sets recently brought out both in this country and abroad.

This pocket book radio set puts us in mind of the chap who some years ago contributed a short, witty article to the *Modern Electrics Magazine,* in which he used the coiled springs on his bed for tuning inductances while he pasted sheets of tin-foil on the door and on the wall back of the door, so that when the door was opened and closed, a variable capacity of several odd hundreds of microfarads was attained! The book style of tuner, however, all jokes aside, represents a very neat principle and one which can be very well exploited in popularizing radio sets for the layman.

Articles to Appear in January Issue of "Radio News"

A Complete Portable Set
By D. R. Clemons

Comparison of Modulation Methods in Radio Telephony—Part 2
By A. S. Blatterman

A "Phoney" Phone
By Volney G. Mathison

A Honeycomb Coil Winding Machine That Works *By Raymond Roof*

A Simple and Efficient Transmitter
By Frederick J. Rumford

Practical Construction of an Amplifying Transformer
By Robert E. Lacault

LATEST PATENTS

Phonograph Record-Lifter.

(No. 1,347,548 Issued to Joseph Menchen.)

This is a very neat contrivance adaptable to phonographs so as to

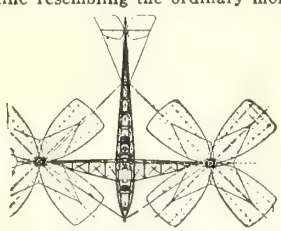


automatically lift the records. It consists of a spring attached to a phonograph, to the end of which is fastened a rubber suction cup fitted with an automatic valve. By pressing the cup against the record, a semi-vacuum is created sufficient to raise the record from the turntable of a talking machine. Several types of valves are employed for releasing this record from the lifter, several of which allow for a gradual seepage of air and others which allow air to enter the vacuous space by pressing upon a valve stem.

Revolving Wing Flying Machine.

(No. 1,350,982 Issued to Alexis Beurrier, Edouard Bigourdan & Louis Lacoin.)

This is an improved flying machine resembling the ordinary mono-

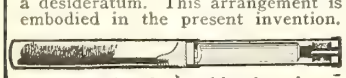


planes in the fuselage and other features except that instead of the forward wing or plane, we have two screw propellers having very wide vanes and connected to the engine by means of gears. The axles of these propellers are inclined toward each other. Each screw propeller is so arranged that it can assume various inclinations about its axis. In this manner, the plane itself can be tipt to the right or left, forward or rear. By tipping the wings forward the pull of the plane is exerted slightly in front of its central axis causing the machine to travel forward.

Toothbrush and Paste-Case.

(No. 1,349,110 Issued to William Ogle Snyder.)

Sometime ago in this magazine under "What to Invent," Mr. Hobson pointed out that a combination tooth brush and paste container was a desideratum. This arrangement is embodied in the present invention.

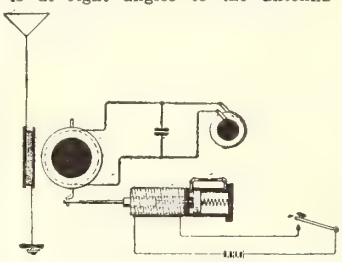


The toothbrush combination is so arranged that each part is interchangeable. At one extremity is the brush fitted by a cap, the brush being so set that it can be removed at any time and a new unit inserted. The handle is hollow and holds the tooth paste or powder tube and a spool of dental floss.

Radio Telegraphy.

(No. 1,350,801 Issued to John Hays Hammond, Jr.)

This is another of the many patents which Mr. Hammond has taken out on radio-control devices and in this instance it relates to the transmitting station. A high frequency generator is placed in circuit with an inductance coil and in shunt with a condenser. This is placed in apposition with another coil connected to the aerial and ground of the transmitting station. Connected to the inductance first mentioned, is a crank handle coupled to the core of a solenoid, which core is likewise coupled to a dashpot arrangement so that when current is allowed to flow thru the solenoid, its action is then not quick and decisive, but on the contrary, very slow. A spring again brings the solenoid back to the first position. The action of the device is as follows: The generator is sending high frequency currents to the coil but when the key is open and the electromagnet deenergized, the coil is at right angles to the antenna

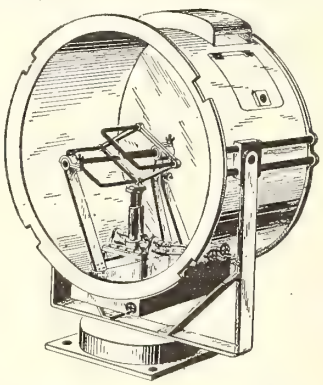


coil and hence, will hardly induce oscillations into the antenna circuit. When the key is prest, the solenoid forces the coil thru a semi-circle, causing it to assume a position parallel to the antenna coil. The effect on a commercial receiving station is very slight, and then only if the receiving apparatus is closely attuned with the transmitting apparatus. In this manner no interference is set up.

Magnetic Deflector for Electric Arcs.

(No. 1,353,693 Issued to John Paley Yorke.)

The inventor here has devised a method whereby he will keep the



flame of an arc lamp away from a portion of the mechanism or from the mirror or lens by the simple use of magnetic deflectors. The magnetic deflectors are so arranged that they are adjustable and are magnetized by an electric current flowing thru them. The invention facilitates the use of arcs in any position so that it is practically possible to obtain stability of the arc regardless of what position the electrodes may be in.

Vision Deflector.

(No. 1,356,498 Issued to William E. Snaman.)

The inventor of this device solves in this manner the problem of pro-



tecting the eyes of the driver of an automobile from the glare of the headlights of the approaching vehicle which of course, would cause a sort of blinding effect; by fitting a piece of colored paper on celluloid to a nose piece or to the cap of the driver, he is enabled to protect one eye from the dazzling lights by simply turning his head slightly. The lights from the approaching car then cause a shadow to be thrown on one eye, but permit of its perfect use in vision.

Poison-Tablet.

(No. 1,349,326 Issued to Charles T. Davis.)

This invention involves the incorporation of a gritty substance

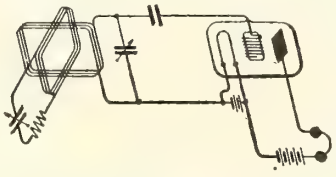


with ordinary antiseptic substances, such as bichlorid of mercury or potassium mercuric iodid, which are highly dangerous when taken internally. In this manner when the tablet is taken an unpleasant sensation is produced by contact of the harsh grit with the tongue or walls of the mouth or with the teeth. The presence of a small amount of gritty substances produces an extremely disagreeable sensation which compels attention and develops a tendency to expel the substance from the mouth.

Radio Receiving System.

(No. 1,350,912 Issued to Ernest F. W. Alexanderson.)

In this invention a method of filtering out, so to speak, of a nearby transmitting station in order to receive a distant station is employed. A coil is connected to a circuit

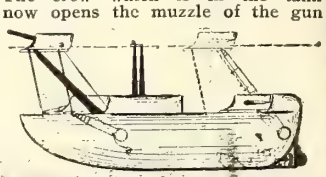


involving the usual vacuum tube, variable condenser, etc., and tuned to the distant station. This coil is in line with the distant station. Another coil at right angles to the first coil is connected to a variable inductance and capacity and is tuned to the local station. In this way, an effective screening is produced, inasmuch as the second coil has no effect upon the first coil and the second coil likewise absorbs energy from the local transmitting station, undesirable currents are not set up in the receiving circuit and it is possible to receive the distant station easily. Such a method makes it possible to transmit and receive messages simultaneously at a given point without locating the receiving apparatus far away from the transmitting apparatus.

Submarine Vessel.

(No. 1,356,294 Issued to Joseph Kuhajda.)

This invention has for one of its main objects, the production of a vessel which may serve for defensive and offensive purposes. It provides the submarine with two gun carrying buoyant tanks. Entrance to the gun carrying tanks is made from the submarine whereupon a collapsible tube allows one of the buoyant tanks to float upward to the surface of the water. Cables are employed for steadying the tank. The crew which is in the tank now opens the muzzle of the gun

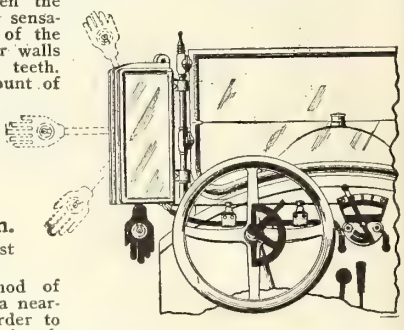


by means of the cable attached to it and can carry on a defensive or offensive warfare while the submarine proper is amply protected because of the fact that it is considerably below the water line. The collapsible tube is extended by comprest air when the air is locked automatically, the tube takes up the recoil due to the firing of the gun.

Automobile Traffic-Signal.

(No. 1,348,367 Issued to Shigeru Masumoto.)

This is another of the many methods of semaphore signaling which are being used by automobilists today. It consists of a mov-



able arm actuated by a series of gears and controlled from a dashboard of the automobile. By pushing a handle to any one of a desired number of locations, the position of the hand of the semaphore is automatically located in a predetermined position to denote a turn. The hand is fitted with a small electric light also controlled from the dashboard, so that it can be illuminated at night. The novel feature of this device lies in the fact that it can be manually controlled, and for that reason the condition of the batteries need not be perfect as is the case with many of the electrically controlled semaphores now employed.

Scientific Humor

A Sad "Reflection."—"I want to see some mirrors."

"Hand mirrors?"

"No; the kind you can see your face in."

—*Dudley Holbrook.*

He Lost Momentum.—"What is the matter with you?" asked the physics professor of a student who had fainted during examination.

"I suppose I had a moment of inertia," answered the young hopeful.—*Felix Kohn.*
10 Rue du Lunain, Paris.

Or—Dead!—A recent sign seen in a feed store reads like this:

"If 'Eggo' don't make your hens lay—they're roosters." —*James E. Harne.*

Cor-Wreckt!—Al. Bert: "How do these ove triangles usually end?"

Phil. Bert: "Most of them turn into a wreck-tangle.'"—*John Andersen, Jr.*



Why He Didn't Buy-Carbonate.—"Two penn'orth of bicarbonate of soda for indigestion at this time of the night," cried the infuriated chemist, who had been aroused at 2 A. M., "when a glass of hot water would have done just as well!"

"Weel, weel," returned Sandy, hastily; "I thank you for the advice, and I'll no' bother ye after all. Good night."

—*Max P. Huy.*

What Did the Engineer Slip Him?—A green brakeman was making his first trip up the Sierras. The train was going up a very steep grade, and with unusual difficulty the engineer succeeded in reaching the top. At the station, looking out of his cab, the engineer saw the new brakeman and said with a sigh of relief:

"I tell you what, my lad, we had a hard job to get up there, didn't we?"

"We certainly did," said the brakeman," and if I hadn't put on the brakes, we'd have slipt back."—*Carl A. Fanton.*

Fine—But Not on the Square.—Farmer Jenkins brought his new flivver into town one day and left it in the public square.



"Hey, there," yelled the traffic cop, "you can't park your car here."

"What you got that sign up for, then? Don't it say FINE FOR PARKING AUTOMOBILES?"—*J. A. Poythress, Jr.*

So Would We.—"Daddy, I've got a sentence here I'd like you to punctuate."

This is what Paw-Paw read:

A five dollar bill flew around the corner

He studied it carefully. "Well," he finally said, "I'd simply put a period after it like this."

"I wouldn't," laughed the high-school girl, "I'd make a dash after it!"

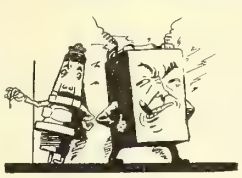
—*Ora Krumps.*

Did He Wax Enthusiastic?—Doctor: "I will not deceive you, your life now hangs on a single thread."

Tailor (feebly): "That will do. If the thread's waxed, Doctor, I'll pull thru."

—*Carl A. Fanton.*

FIRST PRIZE $3.00



And Tomorrow They'll Do It Again— Spark Plug: "I got fired today."

Battery: "That is nothing, I'm discharged, also."

—*Carl Hawkins*

And Juggles with Figures, Too!—First Student: "A thermometer certainly is a clever instrument to be able to tell temperature so well."

Second Student: "It should be; it has a college education."

First Student: "A college education, how so?"

Second Student: "Well, isn't it graduated with many degrees?"—*Roy H. Cantor.*

How About a Sextette?—Teacher: "Johnny, stand up and tell us how many sexes there are?"

Johnny: "Three."

Teacher: "What are they?"

Johnny: "Male sex, female sex, and insects."—*J. P. Eckersen.*

ALL jokes accepted and publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

Don't Fall For This!—"Nearly everybody has a well-developed bump of curiosity."

"And what does it lead to?"

"Why, in this case, it leads to turning the paper upside down."

—*J. L. Cassidy.*

8 2 Much.

I often sit and medit8
Upon the scurvy trick of f8
That keeps me still a celib8
Oh, cruel f8.

I want a 10der maid sed8
To love me and be my m8!
My 40 2de is not so gr8
I cannot w8.

Oh, f8 be9! Be4 2 L8,
Relieve my awful single st8,
And when I've 1 this maid sed8
We'll oscul8.

—*John R. Hanlon.*

Ought to Meet Einstein.—"My office boy is one of the greatest inventors of the age."

"What did he invent?"

"He invented petrified motion."
—*John B. Moore.*



"Step Lively" Would Be Better.—A prison paper back East runs the list of deaths by electrocution under "Current News."—*Morris Kirshner.*

Then the "Lights" Went Out.—The movie-house manager was dying. The nurse and doctor were waiting for the end of the animation.

"Notice the change in features?" said the doctor.

"Features change daily," breathed the dying man while reeling over, as a film covered his eyes and his spirit was released

—*Sam Elder.*

And Moist From Perspiration.—Prof.: "How can you prove that steam does work in an engine?"

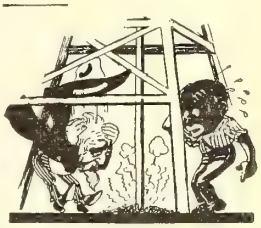
Student: "Because after it pushes the piston, it's tired."

Prof.: "Tired?"

Student: "Sure; isn't it all exhausted?"

—*Roy H. Cantor.*

Well, Well!—'Colonel, I understand your oil well was down 4,000 feet last week."



"Um."

"How far down are they now?"

"Must be getting near the infernal regions—they've struck asbestos!"

—*J. H. Schalek.*

Alas! 'Tis True.—Teacher (to pupil): "What is Science?"

Pupil: "Science is that branch of learning in which one person will prove the reason for a certain thing doing what it does, contrary to popular belief, and then another person will come along and prove it to be different and him to be a liar."

—*C. Willard Duckworth.*

Hope It Isn't a Shooting Star.—He: "Mademoiselle, you are the star of the evening."

She: "You are the first to tell me so."

He: "Then allow me to claim my reward as an astronomer."

She: "How so?"

He: "To give my name to the discovered star."—*Felix Kohn,* Paris.

And Wasn't Patented, Either!—A reporter was interviewing Thomas A. Edison.



"And you, sir," he said to the inventor, "made the first talking-machine?"

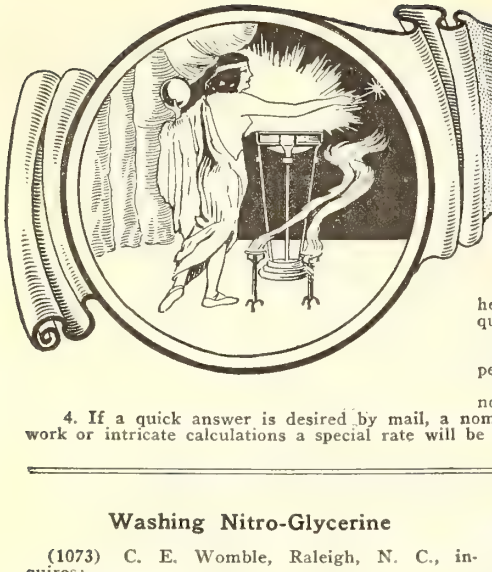
"No," Edison replied, "the first one was made long before my time—out of a rib."

—*Merit Kirk Burrous.*

They Even Adulterate Vacuums!—We know a chap who received a gross of varicolored electric light bulbs the other day. They were fitted with corks and contained liquid matter of an exceedingly "high voltage."

He was all lit up while the "current" lasted.—*L. Hanson.*

Lead Us to Her, Boy!—The other day we heard of a man trying to cross a cow with a mule in order to get milk with a kick in it.—*Franklin Williamson.*



THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Washing Nitro-Glycerine

(1073) C. E. Womble, Raleigh, N. C., inquires:

Q. 1. How to wash nitro-glycerine.

A. 1. Nitro-glycerine when formed, is insoluble in cold water, and hence washing is comparatively a simple operation. It is washed in cold water only, and the colder the better.

Of course, the water should be above 3 or 4 degrees Centigrade, as nitro-glycerine freezes at this temperature. Water can be sprayed into the nitro-glycerine for washing purposes, or the nitro-glycerine poured into water, where repeated changes of water are necessitated.

Removing Stains from Ivory

(1074) Frank Ferrier, Bath Beach, Brooklyn, N. Y., writes:

Q. 1. Please tell me how to remove stains from ivory beads.

A. 1. The beads are moistened and placed upon a tripod over which has been stretched a thin piece of gauze or cheesecloth. This tripod holds the beads resting upon the gauze membrane a few inches over a vessel containing chlorid of lime moistened with a little hydrochloric acid.

The entire arrangement is then covered with a bell jar and exposed to direct sunlight. When the ivory objects have been bleached, they are removed and washed in sodium bicarbonate, then rinsed in water and allowed to dry. If not completely bleached when the above process is completed, then apply a paste of whiting and benzol or carbon disulfid, covering the article completely and, after it is dry, rub briskly with chamois or soft wool cloth.

Silver Plating Solution

(1075) H. J. Dritt, Ft. Wayne, Ind., writes the "Oracle":

Q. 1. Kindly give formula for silver plating, using the dipt or *hot bath* process. Either of these methods are satisfactory for plating silverware.

A. 1. In order to silver copper or silver, brass or bronze articles by the hot dip process, you dissolve ten parts of fused silver nitrate in 500 parts of distilled water, and 35 parts of potassium cyanid in 500 parts of distilled water.

Mix both solutions and stir. It is then heated to a temperature of 176 to 194° Fahrenheit in an enameled vessel and the articles introduced, after being well cleansed of fat and other impurities.

Powerful Amplifiers

(1076) L. C. Bundorf, Chicago, Ill., asks:

Q. 1. Several questions concerning amplifiers.

A. 1. The largest sound reproducer and amplifier of telephonic currents is the Magnavox, although this does not mean to state that others may not from time to time be evolved.

With the Rochelle salt crystal, the effect is not an amplification effect, but is simply a transmitter effect. The best amplifier of telephonic currents is some form of vacuum tube, preferably the large size vacuum tube produced for transmission purposes. There does not seem to be any limit of amplification of such currents; this depends entirely on the number of tubes employed in the circuit.

We do not know of any electro-mechanical device capable of giving a higher amplification than the vacuum tube.

Bichromate Battery Query

(1077) J. A. Gerson, Houston, Texas; writes:

Q. 1. Referring to the August issue of your journal, under *Practical Chemical Experiments*, the author states that a bichromate cell can be made by using 710 cu. cm. of water and dissolving in it 80 grams of chromic acid, and then adding 45 cu. cm. of concentrated sulfuric acid. In reference to the 80 grams of chromic acid, there surely must be some mistake, as 80 grams is over two ounces and one-half of same, and chromic acid costs $.65 per ounce, which would make it a very expensive battery.

A. 1. The figures referred to under *Practical Chemical Experiments* were correct. One cu. cm. of water weighs one gram and the usual proportion for chromic acid cells is as above. It is quite true that the cell is expensive, but it is a large size battery, giving a very powerful current for a short time.

When much used the cell becomes saturated with chromium sulfate. In some cases potassium bichromate is used instead of chromic acid, in which case chrome alum is formed, and the chrome alum crystallizes out and sticks so firmly to the bottom of the cell that it is sometimes quite difficult to remove. Potassium bichromate at one time was very cheap, and it will probably come down to the same figure again, when this product is being imported in greater quantity.

ARTICLES WANTED!!!

There is at the present time an excellent opportunity for writers of semi-technical, popular scientific articles and stories, as we are publishing more material of a popular nature each month. Stories should be as snappy as possible and should have well-rounded plots and characters. They should of course revolve around a scientific, electrical or radio focal point, to prove available for the columns of "Science and Invention." Good rates are paid on publication for stories accepted and publisht, and usually 2,500 to 3,000 words are sufficient. We also desire short write-ups with clear photographs on new scientific, electrical and radio subjects. Address all manuscripts to the Editor, "Science and Invention," 233 Fulton Street, New York City.

Photo-Electric Cells vs. Selenium Cells

(1078) A. M. Bouche, Canal Zone, writes the *Oracle*:

Q. 1. What is the effect of a low potential alternating current on the magnet coils of a sensitive polarized relay and do they cause heating after continued use? Would it cause "chattering"?

A. 1. The effect of a low potential alternating current on the magnet coils of a sensitive polarized relay, would be that, after a considerable period there is a chance that these may cause a gradual demagnetization of the permanent steel magnet in the relay. Undue heating effect should not be noticeable or produced unless the current is of decidedly too high an amperage for the electro-magnets which happen to be used on the relay. Direct current is invariably used on all polarized relays. It is possible to use alternating current on a relay without the least sign of "chattering," as described in the May, 1920, issue of the ELECTRICAL EXPERIMENTER, on page 39, where Mr. Donald McNicol describes his arrangements for using A.C. on the D.C. relay in a perfectly satisfactory manner.

Q. 2. Are selenium cells reliable and do they deteriorate with use? Where can selenium cells be obtained and about what is their approximate price? Does a selenium cell operate the same on alternating current as it does on direct current? Is a selenium cell sensitive to different intensities of light?

A. 2. Selenium cells are reliable for a certain period of time, but they deteriorate with age and also become more sluggish usually after a certain period, say a month or two. There is something new, however, in photo-electric cells which is very constant in its action and it is called the "Case" *photo-electric cell*. Selenium cells can be obtained from various supply houses advertising in this journal. We have never used selenium cells on alternating current and cannot say much about their behavior in this way, but we presume that they can be used in such a fashion with the proper form of circuit, with suitable condensers to smooth out the current, etc. A selenium cell is sensitive in proportion to the amount of light thrown on it, and the stronger the light, the greater the ratio between its light and dark resistance.

Plastic Compound Formula

(1079) Mr. E. L. Behrens, Waukesha, Wis., asks:

Q. 1. For a plastic compound suitable for molding knobs, condensers, handles, etc.

A. 1. We give herewith a compound which may be molded and which is plastic.

Glue is dissolved and boiled. To this tissue paper is added which readily goes to pieces. Some chalk is steered into the mixture and linseed oil added. This should form a thick dough. It is kneedable between the fingers and can be prest into molds. It becomes as hard as stone and very firm.

Battery Charging Resistance

(1080) James Tompkins, Staten Island, N. Y., asks the Oracle:

Q. 1. How to compute the necessary resistance to effect a given drop in voltage for re-charging storage batteries or operating low voltage charges from 110 volt D.C. lighting circuit.

To answer the above question, the resistance within whose limits the potential desired is to be expended, must be known; or, what follows from the above, the desired current—otherwise, no answer is possible. Then in series with the above resistance, place a second resistance equal to 110 minus the desired voltage multiplied by the first resistance and divided by the desired voltage.

Suppose you want a potential drop of 8 volts within a resistance of 2 ohms: 110 minus 8 gives 102; 102 multiplied by 2 gives 204; 204 divided by 8 gives 25½ ohms; this is the resistance to be put in series with your resistance.

Or do the same thing this way. Divide the desired potential which we assume to be 8 volts, by the resistance of your appliance, assumed to be 2 ohms. This gives 4 amperes for the current. Divide the total voltage 110 by the current 4—this gives the total resistance which is 110 divided by 4, giving 27½ ohms. Subtract the resistance of your appliance from this and 25½ ohms are left. This is the resistance to be put in series with your resistance, which is 2 ohms, as stated above.

The general idea is to connect the two points between which the 110 volts difference of potential is maintained, with a resistance, the capacity of whose conducting wire must be enough to carry the current without undue heating. Then by tapping the resistance, voltage or potential difference may be obtained, exactly in the proportion of the resistance tapt to the total resistance. It is therefore necessary to know what current you wish to have before the calculation can be made.

DETROIT

The Auto Center is the Logical Place To

LEARN AUTOMOTIVE ELECTRICS



Training for Head and Hand

Today the real trained man in the Automobile and Tractor business makes big money and easily gets into business for himself.

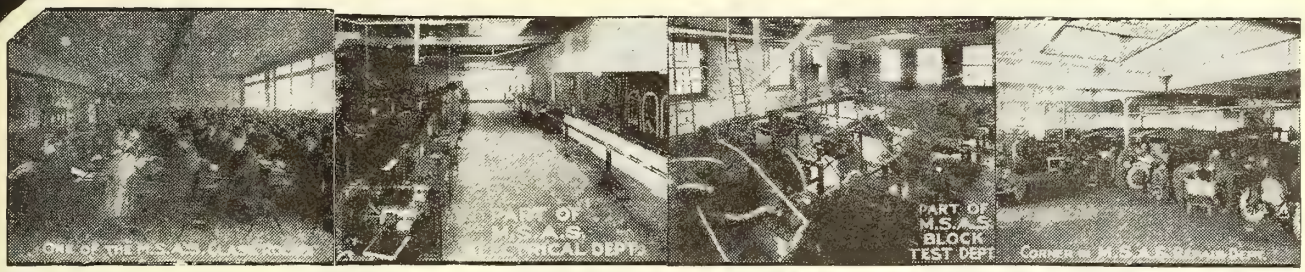
It is necessary to understand both the electrical and mechanical ends of the business in order to be successful. They go together.

Thousands of Men Wanted

In addition to the constant demand for real trained men in the production end, ten million or more autos, trucks and tractors in use in America must be kept in repair. You can start a garage, repair shop or service station of your own. Or operate, repair and sell tractors and automotive equipment used on the farm. Experts are needed to install and do service work on lighting systems. They must know gas engines and automotive electricity thoroughly. Salesmen that understand the mechanical and electrical part of the automotive machinery are winning big success. More brazing and welding shops, more Tire Repair Shops, are needed.

There is no other line of business where a man can go out and do what our graduates do, in such a short time. Many of them go right from our school into business for themselves and

Make $500 a Month and More



M. S. A. S., THE FACTORY ENDORSED SCHOOL

LEARN IN DETROIT

More than 180 of the leading automobile and accessory factories are located in Detroit District—94% of all automobiles are manufactured within a radius of 100 miles around Detroit and 71% are made right in the city. All leading manufacturers endorse our school. **The manufacturers know their business. Our course is given as specified by them.** That's why our graduates succeed, are constantly in demand and are given preference. Nowhere else can this **factory outlined** and factory endorsed course be found.

WHAT WE TEACH

We teach the automobile and tractor business from A to Z. Especially thorough and complete training is given in electrics, starting, lighting, ignition, wiring, testing, repairing.

Our equipment and instruction are positively the best. We give actual factory experience in assembling, block testing, bearing scraping, valve grinding, road testing, etc. LIGHTING PLANTS, TRACTORS, BRAZING AND WELDING AND TIRE REPAIRING are also thoroughly taught.

Learn the Automobile and Tractor Business

Put your electrical experience to work in the world's greatest industry. Automotive electricians are the most valuable men in the automotive field. They earn the largest salaries. The importance of electrical work in the automotive industry is well recognized. Every electrician knows that electricity and mechanics as used in automotive work are so connected that a knowledge of both is absolutely necessary. For this reason the Michigan State Auto School gives a thorough and complete course covering every point of knowledge and practice required of a successful automotive expert.

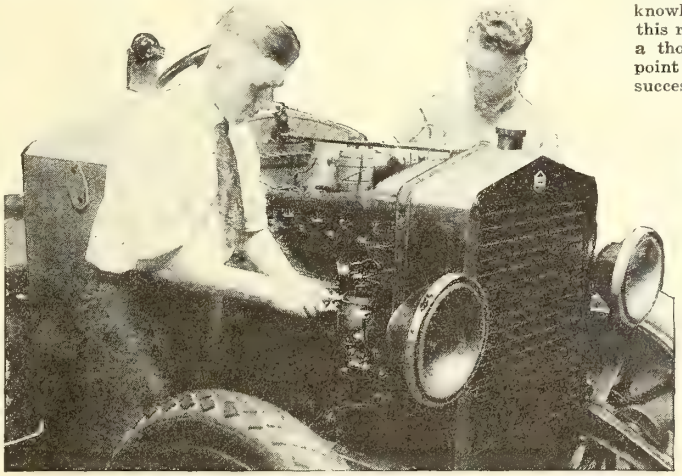
Money Back Guarantee

We guarantee to qualify you for a position as chauffeur, repair man, demonstrator, auto electrician, garage man, automobile dealer, tractor mechanic and operator or farm lighting expert, paying from $125 to $400 monthly, or refund your money.

FREE!

Big 124-Page Catalog

Send the coupon today for big 124-page illustrated catalog and copy of latest "Auto School News." They tell about Courses—show more than a hundred pictures of equipment—give letters from big auto factories and stories of success from graduates and opportunities for you. Resolve to learn the Auto business in Detroit, the Heart of the Auto Industry. Use coupon now.



M. S. A. S. students learning the electrical end of the ESSEX

SEND THIS COUPON TODAY

MICHIGAN STATE AUTO SCHOOL,
661 Auto Bldg., 3729 Woodward Ave.,
Detroit, Michigan, U. S. A.

Gentlemen.—Please send me absolutely FREE New 124-page Illustrated Catalog, "Auto School News," and information as checked below.

(Mark each course you are interested in)
[ ]Auto and Tractor Course
[ ]Tire Repairing [ ]Brazing and Welding

Name .....

Street .....

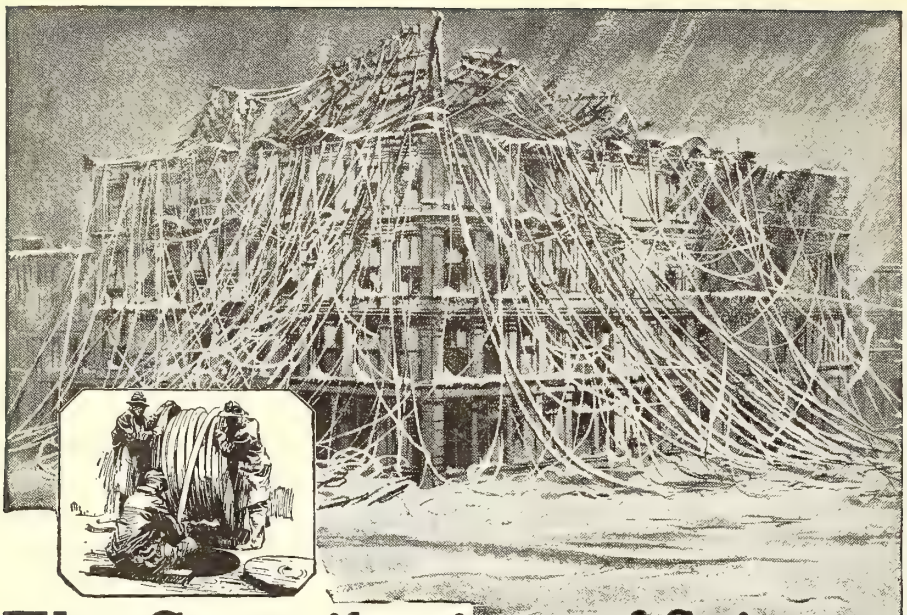
City..... State.....

P. S.—Or, better still, you can expect me to look over your school about.....

MICHIGAN STATE AUTO SCHOOL

"Most Progressive Auto School in America"—"In the Heart of the Auto Industry"

661 Auto Building
3729 Woodward Ave. **Detroit, Mich., U.S.A.**



The Contributions of Science

The greatest material benefits the world has received have come from the laboratories of the scientists. They create the means for accomplishing the seemingly impossible.

Science, after years of labor, produced the telephone. From a feeble instrument capable of carrying speech but a few feet, science continued its work until now the telephone-voice may be heard across the continent.

In February of 1881 a blizzard swept the city of Boston, tearing from the roof of the Bell telephone building a vast net-work of 2,400 wires. It was the worst wire disaster the Company had sustained.

Now through the advance of science that number of wires would be carried in a single underground cable no larger than a man's wrist.

As the fruit of the effort of science greater safety and greater savings in time, money and materials are constantly resulting.

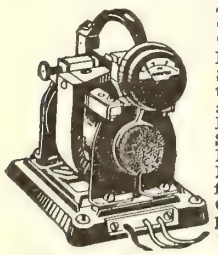
And never before as now, the scientist is helping us solve our great problems of providing Telephone service that meets the increased demands with greater speed and greater certainty.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
One Policy *One System* *Universal Service*
And all directed toward Better Service

AUTO OWNERS—BATTERY USERS—WIRELESS OPERATORS—EXPERIMENTERS

10c CHARGES YOUR BATTERY AT HOME WITH AN F-F BATTERY BOOSTER

IT PAYS BIG



or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current

Bantam type 6-6 ampere for 6 volt battery.$15
Type 16-8 ampere for 6 volt battery.... 24
Type 166-12 ampere for 6 volt battery.. 32
Type 1626-12 amperes or 7 amperes in combination for both 6 volt and 12 volt batteries 48
Bantam type 12-5 ampere for 12 volt battery $15
Type 112-6 ampere for 12 volt battery.. 24
Type 1612-7 ampere for 12 volt battery. 32

F-F Battery Boosters are entirely automatic and operate unattended.
Screw the plug in lamp socket in your garage, snap charging clips on battery terminals without disconnecting or removing battery from car, turn switch and lock garage door, knowing your battery will be charged in the morning. High charging rates are best for large batteries, or where time is limited. Shipping weight complete with **AMMETER** and **BATTERY CLIPS**, 11 to 15 lbs. Include postage and insurance with remittance for parcel post shipment. Keeping your Starting Storage Battery in charged condition makes it delightfully responsive and last longer, requiring fewer expensive battery renewals. Other F-F Battery Boosters for Farm Lighting Plants and Direct Current. **Battery Stations and Garages Use New F-F Rotary Rectifier for Group Charging. WRITE FOR BULLETIN NO. 12 NOW, IF NOT YET READY TO ORDER.**

THE FRANCE MANUFACTURING CO., Offices and Works, Cleveland, Ohio

Bench Drill from Pipe Fittings

By R. E. NELSON

(*Continued from page 993*)

Drive the shaft in place in the pulleys and using the shaft as an arbor, true the outside diameters of the pulleys and face the sides off in a lathe.

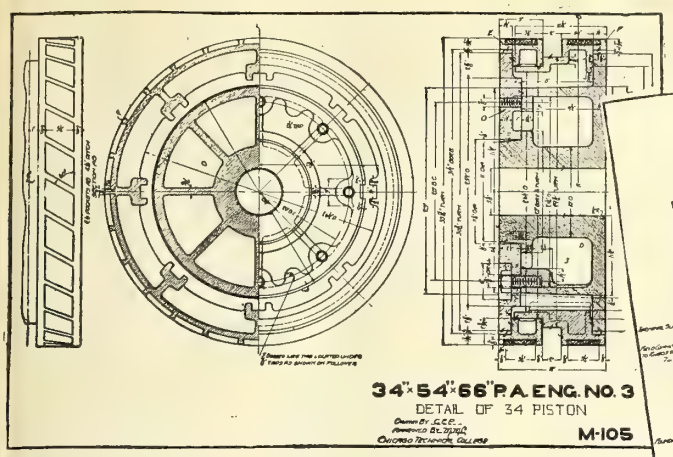
If different spindle speeds are desired it will be necessary to change the sizes. The pulleys shown in the drawings give spindle speeds of approximately 2300, 1400 and 840 R. P. M. when the motor runs at 1750 R. P. M. I purchased a ¼ H. P. washing machine motor which came equipt with a 2″ grooved pulley and I did not alter the size of this.

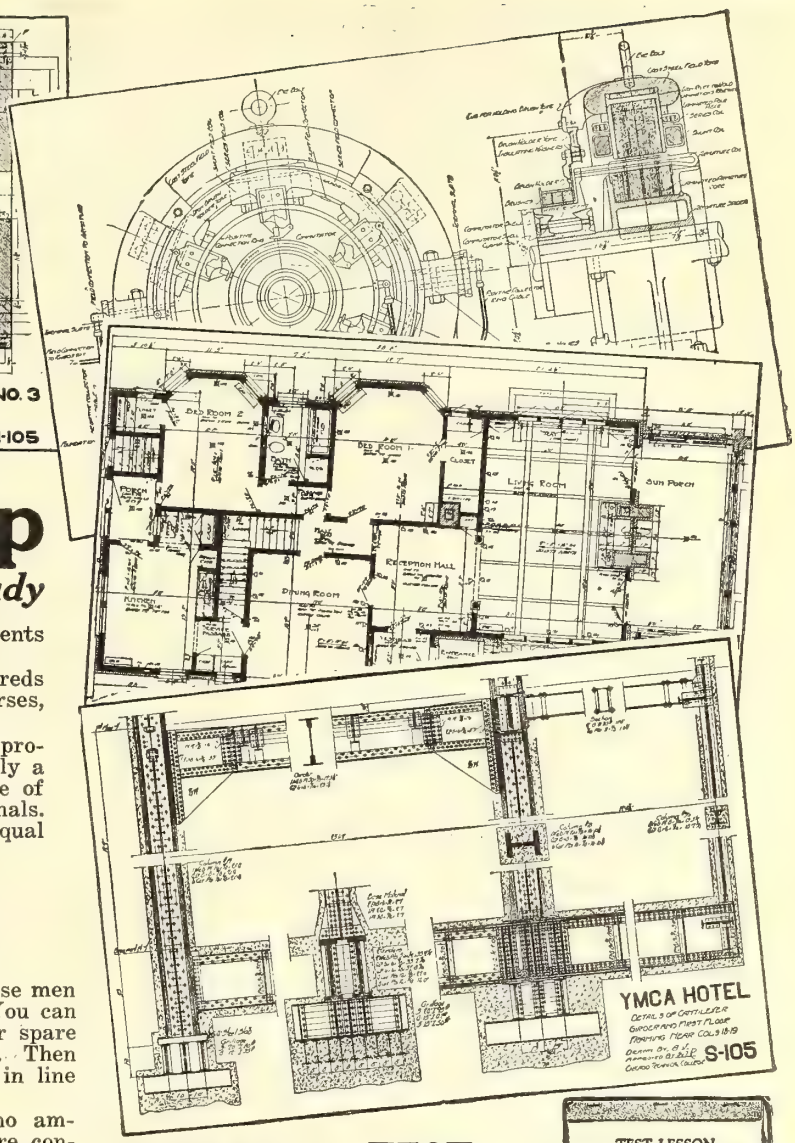
The easiest method of supporting the shaft "T" is to make two bearings from cast babbitt, one as shown at "S," figures 2 and 3, to fit around the main column "Z"; and the other in the shape of a small pillow block as shown at "W," which can be mounted on a wooden block of the proper height. Oil holes should be drilled in the top of each bearing, or else oil cups should be fitted to properly lubricate the shaft.

Babbitting Spindle Bearing.

After these parts have been completed the next step is to babbitt the spindle bearings. This requires very careful work as the accuracy of the drill depends upon it. First bolt the frame to the base board. Next cut four pieces about 2½″ x 2½″ out of 1″ soft pine. With an expansion bit bore a hole *one half* of the way thru each piece of such a size that the ends of the tees "C" and "C'" will just fit snugly in the holes. With a ½″ bit bore a hole the rest of the way thru the blocks. Fit one block on the top and bottom of each tee and then push the spindle thru these holes. After the spindle has been lined up cut a pouring lip on the top block of each tee, or, if the builder desires it, the top block on each tee may be left off entirely and the lower block on each tee relied upon to hold the spindle in alignment. Before pouring the babbitt be sure to plug the nipples "N" and "N'" with something (clay or putty), to prevent the babbitt from running down in the frame. Both bearings should be poured at the same time to prevent the spindle from springing or warping. A little white lead smeared on the spindle will prevent the babbitt from sticking to it. When the metal is cool drive out the spindle and polish it up. If the bearings are tight turn the spindle by hand using plenty of oil until they loosen up. Cut oil grooves in each bearing and drill an oil hole at the top of each tee and fit an oil cup.

The final step is to assemble all of these parts and give the drill a trial run. Whether or not the spindle runs true and free from wobble depends upon the workmanship as a whole. In conclusion it may be well to state just what may be expected of the drill. The writer is using a drill as described for the usual run of light work and it is giving fine service. It will drill a 5/16″ hole in soft steel with ease, and when working in fibre and softer materials a ½″ hole can easily be drilled.





Draftsmanship

Become an Expert by Home Study

The illustrations show the work of some of the students of Chicago Technical College.

These drawings were picked at random from hundreds equally good made by men who, before taking the courses, had had no training as draftsmen.

Naturally the large reduction made necessary to reproduce the drawings in the space of this page gives only a partial idea of the high excellence of the work—some of the lines losing the strength they show in the originals. But even so, it will be seen that these drawings are equal in merit to the work of men of long experience.

Make Yourself Worth $60 to $150 a Week

You, too, can master draftsmanship as easily as these men did under the Chicago "Tech" method of training. You can soon become proficient simply by giving some of your spare time to home study under the direction of our experts. Then you will be ready to step into a paying job and be in line for promotion to important managing positions.

Draftsmanship today offers opportunities which no ambitious man should overlook. American industries are constantly looking for experts—and none are more eagerly sought than the draftsman.

No need for you to settle down in any humdrum occupation or to accept an outlook without promise of large success when great manufacturing organizations, railroads, architects—all classes of concerns engaged in technical work—are searching everywhere for trained men. At least look into this profession today.

Train Under Practical Men

From the day you enroll with Chicago "Tech" you are under the direction of practical engineers who teach you thoroughly the methods which they use in their own work and which you will use when you practice the profession yourself. Lessons, exercises and special texts deal with conditions as they exist, so when you graduate you are perfectly familiar with the actual work of the drafting room.

You are carefully instructed on every point, taken upward step by step, everything being made so clear that your advancement is sure and constant. No time is put in on unnecessary studies—you concentrate on the work that will make your services in demand.

You get the same instruction by mail that you would get if you came to Chicago to attend the College. Therefore if now employed you can hold your present position until you are ready to enter the field of expert Draftsmanship.

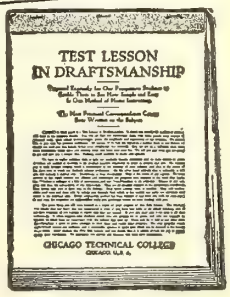
Moderate Fees, Easy Terms

Chicago "Tech" offers this practical instruction at a price and on terms which place any of the courses within the reach even of the man of moderate means. And payment can be made on easy monthly terms. No man who wants such training can give himself an excuse for not grasping the opportunity now.

CHICAGO TECHNICAL COLLEGE
145 Chicago "Tech" Bldg. CHICAGO, ILL.

FREE TEST LESSON

This free test lesson will show you how well qualified you are for Draftsmanship and how practical the Chicago "Tech" courses are. While other schools ask you to enroll and send money first, we send the free lesson first. The only offer of its kind. Read the lesson, practice the exercises and then decide for yourself whether to take the course or not. No obligation on you for asking for this.



Drawing Outfit—No Extra Charge

FREE outfit is included with our Home Study Course or credit given if you already have an outfit. These are high grade instruments, drawing board, T square, etc.—same as used by leading draftsmen.

Other Chicago "Tech" Courses

Chicago "Tech" opens the field of specialized training not only in Draftsmanship but in other paying lines also. If you want information on any of these, mark the coupon with X to show which subject interests you and full information will come by return mail.

SEND THE COUPON

No obligation upon you is implied when you ask for the facts about Chicago "Tech" instruction. We gladly send catalogs and information telling you about the opportunities offered in any line of work we teach. Then you can decide what the field offers for you. Big jobs are waiting now for men like you — WITH TRAINING. Send the coupon—today.

CHICAGO TECHNICAL COLLEGE 145 Chicago "Tech" Bldg., Chicago, Ill.

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below:

[ ] Architectural Drafting	[ ] Auto. Engineering
[ ] Machine Drafting	[ ] Aero. Engineering
[ ] Electrical Drafting	[ ] Gas Engines
[ ] Structural Drafting	[ ] Plan Reading—Buildings
[ ] Sheet Metal Drafting	[ ] Estimating—Buildings
[ ] Topographic Drafting	[ ] Plan Reading—Machinery
[ ] Surveying	[ ] Plumbing—Estimating
[ ] Designing	[ ] Heating and Ventilating
[ ] Contracting—Buildings	[ ] Steam Engineering

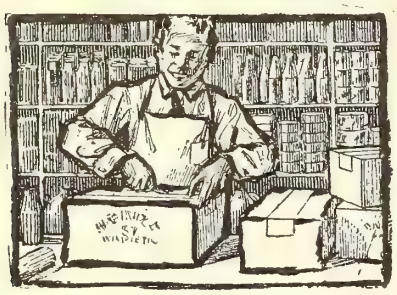
Name.....

Address.....

Post Office.....State.....

Free Trial Lesson included when inquiry is for Draftsmanship or Plan Reading.

College or Home Study, state which.....



Grocery Clerk or Lawyer?

Are you in the right position? Perhaps you, like thousands of others, are wasting your time in the wrong position, doing uncongenial work because you do not know your own capabilities.

You may have ambition — and be sapping the energy of the best years of your life trying to succeed in a position for which you are not mentally or temperamentally fitted.

Patrick Henry failed twice as a grocer before he realized that he was not fitted for it. Had he continued struggling along in the grocery business he never could have attained his great success and fame as a lawyer and legislator.

Find out if you are in the line of work for which you are best adapted. You can then confidently follow the career in which you will be most successful. By the use of the

BOLGER VOCATIONAL CHART

you can in the course of one evening readily analyze your vocational tendencies and determine the career in which you will achieve the greatest success. This chart is based on recognized scientific laws, and contains the essence of the science of vocational guidance. It gives you the opportunity of obtaining information which has helped others to success.

Get yourself on the road to success — Enter the career for which you are adapted — Don't waste your time at unpleasant, unsuitable work. Send one dollar for this chart — This may be the turning point in your life — Write at once to Dept. A-2.

Money refunded if not satisfactory.

BOLGER VOCATIONAL SERVICE
Incorporated
296 Broadway • New York City

Gibson Instruments

Mandolin, Mandola, Mando-Cello, Guitar, Tenor-Banjo, Mandolin-Banjo, Cello-Banjo, Guitar-Banjo, Harp-Guitar, Mando-Bass —



Easy to Play
Easy to Pay

Select your **Gibson** now. You can soon be playing the music of the day. Your friends will be surprised and delightfully entertained. Let us help you organize a **Gibson** Orchestra in your community. You can increase your popularity, income and pleasure by playing for Concerts, Entertainments, Church Affairs, etc. A small down payment and then $5 a month will soon pay for a **Gibson** and will furnish you with wholesome, year-'round entertainment. If you have an old instrument, we will make liberal allowance on a **Gibson**. Write Today for Free Book, Catalog, Free Trial Offer, information about Wm. Place, Jr. Book and the instrument you prefer.

GIBSON MANDOLIN-GUITAR CO.
1061 Parsons St., Kalamazoo, Mich., U. S. A.

5 Master Keys

Have a set of the most wonderful keys in the world, which open hundreds of different locks and replace hundreds of different keys. Used by locksmiths, janitors, and detectives. Set and novel key chain sent for $1.00. Master Key Company, 42 Manhattan Bldg., Milwaukee, Wis.

The Limitations of Sight

By WILLIAM M. BUTTERFIELD

(*Continued from page* 976)

scope as shown in our illustration this is provided for, by light reflected up from a mirror thru the object and around it, as it rests on the stage of the microscope. The general principle of the microscope and astronomical telescope are identical. Each of them produces a focal image within the tube of the instrument by the action of the lens or lenses at the lower or outer end of the instrument. These lenses are the objectives. By a more or less complicated eye-piece, this image is then magnified for its reception by the human eye. The Gallilean telescope, represented by the opera glasses of today, operating on a different principle, produces no focal image within the barrel of the instrument, but transmits the rays from an object to the eye at a greater angle of convergence. But as said before, its action resolves itself into the securing of a better angle of incidence for the rays of light upon the lens of the eye, so as to increase the size of the focal image of the object on the retina.

Photography indirectly increases the range of the eye in telescopic work, because stars absolutely invisible to an observer at a telescope will affect a photographic plate occupying the place of the observer's eye, if a long enough exposure is given.

The photographic plate is much more sensitive to rapid changes in light and also infinitely more sensitive to very faint lights and lights at both extremes of the spectrum. Thus, an ultra-violet light which has no effect whatsoever on the retina will nevertheless affect a photographic plate and quite interesting landscapes can be taken under the influence of either ultra-violet or infra-red rays, even at night.

The photographic plate also seems to have the property of allowing light to accumulate sufficiently upon one spot or cause a decided change in the chemical coating upon that plate. For that reason, many stars have been discovered in the heavens by means of the photographic telescope which had escaped even the trained eye of keen observers, and many hitherto ultra-microscopic objects have been photographed because of the fact that they refract or absorb rays of ultra-violet light. The bacillus which caused the recent epidemic of influenza-pneumonia was claimed to have been discovered in this manner.

Home Mechanics

(*Continued from page* 989)

hollow it out by boring first with a bit, then cutting away the wood between the holes, as shown in the top drawing. Oval or squared openings with round corners can be obtained in this way. The base and bottom is also in one piece, with its holes for the pins bored thru those in the box—to make them match. Those in the top are bored only half thru the wood, but bored also with the bit passing thru the holes in the box as before. To prevent splitting when the bit breaks thru the opposite surface, let the screw of the bit only come thru, then reverse and finish the hole from the unbored side. Three screws may be used in holding the bottom more securely, as well as the pins, if desired. The boxes are stained, varnished or painted in the manner desired.



A SPECIAL Factory Cut Price

U. S. Officer's Shoes

Hand sewed, first-grade factory cut-down price. Direct to you at only **$6.85** Made of the best Water-proof Mahogany calf leather. If these shoes are not just as we say, send them back. You do not lose a cent. Retail price of this shoe is $10.00. Built for work and dress at the same time. If you are sending money order or check do not include postage. Pay only for shoes. We pay postage.

U. S. Army Marching Shoes

First-grade factory, cut down-price. Direct to you at only $5.85. Retail price of these shoes is $8.00. Made of the best elkskin waterproof leather. Second grade $5.15

U. S. NATIONAL MUNSON ARMY SHOE CO., Inc.
Dept. 320
Westfield, Mass.

Order Your Scientific and Technical Books *Now.*

They are difficult to obtain and prices are constantly increasing. We will quote present price on any book of this nature and the price will hold unless the publisher should increase his price in the interim.

Write for our 96-page catalogue—the most complete scientific and practical catalogue now issued. In addition, our 1920-1921 list will be sent you as soon as ready, and the prices in this list will hold good in possibly 80 per cent of cases; but you will be notified of any change before filling order.

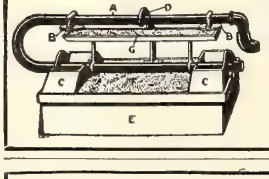
There will be no obligation in requesting catalogue for we want you to know our Book Department. Write today. You'll find it valuable for suggesting books you need.

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Room 655, Woolworth Bldg., New York City





What $15.00 Still Will Buy



Safety, Economy, Convenience, Practicability, Simplicity, Ease of Installing and Handling.

An Oil Gas Burner for every cook or heating stove. Agents address The Vapor Gas Burner Co., Desk 2, Columbus, Ohio.

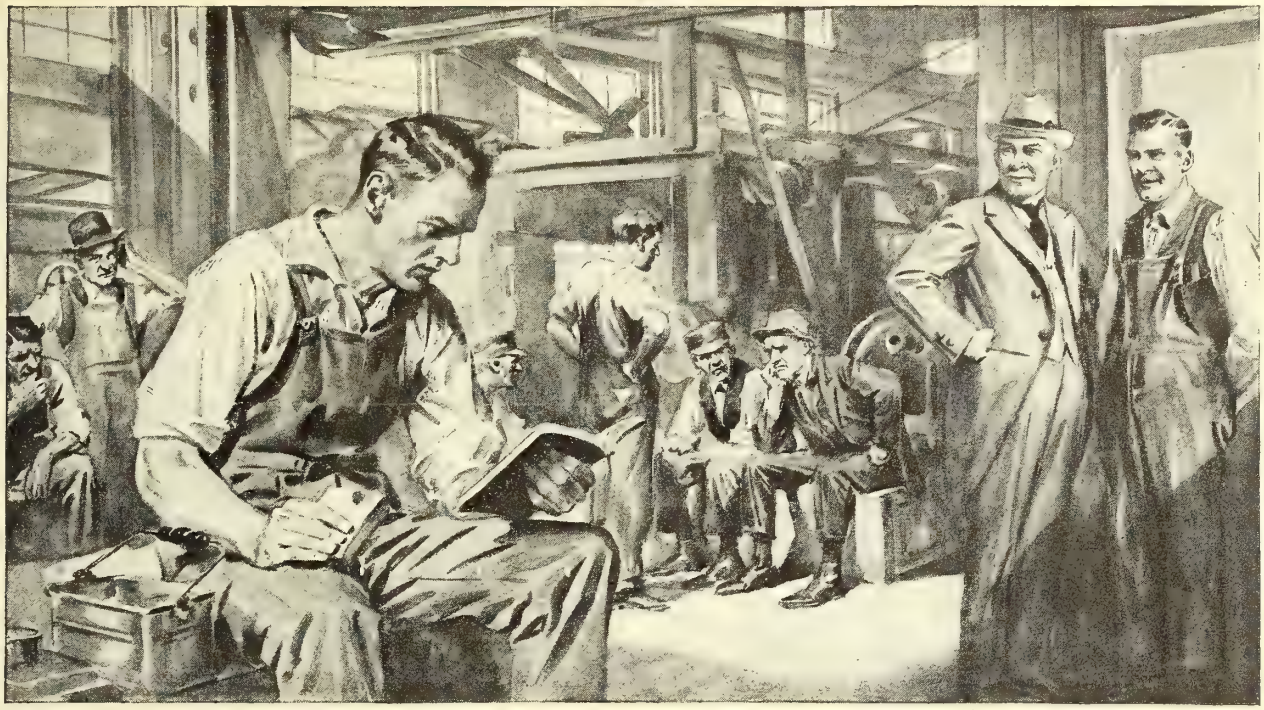
You Can Save $50.00



$7.65 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.



"Keep Your Eye on Jim!"

"It's not alone what a man does *during* working hours, but *outside* of working hours—that determines his future. There are plenty of men who do a good job while they're at it, but who work with one eye on the clock and one ear cocked for the whistle. They long for the loaf at noon and for that evening hour in the bowling alley. They are good workers and they'll always be just that—ten years from now they are likely to be right where they are today.

"But when you see a man putting in his noon hour learning more about his work, you see a man who won't stay down. His job today is just a stepping-stone to something better. He'll never be satisfied until he hits the top. And he'll get there, because he's the kind of man we want in this firm's responsible positions. You can always depend on a man like Jim.

"Every important man in this plant won out in the same way. Our treasurer used to be a bookkeeper. The sales manager started in a branch office up state. The factory superintendent was at a lathe a few years ago. The chief designer rose from the bottom in the drafting room. The traffic manager was a clerk.

"All these men won their advancements through spare time study with the International Correspondence Schools. Today they are earning four or five times—yes, some of them *ten* times as much money as when they came with us.

"That's why I say that Jim there is one of our future executives. Keep your eye on him. Give him every chance—he'll make good!"

Employers everywhere are looking for men who really want to get ahead. If *you* want to make more money, show your employer that you're trying to be *worth* more money. If you want more responsibility, show him you're willing to *prepare* yourself for it.

For 29 years the International Correspondence Schools have been training men and women right in their own homes after supper, or whenever they had a little time to spare. More than two million have stepped up in just this way. More than 130,000 are studying now. Ten thousand are starting every month. Can you afford to let another priceless hour pass without making *your* start toward something better? Here is all we ask—without cost, without obligation, mark and mail this coupon. It's a little thing that takes but a moment, but it's the most important thing you can do today. Do it now!

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6174-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Car Running	☐ Outdoor Sign Painter
☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ BOOKKEEPER
☐ Mechanical Draftsman	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Public Accountant
☐ Machine Shop Practice	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ Common School Subjects
☐ MINE FOREMAN OR ENGINEER	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ STATIONARY ENGINEER
☐ PLUMBING AND HEATING	☐ Textile Overseer or Supt.
☐ Sheet Metal Worker	☐ AGRICULTURE ☐ Spanish
☐ Ship Draftsman	☐ Poultry Raising ☐ French
☐ Navigator	☐ AUTOMOBILES ☐ Italian

Name _____

7-25-19

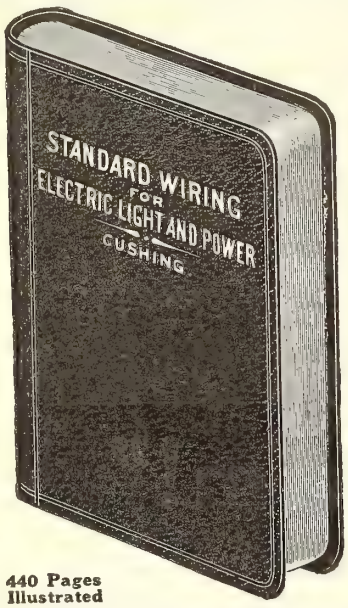
Occupation & Employer _____

Street and No. _____

City _____ State _____

LEARN WIRING
AND EARN
$75 a Week

This latest Edition will make you an Expert



440 Pages
Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. 250 Electrical Units and their Definitions and Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve your wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges. Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.

8 West 40th Street New York

Wonderful Experiments In High Pressure

(*Continued from page* 966)

Phosphorus gave two new forms under pressure. One was a new modification of white phosphorus obtained at high pressures and moderate temperatures. On release of pressure the new white phosphorus changes back to ordinary white phosphorus. With higher temperatures and pressure, *black phosphorus* was produced. The transition required from five to thirty minutes. On release of pressure, black phosphorus does *not* change back to white phosphorus. The black phosphorus is of much smaller volume than the original white phosphorus. It is not definitely a compound, and it seems to be impossible to produce it from red phosphorus.

The specific gravity of black phosphorus is 2.691 as compared with 1.83 for ordinary white phosphorus. It is quite hard to ignite it; it is almost if not entirely stable in the air, and it is a fairly good conductor of electricity. White and red phosphorus are almost perfect non-conductors.

The electrical resistance of metals except for antimony and bismuth was found to decrease with pressure.

The Making of Copper Articles by Electrolysis

By SAMUEL WEIN

(*Continued from page* 985)

saturated solution of copper sulfate, and sufficient amount of sulfuric acid. The best results are had with the solution advocated in Bulletin No. 52 and issued by the Bureau of Standards. This consists of:

Copper Sulfate	27 ounces
Sulfuric Acid	11 ounces
Water	1 gallon

The specific gravity of this solution is 18 degrees Baumé. It is advisable in preparing the solution to stir it well and then to allow it to stand until perfectly cold when it will be ready for use.

The best results are had with a current density of about 18 amperes per square foot, and 1½ volts at the beginning of the electro-deposition; this is maintained for about three hours, after which the voltage is reduced to about 1 volt and kept at this potential until the completion of the 24 to 36 hours, or until the desired thickness of deposit has been obtained.

It is interesting to note that an increase in the amount of copper sulfate or of the sulfuric acid will slightly increase the tensile strength of the deposited copper.

Such compounds as gelatine, glue and tannic acid in the proportions of one part to one thousand of acid copper-sulfate electrolyte, will give a fine grained tenacious deposit under the usual conditions of plating. The effect is more marked if the electrolyte is slightly warmed to 25 or 35 degrees centigrade.

The deposition of copper is very even and homogeneous, but for practical purposes, it is somewhat too slow. It is for this reason that the solution is made hot (by steam pipes laid on the bottom of the tank) and is subjected to agitation. There are several ways of agitating the solution; these are by blowing compressed air thru it, by revolving the cathode in a horizontal, vertical or in an inclined position, or by mechanically stirring the liquid. This permits the use of a greater current density in the electrolyte.

By increasing the temperature above the normal, the tensile strength will decrease.



Voice Thrower 10c

Learn to throw your voice into a TRUNK, under the bed, out in the hall or anywhere. Lots of FUN fooling the Teacher, Janitor, Policeman, Parents, Neighbors, or Friends.

THE VENTRILO

is a little instrument that fits into the mouth out of sight. BOYS or GIRLS can use it in conjunction with the above for imitating birds and animals. Never fails. A 32-page book on Ventriloquism sent with the Ventrilo for 10 cents.

NEW FORD JOKE BOOK 1920

All the latest jokes on the Ford auto. Hundreds of them, and all good ones. Spring a new one on your neighbors.

Large book with cover by mail, 10c





ROGEN X-RAY

Price 12 cents

HERE, BOYS, is just what you want. With this instrument you can apparently see the bones in your fingers. Think of the fun you can have with it. Sample by mail, TWELVE CENTS.



SKULL RING

Here is a handsome, up-to-date Ring, representing a Skull and Cross-bones. Has stones in the eyes and looks something frightful. Women won't like it, but for men or boys it is a great novelty. **Sample, by mail, 20c.**



Gee! What a Wad!

This is STAGE MONEY

Looks like the GENUINE STUFF. Some Green backs and some Yellow backs. Create a BIG sensation among your friends. The girls will all be after you when they see the wad. BIG roll of 15 pieces by mail, 10 cents.



ENCHANTED BARREL

The Most Wonderful Pocket Trick Made

CHANGE A CENT INTO A DIME

Ask your friend to drop a dime in the barrel. When he takes it out, Behold! It is a CENT. You make 9 cents every time you fool them. Never fails. They cannot get on to it. Sample barrel, with directions, only.... **12c**

BIG VALUE for 10 Cts.



6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Baseball Book, giving rules for games; 1 Toy Maker Book; Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 5 Puzzles; 12 Games; 30 Verses for Autograph Albums. **All the above by mail for 10c.**

Any of the above Mailed with Catalog

ROYAL NOVELTY COMPANY

488 East Ave. South Norwalk, Conn.

All About the Moon and the Tides it Creates on Our Earth

No doubt we all are interested in the fact that the moon is the cause of the tides. We have been told again and again that the moon lifts up the waters of the ocean by attraction. It is supposed to do that by a so-called pulling force. A great many are justly puzzled by such an explanation, and they are right in refusing the theory. We often see in our daily papers, letters addressed to Professors asking them to explain the phenomena. The professor gives an explanation as it is found in books. He thinks it right but he is wrong like his predecessors. A recently copyrighted publication however, gives a very clear and very simple explanation. The author has found out by long personal study that all the books and all the professors were all wrong when they went to explain this twice a day occurrence. This author has in fact made a great discovery.

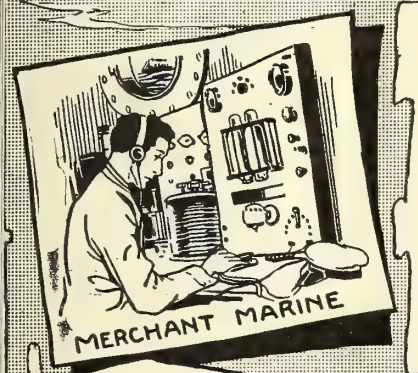
READ IT

It will make you feel happy to be able to talk about this thing intelligently. It will be a great addition to your education. Be up to date and send for it as soon as possible. The cost is insignificant compared with the information it brings to you.

Sent to any address in the United States for 35c. in silver.

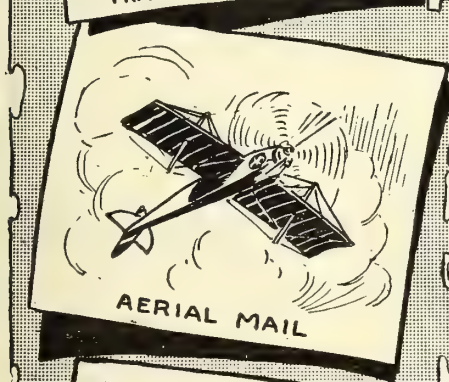
Address: Clement Engel, Box 119 New York City
Madison Square Station

LEARN WIRELESS At Home By Mail













Calls Coming In Steadily For National Radio Institute Graduates. Big Concerns in Need of Operators.

MANY attractive positions are now open in Merchant Marine, Commercial Land Radio Service, Radio Supply Factories, U. S. Navy, Aerial Mail and large Business Corporations.

Salaries Up To $3,500 a Year

Exceptional opportunity for ambitious men for promotion to the higher branches of Radio. Our graduates are qualified as Senior Operators, and besides room and board, receive $125 a month to start, which altogether means more than $200. Positions to which they can promote themselves are as follows: Supercargo and Wireless Operator—$175 a month; Radio Mechanic—$1,500 to $2,000 a year; Radio Aid—$6 to $8 per day; Radio Inspector—$1,500 to $3,000 a year; Radio Engineer—$6,000 and more a year; Radio Draftsman—$7 to $10 a day. You can learn wireless the National Radio Institute way, quickly and easily, by mail right in your own home, in your spare time. No previous experience or training is necessary. With our help you can quickly qualify for first-grade government license and a fine position.

U. S. Department of Commerce Recognizes N. R. I.

and allows its graduates 5 to 10 points credit when taking the examination for First Grade Government License. This school heads the printed list of reputable Wireless Schools recommended by the U. S. Shipping Board.

Travel Without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs. Wireless offers the chance of a lifetime. On shipboard you are rated as an officer. You need not travel unless you wish, but may secure a position at one of the many ever-increasing land radio offices.

Pay as You Learn

Our plans of payment place a wireless education within the reach of anyone who desires to learn. A small payment down and the small payments made during the course make it possible for you to earn the cost of your tuition while actually learning to be a wireless operator.

New Automatic Wireless Instrument Free

In addition to all necessary text books and other equipment with which we supply you, we furnish FREE to every student our marvelous new automatic Natrometer, which transmits wireless messages in 600 different combinations, and can be regulated to operate at any speed from 1 to 30 words a minute.

It is complete with phones, etc., and is sent you in a neat carrying case. This instrument is operated entirely without the use of aerials and is used exclusively by the National Radio Institute to teach wireless at home in the scientific way.

You receive the instrument after your enrollment; it becomes your personal property upon completion of our course.

FREE In addition to our complete course in Radio Telegraphy, every student is given our complete course in modern Radio Telephony. These combined courses enable our students to fill positions requiring a knowledge of both Radio Telegraphy and Telephony. Send the following coupon today for our FREE BOOK containing all particulars.

MAIL THIS COUPON TODAY

NATIONAL RADIO INSTITUTE,
Dept. 420, Washington, D. C.

Send me your FREE book, "Wireless The Opportunity of Today." Tell me about your Home Study Course in Wireless Telegraphy and Telephony—the free post-graduate course—and your special Instrument offer.

Name.....

Address.....

City..... State.....



The Hour That Counts!

When you see a man putting in his noon hour learning more about his work, you see a man who won't stay down. He'll never be satisfied until he hits the top. And he'll get there!

In shops, factories, offices, stores, in every line of industry, men are holding splendid positions won through spare time study with the International Correspondence Schools. Today they are earning four or five times—yes, some of them *ten* times as much money as when they started.

Employers everywhere are looking for men who really want to get ahead. If *you* want to make more money, show your employer that you're trying to be *worth* more money.

For 29 years the International Correspondence Schools have been training men and women right in their own homes.

More than two million have stepped up in just this way. More than 130,000 are studying now. Can you afford to let another hour pass without making *your* start toward something better? Here is all we ask—without cost, without obligation, mark and mail this coupon!

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6175-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

MEN WANTED



Mechanically Inclined—to send for my big illustrated 72-PAGE BOOK—**FREE!**

It tells how in a few weeks you can earn from $150 to $400 a month in the Auto and Tractor business. ***Be Your Own Boss.*** At small cost learn to be an expert mechanic by the Sweeney System of working on real cars. ***Use tools not books.*** Simply send your name and address today, a post card will do, for our **Free** book and 27 photographic reproductions of machine shop work, etc. **Let's Go---Write Now!**

EMORY J. SWEENEY, President

LEARN A TRADE—Sweeney

SCHOOL OF AUTO-TRACTOR-AVIATION
188 SWEENEY BLDG KANSAS CITY, MO

Telegraphing Photos by Code

(*Continued from page 967*)

at the office of the *Daily Express,* each of which constituted the make-up for one of the celebrities aforementioned.

It is claimed that Mr. Andersen uses a special apparatus for translating the cablegrams and reconstructing the picture therefrom, which instrument and method has to be employed in a photographic dark room. The details of the Andersen system have not been given out yet, but he is frank to say that it is unlike any of the previous systems of transmitting photographs or photo-diagrams based on the employment of numbered or lettered squares,—such as the Leishman method which has been in use for some time between New York and Denver for transmitting photographs of the newest happenings.

One thing is known with reference to the Andersen system and that is that the original photograph or sketch has first to be accentuated by an artist, so as to represent a decided contrast between light and shade. The elements of this method, as far as known at present, can be gleaned further by inspection of Figs. 1, 2 and 3.

Fig. 1 shows a half-tone or photograph of a woman's face, while Fig. 2 shows the artist's or draftsman's line cut accentuation of the same picture, preparatory to its transmission by code.

Now it becomes an easy matter with a suitably divided and numbered scale to code such a picture so that it can be sent by telegraph, telephone or radio in the usual manner, to practically any distance desired. Fig. 3 shows a simple scale which the student of such subjects may like to reconstruct, and this of course should be made of celluloid such as used in making animated movies. It may be divided by vertical and horizontal lines drawn with India ink and a draftsman's ruling pen in the manner indicated, and the horizontal lines or abscissæ lettered A, B, C, while the vertical ordinates may be numbered 1, 2, 3, 4.

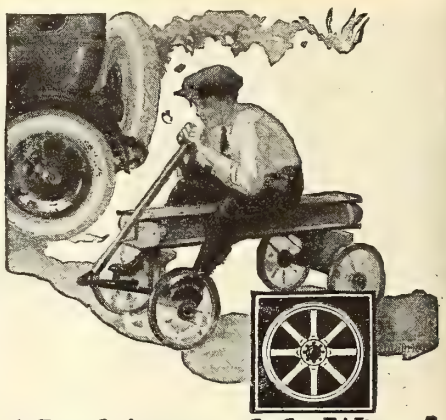
When this scale is placed over the line cut or accentuated photograph representing the line cut, it becomes a comparatively simple matter to write a code message such as that given in the illustration, Fig. 4, whereby a person receiving the code message can, with a small scale and a piece of thin tracing paper placed over it, reconstruct the picture line for line. An improvement over the method of simply placing a piece of thin tracing paper over the scale, would be to place the scale and paper over a piece of glass and provide an electric light behind it, which should make the drawing or picture more accurate and visible.

It will be at once perceived, of course, that any method of this nature, whether it uses numbered squares or some other scheme, is practically always limited in its accuracy or reproduction of the picture by the size of the squares,—the smaller the squares or the finer the lines forming the squares shown here for an illustrative example, the more accurate the products will be, and the larger the squares for a given size picture, the cruder the results obtained in the reproduction will appear.

It is said that the cablegram used in transmitting Miss Vanbrugh's photo contained but 145 words, while King George's photograph required 185 words.

The apparatus is said to be simple and of low first cost, and the system worked out by Andersen can be taught to anyone in a short time, so he says.

"So long as the code words are accurately transmitted," states Mr. Andersen, "there is no doubt about the exact reproduction of the photograph."



A Real Automobile Wheel

Haven't you often wished for a wagon equipped with wheels like those on an automobile? Of course you have—and here's your chance. The Auto-Wheel Coaster and the Auto-Wheel Convertible Roadster have standard automobile-type wheels with steel tires. They are designed by engineers, on scientific principles. THE



Auto-Wheel Coaster and the Auto-Wheel Roadster



are real wagons for real boys. Automobile-type wheels are only one good feature about these wagons. Each one is equipped with roller bearings, special hub-caps, locking pins and a safety brake; and each one is durably constructed of seasoned ash. It is a wagon of true mechanical parts.

Organize an Auto-Wheel Coaster Club and become its captain. We will furnish caps to members of the club and send you a special cap as captain.

Send us the names of three coaster wagon dealers in your town, telling us which ones sell the coaster with the name "Auto-Wheel" on sides, and we will send you our magazine "*The Auto-Wheel Spokesman*" for six months and an Auto-Wheel Dime Bank—FREE.



The Auto-Wheel Coaster Co., Inc.
Formerly
The Buffalo Sled Company
163 Schenck Street,
N. TONAWANDA, N. Y.
In Canada: Preston, Ont.
Export Office: 865 W. 23rd Street, New York City.

Auto-Wheel

NEW MOTOR BARGAIN



GENERAL ELECTRIC ¼ **HP** Motor 110 V. A. C. 60 cycle single phase, 1750 Speed. Complete with Cord, Plug and Grooved Pulley.

Will operate **$23.50** Washing Machines, Sewing Machines, Small Lathes, Grinders, Bottle Washers, Etc. Satisfaction guaranteed or money refunded.

Illustrated catalog of motors and supplies FREE

HYRE ELECTRIC CO.
631 South Dearborn Street Chicago, Ill.

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue, 774 Bogue Bldg., Indianapolis



INSYDE TYRES

Inner Armor for auto tires. Prevent blowouts and punctures. Double tire mileage. Easily applied to any tire between casing and tube. Details free. Agents wanted. Liberal profits.
Amer. Access. Co. Dept. T-1961 Cincinnati, O.

Learn Write

I TEACH BY MAIL

WRITE FOR MY FREE BOOK
"How to Become a Good Penman"
and beautiful specimens Your name elegantly written on a card if you enclose stamp. Write for it today. **F. W. TAMBLYN, 424 Meyer Bldg., Kansas City, Mo.**

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

LEARN WIRELESS AT HOME

The Demand for Good Wireless Operators Far Exceeds the Supply

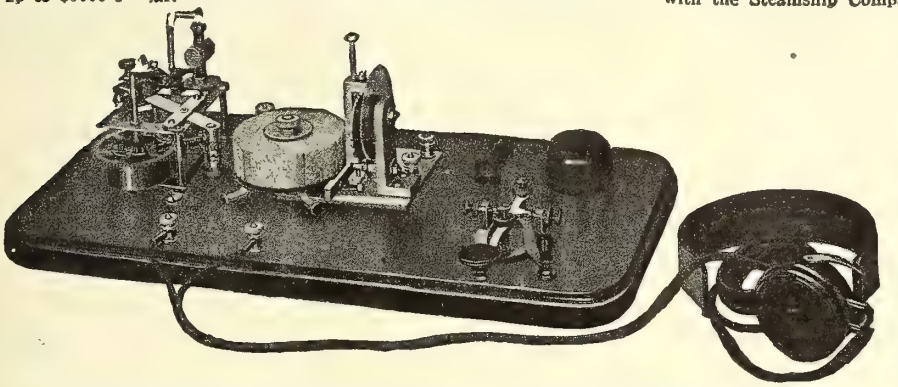
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, formerly Chief Radio Inspector, Bureau of Navigation, N. Y. He resigned last August to accept a position of still greater responsibility with one of the largest Commercial Radio Corporations in the United States. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course.

FREE Instruments and Text Books

We furnish free to all students, during the Course, *the wonderful receiving and sending set exactly as shown in the illustration.* **This set is not loaned, but *given* to all students completing the Course. One cell of dry battery all that is required. No additional wiring, aerials, etc., needed.**

The Transmitter shown is the celebrated **Omnigraph** used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the **Omnigraph**, place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the **Omnigraph**—the same model **Omnigraph** as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

Wireless Telephony Course

We have incorporated in our Institute an up-to-date and complete Course in Wireless Telephony, written by our Chief Instructor, Mr. L. R. Krumm. **This Course is also furnished free.**

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in New York City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

The Department of Commerce of the U. S. Government

recognizing the value of the instruction furnished by us, allows all of our graduates a five-point credit in their examination for first-grade license.

THE U. S. SHIPPING BOARD will also testify as to the value of this instruction.

America's Fastest Growing Wireless Institute

There Must Be a Good Reason. There Is—

The Best Course in Theory available.

The Best Instruments obtainable.

The Best Text Books and Diagrams on the market.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—**but do it today.**

NEW YORK WIRELESS INSTITUTE,

Dept. 77, 258 Broadway **New York City**

New York Wireless Institute
Dept. 77, 258 Broadway, N. Y. City.

Send me, free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your **Free Instrument offer.**

Name .....

Address .....

City or Town.....State.....



Be a Draftsman!

Make $40 to $100 a WEEK

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $40 to $100 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 6½ x 8¼ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

75c a Week Only $3 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership **given free** with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-251, Chicago, U. S. A.



AMERICAN TECHNICAL SOCIETY
Dept. D-251
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $3.00 a month until $19.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....

Earn $2,500 to $5,000 a year

Be a Signal Engineer

Qualify at home in spare time for a big position as Signal Engineer. Get into this great new field of fascinating work where quick success, swift promotion and a high salary await you. Railroads everywhere need men who understand Signal Engineering and electrical safety devices.

Book FREE

Send quick for big illustrated Book on Signal Engineering and details of our great Free Outfit Offer and our wonderful system of training which includes a *Complete Course in Practical Electricity and Mechanical Drafting.* Send postal today. Don't delay! Get it now!

DEPART. OF SIGNALING, Dept. 1791
1924 Sunnyside Ave., Chicago, Ill.





Send Your Name and We'll Send You a Lachnite

DON'T send a penny. Just send your name and say: "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will send it prepaid right to your home. When it comes merely deposit $4.75 with the postman and then wear the ring for 10 full days. If you, or if any of your friends can tell it from a diamond, send it back. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.

Write Today Send your name now. Tell us which of the solid gold rings illustrated above you wish (ladies' or men's). Be sure to send finger size.

Harold Lachman Co., 204 S. Peoria St., Dept. 1251 **Chicago**

Science and the Weather Man

(*Continued from page 969*)

bottom and a small tubulure at the center so that the water *falling within the collector is conducted to a point directly over the center of the tipping-bucket bearings.* See photo and diagram.

The *tipping bucket* and a portion of the frame are shown in figure. A central partition, indicated by dotted lines in the drawing, divides the bucket into two *equal* compartments. The trunnions forming the axis upon which the bucket tips are placed below its center of gravity. In either position of the bucket, one or the other of the compartments will receive and retain the water delivered thru the funnel of the collector.

The weight of the bucket and the position of its center of gravity have been so adjusted in relation to its supports that when one of the compartments has been filled with the quantity of water representing one-hundredth of an inch of rain in the 12-inch gage, the bucket tips upon its bearings, emptying the water from one compartment, and at the same moment presenting the other compartment to receive the incoming water. The water thus delivered from the buckets is retained in the reservoir section for subsequent measurement in bulk. The apparatus recording the tippings of the bucket is attached to the so-called triple register. The record sheet upon this instrument moves at a relatively rapid rate by clockwork. Nevertheless, in order to render the registration of the most rapid rates of rainfall legible, the recording pen traces its record in a zigzag line of steps, each step represents one-hundredth of an inch of rain, and one complete zigzag comprises ten steps. In the majority of cases the individual steps are perfectly legible, but in records of very rapid rates each individual step cannot always be discerned. The points of the zigzag, however, are separated by ten tips or steps, and are distinguishable under even the most rapid rates.

THE ROLE OF THE BAROMETER IN WEATHER FORECASTING.

Possibly one of the least understood phases of weather reports and weather forecasting, are the terms *high and low pressure areas,* as shown on the weather maps gotten out daily by the Weather Bureau and posted in public places; and also the interpretation of high and low barometer and barograph readings. We are indebted to Dr. James H. Scarr, meteorologist in charge, New York branch of the U. S. Weather Bureau.

In many public places, hotels, restaurants, clubs, etc., there are placed barographs which record continuously on a revolving paper covered drum, the barometric pressure at that locality, so that those interested may, by keeping in mind the following principles, and a daily reference to the "Weather Map," form an enlightened opinion of the relative position of the locality of the observer to the general conditions prevailing over his section of the country. He may note the slow or rapid progress of these conditions, and supplement the daily weather forecast with "up to the minute" information.

In the latitude of most of the United States and the southern portions of Canada, the march of weather conditions is from west to east. Waves of high and low pressure (Barometer) follow each other alternately across the continent in pretty regular succession like the waves of the ocean influenced by a west wind. The crests of these waves are the "highs" and

Learn Music At Home!

Easy Lessons Free!



Piano, Organ, Violin, Saxophone, Flute, Clarinet, Ukelele, Trombone, Cornet, Guitar, Banjo, Mandolin, Harp, 'Cello, Sight Singing, Drums and Traps. No longer need the ability to play be shut out of your life. Just write us a postal today for our new Free Book, fresh from the printer. Let us tell you how you can easily, quickly, thoroughly learn to play your favorite musical instrument by note in your own home, without a teacher, by our New Improved Home Study Method, *without paying a cent for lessons!* Different, easier than private teacher way—no tiresome, dry exercises—no inconvenience. No trick music, no "numbers," yet simple, wonderful, amazingly easy for even a mere child.

250,000 Pupils!

We have successfully taught over 250,000 people, from seven to seventy, *in all parts of the world!* Hundreds write—"Have learned more in one term in my home with your weekly lessons than in three terms with private teachers." "Everything is so thorough and complete." "The lessons are marvels of simplicity. My 11-year old boy has not had the least trouble to learn."

Wonderful New Book Free!

We want to have *one pupil in each locality at once* to help advertise our wonderful easy system of teaching music. *For a limited time,* we therefore offer our marvelous lessons *free.* Only charge is for postage and sheet music which averages just a few cents weekly. Beginners or advanced pupils. We have hundreds of pupils *right here in New York,* the musical center of America, who prefer our Home Study method in place of best private teacher. Get all the proof, facts, letters from pupils, *amazing free offer* and fascinating New Book just issued, *all free!* Write postal today. Address **U. S. School of Music, 1331 Brunswick Building, New York**

WARNER'S "INFALLIBLE AUTOMATIC"



32 CAL.

15 QUICK SHOTS NO JAMS

"THE PISTOL That Shoots and Hits the Mark"

Before buying ask your dealer about the $18 Warner "Infallible." Get the best and save at least **$5**

Get a Warner "Infallible" Automatic and teach the women how to plug the bull's eye. Target shooting is intense, exciting sport. Excellent training for nerves and eyes. Teaches self-reliance, confidence and familiarity with weapons. What a Shooter Says: "Your **"Infallible" Automatic Pistol** is all that you claim and more. I put seven shots in bull's eye one inch in diameter at distance of twenty-five feet with the pistol. The accuracy of this arm is unsurpassed by any regardless of price." C. S. Hoffman, 157 Oakwood Avenue, Orange, N. J.

FREE LESSON OFFER

An authority has prepared for us, a set of six lessons on the **Art of Pistol Markmanship.** These lessons are of marvelous value in the use and care of a **Warner "Infallible" Automatic.** Write today for illustrated circular and terms of **Free Lesson Offer.**

PRICE $8.00 WITH 2 MAGAZINES

KIRTLAND BROTHERS & CO., INC.
96 Chambers St. (DEPT. E-E) New York

DEPENDABLE **KNAPP** ELECTRIC SPECIALTIES

LEADER

The Big Power Motor for Boys $5.00



A compact, highly efficient reversible motor, perfect in every detail. The reducing gear, easily adjusted, transforms the high speed to more power at slower speed. The reversing switch is positive in action, and operates either as a starting switch, or to reverse the direction of the motor at will. This motor is guaranteed by us to be exactly as represented.

AT ALL LIVE DEALERS

Insist on your dealer showing you the **KNAPP** line—**KNAPP** goods are best. If your dealer cannot supply you, order direct. Send for **FREE** illustrated catalogue showing a complete line of Electrical Motors and Novelties.

KNAPP ELECTRIC & NOVELTY CO.
523 West 51st Street, N. Y. City

the troughs are the "lows." The space between the crests of two successive waves is on the average about three days. The average forward or eastward movement of the wave crest varies from some two hundred to five hundred miles in each 24 hours in summer, to twice that amount in winter. Both these elements of extent and movement vary greatly in all seasons.

At the surface the greater pressure (weight) of the mass of atmosphere under the crest of the wave causes the air (wind) to flow toward the trough of the wave where the pressure is least.

Owing to the earth's rotation, these winds caused by differences in pressure are deflected toward the right, and set up great whirls or depressions, making the trough of the wave much lower in some places than in others. These produce the more or less elliptical form of the surface isobars (lines of equal pressure), and the term "cyclone" is applied to such a depression It is also called a "center of disturbance."

These "depressions" tend to destroy the symmetrical appearance of the pressure waves at the surface; but at elevations of 10,000 feet most of the closed or circular isobars disappear, and the true symmetrical wave motion is apparent.

Now take a cross-section of the atmosphere from east to west. Remember we are not riding on *top* of these atmospheric waves, but are standing on the solid bottom of this relatively shallow ocean of air, and just slightly west of the crest of a great wave. Our barograph trace has reached the highest point and is starting down its westward slope. This slope is just beginning to *us,* but it has been going on to the west of us for two or three days—possibly a week or more—gradually drawing nearer till now the crest of this particular wave has past overhead. The wind is moving westward (an east wind) toward the trough of lower pressure, gradually increasing in velocity and turning more and more to the right. All the time the air as it approached the lowest part of the trough and met with the west winds moving eastward from under the crest of the next wave to the west, arose, being forced upward by the greater pressure on either side. By the time these winds reach the center of the trough or depression, those from the east have turned so far to the right that they are moving north (south winds); while those from the west are now moving south (north winds). This is really the chief cause of the more or less circular "depressions" of the low pressure trough at the surface.

Now south winds are warmer and for that reason have a greater capacity for moisture than north winds. These winds of different temperatures and moisture content (humidity) swing slowly round and round in a whirl mixing and forming clouds as they rise to higher elevations and lower temperature. Most of this cloud mass is pushed off to the east of the disturbance trough by the west winds of high velocity which are nearly constant at high elevations. Rain, snow, sleet, hail (precipitation) are formed in this cloud mass which sometimes extends over the entire western slope of the retreating wave crest which has just past us.

Perhaps before the crest past and our barometer began to fall, long cirrus streamers of white fleecy clouds (mare's tails) began to overspread the sky from the west or southwest. The rate of the fall in pressure (barometric gradient) depends on the depth of the depression below the crest of the wave and the rate at which it is moving. The center of depression itself may be getting deeper as it advances. This is usually the case in severe storms where the rotary movement of the winds at the center is rapid, and the uprush of air is correspondingly greater The distance of the observer, therefore from the center of the trough, or the rate of its



Learn
In the Great Shops of
COYNE

Earn $65 to $175 a Week

Hundreds of our graduates are making THREE to FIVE times as much as YOU—as Superintendents, Power Plant Operators, Electrical Engineers and Electric Automotive Experts. Many more are earning $3,000 to $10,000 a year in business for themselves as Electrical Contractors. You can do it.

Come With Us for 98 Days!

Our system assures your success in this study. In 98 days we have fitted thousands to make a smashing success. Now we want you to come—for the demand for practically trained men was NEVER so large.

We beat the world at turning out PRACTICALLY TRAINED ELECTRICIANS in quick time at small cost. We'll fit you in 98 days (stay longer if you wish ABSOLUTELY FREE of charge) to do all kinds of electrical work—from the simplest bell mechanism to the mighty motor and Electric Locomotive—and turn you out an all-around man ready to accept a fine position as a

COYNE TRAINED EXPERT

Our diploma is known and approved by employers and you need it to help push you ahead quickly. Come just as you are and we will train you by putting you to work on our wonderful equipment. We use no books, but an instructor, at your elbow, shows you how to WORK. Thus you qualify FAST. In 98 days we will teach you Electricity complete—all the big-paying, fascinating branches—and send you out with all our influence behind you. The $100,000 spent to fit and equip this school to help you to a big success is ready to back you up. Get the benefit—NOW.

Electricity

EARN WHILE YOU LEARN

We supply all tools and materials free, and we will help you to EARN YOUR WAY, if necessary, by aiding you to get a job through our specially organized EMPLOYMENT DEPARTMENT. You can attend both day and evening classes without extra charge, and easily arrange your study time and work time so as to make every minute count.

FREE
Course in
Auto Electricity

In our newly equipped and greatly enlarged Automotive Dept., as a student of Coyne, you can secure the finest Electrical Automotive Course in America FREE OF CHARGE. If you write at once, we will reserve a course for you—without extra charge. Think of it! Modern training on Batteries, Lighting, Starting and Ignition, on the finest new equipment, FREE. Get details on this—NOW. The offer may not appear in this publication again.

Send Coupon

Get Our Catalog Contains hundreds of large size photographs of our shops and our wonderful equipment. This is a very large and expensive book, but it's yours FREE for the asking. Get it now and learn all about the great opportunity we offer you. Send the coupon or a postal—TODAY.

BENNETT W. COOKE, President
Coyne Trade and Engineering Schools
Dept. 21, 39-51 E. Illinois St.
Chicago, Ill.

MAIL THIS FOR QUICK ACTION ON OUR OFFER

B. W. Cooke, President, Coyne Trade & Engineering Schools, Dept. 21, 39-51 E. Illinois St., Chicago, Ill.

Sir: Send now—free—prepaid and without obligation to me—big catalog—reservation offer of a free course in Automotive Electrical Engineering, and full details.

Name .....
Street (R.R.) .....
City ..... State .....

approach are mere conjecture unless the development of the disturbance has been observed before it began to have any effect on our barometer. But with the weather maps of yesterday and the day before, we may form fairly accurate short-range conclusions from observing its action.

If, for instance the storm (disturbance) center yesterday morning was in the vicinity of Chicago, and this morning in the vicinity of Erie, the continued projection of that course will cause the center of the path to lie thru southern or central New England.

Now by projecting the point of observation westward parallel to the projection of the storm track, we can estimate with reasonable accuracy just what relation or position we will sustain with reference to the storm center at any given time within the next 24 to 36 hours. An occasional reference to the barometer will disclose whether or not such projection and prognostication is being fulfilled.

When our barometer has reached its lowest point and begins steadily to rise, we may be sure that the storm center has past our latitude, and that we are passing under the next advancing wave of higher pressure to experience conditions generally prevailing in those portions of the country already under the influence of this condition of rising barometer. This change will almost invariably be accompanied by a shift of wind from easterly to westerly, with clearing and cooler weather.

The order of the wind shift will depend on the position of the observer with reference to being north or south of the path of the disturbance center.

If the path lies to the north of the observer the wind will shift through south, southwest, and to northwest, and the change to colder will be somewhat gradual.

If, on the other hand, the path of the disturbance center is to the south of the observer, the wind will back quickly thru north to northwest, and the change in temperature will be greater and more abrupt.

It may be inferred from the foregoing that the presence or absence of water vapor in the air is not the thing that appreciably affects the rise or fall of the barometer. Air and water vapor, like all other gases, occupy space practically independent of each other. A given space at a given pressure and temperature will absorb or be saturated with a given amount of water in the form of vapor, regardless of whether the same space contains air or other gases or only ether. It follows then, that when space is filled with one gas (say air), and another gas (say water vapor) is injected into it, the weight of the contents is the combined weight of both gases. Water vapor is, as a gas, lighter than air, but a cubic foot of dry air weighs more than when water vapor is associated with it. So, then, it is not moist or dry air that causes either high or low barometric pressure. Rather the moisture or dryness of air is the result of changes in the position, or elevation of masses of air, as a result of differences in pressure. Of course it also depends on the nearness or remoteness of a plentiful supply of water surface from which air in passing becomes more or less humid.

Moderately warm air with a moderate relative humidity at the surface, will be reduced to saturation and precipitation if forced high enough to cool it below the "dew point." If all air currents (winds) were parallel to the surface, there would probably be almost no precipitation except where the air was forced upward over mountain ranges. But fortunately, due to differences of temperature and pressure, air is forced upward or downward as well as laterally, and thereby undergoes the changes necessary to produce condensation and precipitation of its moisture.



Could you hold your own?

YOU probably haven't had a real fight since you were very small. Settling a dispute with your fists is the last thing you'd think of. And yet, a time may come when you will **have to fight.**

Suppose you saw a rowdy in the act of insulting a woman. Could you look the other way? No, sir, you'd want to step right up and teach him the lesson he deserved. But could you? A quarrel might lead to the challenge, "Come outside and fight." Could you do it and hold your own? Or suppose you were attacked in a deserted street after dark. You'd **have to fight!** Your very life might depend upon being able to disarm the thug and cripple him with a powerful blow or jiu jitsu hold.

Remember, those two fists of yours are the best weapons —they're always with you, always ready.

Marshall Stillman will teach you boxing and self-defense in your own home. His system is the result of 30 years' study—he's an expert boxer himself, and a pupil of Professor Mike Donovan who retired, undefeated, middleweight champion of the world.

In his course, the fundamentals (hitting, guarding, ducking, feinting and footwork) are easily learned, because you start by practising simple movements before a mirror—the breast stroke in swimming, holding out your hand for a coin, etc. Subconsciously you are led into striking heavy blows, guarding, ducking, feinting, etc., just as though you had a real opponent before you.

When you've mastered the fundamentals, you're taught every good blow in the ring—when to land it, where to land it, and how to guard against your opponent's counter attack.

Then comes **shadow boxing.** Marshall Stillman has combined such scientific blows as the Jack Dempsey Triple, the Bennie Leonard Triple, the Mike Donovan Double, etc., into three lively rounds for daily practice.

You're also taught 12 wrestling holds and 15 jiu jitsu holds—how to disarm a man with a pistol, dagger or club, how to break a strangle hold, etc.

The course includes a set of muscle building exercises. The Colon Exercise (a remedy for constipation) and Synthetic Breathing (a lung developer and aid in curing nervousness).

As an added feature, there's an illustrated history of 69 great boxers with "inside" stories seldom heard outside professional circles.

There are 246 illustrations in the course.

Sent Free on Approval

The entire course is sent on approval. You keep it 10 days, and then if not satisfied, return it. If you buy it, you have till the 15th of the following month to pay ($5 in the United States, $6 in Canada, $7 in foreign countries). Send no money, but mail the coupon now to **Marshall Stillman Association, Suite E-201, 461 Fourth Avenue, New York.**

- - - FREE APPROVAL COUPON - - -

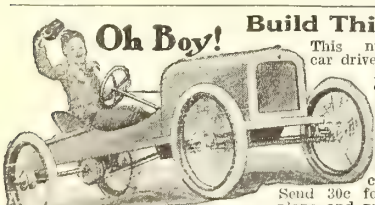
MARSHALL STILLMAN ASSOCIATION,
Suite E-201, 461 Fourth Avenue, New York.

You may send me your complete course in Boxing and Self-Defense, including extra instruction described above. I give you my pledge that you may feel safe in trusting me as agreed, and that I will pay $5 ($6 in Canada, $7 in other countries) for the course on the 15th of next month, or return it in 10 days after I receive it.

Name.....

Address.....

Oh Boy! Build This Car.



This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 30c for building plans and price list of parts showing how to build this lad's car.
SYPHER MFG. CO. 156 Sypher Bldg., Toledo, Ohio

Learn Watch Repairing

Be a watchmaker—you can learn this profitable trade by correspondence in a few weeks in your own home by the DeSelms Chart System. After you complete the course you will know a watch from A to Z. You will know just what the matter is and how to repair one. When you graduate you will be a practical watchmaker and repairer and competent to fill any position. Positions for our graduates.
Ask for our Free Book. It explains our system and terms.



THE DeSELMS WATCH SCHOOL
720 Perry St., ATTICA, IND.

SKINDERVIKEN TRANSMITTER BUTTON



Made in several styles for experimenters and wireless men. Super-sensitive style for detectiphone work. Common battery style for wireless telephone and amplifier use. Capable of passing a greater amperage than most transmitters. Price with complete instructions for use $1.00.

MECHANICAL STETHOSCOPE

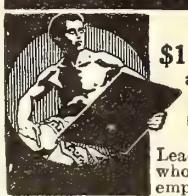


PRICE $5.00

Detects knocks and trouble in all running machinery. Use it to test the motor of your automobile.

GENERAL SOUND TRANSMISSION CORP.
Room 507B 2 Rector Street New York

"EARN WHILE YOU LEARN"



If you are earning less than
$100.00 PER WEEK
and like to draw—you should study

Commercial Art

Leading Art Managers—the men who know—recommend us and employ our students. We will guarantee to make you successful—Learn at home in your spare time—or in our resident school—Day or evening. Many of our students earn money by the sale of their drawings while learning. Write for FREE illustrated catalogue.

COMMERCIAL ART SCHOOL
709, 116 So. Michigan Avenue, Chicago, Ill.

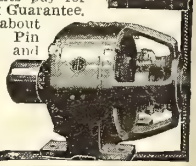
PROFITS for YOU Charging Batteries Making Electric Lights

With the HB Lighting and Battery Charging Set you can make your own electric lights for as low as 2c per KW, and make a profit from $100 to $150 per month on battery charging. Anyone can easily operate without experience. Sturdy, dependable, economical to operate from line-shaft or your engine. *Makes big, easy profits.*



Small Payments Put This Money-Maker in Your Shop

Balance on easy terms. Profits pay for outfit. Absolute Money-Back Guarantee. Ask our Service Department about proper size for your needs. Pin this ad to your letterhead and write TODAY for information.



HOBART BROTHERS COMPANY
Box 18E Troy, Ohio
Successful Manufacturers Since 1893

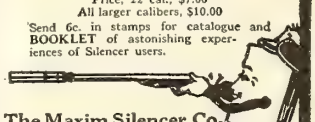
Shoot Without Noise

Cut out that unnecessary report noise. Don't scare away all the other game.
USE THE NEW MODEL 1920

MAXIM SILENCER

Price, 22 cal., $7.00
All larger calibers, $10.00

Send 6c. in stamps for catalogue and BOOKLET of astonishing experiences of Silencer users.



The Maxim Silencer Co.
89 Homestead Ave.
Hartford, Conn.



Oh Boys, Girls! Great Sport with CLAXOPHONE

Voice Thrower

Throw your voice under the **table, back of a door,** into a **trunk,** desk in **School,** any old place. **Big FUN** fooling **Peddlers, Policeman, Friends,** anybody. This **Claxophone** is a small device that lays on your tongue unseen, **always ready** for use by **anyone. Claxophone** with **full** instructions, also **Set of Secret Writing Tricks,** all sent for **10c** coin. (No stamps.)

CLAXO TRICK CO.,
Dept. K. New Haven, Conn.

Perpetual Motion Prize Winner

(*Continued from page 995*)

Third Honorable Mention.

In your October issue you publish Mr. A. d'Abro's criticism of Mr. Burgin's explanation of why rubber cylinders, with top and bottom rigid walls, one weighted and free to move, would not work if attached to an endless belt passing around wheels arranged one above the other. Mr. Burgin said the bouyancy (weight) would be the same on either (sic) side. Mr. d'Abro says this is incorrect, because: (a) when the weight is on top and compresses the air, the sides will bulge (which is correct); but when the cylinder is inverted and the weight pulls downwardly, the cylinder is lengthened, which would "increase the volume of air and decrease its pressure."

This is wrong. Pray tell us where he gets additional air to increase its volume. The air is attenuated or rarefied and its pressure is decreased. Again, he says that the weight is balanced or reaches a state of equilibrium when "the interior push on the bottom of the cylinder will be equal to the atmospheric push" (outside pressure, 15 pounds per square inch) "on the bottom, minus the weight, thus the interior pressure is reduced." Ye gods! what illogic. What becomes of the sustaining support of the rubber cylinder? When ever did a "minus" pressure equal zero, or atmospheric pressure?

In Mr. d'Abro's suggested modifications his false physical assumptions are again paraded as facts. Instead of rubber pockets he proposes two metal cylinders, equidistantly placed on an endless belt running over and under two wheels, in vertical alignment, immersed in water up to the center of the shaft of the upper wheel. The cylinders are open at one end and contain movable weighted pistons which move "without friction" (a mechanical impossibility) in the cylinders, but can't escape. The cylinders contain no air, and at starting the pistons are at the bottoms of the cylinders. The piston in the inverted cylinder slides down (a practical impossibility in the presence of a supposed perfect vacuum), but he says it does, anyway, so we will let it go at that. In any event, "to obtain this result," he says, "it will be necessary for the weight to be of sufficient magnitude to overcome the cumulative effect of the atmospheric pressure, plus the hydrostatic pressure—theoretically at least, this is possible." If the cylinder is immersed, where, oh, where, does he get his "atmospheric pressure"? Answer: Probably from the same place that he got it to increase the "volume" in his stretched rubber cylinder—his imagination. His hydrostatic pressure is there, and depending upon the depth of submergence, is exerting an upward pressure on his "frictionless" piston, assisted by the vacuum exerting an upward pull of 15 pounds per square inch. But we must not say this. We must violate all physical laws and the laws of nature and assume that the weight moves down. What if it does? A vacuum is nothing, it is the absence of all matter, possessing neither weight nor any other property. But we shall invest our vacuum with the property of buoyancy, a relative term, because we must stick to our false assumption and displace some of the water, as well as our faith in the laws of nature, permitting our expanded chamber to rise until it floats—and stops. Unfortunately, we do not have frictionless bearings for our shafts, nor frictionless belts, nor frictionless anything that moves except the pistons in our cylinders, and even these together with the whole

Drive Out
Aches, Pains
As Well as the Cause of Sickness



Apply thousands of volts of painless, harmless, high frequency electricity without the slightest shock or unpleasant feeling, just an exhilaration of well-being. Aches, pains, soreness, tired feeling, sub-normal conditions depart and the natural joy of good health is restored. You may now do this at home with a

The Vibrant Health-promoting forces of High Frequency electricity, the Violet Ray has accomplished truly wonderful results for others. Learn what it can do for you.

RenuLife
VIOLET RAY HIGH FREQUENCY Generator

Transforms the current from your light socket into this wonderfully effective form of electricity; penetrates deep, saturates entire body; increasing circulation, adding oxygen to the blood, promoting elimination of waste products. The local pain or ache or ailing tissues are directly stimulated while the cause is attacked and the whole system toned and benefited. It's a fundamental treatment working to re-establish normal healthy conditions. That's why it is used and recommended for such a long list of human ills. Get full particulars.

Statement of User

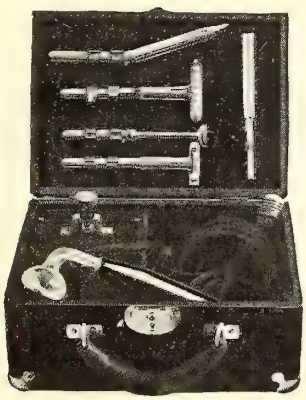
"I had a stroke of paralysis two years ago and spent thousands of dollars seeking a cure but without results. In fact I have derived more benefit from your Violet Rays in three weeks than all other treatments combined. I feel almost certain of a complete cure. My arm and hand are as good as ever and I can walk comfortably and without a cane. I am feeling fine in every way. I cannot express sufficient thanks to you for my wonderful improvement."

NOTE.—Thousands of people, with all manner of ailments, have told us of the benefits, obtained from Renulife self-treatments. If you are in ill-health, learn what relief you may expect from this modern, scientific and simple means.

Liberal Trial Plan

You can determine by actual use at home what benefits you will derive from a Renulife Violet Ray. Send for our book giving full information on the use and success of the Violet Ray. Then decide which model you want to try.

You know that by getting the circulation of pure blood—alive with germ-fighting white corpuscles—flowing through an organ or tissues—that are stagnant or starved—you have started a common sense treatment in the right direction. That's what the *Renulife* does. Learn all about it. Send for full information contained in our book.



SALE DISTRIBUTORS

If you can handle an exclusive territory in a big way, write for attractive proposition.

RENULIFE ELECTRIC CO.
1201 Marquette Bldg., Detroit, Mich.
Netting Bldg., Windsor, Canada

VIOLET RAY BOOK TELLS how the Violet Ray is used for more than 100 different ailments. It is a marvelous story, intensely interesting.

Send For Free Book

Renulife Electric Co.
1201 Marquette Bldg.,
Detroit, Mich.

Please send me, without obligation, a copy of your
RENULIFE BOOK
Health
via
Violet Ray.

Name.....

Street.....

City..... State.....

Start the New Year Right

Does 1921 Mean Success or Failure?

It is up to you right now to decide. If you had started right one year ago you would be on the high road to success this minute. Don't let another year pass by. It is within your power to make yourself what you will. Let this be the beginning of a new life and a better one.

I Will Give You Wealth—Health—and Happiness

I will take that body of yours and make it physically perfect. I will make a new man of you. I will fill out your chest so that every breath means increased life, purifying your blood and sending vim and vitality throughout your entire system. I will broaden your shoulders, and give you the large muscular arms and legs of an athlete. I will strengthen your back and every vital organ within you. You will be bubbling over with life, having the keen alert brain, the bright flashing eyes and the spring and step of youth. Passers by will stop and admire you for your physical make up; and you will be the favorite in both the business and social world—you will be a leader of men, and the good things in life will naturally come your way.



Latest photograph of EARLE E. LIEDERMAN taken October 10, 1920

I CHALLENGE THE WORLD

If a man stood on the house-tops and shouted to the people that he was the strongest man on earth, it would avail him nothing. Someone would make him come down and prove it. But records speak for themselves. I will gladly show anyone personal letters from the leading strong men in the world today that my course is absolutely the best and the quickest to acquire physical perfection. Come on then and make me prove it—I like it. I have the means of making you a perfect physical specimen of manhood, of making you a successful leader of men. You will be a credit to your community. I have done this for thousands of others. What I have done for them I will do for you. I don't care what your present condition is. The weaker you are, the more noticeable the results. Come on then. START THE NEW YEAR RIGHT.

Send for My New Book
"MUSCULAR DEVELOPMENT"
IT IS FREE

It tells the secret. Handsomely illustrated with 25 full-page photographs of myself and some of the world's best athletes whom I have trained. Also contains full particulars of my splendid offer to you. The valuable book and special offer will be sent on receipt of only 10c stamps or coin, to cover cost of wrapping and mailing.

Don't miss this opportunity. Sit right down now and fill in the coupon. The sooner you get started on the road to health the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon today.

EARLE E. LIEDERMAN

Department 201, 305 Broadway New York City

EARLE E. LIEDERMAN,
Dept. 201, 305 Broadway, New York City.

Dear Sir:—I enclose herewith 10 cents, for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name .....

Address .....

City ..... State.....

The Key to Success

Stop Forgetting



Make Your Mind a File—Not a Pile

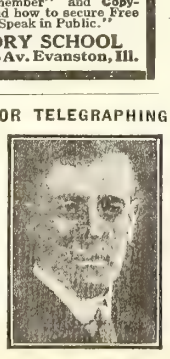
The Key to Success is the ability to remember. I can make your mind an infallible classified index from which you can instantly select thoughts, facts, figures, names, faces. Enables you to concentrate, develop self-control, overcome bashfulness, forgetfulness, address an audience. Easy. 20 years' experience developing memories of thousands. Write today for free booklet, "How to Remember" and Copyrighted Memory Test, and how to secure Free my $3.00 book, "How to Speak in Public."



DICKSON MEMORY SCHOOL
Dept. 101 1041 Chicago Av. Evanston, Ill.

MAKE YOUR OWN MACHINE FOR TELEGRAPHING PICTURES

Something never offered before—secret, blue print and complete instructions for most marvelous invention of the age. Machines easily and inexpensively made from material and simple articles already in the hands of every experimenter. Will transmit pictures, maps, drawings and handwriting. This picture transmitted on set of these machines. Only $2. Send today.



L. J. LEISHMAN CO.
Dept. F Ogden, Utah

mechanical abortion, will stop when they reach a state of equilibrium.

F. R. CORNWALL.

St. Louis, Mo.

[EDITOR'S NOTE:—A complete vacuum back of the piston will not prevent its movement to the outer end of the cylinder, if a force exceeding 14.7 (about) pounds to the square inch of its area is exerted upon it. A vessel, with a perfect vacuum maintained in it, will be more buoyant than if full of air. Any object or vessel immersed in open water is subjected to atmospheric pressure.]

Fourth Honorable Mention

Before the piston can exert the necessary pressure on the water it must first be lifted to such position that the piston will slide, and this takes more than the available motive power, which will be understood when we remember, that no body can give out energy unless that energy has first been stored into it by a force of sufficient magnitude to do the work that is expected from the first body; so if we observe the work to be done and the available energy to do it, we see at once that there is a point in the cycle, where both sides of the apparatus are balanced, where the opposing force equals the motive force. Searching for perpetual motion, therefore, is comparable to the man trying to life himself from the ground by his boot-straps.

LEO RADEMAKER.

R. F. D., No. 24, Wooster Road, South Akron, Ohio.

Practical Chemical Experiments

(*Continued from page* 990)

alloy of the same metals as solder. One important fact about solder is its low melting point. It is lower than that of lead alone and can therefore be used in making a lead joint. If pure melted lead were used the object to be soldered would itself be melted.

Preparation of Type Metal

When we stop to consider the multitude of books, magazines and newspapers that must be printed from type we see the importance of having some metal substance that will not only be durable, but will also give type with clear-cut definite edges. No single metal, that will readily fuse, answers these requirements. Either the metal is too soft or in solidifying in the mould it contracts and gives type with rounded edges. It was found that if antimony and tin were added to lead an alloy resulted which was not only hard but on solidifying actually expanded instead of contracting. This solved the problem and gave type with firm definite outlines.

To make the alloy, using the same apparatus as before, melt together 75 grams of lead, 20 grams of antimony and 5 grams of tin. Also mold this into sticks. (See Fig. 2.)

It will be found interesting to start a chemical museum and these alloys might well be its nucleus. Obtain some small specimen tubes for holding them and place a neat label on the outside of each. (See Fig. 2.)

An Alloy That Melts in Hot Water

This alloy is called Wood's Metal and sometimes with a slightly different composition Rose's Metal. For many years it was only a curiosity, but with the coming of automatic fire extinguishers of the sprinkling type this alloy became of great importance. The perforations in the sprinkling pipes which lead thru the build-

19 Jewel

Thin Model—25 Year Gold-filled Case

Adjusted—

To Positions
To Temperature
To Isochronism
To the Second

$3 A MONTH



—Send No Money!

You Don't Risk A Cent

when you deal with Harris-Goar Co.

Merely send your name and address (postal will do) so that we may place this superb watch in your own hands for free examination. We want to prove to you, as we have to thousands of others, that this is the world's greatest 19 Jewel watch, and that our price is the lowest.

30 Days Approval

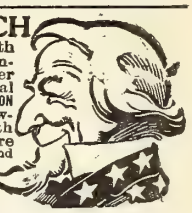
Write us Today! We want to send you this watch on 30 days' Free Trial. We have trusted wage-earners everywhere for more than 20 years, and we will trust you.

Our Catalog will be mailed you same day we hear from you. It is full of Watches, Diamonds—real bargains—the same as we carry in our large branch stores. We often save our customers a third, besides giving them easy terms. Send your name—do it today.

HARRIS-GOAR COMPANY
Dept. 291 Kansas City, Missouri

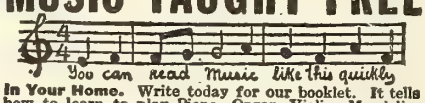
COPY THIS SKETCH

and let see what you can do with it. Many newspaper artists earning $30.00 to $200.00 or more per week were trained by my personal individual lessons by mail. LANDON PICTURE CHARTS make original drawing easy to learn. Send sketch with 6c in stamps for sample Picture Chart, long list of successful students, and evidence of what *YOU* can accomplish. *Please state your age.*

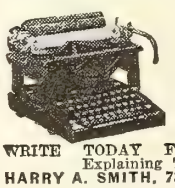


The Landon School
312 Schofield Bldg. Cleveland, O.

MUSIC TAUGHT FREE



In Your Home. Write today for our booklet. It tells how to learn to play Piano, Organ, Violin, Mandolin, Guitar, Banjo, etc. Beginners or advanced pupils.
American School of Music, 57 Lakeside Bldg., Chicago



$4 A MONTH AND $5 WILL BUY A Standard, Guaranteed TYPEWRITER

With Every Modern Writing Convenience

WRITE TODAY FOR ILLUSTRATED CIRCULAR
Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

BUILD A WHITE FIREFLY $2.00



CARRIES FULL GROWN MAN

World's lightest and simplest aeroplane. Designed by George D. White, America's foremost aeronautical engineer. Weight 150 pounds, length 15 ft. Needs 8-12 H.P. motorcycle engine. Lands and takes off at 24 miles per hour. Useful load 165 pounds. Can be built in a few weeks at home. Send $2 for complete working drawings, building instructions and price list of parts. SEND $2 NOW!

WHITE AIRCRAFT WKS.
Dept. 18, 425 Merchants Trust Bldg., Los Angeles, California.

GET ON THE STAGE



I Tell You How! Stage Work and Cabaret Entertaining successfully taught by mail. Your BIG opportunity. Travel, see the world as vaudeville actor or actress. My great Professional Course—only one of its kind—COVERS ALL BRANCHES. Develops Personality, Confidence, Skill and tells you just how to get on the Stage. Send 6c postage for illustrated booklet, "All About Vaudeville." State age and occupation. Write for this free Stage Book today!
FREDERIC LA DELLE Box 557-W LOS ANGELES, CALIF.

STUDENTS ART MAGAZINE



Publishes cash artassignments, lessons and articles on Cartooning, Designing, Illustrating, Lettering and Chalk-Talking. Criticises amateurs' work. Full of information for artists and art students. Satisfactory or money refunded.

20c a copy, $1 for 6.

Send $1 NOW. Thrift Stamps Taken
G. H. LOCKWOOD, Editor, Dept. 636, Kalamazoo, Mich.

ing are filled with plugs of this alloy. Then if fire breaks out at night or at any other time these little plugs melt out at temperatures far below the kindling points of the surrounding objects, which are so thoroly wet down that they will not take fire. Fire which has actually started is also extinguished.

One such alloy is made by melting together 80 grams of bismuth, 40 grams of lead, 20 grams of tin and 15 grams of cadmium. Bismuth is a heavy silvery white metal and the low melting point is due chiefly to its presence.

After you have made some of this alloy place a beaker of water over a Bunsen burner and raise the temperature until a thermometer indicates about 60 degrees C. Then introduce a stick of the metal and you will find that it melts off and dropping to the bottom runs about like mercury. You may find it necessary to raise the temperature a little above 60 degrees, but in any case the alloy will melt far below the temperature of boiling water. (See Fig. 3.)

Another application of these low melting point alloys is to be found in fuse wire used as a protection against the overloading of an electric circuit. Such wire consists chiefly of lead and tin, and it can be made with great accuracy to melt at a certain definite number of amperes. If you have no means of drawing wire it will be impossible for you to prepare fuse wire.

Babbitt's Metal

This is one of the most useful and widely known of the common alloys. It is called an *anti-friction* alloy and is used for journal bearings. Molten mixtures of metals do not always solidify into a perfectly uniform mass, but such a condition is desirable in an anti-friction alloy. What is wanted is a soft mass but one containing hard particles. The hard particles bear most of the pressure but, as the alloy wears, they are prest into the soft matrix, so that a smooth surface is always presented.

To make such an alloy melt together 3 grams of antimony, 4 grams of arsenic, 69 grams of zinc, 5 grams of lead and 19 grams of tin. In many of these anti-friction bearings copper is also present.

Lead Shot

It was early found that lead alone was too soft for the best projectiles. Therefore, something must be found which, by being alloyed with it, would increase its hardness. As a result of the search it was discovered that a very small quantity of arsenic would give the required degree of hardness.

In preparing this alloy melt 100 grams of lead and then sift into it one-half gram of arsenic. When it has cooled test the hardness of some of the original lead and that of the alloy by trying to cut them with a knife blade.

Preparation of Bronze

For the preparation of bronze a considerably higher temperature than that possible with the Bunsen burner will be required. Either you must have a forced draft or some type of electric furnace. If you have access to a country blacksmith shop, undoubtedly you can obtain the necessary temperature by using the bellows and forge. I once had a gas furnace connected to a chimney giving a 20-foot draft which would melt copper. This means, however, a temperature of nearly 1,100 degrees Centigrade or about 2,000 degrees Fahrenheit. Either the electric arc furnace or the resistance crucible furnace described in the *November* issue will be found very useful in this work. The resistance furnace is best but cannot be so easily made and costs more if you buy it.

"I'm A Man- I Want Man's Pay!"

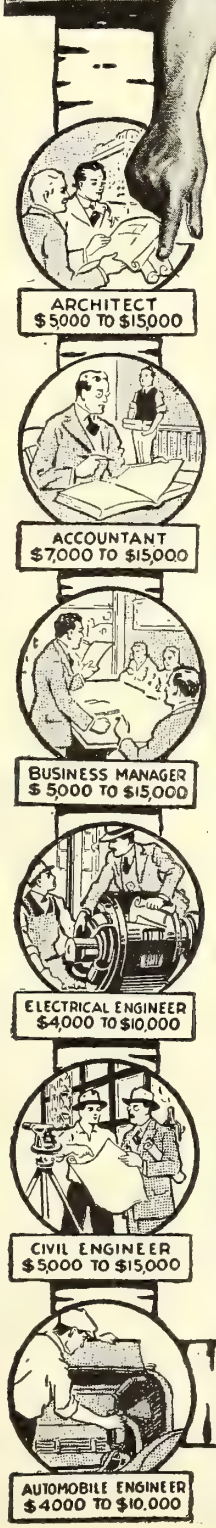


That is what Albert Foster wrote us eighteen months ago, and he goes on: "I'm tired of being bossed for $25 a week. I want a He-Man job with real pay. I want to get into the $100 a week class. Tell me how to do it." We showed him how. Today he has a He-Man job and He-Man pay. We tell of his experience because it's typical.

WHAT ARE YOU? A man who is up and doing, getting real money, or are you simply marking time on $25 or $30 a week? $100 jobs don't go begging. If you want one you've got to go after it. Are you satisfied with your present condition in life? If you are, we have nothing to offer you, but if you want one of these real jobs with big pay, then we can help you and help you in a hurry.

A REAL MAN with a real man's pay is what you want to be, and we will show you how. Without loss to you of a single working hour, we will show you a sure way to success and big pay. A large number of men in each of the positions listed are enjoying their salaries because of our help—we want to help you.

Make a check on the coupon against the job you want and we will help you get it. Write or print your name on the coupon and send it in today. You will be under no obligation.



American School of Correspondence
Dept. G 126 **Chicago, U. S. A.**

AMERICAN SCHOOL of CORRESPONDENCE

Dept. G-126 Chicago, Ill.
Explain how I can qualify for position checked:

___Architect $5,000 to $15,000	___Accountant and Auditor $2,500 to $7,000	___Steam Engineer $2,000 to $4,000
___Building Contractor $5,000 to $10,000	___Draftsman and Designer $2,500 to $4,000	___Foreman $2,000 to $4,000
___Automobile Engineer $4,000 to $10,000	___Electrical Engineer $4,000 to $10,000	___Photoplay Writer $2,000 to $10,000
___Automobile Repairman $2,500 to $4,000	___General Education In one year	___Sanitary Engineer $2,000 to $5,000
___Civil Engineer $5,000 to $15,000	___Lawyer $5,000 to $15,000	___Telephone Engineer $2,500 to $5,000
___Structural Engineer $4,000 to $10,000	___Mechanical Engineer $4,000 to $10,000	___Telegraph Engineer $2,500 to $5,000
___Business Manager $5,000 to $15,000	___Shop Superintendent $3,000 to $7,000	___High School Graduate In two years
___Certified Public Accountant $7,000 to $15,000	___Employment Manager $4,000 to $10,000	___Fire Insurance Expert $3,000 to $10,000

Name _____
Address _____



A New Profession for Ambitious Men

Become an

ELECTRO-TECHNICIAN

Enter the field of electricity as an Electrotechnician. Qualify as a Power Plant Superintendent, City Technician, Salesman of Electrical Equipment, Supervisor of Electrical Equipment Erection and Maintenance, and you can earn *big* money. Field unlimited. More positions than men to fill them.

This is the only school that prepares you for this field by offering a special, condensed course in Electrotechnics. Open to all grammar school graduates. High School or College work credited to give you advanced standing, enabling you to shorten course from 6 to 18 months. Quick and thorough. Expert instructors, complete laboratories and equipment.

"Earn While You Learn" If You Wish

New term soon starting. Don't delay. Mail coupon for full particulars.

School of Engineering of Milwaukee,
Dept. S. 20, 373 Broadway, Milwaukee, Wis.

Without obligation, send me catalog and full particulars regarding the Electrotechnician course and your "Earn while you learn" plan.

Name.....

Address.....

Town.....State.....

Age.....Education.....

"I Would Not Part with it for $10,000"

So writes an enthusiastic, grateful customer. In like manner testify over 100,000 people who have worn it. Conserve your body and life *first*.



The Natural Body Brace

Overcomes WEAKNESS and ORGANIC AILMENTS of WOMEN AND MEN. Develops erect, graceful figure.

Brings restful relief, comfort, ability to do things, health and strength.

For Children Also

Wear It 30 Days Free at Our Expense

Does away with the strain and pain of standing and walking; replaces and supports misplaced internal organs; reduces enlarged abdomen; straightens and strengthens the back; corrects stooping shoulders; develops lungs, chest and bust; relieves backache, curvatures, nervousness, ruptures, constipation. Comfortable and easy to wear.

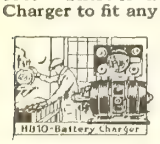
Keep Yourself Fit

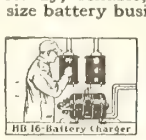
Write today for illustrated booklet, measurement blank, etc., and read our very liberal proposition.

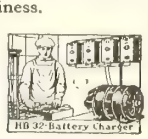
HOWARD C. RASH, Pres. Natural Body Brace Co.
286 Rash Building SALINA, KANSAS

Battery Charging Your Biggest Money-Maker

Profits of $100 to $300 a month are easy—and winter brings biggest opportunity. Cost 4c. to 12c. per battery—customer pays 75c to $2.00—*cash business, too!* There is a sturdy, reliable, economical HB Charger to fit any size battery business.


HB10-Battery Charger


HB 16-Battery Charger


HB 32-Battery Charger

Mark a cross (X) on the outfit suited to your needs. Then tear out this ad and mail TODAY for complete information. Small cash payment—balance easy monthly terms. Get busy.

HOBART BROTHERS COMPANY, BOX 17E, TROY, O.

Bronze as originally made contained only copper and tin, but the bronze of today has zinc as a constituent.

In preparing the alloy weigh out 75 grams of copper, 15 grams of zinc and 10 grams of tin. Do not add the zinc and tin until the copper has been melted. Place the crucible with the copper in the furnace and cover tightly with the lid. With the furnace at full heat it will require about 20 minutes probably to melt the copper. As you remove the cover occasionally to observe the process it will seem as if the white-hot copper will absolutely resist the tremendous heat and refuse to melt. But it cannot fuse until its melting point has been reached, however much it may seem as tho it ought to succumb to this onslaught of heat energy. Finally, tho, as you take another look, you will see the copper changed into a lake of molten metal as clear and limpid as water in a cup. Then add the zinc and tin and after they have have had time to mix, which will require only a few moments, remove the crucible with a pair of long tongs and immediately plunge it beneath the surface of water in a pail ready at hand. (See Fig. 4.)

Once in carrying out this operation I used, instead of a pail, a large battery jar. Immediately, however, upon immersing the crucible and contents a terrific explosion occurred and the battery jar was blown to fragments. The crucible, too, was shattered and the bronze was reduced to a fine sand.

Preparation of Brass

Brass may be prepared in exactly the same way as bronze. It consists of 70 parts by weight of copper to 30 parts of zinc.

After you have prepared some brass chip off a little piece and dissolve it in nitric acid. A blue color will at once appear showing the presence of copper, which may be intensified by the addition of an excess of ammonia solution. This shows that copper is present.

There are a number of other common alloys which you could prepare if you cared to do so. These, however, illustrate the process sufficiently and only a few others will be enumerated here. *German Silver* consisting of copper, zinc and nickel, is very important as an electric resistance wire. Contrary to the common supposition, it contains no silver. To show the presence of copper add nitric acid and excess of ammonia as above. Gun metal, coin silver, coin gold and nickel and aluminum bronze are among the more common alloys.

Some Iron Alloys

By far the most useful of all the metals is iron. Yet pure iron is a curiosity. Very few people have ever seen the pure, soft, ductile and silver-white metal. So great is its affinity for oxygen that, even if it is prepared in the pure state, it quickly rusts on the surface to iron oxid unless special means are taken to prevent this action. Every year the blast furnaces of the world turn out 72 million tons of iron but in that same time a quarter as much returns to its original form of iron oxid.

It has been found, however, that steel alloyed with 25 per cent. of nickel will not corode and is also non-magnetic. The steel is also made stronger and tougher.

Steel containing 15 per cent. of silicon is rust-proof and will resist the action of strong sulfuric, nitric or acetic acids. Neither will the dilute acids affect this alloy. In America this product is known as "Buflokast."

Chromium alloyed with steel gives a product that is exceedingly hard and of great penetrating power. In connection with nickel, which adds elasticity, it is used in the steel for projectiles, big guns and armor plate.



Don't Marry Until You Read These Private Lessons On SEX FORCE

To anyone contemplating marriage, the great value of these wonderful lessons on Sex Force can not be overestimated. Sex Force is the most vital power of attraction. When properly understood and controlled, as these lessons clearly teach, it makes men noble, virile and attractive; women beautiful, sweet and lovable, and paves the way for happy marriages.

These private lessons, now for the first time published in book form, impart **sex secrets** that every man and woman should know. It is the only work published that breaks down the criminal silence concerning Sex—that rises above hypocracy and divests the subject of all uncleanliness.

Priceless Truths You Should Know

Chapters covering Preparations for Entering Wedlock; Important Problems of the newly married; Duties of Husband and Wife; Secrets of Sex-Anatomy; Sex Physiology and Psychology; Sex Control; Sex Morality; Evolution of Marriage; Fall and Rise of Woman; Mistakes of the Bride groom; Unusual Theories of Sex-Life; Standards of Sex-Morality; and hundreds of special subjects that every young man, young woman, young husbands and wives, fathers, mothers and teachers should know.

Special Now for a short time only, these remarkable private lessons will be sent to any address **prepaid** for only $1.60. Endorsed by highest authorities—educators, clergymen, doctors. Order today. Your money refunded if you are not more than satisfied.

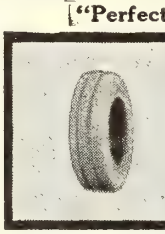
FREE Send at once for large folder giving full description and table of contents.

But to **be sure** of securing your copy of **Private Lessons** —send your remittances of $1.60 **now**—TODAY.

UNITED SALES CO. Dept. 160 Springfield, Ill.

FOR YOUR TYPEWRITER!

"Perfect Roller-Grips"



Price, $1.00 Per Set
All Charges Paid

Ingenious little Non-Skid Rubber "Tires" that fit snugly over the platen finger-knobs of any standerd typewriter.

They eliminate calloused, irritated tired fingers.

They are indispensable to manifolding.

Used by hundreds of efficient typists.

"Perfect Roller-Grips" are positively practical, efficient and indispensable typewriter attachment.

Send us your order to-day!

AMERICAN ROLLER-GRIP CO.
HORNELL, N. Y.
(Folder on Request)



KNOBS

We have a large stock of knobs as illustrated. This knob is made of "Insulate" and is 1 inch in diameter with a 5/8-inch 1/2 threaded shank. Just the thing for rotary switches.

No. 4 Knob, each 15c; Per dozen $1.50
Shipping weight, each 2 ozs. per doz. 1 lb.

OTHER BARGAINS

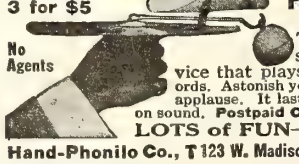
Young & McCombs rotary spark gab, shipping weight 4 lbs. $16.00
Young & McCombs saw tooth rotor, shipping weight 1 lb. $4.50
De Forest variable condenser, shipping weight 2 lbs special price $5.75
Skinderviken transmitter button, shipping weight 4 oz. . . $1.00
Acme 1-2 K. W. semi-mounted transformer, shipping weight 30 lbs. $22.00

Send 15c for our big illustrated catalogue. This amount may be deducted on your first order for $1.50 or over. High printing costs make free distribution impossible.

ELECTRICAL SPECIALTY CO.
Dept. E. 48-50 S. Front St. Columbus, Ohio
Dept. E. 20 N. 9th. St. Philadelphia, Pa.

Foreign Countries 3 for $5

No Agents



A Pocket PHONOGRAPH AT LAST!

The Phonilo is a simple pocket device that plays all needle records. Astonish your friends and win applause. It lasts a lifetime. Sells on sound. **Postpaid One Dollar in U. S.**

LOTS of FUN—NOT A TOY

Hand-Phonilo Co., T 123 W. Madison Street, Chicago

READ LOCOMA



—an interesting, instructive MAGAZINE, on personal subjects, such as Love, Marriage, Divorce, Eugenics, Birth Control, Sex Hygiene, etc. For Men and Women only. 15 cents a copy, $1.50 a year, 8 months' special trial 50c.

100 E.E. & M. Bldg., Farmington, Mich.

"FIBRE-LITE" LIMBS



Easy Payments—Do Nature's Work. AGENTS WANTED who wear leg. Good Pay. FREE Fibre Sample.

Describe Stump to

WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.

Tungsten prevents the softening effect of high temperatures on steel and increases its hardness. It is used in making high-speed steel for lathe tools. Tungsten also increases the magnetic retentive power of steel and is used in making permanent steel magnets for use in electrical measuring instruments, where the strength of field must be uniform from year to year.

Vanadium, a very rare earth metal,, has the most powerful effect upon steel for the quantity used of any element known. As little as 0.2 per cent. raises the tensile strength and elastic limit of mild steel by 50 per cent. It trebles and quadruples the cutting qualities of high-speed steels. The heat developed does not draw the temper. It also produces what is called "anti-fatigue" steel. Steel that is alternately under tension and compression tends to become brittle or "fatigued," but vanadium prevents this. It is used in making automobile springs, engines, tractors, etc.

Molybdenum and *uranium* are also used in steel and today steel having many desired qualities can be made by alloying with the iron small quantities of the various metals.

Prevention of Rust

Iron is more easily oxidized than other common metals and the matter of rust-prevention is of the utmost importance. Oil can be used in a thin film but for most purposes this is unsatisfactory. For many years plating iron with other metals such as copper, nickel, zinc and tin has been found a very effective means of rust-prevention. Of all these metals zinc is the best, for as explained in the preceding article in this series, zinc is negative with respect to iron, and therefore, when any of the zinc is worn away exposing the iron, the zinc must oxidize in preference to the iron and zinc oxidizes very slowly.

Galvanizing Iron

Iron can be galvanized by dipping it into molten zinc. To carry out this process fill a sand or fire clay crucible with zinc and melt it over a Bunsen burner. Then select a large "cut" nail and strongly heat it in the flame of a blast lamp or, if you have none, the flame of a Tirrill or Bunsen burner. After cooling carefully clean it with hydrochloric acid and sand. Wash off all the acid and dirt and then reheat. While still hot dip it into some olive or cotton-seed oil and then plunge it into the molten zinc. Upon removing and cooling you will find that the portion which has been dipt in the zinc has become galvanized.

Expose this galvanized nail to the weather and note the effects upon it as compared with the action upon an ungalvanized nail.

Tin Plate. Tin plate can be prepared in the same way as galvanized iron, substituting molten tin for zinc.

Other Alloys

By the addition of five to ten per cent. of magnesium to aluminum, an alloy is obtained that is almost as light as aluminum and nearly as strong as steel. This is called *magnalium.* An alloy consisting of 90 per cent. aluminum and 10 per cent. calcium is both lighter and harder than aluminum and is not so easily corroded. An alloy called *palau,* consisting of 20 per cent. palladium and 80 per cent. gold, makes a satisfactory substitute for the platinum of crucibles in the chemical laboratory and costs only half as much as platinum. A similar alloy called *rhotanium* has recently been introduced. An alloy called *invar* and made up of 36 per cent. nickel, 5 per cent. manganese and the rest iron expands and contracts almost none at all with changes of temperature, and is used in watches and measuring instruments.

Learn Mechanical Drawing



Are you earning less than $35 a week? Can you reasonably expect your present position to pay you $35 to $100 a week in the near future? If not, this offer will interest you. We offer to qualify you for a profession which, at the very start, pays higher salaries than the average man receives. We offer you the best personal service obtainable. We offer you personal instruction in mechanical drawing and teach you expert Draftsmanship in your spare time, at your home, by mail, in the same practical way that you would learn it in any big Drafting department. We offer to qualify you for one of the many high-salaried positions in the Drafting field, and to keep you in touch with openings for Draftsman in big machine shops, industrial plants, manufacturing concerns and United States Government Departments. We guarantee to start you on real Drafting work at once qualifying you as a thoroughly trained professional Draftsman, capable of succeeding from the very start. We offer to do all of this at a low cost for such service and in a comparatively short time.

I personally stand back of the Columbia School of Drafting—founded, directed and owned by myself—and guarantee the training given by it to be absolutely as represented. The work of each one of our students has my personal supervision. We seek "Quality" students rather than "quantity," as our proposition is of the highest character in every respect.

Roy C. Claflin
President

You cannot make a mistake by taking up mechanical drawing. The field is not crowded, nor can it be. No single profession today offers better opportunities. The great need for trained Draftsmen continues to increase. Each step forward in mechanical development creates a need for more trained Draftsmen. Promotion in this field is sure and certain. Men who start as Draftsmen are often advanced to Chief Draftsmen, Chief Engineer, Production Manager or other high-salaried positions. There is a constant demand for our graduates. We cannot supply them rapidly enough. Many of them are accepted even before they complete their training. This unusual demand for "Columbia Trained Men" is explained by the fact that our students enter upon actual drawing work the day they receive their first lesson. They spend no time with unnecessary preparation or useless theory.

One of the Finest and Best Equipped Institutions in America Teaches You Mechanical Drawing at Your Home

This is the mechanical age in world history. The day of big opportunities for technically trained men is here. Especially is this true in the case of Draftsmen, on whom the mechanical industries of America and the entire world depend. On no one profession does the continued development of machinery so nearly center. With the training which we can give you at your home, your services will always be in demand, at a premium, in this permanent, highly paid field.

Drawing Instruments Furnished

We supply our students with complete drawing equipment. A professional outfit is furnished, together with a highest grade set of Drafting instruments for your permanent use.

No Previous Training Necessary

As our students are put into actual practice at the beginning, they grasp the essentials of drawing quickly. The lessons supplied are thorough, clear and easily understood even by those who have had no previous technical training of any kind. No previous experience or special education is necessary.

Return the Coupon Today

It Brings to You a Valuable Book of Information FREE. Your future depends upon what you do now. We cannot begin to tell you here, in so few words, of the advantages afforded you by this unusually practical course in up-to-date mechanical drawing. If you are in earnest and desire to learn a big-paying profession, we urge you to act now by returning the following coupon. We will immediately send you our valuable book free, "Your Future in Drafting," which tells of our new method of teaching mechanical drawing and outlines our offer to you fully.

COLUMBIA SCHOOL of DRAFTING
Roy C. Claflin, *President*
Dept. 1275, 14th and T Streets
WASHINGTON, D. C.

FREE COUPON—RETURN TODAY

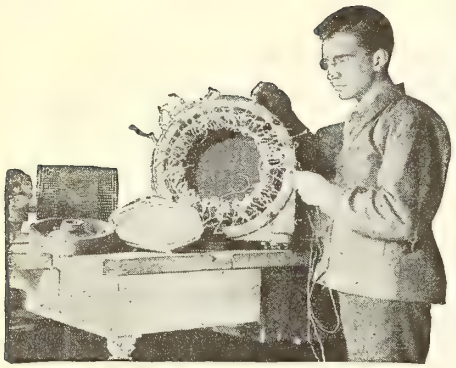
COLUMBIA SCHOOL of DRAFTING
Dept. 1275, 14th and T Sts., WASHINGTON, D. C.

Without obligation to me, please send me your illustrated book on Drafting, telling how I can secure your complete home study course (with which is furnished the professional set of drawing instruments and equipment), and your help in securing a position as Draftsman.

Name.....

Address.....

City.....State.....



Become An Expert in

Armature Work

Trained men who understand Armature building and winding, Motor and Generator Repair and maintenance are in big demand right now. Take up this work and before long you can step into this growing field and insure yourself a permanent, well paying position with big opportunities for advancement.

Learn in 3 Months

In 3 months you can qualify for positions paying $1.25 to $1.50 an hour and more. Come to this well founded school where you learn by actual practice. Hundreds of motors to experiment on; D.C. and A.C. Work.

Write for Free Book

Mail the coupon today for full particulars of our 3 months' course in Armature work. Send the coupon and see how easy it is for you to become an expert on armatures.

SCHOOL OF ENGINEERING OF MILWAUKEE,
Dept. S-19, 373 Broadway, Milwaukee, Wis.

Please send me full information about your three months' course in Armature work. No obligation on my part.

Name .....

Address .....

City..... State.....

Age..... Education.....

LEARN ENGINEERING

Electrical and Mechanical Engineers receive fabulous salaries. Thousands needed. We give you thorough personal training from 3 mos. to 2 yrs., under expert instructors. NOT A TRADE SCHOOL but a PRACTICAL-TECHNICAL COLLEGE teaching electricity, steam, gas, auto-tractor, armature winding, drafting. Extensive laboratory and shop equipment. DEGREES AWARDED. Day and night sessions: enroll any time. Write for free catalogue. Earn-while-you-learn plan.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.

30 Days' Free Trial Select from 44 Styles, colors and sizes, famous **Ranger** bicycles. Delivered free on approval, from maker - direct - to - rider, at Factory Prices. Save $10 to $25 on your bicycle.

12 Months to Pay Immediate possession on our liberal Easy Payment plan. Parents often advance first deposit. Energetic boys earn the small monthly payments thereafter.

Tires Horns, wheels, lamps, parts and equipment at half usual prices.

SEND NO MONEY—Ask for big free Ranger Catalog, marvelous prices and terms.

Mead Cycle Company Dept. C-107 Chicago

Special offer to Rider Agents



LEARN WATCH REPAIRING



You can learn by our modern and original system of instruction every part of the Watch Repairing Trade at home as good or better than at a shop. You can earn money while learning and secure a well paying position or start in business after completing our course of instruction. Good watch repairers are always in demand and earn from $30 to $65 per week. For particulars apply to the

MILWAUKEE SCHOOL OF WATCH REPAIRING, 166 Mason St., MILWAUKEE, WIS.

HANDY BINDER
FOR THE ELECTRICAL EXPERIMENTER

Holds and preserves 12 issues, each of which can be inserted or removed at will, without tools. Will keep your magazines perfectly for all time or just preserve them permanently. Made of heavy material, extra strongly reinforced at the back and covered with handsome green cloth, suitably lettered in gold. **65c**

Add postage for 2 lbs.

Experimenter Pub. Co., Inc. Book Department 233 Fulton St., N.Y.



Printing Cheap

Cards, circulars, labels, book, paper. Press $12. Larger $35 Job press $150. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE, cards, etc. THE PRESS CO., D-47, Meriden, Conn.

Electrical Marvels Startle Delegates

(*Continued from page* 975)

simultaneously received over the circuit and deciphered by an automatic apparatus. It was shown that any plain text message could be deciphered easily and accurately at great speed with absolute secrecy, and that the running cipher key used, consisting of a succession of characters, could easily be altered within fifteen minutes.

Research Laboratory Wonders

The delegates witnessed everything from the electrical recording of the energy furnished by the beating of the human heart to the reproduction, on what was described as an oscillograph, of a picture of the human voice and its vibrations. Eminent men among the delegates sat before an instrument which registered through electricity their own bodies generated the beating of their hearts and as each arose from the chair a photographic record of his heartbeats was handed to him. During the projection on a screen in a dark room in the electrical recording of the vibrations of the human voice, one of the scientists of the laboratory talked into a telephonic receiver an address in which he described the wave lines of his own voice as his lecture was projected in a vibrating line on the screen.

The visitors were almost bewildered by the rapid succession of things of this sort shown to them and were especially interested in the apparatus which will be used when the entire telephone system of New York City is transformed from a manual system to a new developed form of automatic telephony.

Building a Small Automobile

By H. WINFIELD SECOR

(*Continued from page* 992)

It is understood, of course, in either case, whether utilizing two or four electric motors, that the wheels rotate freely on the shaft and are not secured thereto in any manner. A speed control and reverse action can be readily constructed with a switch, some resistance wire, or simply using iron wire for the rheostat coils.

To reverse any motor, whether of the series or shunt-wound type, the field or the armature connections, but not both must be reversed, necessitating the carrying of four wires from each motor to the reversing switch and controller. Such a machine has been built, using a regular automobile starting motor, rated at about one-half horse-power, this motor operating on six volts, and requiring of course, a considerable amperage. Several ignition batteries can be connected in parallel to supply the necessary current, keeping in mind that the standard, as well as safe discharge rate for lead plate cells, is eight hours; 120 ampere-hour batteries should be discharged at no more than the rate of 15 amperes for eight hours, normal rate, etc.

With a one-half horse-power auto starter motor, you will require about from 400 to 500 amperes at full load; a sufficient number of batteries should be connected on parallel to permit of the normal eight-hour discharge rate.

At Fig. *D*, is shown the usual arrangement with gasoline engine or single electric motor power plant, centralized and caused to drive the two rear wheels of the vehicle

(*Continued on page* 1026)

Big Profits Every Month Get an HB 16-Battery Charger

MAKE BIGGEST PROFITS THIS WINTER

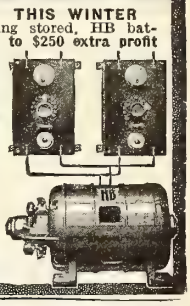
With winter here and cars being stored, HB battery charging can pay you $150 to $250 extra profit every month. Someone gets the business of charging those batteries—why not you? Start **now**—get a sturdy, dependable HB Charger with ample capacity to handle this profitable business.

THIS HB 16-BATTERY CHARGER Recharges 1 to 16 6-volt batteries or equivalent at once. Uses 2 or 3 phase city current—cheapest and best. Current cost 4c to 12c each—owner pays 75c to $2.00. Quick, clean, permanent profits easily made.

Small Payment Puts This Money-Maker in Your Garage or Shop

Balance on easy monthly terms. Absolute Money Back Guarantee. Write TODAY for information.

HOBART BROTHERS COMPANY
Box 110-E TROY, OHIO
Successful Manufacturers Since 1893





Book on Law Free



Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.

Write Today—now while we are making a special reduced price offer.

American Correspondence School of Law
7441-3601 Michigan Ave., Chicago, Illinois

MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE

Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only One Dollar Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah



"Lighting Fixtures"
Ready to Hang

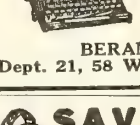
(Direct from Manufacturers)

Completely wired, including glassware. New designs.

Send for catalog No. 20

ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

ALL MAKES



Underwoods, Monarchs, Remingtons, L. C. Smiths, Olivers, Royals, Coronas AT REDUCED PRICES. Prices as low as.... **$20.00**

Write for our Catalog No. 15

BERAN TYPEWRITER CO.
Dept. 21, 58 W. Washington Street, Chicago

SAVE 25% to 60%
on slightly used
GRAFLEX-KODAKS



Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 10 days' Free Trial. Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.

CENTRAL CAMERA CO., Dept. 111 124 S. Wabash, Chicago

BLUE PRINT READING



Electricians, Carpenters, Bricklayers, Mechanics, Shipyard, Sheet Metal, Structural and Concrete Workers, Boiler Makers, Plumbers, Pipefitters and others can earn big money if they can read Blue Prints. Get into the big-pay class. By our simple method we train you in a short time. Write for Catalog 15-B, **stating trade. Do it today.**

BE A DRAFTSMAN
Earn $35-$150 a Week

Employers everywhere are looking for draftsmen. They are offering big salaries and good positions are always open. By our practical method we train you quickly in your spare time. Drawing outfit, books, etc., furnished FREE. We help you to obtain position when qualified. Write for Catalog 15-G. DO NOT DELAY.

COLUMBIA COR. SCHOOL
Dept. 1, Drexel Bldg., Phila.

Be a Finger Print Detective



Earn Big Pay

Get into this fascinating new profession. Big salaries, rewards and fees are paid in this work. Finger Print experts needed by governments, corporations, police departments, and other institutions. Learn in spare time at home to fill one of these big jobs or go into business for yourself as a Finger Print Detective.

Book FREE Write quick for big, fully illustrated Finger Print Book. Tells all about this wonderfully interesting work and how you can easily qualify. Right now we are making an amazing special offer of a **FREE COURSE** in Secret Service.

UNIVERSITY OF APPLIED SCIENCE
Dept. 1791, 1920 Sunnyside Ave., Chicago, Ill.

Handwriting Tells You Secrets

Be successful. Find out what holds you back. Send us an ink specimen of your handwriting and $1.00. Our expert Graphologists will tell you your faults, virtues, talents, etc. Your $1.00 back if you are not satisfied.

ROBERT R. ROSS, 110 West 40th St., N. Y.

Learn to Dance!



You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful **Peak System of Mail Instruction.**

New Diagram Method. Easily learned; no music needed: thousands taught successfully. **Write for Special Terms.** Send *today* for FREE information and surprisingly low offer.

WILLIAM CHANDLER PEAK, M. B.
Room 240, 4737 Broadway, Chicago, Ill.

STAMMER NO MORE

Kill the fear of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Order a copy today. **THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago, Illinois**

LABORATORY APRON

Waterproof; contains three pockets and is well constructed. The best of its kind on the market and the only thing to protect your clothes. Sent postpaid for $1.25.

ROBERT RACHMIL
423 15th Street Brooklyn, N. Y.



Cleartone Phonographs
$4.00 to $200.00 Retail

Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 501B East 19th Street, N. Y.

$1.00 Complete Outfit
ALCOHOLIC SPIRIT HYDROMETER

Complete with Testing Jar. Directions FREE. Will test liquids accurately from 1 to 200 per cent. proof. All postal charges prepaid. Send draft or money order.

PEOPLES FAIR STORES, 3222 W. 26th St., Chicago, Ill

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. **Only finest approval sheets, 50 to 60%. Agents Wanted.** Big 72-p. Lists Free. **We Buy Stamps.** Estab. 25 yrs. **10c.**
Hussman Stamp Co., Dept. 118, St. Louis, Mo.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page* 987)

moon to full moon it will therefore, rise *after* the sun and set *after* the sun. The waxing crescent moon will not be visible in the morning hours because it rises *after* the sun, and is lost to view in the brilliant solar rays. Nevertheless, it follows the sun

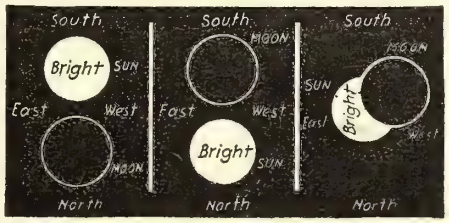


Fig. 1. The New Moon. Showing the Three Different Relative Positions that the Sun and Moon May Occupy at Time of New Moon.

across the sky and becomes visible in the west as soon as the sun's rays have disappeared below the western horizon. The thin illuminated crescent has its horns or cusps turned *away* from the point where the sun has set. The horns of the crescent can never point *towards* the horizon since the illuminated side of the moon is always turned towards the sun whether the sun is above or below our horizon. For the exact form and appearance of the waxing crescent moon see Fig. 2.

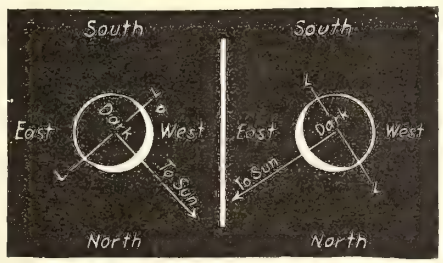


Fig. 2. The Crescent Moon.

Left—The Waxing Crescent Moon. The Width and Area of the Crescent Increases Continuously from New Moon to First Quarter. The Distance of the Moon East of the Sun Increases Gradually from 0° to 90°, and the Moon Appears Higher Above the Western Horizon at Sunset Each Successive Evening.

Right—The Waning Crescent Moon. The Moon Is Now Visible in the East Before Sunrise. Its Altitude Above the Eastern Horizon at Sunrise Is Less Each Successive Evening from Last Quarter to New Moon and the Crescent Is Decreasing Gradually in Size.

The Crescent Moon Is Always Convex Toward the Sun So that the Horns, or Cusps, Are Always Turned Away from the Horizon. The Line Connecting the Cusps LL' Always Passes Thru the Center of the Disk and a Line Drawn Thru the Center Perpendicular to LL' Points to the Sun. The Faint Illumination of the Dark Portion So Frequently Seen at the Crescent Phase Is Due to the Fact that the Earth as Seen from the Moon Is Now Nearly "Full" and We See this "Earth-Shine" Reflected Back to Us from the Lunar Surface.

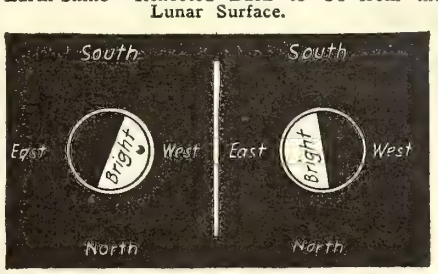


Fig. 3. The Moon at First and Last Quarter. Left—At First Quarter, About Seven or Eight Days After New Moon, the Western Half Fully Illuminated. The Moon Is Now 90° East of the Sun and on or Near the Meridian at Sunset. Right—At Third or Last Quarter, the Eastern Half Fully Illuminated. The Moon Is Now 90° West of the Sun and On or Near the Meridian at Sunrise.

Your Choice 75c a Week



FREE!

With every set is included—FREE—a Consulting Membership which gives you the privilege of submitting your perplexing problems to a corps of experts for an entire year. This Consulting Membership regularly sells for $12.00.

No matter what your occupation, one of the home study sets listed below will quickly fit you for a better job and bigger pay. Any set you select will be sent for seven days' examination, and if you decide to buy you may pay the rock-bottom price at the rate of **only 75c a week.** But you must act now! When our present supply of paper and binding materials, bought at pre-war rates is used up, production will cost more and prices must be raised.

These books are the work of recognized authorities. They are written in plain, easily understood language, by recognized authorities, and contain hundreds of photographs, diagrams, tables, etc., that make difficult points as simple as A-B-C. Handsomely and durably bound in half or full morocco leather (except as noted), and stamped in gold.

Pay-Raising Books
At Greatly Reduced Prices

Accountancy and Business Management, 7 vol., 2700 pages, 1000 pictures.	Was $52.50	Now $29.80
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures.	Was $37.50	Now 24.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures.	Was $67.50	Now 39.80
Electrical Engineering, 8 volumes, 3000 pages, 2600 pictures.	Was $60.00	Now 34.80
Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures.	Was $45.00	Now 29.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures.	Was $45.00	Now 29.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures.	Was $52.50	Now 29.80
Law and Practice (with reading course), 12 volumes, 6000 pages, illustrated.	Was $97.50	Now 49.80
Fire Prevention and Insurance, 4 vols., 1500 pages, 600 pictures.	Was $30.00	Now 19.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures.	Was $30.00	Now 19.80
Sanitation, Heating and Ventilating, 4 volumes, 1454 pages, 1400 pictures.	Was $30.00	Now 18.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blue-prints, etc.	Was, $30.00	Now 19.80

Send No Money
Shipped for 7 Days' Trial

Yes we'll gladly ship any set right to your home or office upon your simple request. Pay only shipping charges when the books arrive. Don't send a penny until you have used them seven days, then remit only $2.80 or return them at our expense. Pay balance at the rate of $3.00 a month—**75c a week.**

Act now—while these splendid books are being offered at 20% to 50% less than regular prices. This offer is open to every person within the boundaries of the U. S. and Canada. Grasp your opportunity—**fill in and mail the Coupon NOW!**

American Technical Society, Dept. X-251, Chicago

American Technical Society, Dept. X-251, Chicago, U. S. A.

Please send me set of.....

.....

for 7 DAYS' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3 each month, until I have paid the special price of..... If I decide not to keep the books, I will notify you at once and hold them subject to your order: Title not to pass to me until the set is fully paid for.

Name.....

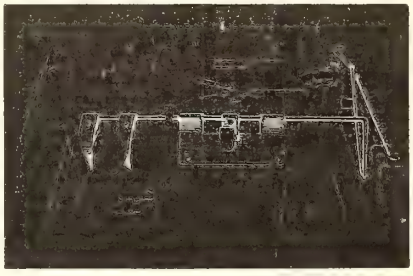
Address.....

Reference .....

AGENTS---SALESMEN
SALES MANAGERS
EXCLUSIVE TERRITORY ON NEW INVENTION

Will you listen when opportunity knocks? Fortunes have been made in new automobile inventions. **Grab this one quick.** Your minutes are like dollars—don't waste them now. **Read—investigate—then act.** The Speederator for Ford cars is a new invention that **makes any Ford run like a Packard.** Stops **stalling, bucking and motor racing.** Gives a smoothness to Ford driving that is wonderful. And just think—**Speederator** is put on **without boring holes** or special tools of any kind. Any Ford driver can put one on complete in **twenty minutes.** Never wears out—never needs attention—**operates automatically. Sells like lightning.** Old Ford drivers say best and only necessary Ford part. **Get full information.**

The Greatest Ford Invention



Ford Owners Buying Everywhere

LISTEN This is not a ready-made fortune, but it is the opportunity to secure the **exclusive sales agency** for this new invention. Don't take our word—get the proofs. Just be honest with yourself and **investigate.** Let the **money you make talk** from now on. Smashing records of success will show the way; **Helton, Utah,** sold six hundred in five weeks—**profit $1,800.00. Crist, N. Y.,** sold 23 first day—said would have sold more if he had had them—now averages more than 400 a month—**profit $1,200.00. McAllister, Ills.,** says sold four first afternoon. He is now using 100 a week. These straight-from-the-shoulder facts point the way. **Hoover** down in **Ohio** sold 29 one day, **profit $87.00. Benke, Mo.,** averages 200 a month. **Campbell, Tenn.,** 1000 a month. **Crandall, Iowa,** put on thirty sub-agents in one week. **Dryden, Calif.,** sold 150 in ten days. **Grace, Hawaiian Islands,** 200 in two weeks. **Teeters, Mich., first three** dozen in ten days. We say you can make

$55.00 TO $300.00 WEEKLY

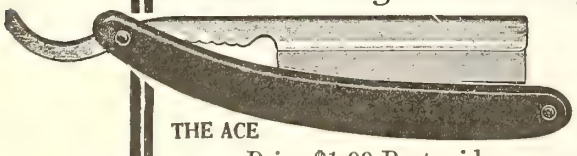
selling the Speederator. Best article to advertise itself you ever saw. Once on a car the driver will never let you take it off. Sales are made fast and furious. **Boyer, Penna.,** made $72 first day. **Cook, N. Dak.,** 150 sold first two weeks. **Cahan, Ariz.,** 72 in two weeks—$216.00 clear. Join the ranks of successful men in this work.

NO EXPERIENCE NECESSARY

Just show us that you mean business and are ready for business and **we will show you how.** But first, **make us prove these facts.** We have nothing to apologize for. The **Speederator is a grand success**—you can make money fast if you have the territory—so get busy now. Write today for the necessary information and see for yourself. Don't delay—**plenty of good territory left**—if you are a hustler you can have money in the bank in a few weeks. **Just write—now—to**

THE PERRIN METAL PARTS CO.
1079 HAYWOOD BUILDING
DETROIT, MICH.

The Swing of a Straight Edge Razor, *Plus Safety*—



THE ACE

Price $1.00 Postpaid

Money-Back Trial Offer

SEND $1.00 for this razor to-day! Use it for ten days. Then, if you are not thoroughly satisfied that you have had the ten quickest, cleanest, smoothest shaves in your life, return the razor and your money will be refunded without question. Detachable, selected steel blade, good for 4 months. Black enameled handle. Well made and handsome thruout.

RAYMOND FARRELL CO., Dept. 22, 3256 THIRD AVE., NEW YORK

NOTHING approaches the old straight razor for smooth shaving. It really *shaves,* never *scrapes!* Here is a real straight razor, with the safety feature added. The specially designed guard is instantly attached, absolutely safe, and preserves all the smooth shaving qualities of this *real* razor.

How and Why of Radio Apparatus, by H. W. Secor. A book every Radio Operator should have—$1.75. Experimenter Publishing Co., 236 Fulton Street, NewYork City.

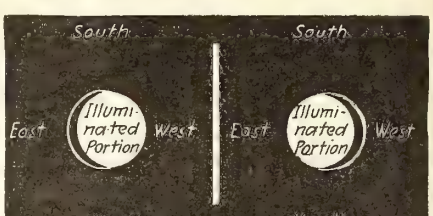


Fig. 4. The Gibbous Phases.

The Shape of the Illuminated Portion Is Now That of a Circle Minus a Crescent. This Is the Phase Seen Between First Quarter and Full Moon and Between Full Moon and Third Quarter. Left—The Distance of the Moon East of the Sun Increases from 90° at First Quarter to 180° at Full Moon. The Western Limb of the Moon Is Fully Illuminated, the Eastern Limb Dark or "Defective."

Right—The Moon Is Between 180° and 90° West of the Sun. The Eastern Limb Is Now Fully Illuminated, the Western Defective.

As hour by hour and day by day the waxing crescent draws farther and farther eastward and increases its angular distance from the sun we see more and more of the illuminated side; the crescent increases in width and area and the moon appears higher in the western sky each night at sunset.

Usually about seven and a fraction days after the date of new moon the moon completes the first quarter of its revolution around the earth. The period from one phase to the next is variable and irregular

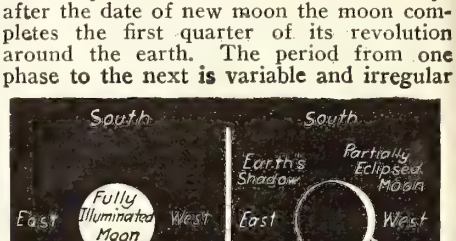


Fig. 5. The Full Moon.

Left—The Moon Is Now 180° East, or West, of the Sun. It Rises in the East About Sunset, Is Nearly Due South at Midnight and Sets About Sunrise, and Is East of the Meridian the First Half of the Night and West of the Meridian the Second Half of the Night.

Right—The Earth Is Now Directly Between the Sun and Moon and at This Time Lunar Eclipses Occur When the Moon Is Near Its Nodes or the Points Where Its Orbit Crosses the Ecliptic.

being sometimes less than seven days and at other times more than eight days since the rate of revolution of the moon is not uniform.

When the moon has completed the first quarter of a revolution it is ninety degrees east of the sun and presents the phase

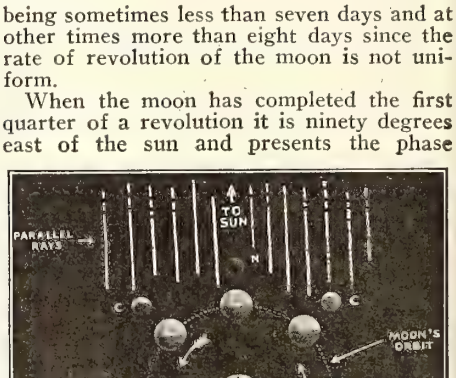


Diagram I. To Show the Various Phases of the Moon at Different Points in Its Orbit. The Rays of the Sun Fall upon the Moon from a Point Above the Plane of the Paper and the Motion of the Moon Around the Earth Is from West to East in the Direction of the Arrows. The Outer Circles Represent the Appearance of the Moon Viewed from the Earth When at the Points in Its Orbit Occupied by Inner Circles at Corresponding Positions. The Dark Portions Are Unilluminated by the Sun.

N—New Moon. C—Crescent Moon. F.Q.—First Quarter. H.M.—Half Moon. G.—Gibbous Moon. L.Q.—Last Quarter. F.—Full Moon.

known as "half-moon" since half of the surface that is turned toward the earth is illuminated and half is in darkness. It is at the first quarter. The illuminated half is of course the western half because the sun is to the west of the moon. The half moon is near the meridian at sunset in mid-latitudes and sets near midnight. Up to the first quarter, then, the moon is a crescent in the western sky during the first part of the night and should never be represented as *east* of the meridian or near the meridian at midnight.

After the moon has passed the first quarter and before it is full more than half of the side turned toward the earth is illuminated and it is in the "gibbous" phase. It is still the western limb that is fully illuminated. The moon is now east of the meridian at sunset and it crosses the meridian before midnight and sets before sunrise. All engaged in outdoor pursuits during the first half of the night find this phase of the moon more favorable to them than the gibbous phase *following* full moon.

The moon now being above the horizon at sunset is visible continuously from sunset to midnight but sets some time during the second half of the night, while the full moon shines thruout the night rising in the east about sunset and setting in the west about sunrise.

When the moon is full it is 180° east, or west, of the sun and so both its eastern and western limbs are perfectly illuminated. After the full the moon goes thru its phases in reverse order being first gibbous then a half moon once more and lastly a waning crescent.

It is now *west* instead of *east* of the sun and so it is the *eastern* limb that is fully illuminated by the sun. Being west of the sun it will now *rise before the sun* and *set before the sun* the interval decreasing each day as the moon draws in toward the sun and the phase of new moon once more.

The gibbous phase preceding full moon is favorable to all abroad before midnight but the gibbous phase following full moon is more favorable to those who are abroad after midnight for from full moon to last quarter the moon is below the horizon at sunset and of course is rising later and later each night while at sunrise it is still above the horizon appearing higher and higher above the western horizon at sunrise as it approaches the third or last quarter.

When it has reached this point it is once more a half-moon tho now it is the eastern half instead of the western half of the disk that is fully illuminated. The moon is 90° west of the sun at third quarter and from this phase to the phase of new moon it is a crescent once more tho now a waning instead of a waxing crescent. It appears east of the meridian before sunrise and as the crescent grows thinner it draws nearer and nearer to the eastern horizon and the rising sun. As with the waxing crescent moon the horns are turned away from the horizon. The waning crescent moon is always to be looked for *east* of the meridian and to be associated with the rising sun while the waxing crescent moon is to be looked for west of the meridian and associated with the setting sun. Neither the waxing nor the waning crescent moon is to be found near the meridian around the midnight hours.

As the waning crescent moon grows thinner and draws in closer to the sun each successive night its time of rising precedes that of the sun by an ever decreasing interval until finally the crescent disappears from view in the eastern sky; the next day we see no crescent either in the eastern or western skies the moon is once more in conjunction with the sun and "new." One revolution of the moon about the earth has been completed and a day or so later we may look for a new crescent moon in the western sky after sunset.

Use Starrett Tools

TURN to the INDEX

THAT'S the quickest way to learn how much vital information it contains. But only constant use will teach you the full value of the STARRETT DATA BOOK FOR MACHINISTS.

Experts selected its tables and formulas to meet the requirements of practical machinists. Useless matter has been eliminated, with the result that each of its 180 pages will aid you to solve some specific problem. It is the logical sequel to the Starrett Book for Machinists' Apprentices, now in its fourth edition.

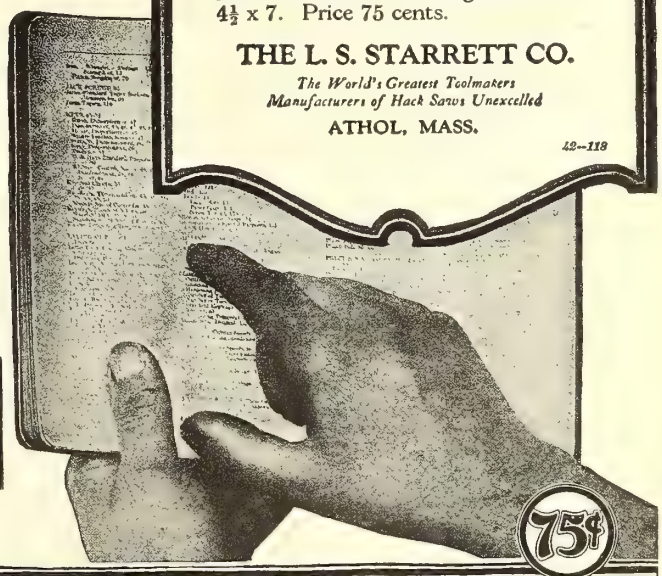
180 pages, bound in red Atholeather. Numerous tables and diagrams. Size 4½ x 7. Price 75 cents.

THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled

ATHOL, MASS.

42—118

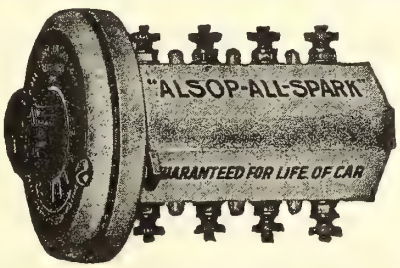


For the Machinist Apprentice Vol. I of the Starrett Books is invaluable. It deals with how to use tools and is an instruction rather than a reference book.

75¢

Starrett Books—Vol. II

NO MORE SPARK PLUG OR CARBON TROUBLES



When You Use The Alsop-All-Spark

Saves the replacing of Spark Plugs and ELIMINATES CARBON

Controlled from Dial on Dashboard.
Gives Your Car Greater Power—Prevents Miss-fires.

Cost complete with MONEY-BACK GUARANTEE, $7.50

Saves gas, battery and starter. You cannot afford to be without it.

WRITE FOR OUR GOVERNMENT TESTS

Some of our satisfied users write:—

"I like this DEVICE fine! I filled the spark plugs with grease and the grease was burned out in fine shape. I used plugs with broken porcelains and they fired just as good as new ones with YOUR DEVICE on my car."

ALL-SPARK IGNITION CO., Inc.

13-X Water Street **New York, N. Y.**

Be a Movie King



OH BOY! SOME SPORT
Surprise the Bunch—Have a Barrel O' Fun
Own a Genuine Moving Picture Machine

Here's what you've always wanted—a genuine MOVING PICTURE MACHINE—a machine that uses STANDARD FILM—like the Big theatres show—at a price you can easily afford to pay. This is the BIG opportunity—don't MISS it. Read every word, then act quick. Three swell models to select from. Each the best of its kind. All REAL moving picture machines—not toys or magic lanterns, but REAL Movie Machines, that show the pictures on the screen. The Films are supplied to us by the leading film companies in America, and the subjects include all the LEADING actors and actresses that you see and admire in all the big theatres. The "fellers" and girls and the grown-ups, too, will sit spellbound, or roar with laughter at the wonderful, lifelike, real movies you can show them.

Three-Reel Cinematograph

Here is an astonishing bargain. Our latest Model Cinematograph is a whirlwind value. At the price it has everything beat you ever heard of. Here is a genuine Moving Picture Machine, made entirely of metal, solidly constructed, and put together by expert workmen, that you can buy at a price that will simply astound you. It comes equipped with a SAFETY CARBIDE Gas Generator, and can be used to show moving pictures anywhere. The mechanism is so simple it can be operated by anyone. The greatest value in a Genuine Moving Picture Machine ever offered at the price. Think of it! A genuine Moving Picture Machine, using STANDARD FILMS, shipped by express, charges collect, with 3 REELS FREE, for ONLY $3.00; or shipped by parcel post to any address in the world prepaid for $3.25.

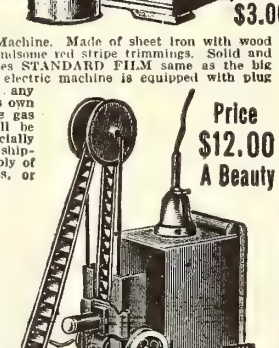


$3.00



New Model Movie Machine
Your Choice of Gas or Electric Light

This is a beautiful, high-class Moving Picture Machine. Made of sheet iron with wood base. Finished in black or battleship grey with handsome red stripe trimmings. Solid and substantial construction. Size 12x7½x5½ in. Uses STANDARD FILM same as the big machines. TWO TYPES—Electric and Gas. The electric machine is equipped with plug and cord complete, ready to attach to any electric light socket. Gas machine has its own generator and makes its own light. The gas machine can be used anywhere and will be sent unless electric type machine is specially ordered. Sent securely packed in special shipping case with full instructions, film, supply of show tickets, etc., for $7.50, by express, or $8.00 if sent by prepaid parcel post.



Keystone Moviegraph
Moving Picture and Magic Lantern Combined

A regular beauty, all complete, ready for you to use the minute it arrives. Hang up a sheet, put on a reel, turn the crank, and you're off. That's all there is to it. Made of metal throughout, with heavy base casting. Finely adjusted mechanism, easily operated. Electric model only; simply screw in plug to your electric light socket and you are all ready for an exhibit. Equipped to show slides as well as Real Moving Pictures—just like the big machines. 12x9½x6 in. Comes with 3 EXTRA LONG STANDARD SIZED FILMS, 3 FINE LANTERN SLIDES, and admission tickets—all FREE. A machine you will be proud of. You can have endless fun and amusement, and MAKE MONEY with it. Sent by express, with full instructions and extra long cord and plug, securely packed, for $12.00; or by parcel post, to any address in the world, for 75c extra.



No. 2 Rewind Model
Largest and Most Powerful Model

This is the No. 2 Rewind Model, with equipment for unwinding and rewinding 100 to 200 feet of film. The size of the machine is 6¾ x 14 x 19 inches. It is constructed on a wooden base 6¾ x 11½ inches, which will not scratch the furniture. Electric model only, it operates from any electric lighting circuit. All you have to do is to screw in plug to any electric light socket. It has a regulator so that different sized lamps may be used—electric socket, plug and six feet electric lamp wire cord, and nickelled reflector. Also shows magic lantern slides. With this machine we furnish a can of 100 feet of film, three American-made Lantern Slides—subjects of which are Wilson, Pershing, Aeroplanes, Boy Scouts, Charlie Chaplin, Jiggs, Comics, etc., 100 Theatre Tickets, guarantee and full directions. PRICE $20.00, shipped by Express, or by prepaid parcel post to any address in the world for $1.00 extra.

Extra Films

EXTRA FILMS. For all our Machines. Big variety of subjects, including leading and best known movie actors and actresses. Standard size. **Short Reels, Price** 15 cents each. **Extra Long** (5 feet), **Price** 3 for $1.00. **Special 100-foot reels** $2.50 each. CHARLIE CHAPLIN FILMS, 25c each; 5-foot lengths, 60c each. All postpaid.

LANTERN SLIDES for Keystone Moviegraph, American made, 6 for 75 cents.

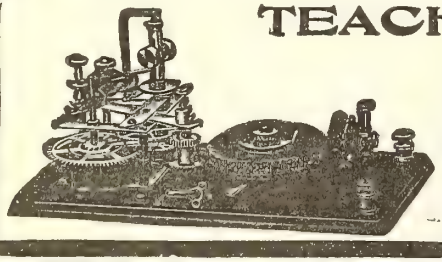
"U-MAK-EM" SLIDES. A special slide for use with the $12.00 and $20.00 machine or any other machine with Lantern Slide equipment, for showing on the screen announcements such as "Please Remove Your Hat," "No Smoking," "Intermission," "Goodnight," sporting results and even advertisements, etc. Can be used repeatedly. **PRICE** 3 for 50 cents postpaid.

JOHNSON SMITH & CO., Dept. P.M.36 3224 N. HALSTED ST., CHICAGO

"THERE'S MONEY IN IT"

AT HOME **LEARN TELEGRAPHY** AT HOME

MORSE AND WIRELESS

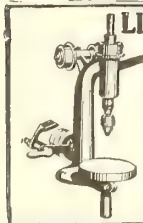


TEACH YOURSELF

In half the usual time, at trifling cost, with the wonderful Automatic Transmitter. **THE OMNIGRAPH.** Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
26 L Cortlandt St. New York



LITTLE GIANT DRILL PRESS

Just the thing for small shop and experimental work. Mechanically right and well made. Size 0 to ¼" drill. Weight 22 lbs. Price $15.00.

Send for circular

SYPHER MFG. CO.
Dept. "C" Toledo, Ohio



DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and **my sworn statement** of how I recovered my hearing.

A. O. LEONARD
Suite 369, 70 5th Avenue -- New York City

A Fairyland of Bubbles

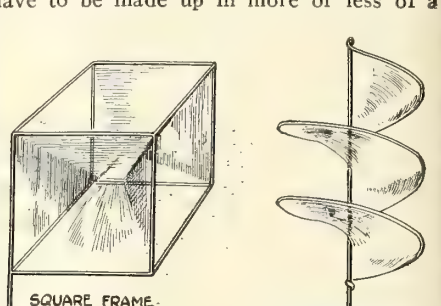
By JOSEPH H. KRAUS

(*Continued from page* 964)

namely, that of blowing permanent soap bubbles.

Blowing Permanent Soap Bubbles

The liquid for the next experiment will have to be made up in more or less of a haphazard manner as different soaps and different constituents cause different effects. The ingredients are readily obtained from any pharmacist. About six ounces of acetone is placed in a bottle to which is added enough celluloid film to make the solution quite thick. To a similar quantity of acetone, about one ounce of powdered Ivory Soap is added. This soap has been found to be very satisfactory. The solutions are allowed to stand for 36 to 48 hours.

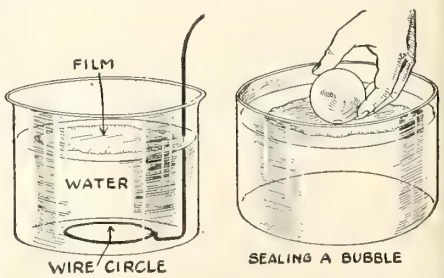


Two Wire Frames, as They Appear When Removed from the Permanent Bubble Solution. These Frames May Be Inserted into a Stand Preferably Made from a Cork Stopper and Can Then Be Put into a Curio Cabinet or a Laboratory Show-Case and Preserved for Future Use.

These solutions are then mixed together until of such a consistency that they can be blown with an ordinary clay pipe in the same manner as soap bubbles, a bubble about four inches in diameter being the maximum size produced.

The ends of the pipes are then stopt up with a wooden plug or with wax and the stems inserted into racks. It will be found that after allowing them to remain this way for twenty-four to thirty-six hours, a quick snap of the pipe will separate the bubble and the same can be caught upon a stretched cotton sheet.

Thereupon, the bubbles can be built into all sorts of fantastic forms. Houses can be erected, bridges built, and castles permanently made as shown in the illustration of the "bubble castle" herewith. In order to do this with a marked degree of success, so that if the castle or the object built is to be moved, and not to break, it will be necessary to moisten the point of contact between two or more soap bubbles with



Above Is Shown a Film, Made as in the First Experiment, Floating on the Surface of Water in a Transparent Container. Note How the Wire Circle Is Bent to Facilitate the Removal of the Film Intact. One Single Drop of the Solution Forms a Film Whose Diameter Is About 6 Inches. A Similar Method Is Used in Sealing the Bubbles.

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures but 4¼ Inches Long. Takes Regular .22 Calibre Cartridges

The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability.** It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard 22-calibre cartridge obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable, six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. The price of the Baby Revolver is only $6.50 sent by mail, p.p.d. to any address.

$6.50

JOHNSON SMITH & CO., Dept. PM36, 2224 N. Halsted Street, CHICAGO

AGENTS WANTED

Cut Your Own Hair WITH THIS Only **50c** Extra Blades, 5c

SAFETY HAIR CUTTER Can cut your own hair with this marvelous invention. Cuts the hair any desired length, short or long. Does the job as nicely before your own mirror. You can cut the children's hair at home in a jiffy. Can be used as an ordinary razor to shave the face or finish around temple or neck. Sharpened like any razor. Saves its cost first time used. **3 for 15 cents.**

JOHNSON SMITH & CO., Dept. PM 36, 3224 N. Halsted Street, CHICAGO

INVISIBLE INK

The most confidential messages can be written with this Ink, for the writing **MAKES NO MARK.** Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private memorandums away from prying eyes. Great fun for playing practical jokes. **Only 25c Bottle**

VANISHING INK

Writing written with this remarkable ink vanishes entirely in a few weeks (sooner if desired), leaving the paper QUITE BLANK. **25c p.p.d.**

Dissolving Ink

Writing appears or disappears at will. Secret with each bottle. Very remarkable.

JOHNSON SMITH & CO., Dept. PM36, 3224 N. Halsted Street, CHICAGO

MAGIC FLUTE

Wonderfully Sweet Toned and Musical

The Magic Flute, or Humanatone, is a unique and novel musical instrument that is played with nose and mouth combined. There is just a little knack in playing it, which when once acquired after a little practice, will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effects are charming, as it is surprising. **25c ppd.**

Post Paid **25c**

Good Luck Ring

Quaint and Novel Design

A VERY striking and uncommon ring. Silver finish, skull and crossbone design, with two brilliant, flashing gems sparkling out of the eyes. Said by many to bring Good Luck to the wearer, hence its name, **Good Luck Ring.** Very unique ring that you will take a pride in wearing. **ONLY 25 CENTS.**

JOHNSON SMITH & CO., Dept. PM36, 3224 North Halsted Street, CHICAGO

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light,** rendering it **perfectly visible in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. Small bottle, **price 25c.** Larger sizes, **50c** and **$1** postpaid. Johnson Smith & Co.

Mystic Skeleton

A jointed figure of a skeleton 15 in. in height, will dance to music and perform various gyrations and movements, while the operator may be some distance from it. **10c pd.**

Serpent's Eggs

Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most lifelike manner. **Price per box, 15c ppd.**

JOHNSON SMITH & CO., Dept. PM36, 3224 North Halsted Street, CHICAGO

All the Latest Surprising and Joke Novelties

"Chicken Inspector" Badge	15c	Luminous Skull	25c
Crying Cat in Bag	20c	Field Glasses	$10.00
Midget Bible (size of stamp)	15c	3-drawer Telescope	$1.75
Anarchist Bombs (Express only) 8 boxes for	$1.00	Invisible Ink (secret writing)	25c
Book on Boxing	35c	Vanishing Ink	25c
Thurston's Wonderful Trk Cards	10c	Liar's License	15c
Box of 6 Wire Puzzles	75c	Fish Lure (catches fish)	25c
Conjurer's Casket of Magic Tricks	75c	Moving Picture Machines $3.00, $7.50 and	$12.00
Watch Camera	$3.60	Nail Klippers	35c
Films for Watch Camera	35c	Exploding Matches (Express only) 8 boxs for	$1.00
Exploding Cigarettes, box	50c	Stage Money, 50 bills	25c
Weather Cottage	$1.90	False Mustache	10c
Seebackroscope (see behind you)	25c	Inkless Pen, writes with water	15c
Amateur Electrician Battery	15c	Exploding Fountain Pen	50c
Firecrackers (Express only) 10 pkts for	$1.00	X-Ray Novelty	15c

JOHNSON SMITH & CO., Dept. PM36, 3224 North Halsted Street, CHICAGO

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP A few hours interesting work saves over half and gives you a machine to suit your ideas. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. Make fine profit building phonographs for your friends.

SAVE OVER HALF

Write today for our Blue print offer. **FREE**

AGENTS wanted for Choraleon King Phonographs

Choraleon Phonograph Co.
121 3rd St., Elkhart, Ind.

FREE THIS BLUE BIRD WATER SET is given to you for selling only 40 packs "Quality Brand Garden Seeds" at 10c. per packet. Order today **Send No Money. We Trust You.** When sold return $4.00 collected and the Water Set is yours. Cash commission if preferred. Many other valuable presents. Catalogue with order.

NATIONAL SEED CO., Dept. 126, LANCASTER, PA

$2 Now!

"Hello There Bill!"

"Say, your voice is clear as a bell. Since I put this New Standard Earpiece on my phone, every word is distinct and powerful. Even a whisper is audible—and you know my hearing was never very good. If you want real 'telephone comfort' get a

"THERAPHONE"

earpiece today. You can put it on in a minute and say 'goodbye' to delay and grouch. Prevents mistakes, conserves energy, saves time and money. It's only $2—Satisfaction Guaranteed."

THE EVOLUTION PHONE CO., Inc.
48C Greenwich Avenue, New York City

a very little of either of the solutions just mentioned; either with the amyl acetate and celluloid solution or with the acetone-celluloid solution.

Coloring the Bubbles

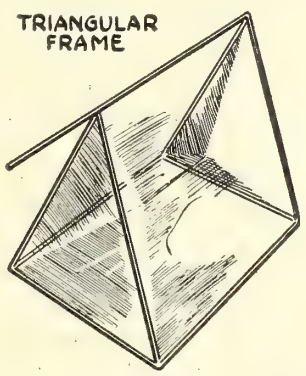
In this manner, the bubbles will last intact for upwards of three years. Another very pleasing and interesting combination is to color some of these with soluble analine dyes. These dyes if delicately handled will give a very faint predominating color characteristic of the bubble, and if an ordinary electric lamp is placed back of a castle built in this manner, very wonderful effects will be produced.

It will well repay any experimenter to delve into such an interesting phase of bubble-blowing.

These bubbles can be blown and then filled with hydrogen, when they will make ascents to great heights. A film produced as in experiment one, can be used to cover the aperture left by the pipe. In order to close this hole, it will be only necessary to float a film on the surface of some water and rest the bubble on the film lightly, a short time after it is produced.

Upon removing the bubble the aperture will be found to be completely closed.

Wire frames of various shapes, the one condition of their construction being that they must be closed into loops or other

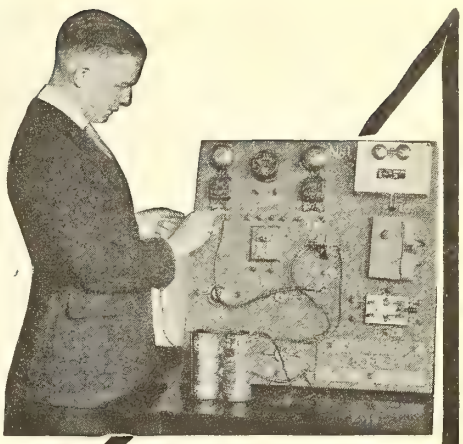


A Triangular Frame Immersed in the Solution of Experiment (Two) Shows How Peculiarly the Film Shapes Itself So That the Three Films Meet Each at an Equal Angle. Any Sort of a Closed Loop Which May Be Devised by the Experimenter Can Be Dipped into the Solution and Removed Whereupon if Allowed to Dry It Will Give a Permanent Article of Considerable Beauty. These Frames after Standing for About One Week Develop Remarkable Colorations. They May at the Same Time Be Colored by an Analine Dye after Which They Assume a Predominant Color Characteristic.

form, if immersed in a bubble solution, give very beautiful effects, developing all sorts of surfaces. The shape of the surfaces is based on the general law that the film will endeavor to take the shape of smallest area. In the illustrations, several such loops are shown filled with film and the experimenter will have plenty of chances to exercise his ingenuity in producing different shapes of frames. The frames may be made about an inch long on the straight sides. Of course, some may not be bounded by straight sides, but the above gives a general idea of about how large they may be. They may be preserved when filled with film for an indefinite period.

CORRECTION NOTICE

On page 752 of the November issue, a mistake was made in the cut of the "Automatic Temperature Indicator." The wire from the upper end of the battery should connect to the top of the set of resistance coils, instead of to the bottom.



Learn Electricity

in you own home with

Real Electrical Devices

HERE is a new way to learn the highly paid profession of electricity. You study with and work on laboratory unit boards right in your home in your spare time just as if you were here in this big, world-renowned school with its wonderful equipment. Thus you gain a complete, practical knowledge and experience in less time with less effort than with the older methods of instruction.

Electrical Apparatus For Home Experiments

Wonderful, cleverly constructed units of electrical apparatus are supplied to each student while learning. These home laboratories are not toys, but life size, expensive instruments and devices which the electrical expert meets with in everyday work. In this way you gain thorough, practical, electrical education at home. Thorough, yet simple, tests enable you to work out problems on your instrument boards. You receive the theory as well as the practice of electrical application, which in a short time will enable you to step into a highly paid electrical position.

Big Field—Big Pay

The opportunity for the well trained, electrical man is practically unlimited. Billions of dollars are invested in this great industry. Thousands of men are employed in it, but the demand today is for men who are trained specialists. These men command handsome salaries—$2,500 to $6,000 and up to $10,000 a year and more. You can easily get into this fascinating, highly paid field of work through our thorough method of instruction and the electrical apparatus that is sent to you for home study.

Write Now for Big Free Book

Send the coupon today for full details on our laboratory unit method of home study and information regarding consultation privileges, our free employment bureau and other special services.

Mail the coupon, now, and begin immediately.

Extension Division

SCHOOL of ENGINEERING of Milwaukee

Dept. S. 16 373 Broadway, Milwaukee, Wis.

Extension Division,
School of Engineering of Milwaukee,
Dept. S. 16, 373 Broadway, Milwaukee, Wis.

Please send your free catalog and details of your laboratory unit method of home study in Practical Electricity. This request obligates me in no way.

Name.....

Adress.....

Town.....State.....

Age.....Education.....

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6176-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Textile Overseer or Supt.
☐ PLUMBING AND HEATING	☐ AGRICULTURE ☐ Spanish
☐ Sheet Metal Worker	☐ Poultry Raising ☐ French
☐ Navigator	☐ Automobiles ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____

THE MIDGET "FIVE-IN-ONE" SLIDE RULE



is a combination Mannheim, Log-Log, Add and Subtract, Polyphase and Binary Slide Rule. It will instantly add, subtract, multiply and divide any combination involving whole numbers, fractions, decimals and mixed numbers. Gives every possible root and power of every quantity. The graduations are printed on metal, coated with white celluloid and are grease and waterproof. While it is the most versatile calculator ever invented, its operation is simple and easily understood. Diameter 4 inches.

Price with 16 page Instruction Book, $1.60. Leatherette carrying case 50c extra. Catalogue Free. Your money back if you are not satisfied.

GILSON SLIDE RULE CO. Niles, Mich.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

Building a Small Automobile

(*Continued from page* 1020)

thru a *differential* or equalizing gear. Those desiring to build a machine of this type can probably secure a differential gear and rear axle from the builders of low-priced automobiles, or possibly from second-hand dealers, or a local garage who may have an old one at hand, discarded from a worn-out machine.

The next interesting subject in the development of a *differential-less* automobile is that shown at Fig. *E*. This is what we might term a "lop-sided" or unsymmetrical tricycle design. It involves the exact principle used by thousands of motorcyclists today, when they attach a side-car to their machine. Here, the motive power, whether derived from an electric motor or gasoline engine, is applied to one rear wheel, the steering being taken care of by the forward wheel. This principle is not efficient or at all desirable in a large vehicle, even in a lightweight automobile of the usual type, such as a Ford. For small motor vehicles or motorcycles of this weight, however, it serves its purpose admirably, as any motorcyclist can affirm.

Going this idea one better, we give the sixth arrangement suggested at Fig. *F*, which has been used now and then by builders of small automobiles and which overcomes the difficulty of procuring a differential gear. Here the four wheels are run loosely on the axles and the power is applied by chain, belt or gearing to only one of the rear wheels in the manner shown. This method of driving a four-wheeled vehicle causes considerable abnormal wear and tear on the single driving wheel to which the engine power is applied, but as some wag has remarked, "We can't have everything!"

Building a Small Motor Tricycle For One or Two Passengers

Having discust the important principles as to how we are going to drive such a small motor vehicle as we are now considering, we might as well follow the trend of European development and select the efficient forms of small motor cars, requiring no differential or other complex machinery for their operation.

A suggestion for a home-made wood or metal body is given in the illustration at Fig. 2-*A*. The dimensions are not given as the builder will invariably make this somewhat to suit himself, keeping in mind, of course, the vital point that the weight must be kept down to the lowest possible limit.

The iron frame forming the chassis for this three-wheel auto may be formed of a substantial size of angle iron, channel iron or plain flat iron bar, but either of the first two mentioned are much more preferable owing to their rigidity and resistance to bending stresses. The vehicle should be fitted with two medium size auto headlights either of the gas or electric types, as well as a tail light. The two license number plates are placed on the front and rear of the machine in the usual manner.

Fig. 2-*B* shows several suggestions for building the suspension springs between the axle and forward wheel and the frame. The Smith motor-wheel is particularly well adapted to the design which the writer has here worked out, and illustrated at Figs. 2-*A*, 2-*B* and 2-*C*. The steering is controlled by swinging the long handle from right to left, the same as featured in some of the British and other European machines of this identical type, and which have been built by the thousands, and should there-

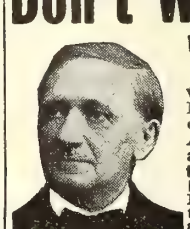
(*Continued on page* 1029)

Write It With a 'Vulcan'



Red or Black "Vulcan" Ink Pencil
The only perfect, non-leakable ink pencils at moderate prices. Long or short.
Absolute necessity to any business man or woman. Promotes efficiency. Unequalled for general writing, billing, ruling and manifolding. Made of pure vulcanized rubber with non-corrosive, durable writing point. Lock-Cap prevents leaking. Extra size, 8 ins. black only, $1.75. *Agents Wanted. Big Profits.*
Order today, Postpaid $1.50
J. F. ULLRICH & CO., 161 Washington St., N. Y.

Don't Wear a Truss



We Guarantee Your Comfort

with every Brooks' Appliance. New discovery. Wonderful. No obnoxious springs or pads. Automatic Air Cushions. **Binds and draws the broken parts together as you would a broken limb.** No salves. No plasters. No lies. Durable, cheap. Sent on trial to prove it. Full information and booklet free.

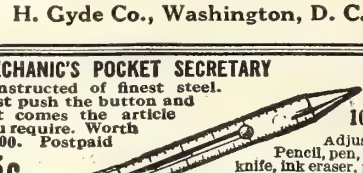
C. E. BROOKS
203D State St. Marshall, Mich.

MEN

Intensely interesting booklet free.
Wonderful results.
H. Gyde Co., Washington, D. C.

MECHANIC'S POCKET SECRETARY 25c

Constructed of finest steel. Just push the button and out comes the article you require. Worth $1.00. Postpaid 10 in 1



25c Get One To-day

Adjustable Pencil, pen, paper knife, ink eraser, pencil sharpener, nail file, and cleaner, mechanic's marking point, fine compass with screw attachment, foot rule.

Universal Co., Box A, Stamford, Conn.

CONVERT YOUR BICYCLE INTO A MOTOR CYCLE



by using a STEFFEY ATTACHMENT
Simple-Reliable-Economical
Fits any ordinary wheel, diamond, double-bar or truss frame. Easy to attach. Send stamp for circulars.

STEFFEY MFG. CO.
Dept. E, 5025 Brown Street, Philadelphia, Pa.

***Why continue to* STAMMER?**

Send for (free) illustrated 200-page book. It tells how Stammering and Stuttering can be quickly cured by the most **Advanced Scientific Method** in the world. THE LEWIS SCHOOL, 40 Adelaide, Detroit, Mich.

DO YOU WANT Prosperity! Power! Happiness?

Positive Wonderful Results by Our System. "Success" Lesson and Personality Sketch for 10c and birth date.

THOMSON-HEYWOOD CO.
Dept. 350 Chronicle Bldg. San Francisco

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**

WIRELESS TELEGRAPHY

Make your own "Wireless," also Dynamos, Batteries, Motors, Telegraph, Telephone, Lights, Bells, Alarms, Coils, Current Reverser, Electric Engines, etc. Book with 75 Illustrations; by experts so anyone can understand it. With Catalog. **All 10c, 3 for 25c pp**

J. C. DORN. 705 S. DEARBORN STREET Dept. 22. CHICAGO, ILL.

BE A BANKER

Prepare by mail in spare time for this attractive profession, in which there are great opportunities. Send at once for free book, "How to Become a Banker"
EDGAR G. ALCORN, *President*
American School of Banking, 114 McLene Bldg., Columbus, O.

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

How to Advertise an Invention*

By JAY G. HOBSON

THE preferred way of advertising an invention depends entirely upon what disposition the inventor wishes to make of his proposition.

If it is desired to sell outright, on royalty or to form a company to manufacture and market it, the copy of the advertisement must be written accordingly to appeal to the class wanted. The advertisement written to interest the cash buyer probably would fail to attract the investor or manufacturer on a royalty basis. The copy must be written with its particular appeal to obtain the desired results.

The reason most inventors fail to profit by their ideas can be plainly seen after a little consideration of examples proving the point.

Few, and they are the successful ones, know how to place their inventions before the proper parties to effect a profitable sale. The analysis of the inventor himself easily explains this peculiar fact. Ninety per cent are either mechanics or average persons with a mechanical turn of mind having no business nor selling ability, which is invaluable in disposing of improvements.

Lacking in knowledge of how to sell, the inventor is easily imposed upon by those who know the selling art. Therefore, it becomes the purpose of this article to impart a portion of this knowledge so that people with practical ideas may succeed in getting their just deserts.

For example, we will take the inventor wanting a cash price for his improvement. He seldom knows the right amount to ask because his inexperienced vision is unable to see the correct commercial possibilities and realities what they are.

Instead he thinks in millions when more than likely five thousand dollars would be a good price. The reason for this mistaken valuation is his unfamiliarity with commercial propositions.

Naturally he often asks a figure far beyond the ability of most buyers, altho there have been a few cases that I remember where the inventor undervalued his patent when he probably could have obtained more. But this is the exception.

It is true, the buyer tries to pay just as little as possible, but he usually knows the limit on the upward bid. But there is no limit going down, for the nearer he can buy a thing for nothing the more he has saved and the happier he is.

The secret for the inventor is to know when the buyer has reached his upward limit and clinch the deal right there without further risk of having to sell for less. This can be done with careful study of business dealings, also of human nature. The close observer will soon notice that the average buyer has his mind pretty well made up on the purchase price he can afford to pay when he investigates it.

The scheme is to draw the top offer from the buyer before quoting him the final price. This is possible by asking for bids and holding off quotations until absolutely necessary to close the deal. Something in this manner should prove effective:

The Buyer: "Well, what is the least you will take for your patent rights?"

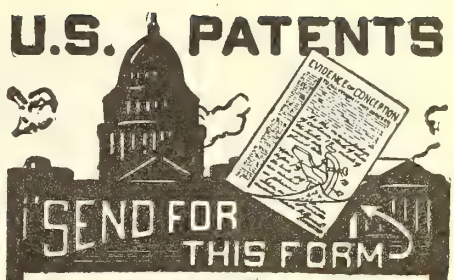
Inventor: "What is the most you will pay. I know the large commercial possibilities of my improvement but do not know your circumstances. You tell me how much you will give and I will tell you frankly if the figure is acceptable. As the inventor I feel it my prerogative to have your offer first."

This presentation of your position in the matter should bring him out, so you may be able to learn the amount he has in mind, if not, then as a last resort make your quotation within reasonable limits for both parties.

Of course, the greatest difficulty inventors find is in getting their improvements before the logical buyers to whom they will appeal for purchase. Experience has repeatedly proven advertising to be most effective as the medium of introduction. But a poorly written advertisement holds the same relation to inefficient selling as does the inventor without knowledge of salesmanship. Both must have the punch of pre-

*No queries are publisht this month owing to the article by Mr. Hobson.

U.S. PATENTS



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St. San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... *Address*.....

U.S. PATENTS

PROTECT YOUR RIGHTS



Write for "Record of Invention" containing forms establishing evidence of conception.
Send sketch and description for report upon patentable nature, and instructions. Preliminary service without charge.
PROMPT PERSONAL - SERVICE

J·REANEY·KELLY
PATENT ATTORNEY
892 SOUTHERN BLDG.
WASHINGTON D.C.

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brain can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

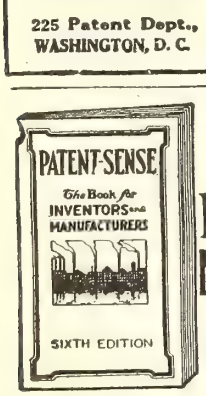
AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE

In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50¢



"The Book for Inventors and Manufacturers"
SIXTH EDITION.
By return mail FREE. Write LACEY & LACEY
Dept K. Washington, D.C.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

sentation, interest, information and conviction to succeed in the mission.

The inventor who knows little of selling, knows as little of writing advertising copy, and herein lies the germ of failure many people become inoculated with after receiving their patents and trying in vain to find some one to whom they can sell them profitably. It appears to me the main reason for this discouragement and failure rests in their inability to obtain a means of connection between themselves and the buyer. With a view to suggesting three feasible avenues I submit the following advertisements for use under classified space in newspapers, magazines and the like. These little adlets often prove more effective than larger display type and cost very much less.

The first one is written to appeal to the cash buyer:

"FINANCIAL OPPORTUNITY"

$10,000 Cash will buy outright recently patented hardware improvement with large demand waiting national distribution to make a great commercial success. Parties able to market this exceptional proposition should investigate immediately. Address, etc.

This one is for the royalty buyer:

"MANUFACTURER'S ATTENTION"

A reasonable royalty contract will secure exclusive rights to my new improvement on practical hardware necessity just patented. The large commercial possibilities of this exceptional invention will be seen immediately upon investigation. For information, address, etc.

And for the investor:

"INVESTORS WANTED"

To cooperate profitably with inventor holding valuable Government patent rights on novel hardware necessity with universal demand waiting introduction. An appeal is made to a limited number for the purpose of raising sufficient capital to market this meritorious product. This is an unusual opportunity for making large profits from a small investment. Your prompt investigation will convince you of the integrity of this excellent business proposition. Send at once for particulars. Address, etc.

When letter or personal replies are received in answer to the above it is necessary to answer them promptly, either in person or by letter, making an appointment for a complete demonstration of the invention. After the demonstration is the psychological time to close the deal.

(*Copyright* 1920)

HOW ODOR TRAVELS.

The rapid propagation of smells noticed in the open air appears due entirely to currents, since in small tubes, where currents do not exist, the rate is found to be very small. Experiments along this line were first undertaken in England by Professor Ayrton, and additional data have been reported in this country.

With ammonia diffusing through a tube a meter and a half long, over two hours elapsed before the smell could be detected at the other end of the tube. Using different lengths of tubing, it was found that the time required for the diffusion of the smell was roughly proportioned to the square of the length. Ammonia and hydrogen sulfid were used for these experiments. The presence of ammonia could be detected chemically at a point in a tube after about the same time as when the sense of smell was used for a detector. The rate of propagation of the smell of ammonia was not markedly different when this had to pass along the same tube either horizontally or vertically upward or downward. With camphor, however, while the rates horizontally and downward were about the same, the speed upward was about twice as great. The smell given to iron and brass by rubbing these with the fingers was also tried, but gave no definite results.

PATENTS

Record your idea by sending for blank form "Record of Invention", before filing your application for patent.

Send sketch or model for preliminary examination.

Our terms are reasonable and our booklet giving full information on patents will be sent on request.

Prompt Service
Highest References

J. L. JACKSON & CO.
270 Ouray Bldg., Washington, D. C.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

PATENTS

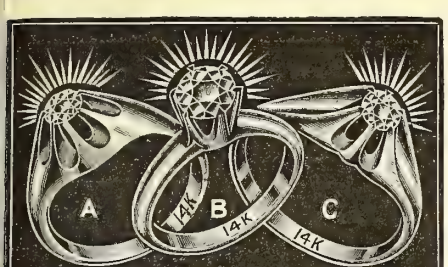
Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.
MUNN & CO., 618 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 625 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

PATENTS & TRADE-MARKS
—FREE BOOKLET ON REQUEST—
MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES —
WARNER I. CUBBERLEY, PATENT ATTORNEY
22 NATIONAL UNION BUILDING
WASHINGTON D.C.

PATENTS
C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.
Patents, Trade Marks, Copyrights, Patent Litigation
Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?
Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.
ELK MFG. CO., INC.
1926 Broadway, New York

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney
"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.
OFFICES
364 University St. Montreal, Canada
919 F St., N. W. Washington, D. C.



Dazzling Brilliant Sparkling **DIA-GEMS** Full of Fire and Radiance

NO MONEY DOWN—30 Days FREE Trial
Compare a DIA-GEM with your diamond. See the marvelous resemblance. Notice the same fiery radiance, gleaming brilliance, fascinating sparkle. Everything good that can be said about a diamond can be said about a DIA-GEM. They are diamond-like gems discovered by science. DIA-GEMS are absolutely perfect in color and cutting; no flaws or imperfections. Just charming brilliance and radiant, fiery sparkle. Perfect in every way. Much superior to imperfect diamonds. Stand all diamond tests. So marvelous and astounding is the resemblance that even experts are puzzled. You will be amazed. Your friends will be fooled. Don't tell them it's not a real diamond and they will never know. The snappy, fiery, dazzling brilliance and color are guaranteed forever.

WEAR YOUR DIA-GEM 30 DAYS FREE!
Your DIA-GEM is the same size as a ¾ carat diamond, but you get 10% more weight in a DIA-GEM than in a diamond at no extra charge. They are set only in 14K solid gold mountings. They have no backing; their brilliance is as natural as a diamond's. The rings are 14K solid gold thru and thru, the same as are used for diamonds. The beautiful gift box is free of charge.

CHOOSE YOUR RING—SEND YOUR NAME
Select your ring, give your finger size, and show your full address. We'll send a DIA-GEM to you by parcel post the same day we hear from you. You deposit only $4.00 with the postmaster to show your good faith or you can send cash with order. It is only a deposit, not a payment. We hold it for you for 30 days and you hold our valuable DIA-GEM ring. Take 30 days to decide. You assume no risk—there is no obligation to buy. You have nothing to lose. Our money back guarantee protects you. If you or your friends can tell it from a diamond, send it back within 30 days and we'll refund your deposit at once. If you are delighted with your radiant DIA-GEM, keep it and pay only $2.00 each month when convenient, for only seven months. Write for your DIA-GEM ring at once. No references—we trust you. No delay and no risk. Order today, and we'll ship immediately.

DIA-GEM COMPANY, 617 World Bldg., New York, N. Y.



SEXUAL KNOWLEDGE
320 Pages ILLUSTRATED Cloth
By Winfield Scott Hall, M. D., Ph. D.
SEX FACTS MADE PLAIN
What every young man and Every young woman should know
What every young husband and Every young wife should know
What every parent should know
Table contents & commendations on request
$1.00 Postpaid. Mailed in plain wrapper.
AMERICAN PUB. CO. 145 Winston Bldg., Philadelphia

A NEW AND EASY WAY TO PAINT
SIGNS AND SHOW CARDS
OUR PATTERNS DO THE WORK
No experience required. Any one can paint all kinds of signs, banners, cards, etc., on any surface with our new and easy system of lettering. Complete outfit containing six alphabets of letters, assorted styles and sizes from two to twelve inches high, also three sets of figures, etc., not printed but life size patterns cut out of durable tag board which can be used over and over again for years, also brushes, colors and book of instructions, **PREPAID $10.00.** Satisfaction guaranteed.
ACME SALES CO., Empire Bldg., Dept. S., Denver, Colo.

TELEGRAPHY
(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.
DODGE'S INSTITUTE A Street, Valparaiso, Ind.

BE AN EXPERT
Penman
Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. **Complete outline FREE.** Write C. J. Ozment, Dept. 44. St. Louis, Mo.

Be an artist
Comics, Cartoons, Commercial, Newspaper and Magazine Illustrating, Pastel Crayon Portraits and Fashions. By Mail or Local Classes. Write for terms and List of successful students.
Associated Art Studios, 111 Flatiron Bldg. New York

Building a Small Automobile

(*Continued from page* 1026)

fore offer no objection to the embryo motorist; he should not object because this design doesn't seem to resemble the usual steering wheel control found on practically all American autos. But for those who prefer to have the usual and ordinary wheel control and gear scheme, this feature is shown worked out in Fig. 3, in conjunction with a special type of tricycle having an engine placed under a bonnet, mounted just ahead of the dash.

One form of wiring, suitable for this tricycle is shown at Fig. 2-*C*. This is adapted for use with a storage battery which may be charged from time to time.

A Special Independent Type of Tricycle

Oftentimes one may have available or might be in a position to procure reasonably a small one or two-horse-power engine such as those sold for doing farm chores and general utility purposes, which they might like to employ for driving a small auto of this type.

The writer has worked out some features, which in detail will be subject to some additions, particularly as to bracing and solidity of the various parts which are illustrated in Fig. 3, suitable for the employment of an independent engine. We remember seeing one commercial motor tricycle which had an engine mounted on top of the vertical shaft over the front wheel, high in the air, and directly in front of the passenger's line of vision. The writer does not think very well of this arrangement for several reasons, and does not believe that the reader would like to place a heavy engine in such a conspicuous and awkward position. Figure 3 shows a scheme whereby the power is applied from the engine to the front wheel thru a system of gearing, at the same time permitting the turning of the front wheel on its vertical axis so as to readily steer the auto. The front wheel may be of steel or of the usual wire construction, and Fig. 3-*A* shows a front sectional view of the wheel mounted on its journal or shaft, arranged to be rigidly secured at right angles to the vertical steering shaft.

A beveled gear (1) is secured to the front wheel and is driven by a beveled pinion (2) secured to the hollow steel shaft (3), which revolves freely about the vertical shaft proper (4). To the upper end of the hollow shaft (3) is secured a second beveled pinion (5), driven by a third pinion (6). Beveled pinion (6) is secured to a horizontal driving shaft (7). This shaft is driven by the clutch (8) which can be slid into contact or away from the revolving worm gear (9). The clutch is formed in the manner shown, the iron disc (8) with its Raybestos or Thermoid (or leather) covering being forced into contact with the flat face of the disc secured to worm gear (9), thru the lever and foot pedal arrangement shown in full detail in drawing, Fig. 3-*D*.

Normally the foot has to be pushed on the pedal to keep the clutch disengaged as as in most modern motor cars, and when the foot is released, the clutch is cut "in." The free running worm gear (9) is driven by the worm (10) secured to the vertical driving shaft (11). Shaft (11) is revolved by either one of two pinions (12 or 13), and here is where the drive is reversed, so far as the front wheel is concerned. Either pinion (12 or 13) may be put in mesh with the beveled gear (14) mounted on the fly wheel (15) of the engine.



Home Study Business Courses

The urgent need of business today is for high-salaried executives, managers and departmental specialists. Under the LaSalle Problem Method you can get, in your spare time at home by mail, under expert guidance, training which parallels actual business practice. The University's staff of 1750 people includes 450 business authorities, educators and assistants ready at all times to give prompt counsel and advice to enrolled members on any business question or problem. This is a service not obtainable from any other educational institution.

Write your name and address at the bottom and mail today. We will send full information and book of remarkable records of advancement made by LaSalle trained men; also our interesting book, "Ten Years' Promotion in One." Low cost and convenient monthly terms which anyone can afford. Money refunded if dissatisfied upon completion of course. More than 250,000 have enrolled. Find out what LaSalle training can do for you. Check and mail the coupon NOW.

LaSALLE EXTENSION UNIVERSITY
The Largest Business Training Institution in the World
Dept. 1371-R Chicago, Ill.

Gentlemen: Send without obligation to me information regarding course indicated below, also copy of your interesting book, "Ten Years' Promotion in One."

☐ Higher Accounting ☐ Banking and Finance
☐ Coaching for C. P. A. & Institute Examinations ☐ Business Letter Writing
☐ Business Management ☐ Commercial Spanish
☐ Traffic Management—Foreign and Domestic ☐ Expert Bookkeeping
☐ Law—Degree of LL. B. ☐ Effective Speaking
☐ Commercial Law ☐ Business English
☐ Personnel and Employment Management ☐ Modern Foremanship
☐ Industrial Management Efficiency

Name.....
Present Position.....
Address.....

YOU Can Do YOUR Own SOLDERING and All Metal Repairing With

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR



25c PER TUBE
TORCH $1.25
A PASTE THAT TURNS INTO METAL WHEN HEATED
A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.
SOLDERALL CO., Dept. E,
129 Sussex Ave., Newark, N. J.
COMBINATION SET Tube and Torch Complete **$1.50**
Dealers Send for Quantity Prices.
LOOK FOR TRADE MARK "SOLDERALL"
BEWARE OF IMITATIONS WITH SIMILAR NAMES

WANTED



MAIL CLERKS
Commence $135 Month
HUNDREDS NEEDED AT ONCE
MEN—BOYS Over 17

Franklin Institute
Dept. F 185, Rochester, N.Y.
Kindly send me, by return mail, free information, telling how I can quickly get into the U. S. Government service as Railway Mail Clerk ($1600 to $2300 a year), or as City Mail Carrier or Postoffice Clerk ($1400 to $1800 a year).
Name.....
Address.....
If not interested, hand to a friend.
COUPON



Take this Short Cut to Accomplish Your Ambition

The field of electrical engineering offers wonderful opportunities for trained men to direct and carry out great industrial and commercial projects. Study here. Receive a thorough training. Become an

Electrical Engineer

with B. S. Degree in 3 Years

Forty instructors, expert in their lines, form our faculty. They are leading hundreds of ambitious young men to sure success. Why not you?

Full provision for making up deficient high school credits. "Earn while you learn" if you wish.

Mail the coupon, now, for full details.

School of Engineering of Milwaukee,
Dept. S. 17—373 Broadway, Milwaukee, Wis.

Please send me your free illustrated catalog on Electrical Engineering and give me the detail of your "Earn While You Learn" plan.

Name.....

Address.....

Town.....State.....

Age.....Education.....



BURN LESS COAL

With an improved, all-cast pipeless furnace you can cut your coal bills in two. This efficient, basement installed heating plant heats and ventilates the entire home. It burns any grade of coal more economically than a stove. It needs no expensive piping or other equipment. Anyone can install it in a day. They are described at our wholesale prices in our Handy Man Book. Send for it.

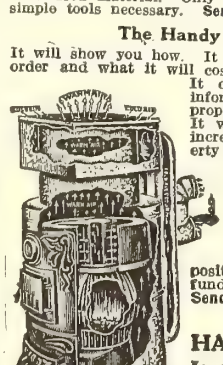


Do Your Own Plumbing and Heating by the Cut-to-Fit Method.

By our new plan anyone can install a complete plumbing or heating plant in his own home. Send us a rough sketch with measurements. Our Engineers will draw your plans, furnish information and see that the supplies you order come CUT-TO-FIT your needs. No waste of time, labor or unused material. Only a few simple tools necessary. **Send for**

The Handy Man Book

It will show you how. It will tell you just what to order and what it will cost at our wholesale prices. It contains plans and useful information for every builder, property owner or contractor. It will convince you. It will increase the value of your property 50%. You can do the work yourself.



We have spared no effort or expense in the preparation of this valuable book. To keep from sending it broadcast to uninterested persons we request a temporary deposit of 25c which will be refunded with your first order. **Send for it Today.**

The Service of
HARDIN-LAVIN CO.
Is guaranteed by 40 years' business at
4510-20S Cottage Grove Avenue
CHICAGO

The Elixir of Life

By H. L. JOHNSTONE

(*Continued from page* 982)

tion against a man older than yourself, and a man of science at that?"

"I mean, er, that it doesn't seem possible," stammered the rattled Billie.

"Yes, I'll admit that it doesn't seem possible," replied the professor, "but remember, young man, that I have been a student for years, and you a clerical laborer. You add up figures, while I use my brains to search out the mysteries of life. I will prove my statement to your satisfaction. I will show you with this cat."

The professor picked up a glass medicine dropper and carefully measured out two drops of the green liquid.

"Get me a dish of milk," he said to Marie. The milk was brought and the professor placed the two drops in it. He woke up the cat, who stretched himself and glared about him. The milk was placed before him, and he started to drink it greedily, his slick tongue causing the only sound heard in the laboratory as the three watched him expectantly.

For two or three minutes after the last trace of milk had been devoured, nothing happened and Billie looked slyly at Marie and winked. Marie smiled and then clutched his arm.

"Oh, Billie, look! Look at that cat!"

"Hush," cautioned the professor, holding up a shaking forefinger to his lips. Before their eyes a strange thing was happening. The old wretch of a cat was slowly but surely shaking off the fetters of old age and becoming a kitten. The torn ear faded away and in its place grew a new one. The tail grew out slick and shiny.

In her excitement, forgetting the warning to keep quiet, Marie exclaimed:

"Oh, the cute little darling. Let me hold it, father." The professor turned to Billie and smiled.

"Now, what have you to say about the Elixir of Life?"

"It's wonderful. Will it work on human beings?"

"I haven't tried it yet, but it will; I'm sure of that."

"What good will it do?"

"I was going to tell you, Billie. It will be one of the greatest blessings that science has ever given to the world. Suppose you had reached the age where you were no longer of any use to yourself or the world either, and looking backward with the wise old eyes of wisdom, gained through all your years of life and experience, you saw the hundreds of errors you had made, the sorrow and suffering you had caused, because you didn't know any better. What would the elixir be worth to you then Billie, if you knew that it would turn back the years, make a young man of you once more, give you a fresh start in life; a life of success; for you would be bound to succeed with such a brain as yours to direct it. With the elixir, men can live for hundreds of years, and grow wiser and wiser, delving into the secrets of life until they will eventually rival the gods of intelligence and understanding."

The rejuvenated cat had been walking around the table while the professor was talking. The little thing was meowing.

"What's the matter with the kitten?" asked Marie.

"Sounds as if he is hungry and asking for something to eat," replied the professor, smiling.

"But that is impossible, father. He just had a dish of milk a few minutes ago."

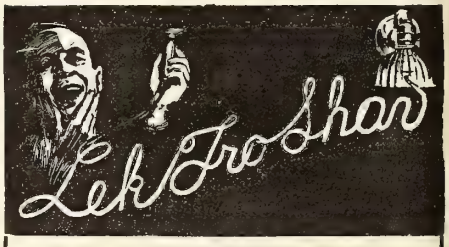
"Yes, so he did, Marie, but, according to the way I look at it, he had it ten years ago."

(*Continued on page* 1032)

Different from all others—the NEW BENJAMIN



Pacific Coast Representatives:
McDONALD & LINFORTH, Call Bldg., San Francisco.



The Electric Safety Razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."

A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.

Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

VIBRATING ELECTRIC RAZOR CO.
Dept. 122, Council Bluffs, Iowa

What a Dime Will bring You From the Nation's Capital

The little matter of 10 cts. will bring you the Pathfinder eight weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for all the Nation; an independent home paper that prints all the news of the world and tells the truth; now in its 28th year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, strongly, briefly—here it is. Send 10c to show that you might like such a paper, and we will send the Pathfinder on probation eight weeks. The 10c does not repay us, but we are glad to invest in new friends. Address:

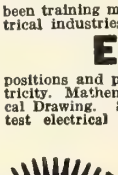
Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, 266 Langdon Sta., Washington, D. C.

Electrical Engineering

men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete

In One Year



Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops. Free catalog. 28th year opens Sept. 29, 1920

BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

—and never forget

You radio amateurs who really take a pride in getting results, never forget one thing—a vacuum tube can be either a detector or an amplifier, but not both efficiently. Never buy a vacuum tube advertised as both a detector and an amplifier—no, not at any price. No one tube can serve both purposes efficiently. That is an established fact. You know it. Only a combination of tubes provide all necessary operating characteristics without compromising essential features. And the A-P Vacuum Tube Combination is the one such proven combination on the market to-day.

When you want an efficient amplifier in which none of the amplifier qualities are sacrificed to make it also a detector, use the A-P VT Amplifier Oscillator. When you want an efficient detector in which none of the detector qualities are sacrificed to make it also an amplifier, use the A-P Electron Relay.

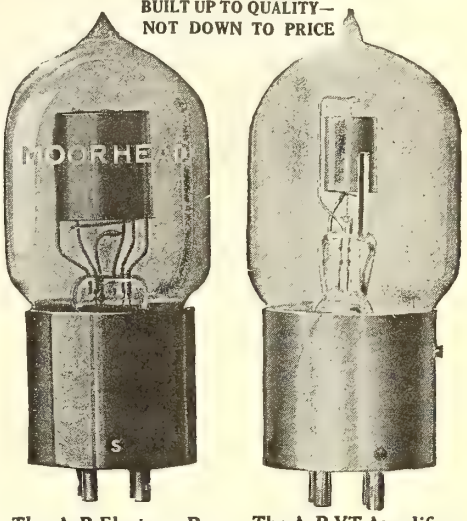
The A-P Electron Relay is the most sensitive spark detector known to the radio art. It is a soft tube. It contains the right quantity of gas and, equally important, the right kind of gas. The electrodes are correctly designed. You know this tube will give you results. On the market since May, 1920, it has made good in actual use.

For sure results, for better results use A-P Tubes—built up to quality, not down to price. Manufactured under the De Forest Audion and Fleming patents. Other patents applied for and pending.

The Atlantic Radio Supplies Co.
8 Kirk Place, Newark, N. J.

The Pacific Radio Supplies Co.
638 Mission St., San Francisco, Cal.

BUILT UP TO QUALITY—
NOT DOWN TO PRICE



The A-P Electron Relay, equipped with the SHAW standard four-prong base. Price $6 and worth it. Order from your dealer.

The A-P VT Amplifier-Oscillator, equipped with the SHAW standard four-prong base. Price $7 and worth it. At dealers.

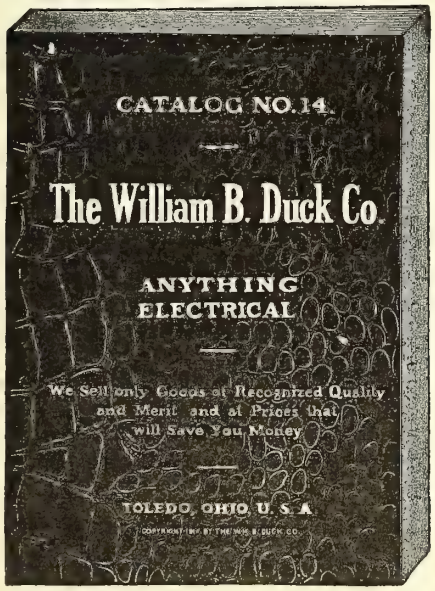
A combination of two or more A-P VT tubes as amplifiers with an A-P Electron Relay as the initial detector or oscillator is the ideal receiving combination for long distance amateur or long wave reception. Only with such a combination can full efficiency be attained.

Distributors for Moorhead Laboratories, Inc., Manufacturers of

The A-P VACUUM TUBE Combination

"The Greatest Radio Catalog in the World—" *The Universal Verdict of Tens of Thousands of Radio Amateurs*

DUCK'S No. 14 Big 200 Page Wireless Catalog



TREMENDOUS CHRISTMAS STOCKS—

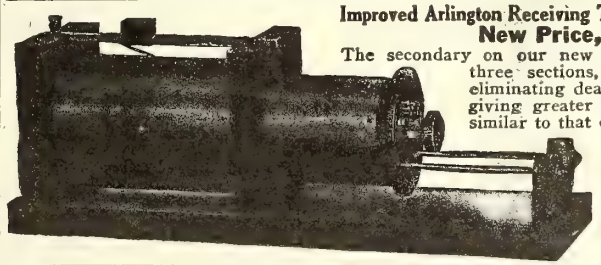
WITH a business of unprecedented volume ever since the close of the war. With nothing short of miserable service from our many sources of supply, and many other unusual conditions to contend with, we found it impossible, up to a comparatively short time ago, to give the service on orders for which we always enjoyed such a high reputation, and which was our pride. We deliberately curtailed our advertising, because we could not get catalogs printed fast enough and because we did not want a volume of business we could not expeditiously handle. We are now able to guarantee the wonderful service that our thousands of patrons received for many years before the commencement of the war.

Announcing Permanent Reductions on 3 of our most popular Radio Instruments

The demand last month for our Navy Type, Arlington, and No. 7721 Receiving Transformers at the greatly reduced prices convinced us that with large quantity production, because of the exceedingly attractive prices on these instruments, we can continue to maintain these low prices. We therefore announce the following permanent reductions on these instruments.

Model 5BB Navy Type Receiving Transformer, Former Price $27.50. New Price $21.95
No. 1091 Improved Type Arlington Receiving Transformer, Regular Price $15.00. New Price $11.95
No. 7721 Receiving Transformer, Regular Price $9.00. New Price $7.50

Send your order immediately for your choice of these popular instruments.



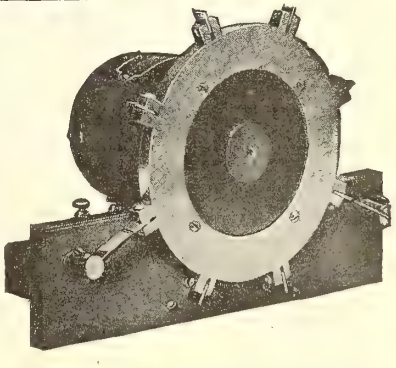
Improved Arlington Receiving Transformer, Regular Price $15.00
New Price, Only $11.95

The secondary on our new type Arlington is divided into three sections, with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy, permitting a looser coupling. The base and primary end pieces have a spline to prevent warping or damage in transit. This feature is also on our Navy. It is a beautifully finished instrument.

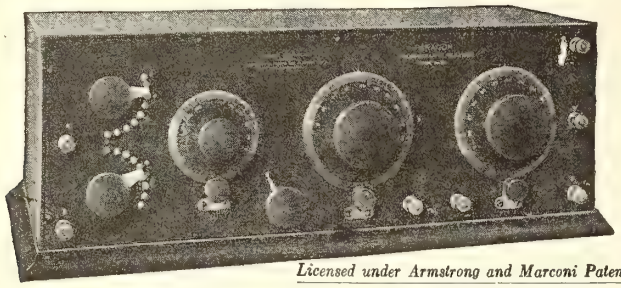
Improved Type Sayville Rotary Gap

Embodies the latest and best features in Spark Gap Construction

Our New Type Sayville Rotary Gap is, we believe, far in advance of any rotary gap on the market within a range even of twice the price. It is the final development of many different types made in our experimental Radio Laboratory. It fulfills every requirement of the ideal rotary gap. It is neat and attractive in appearance; simple and durable in construction; possesses a wonderful motor; has a cast aluminum rotary wheel, beautifully polished; every part is in perfect alignment; there is no wobbling of the rotor; produces and maintains a clear and pure 500-cycle note; is instantaneous in action; permits of no dragging of the spark; has contacts of tempered flat copper of proper length and width, easily and quickly removable, and inexpensively renewable; the stationary contacts are adjustable to any length.—**$27.50**



THE WILLIAM B. DUCK COMPANY, 230-232 Superior Street, TOLEDO, OHIO.



Licensed under Armstrong and Marconi Patents

Wave Length Range Up to 1000 Meters *with No Decrease in Amplification—*

AMATEUR, Commercial and Navy wave-lengths—all are included in the range of the Paragon R. A. Ten! *And all without impairing the amplification one particle.*

Adams–Morgan Company's unapproachable engineers spent two years and thousands of dollars to develop the

PARAGON R. A. TEN *Amplifying Short Wave Receiver*

(Name Paragon Registered U. S. Pat. Office)

TESTS show that it is 24 per cent. more sensitive and selective than even the Paragon R. A. 6. It embodies the most advanced standards of Radio engineering in every detail, but a few of the outstanding features are:

Wave length 160 to 1000 meters.
Amplification 100 times.
No dead end losses whatever.
Vernier attachments on all controls.
Change of spark tone eliminated.
Coupling has scale of 180.

Guaranteed for two years.

PRICE EIGHTY-FIVE DOLLARS

Those who demand the utmost effectiveness in their radio equipment, will not be satisfied with less than the Paragon R. A. Ten. It is as far ahead of the R. A. 6 as that was ahead of all the others.

Send today for our interesting and complete bulletin explaining every phase of the Paragon R. A. Ten's superiority. It's free. *A post card brings it!*

Our word of honor to you is our guarantee. Let us prove it.

CONTINENTAL RADIO AND ELECTRIC CORP.

J. DI BLASI, Secretary — DEPT. A10
Sole Distributors of the Paragon R. A. Ten — 6 WARREN STREET
J. STANTLEY, Treas. — NEW YORK



NEW MOTORS

FACTORY GUARANTEED ALL SIZES PROMPT DELIVERY

Charging Generators
Suitable for all lighting, Battery Charging and Power Requirements.

8 v. 10 amp.	$19.50
15 v., 10 amp.	$26.50
40 v, 6 amp.	$31.50
110 v, 2½ amp.	$31.50
110 v, 5 amp.	$52.50
40 v, 12 amp.	$52.50
110 v, 9½ amp.	$67.50
40 v, 25 amp.	$67.50
110 v, 18 amp.	$116.50
40 v., 50 amp.	$116.50
110 v, 26 amp.	$156.50
110 v, 50 amp.	$238.50
Moving Picture Arc Generator 60 v., 35 a.	$116.50

Polyphase Motors
2 and 3 phase, A. C., 220 v. 60 c., 1750 R. P. M., Complete with base and pulley.

½ H. P.	$46.50
1 H. P.	$66.50
2 H. P.	$86.50
3 H. P.	$98.50
5 H. P.	$116.50
1 H. P. Special Grinding and Buffing Motor	$106.50

Direct Current Motors
110 or 220 volts, D. C., shunt wound, 1750 R. P. M. With base pulley and starting box.

¼ H. P. Washing Machine Motor	$28.50
¼ H. P., 32 v. Washing Machine Motor	$28.50
½ H. P.	$58.50
1 H. P.	$82.50
2 H. P.	$124.50
3 H. P.	$142.50
5 H. P.	$218.50

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

¼ H. P., 220 v. Induction Washing Machine Motor	$28.50
¼ H. P., 110 v. grinding buffing motor	$28.50
½ H. P. Induction, full load start	$46.50
½ H. P. repulsion induction For compressor service	$54.50
1 H. P. repulsion induction, Special Garage Motor	$74.50
2 H. P. repulsion induction with sliding base	$126.50
3 H. P. repulsion induction with sliding base	$146.50
5 H. P. repulsion induction with sliding base	$188.50

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL 1/4 H.P. 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley



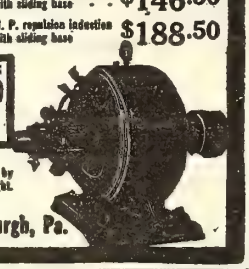
WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. **$26.50 Each** Reg. Val. $34.50

MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 12, West End, Pittsburgh, Pa.



Dependable Radio Apparatus

A new Tuner and a new Short Wave Set have joined the DEPENDABLE FAMILY

Catalogue Mailed for 10 Cents in Stamps

DORON BROTHERS ELECTRICAL COMPANY
Hamilton, Ohio

The Elixir of Life

(*Continued from page* 1030)

"So he did," exclaimed Marie pityingly, giving it another bowl of milk. "Poor little thing is sure hungry."

Accordingly, true to the law of the elixir, he must have been hungry, from the way he cleaned up the milk. As Billie watched him lap up the warm fluid, he thought the present a good time to unburden himself, so nerving himself, he opened up.

"Professor, you have made a wonderful discovery. I congratulate you. The world will soon congratulate you, now that you have been rewarded for so many years' hard work, at last. I have something important to ask you," this as he glanced at Marie. She blushed and nodded in the affirmative. "Marie and I have loved each other since we were little ones together. She is now eighteen, and I am twenty-one. I came here to-night to ask you for her hand. What is your answer?"

The professor gave a sudden start. He had been absentmindedly watching the cat. Marie took the test tube from his hand and placed it carefully on the rack, out of the kitten's reach.

"Eh? What's that? Marry my daughter?"

The professor looked from one to the other in amazement.

"Billie, you're a good boy, and I like you. I never thought of such a thing as Marie getting married. Is she really that old? Yes, I guess you are right. I've been so busy that I have lost track of time. So you want to marry her. Well, well, how much money have you got Billie?"

"I have some money in the bank, not very much, but I am making $25 a week, and have good prospects for a raise soon," explained Billie hopefully.

"What is $25 a week? It is not enough to buy candy for Marie."

"Oh, father. Billie and I can do wonders with $25 a week," exclaimed Marie.

"Sure we can," chimed in Billie.

The professor looked them over for a few moments.

"Tell you what I will do. You go ahead and get that raise you were just talking about. When you get it come to me and I will give you my answer. I think it will be 'yes.'"

And so the matter was settled, for the time being at least. The three left the laboratory for the living quarters, upstairs where Billie listened patiently for hours to the professor's discussion of the wonders of his Elixir of Life. At last the professor yawned and Billie took his departure. As he pressed Marie's hand at the gate he whispered in her ear:

"I'll get the raise dear, so don't worry your pretty head. Good night."

"Good-night, Billie. I am sure you will."

"With such a prize ahead any one would," replied Billie as the front gate clicked behind him.

He went home that night on thin air. As soon as he reached his little room he threw himself on the bed and dreamed of the happiness in store for him. He had $200 in the bank, and prospects for a raise and then—the best little girl in the whole world. What more could he ask for? In this frame of mind, he dropt asleep. Poor Billie. If he had only known what was in store for him, what terrific odds he would have to fight against, he would have broken into the professor's laboratory and destroyed the baleful green Elixir of Life that very night.

Chapter Two

A month past, during which Billie worked as he had never worked before. He was

(*Continued on page* 1034)

MURDOCK

No. 55

THE PRICES ARE UNUSUALLY LOW

2000 OHM DOUBLE SET

$4.50



THE QUALITY IS REMARKABLY HIGH

3000 OHM DOUBLE SET

$5.50

RIGHT IN PRICE AND IN PERFORMANCE

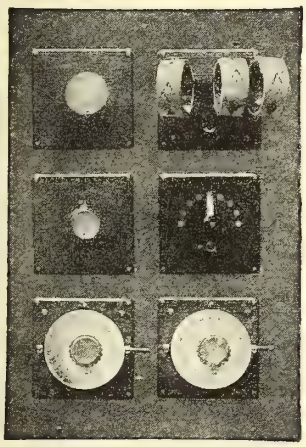
The substantial success earned by these receivers can be attributed to the instant recognition of their remarkable value by thousands of users. If, by chance, YOU are dubious regarding the possibility of securing really good 'phones at such prices, we suggest a trial, with the customary assurance of "satisfaction or money back." Ask your dealer for them.

BULLETIN No. 20 now ready for distribution. Send for your copy.

WM. J. MURDOCK CO. **55 Carter St., Chelsea, 50, Mass.**

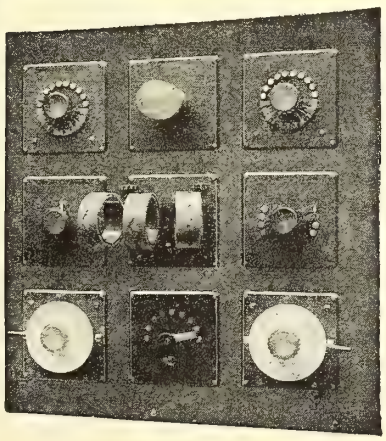
509 Mission Street, San Francisco, Cal.

Newest Ideas in De Forest Unit System Receiving Apparatus



Six Panel Unit Set

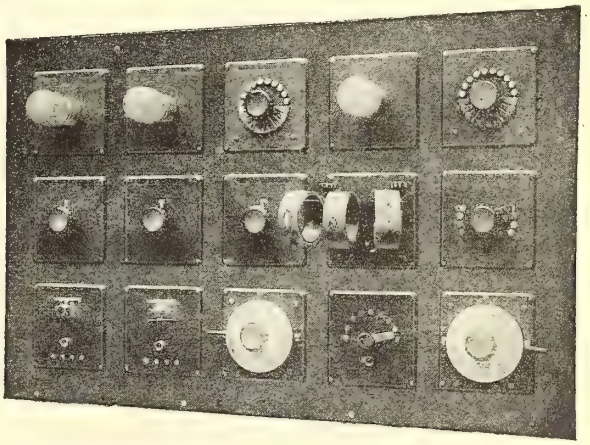
Comprising a combined Tuner and Detector to receive all local stations and practically any large station in the world. Everything necessary for the operation of the set, *including detector tube, "B" battery, head phones and a set of 11 coils,* can be had for $75.00 complete. (Purchaser to furnish panel board and "A" battery.) This set will give greater satisfaction than any outfit at anywhere near this price. Expansion possibilities unlimited.



Nine Panel Unit Set

Comprising the same six panels shown above, and either three additional panels to give one step of amplification, or three panels to increase the efficiency of the original six. The former will add about $23.70 to the cost of the original six; the latter about $12.10.

ADVANTAGES of the Unit System include extreme economy due to the simplicity and interchangeability of the units; convenience in arranging circuits to the individual need; and greater operating efficiency due to the engineering design and quality of the instruments. The Unit Sets shown here are a few examples.



Fifteen Panel Unit Set

Comprising the original six panels, with either of the additional three panels included in the Nine Panel Set, and also two additional steps of amplification. Thus for a total of about $134.50, or $146.10, a full Fifteen Panel Set that will outdo any other receiving apparatus may be had.

DE FOREST RADIO TEL. AND TEL. CO.

Manufacturers and Inventors of High-Grade Radio Apparatus

1415 Sedgwick Avenue, New York, N. Y.

LEE DE FOREST, Inc., Western Distributors

351 Third Street. San Francisco

E. T. Cunningham

announces

THE IDEAL AMATEUR TUBE

in this new

AudioTron Detector Type C-300

WITH STANDARD FOUR PRONG BASE



TYPE C-300 possesses combination properties—it functions as a highly sensitive spark detector, an Audio-Frequency Amplifier, an Oscillator for regenerative amplification and C W reception, a radiophone detector and amplifier—with the added advantages of low B Battery (18-22½ volts) ease and permanency of adjustment, uniformity and quietness.

Type C-300 is produced by an entirely new process of manufacture. Gas action must be coupled with electron emission for high signal audibility and sensitiveness as a detector. In the past it has been impossible to control this necessary gas content during manufacture and also obtain uniformity. Put Type C-300 to the test as we have in comparison with all previous types of tubes. I am confident of your answer.

Produced in large quantities entirely by machinery in the largest vacuum tube factory in the world has made it possible to offer Type C-300 at the remarkable price of $5.00. Every tube is carefully inspected and tested and is guaranteed free of all mechanical and electrical defects.

Insist on Type C-300

$5.00

Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08, and others issued and pending. Licensed only for amateur or experimental uses in radio communication. Any other use will be an infringement.

Cunningham Type C-301 High Vacuum Amplifier

is designed to meet the demand for the Navy Type amplifier and regenerative receiver. The internal structure and exhaust permit operation at plate voltages of 40 to 100. Amplification constant 7 to 9 with internal impedance of 20,000 to 12,000 ohms. Price **$6.50**

SEE YOUR DEALER TODAY and get your copy of Bulletin C-300 describing these new tubes. If your dealer cannot supply you send us his name and address and we will mail you a copy without charge.

Dealers-Jobbers

You will be interested in my proposition on the new tubes with the standard four prong base, packed in attractive individual cartons. DELIVERIES FOR 60 DAYS NECESSARILY IN ROTATION. Write today for full details.

Service and Quality since 1915 Guaranteed by

E. T. Cunningham

TRADING AS

AUDIOTRON MFG. COMPANY

35 MONTGOMERY ST., DEPT. S. SAN FRANCISCO

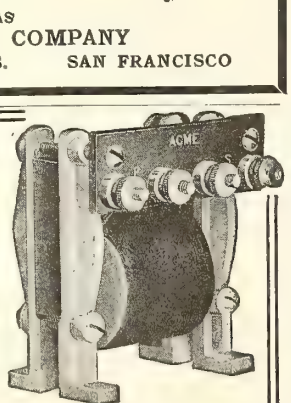
CW TRANSFORMERS

TRANSFORMER SPECIALISTS

Besides manufacturing the well-known ACME Spark, amplifying, CW Power, Modulation and Filament Transformers for use in Radio, we are prepared to build special transformers and coils for experimental and commercial use.

The increased use of large power tubes for CW demands special transformers which we are particularly equipped to design and manufacture.

SEND US YOUR SPECIFICATIONS



Acme Apparatus Company

28 Windsor Street Cambridge 39, Mass.

TRANSFORMERS AND RADIO ENGINEERS AND MANUFACTURERS



Wrestling Book FREE

Be an expert wrestler. Learn at home by mail. Wonderful lessons prepared by world's champions Farmer Burns and Frank Gotch. Free book tells you how. Secret holds, blocks and tricks revealed. Don't delay. Be strong, healthy. Handle big men with ease. Write for free book. State age. Farmer Burns, 1251 Ramge Bldg., Omaha, Neb.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.

L. B. DOVER LONGMONT, COLO.

The Elixir of Life

(*Continued from page* 1032)

trying to attract a little attention from the "Boss," and at last his efforts were rewarded, for he got his raise. Hooray! Now he could go to Professor Straus and demand Marie's hand. During the last month he had swelled his bank account to $250, and now with the raise he felt quite independent.

Once more he watched the clock, and as soon as the hands pointed to the hour of his release he startled the entire office force with the violence of slamming ledgers and the way he hurried into his street clothes and left the office.

"Billie got a raise today, and it has gone to his head. He's going to paint the town red," remarked old Grubb sagely.

At 7 o'clock Billie prest the bell of Marie's house. When he told Marie about his good luck he was rewarded for his efforts by the glad look that came into her eyes.

"Father is in his study with a Mr. Marco Russell. He is some rich old millionaire, and he is trying to make father sell him the elixir. Let's go in and see them," she said to him.

She led the way to the study where Billie was introduced to Mr. Russell, who, judged by outward appearances, was nearing the century mark. His face was seamed and sallow, shining like some dry parchment. His eyes were faded and sunk deep in their sockets. His body was thin and bent a quarter of the way to the ground by feebleness.

He held out a clawlike hand to Billie, peering at him with dim, near-sighted eyes.

"Glad to know you, Billie," he croaked. "Yes, indeed, glad to know you. See if you can help me out. I want to make the professor sell me some of his elixir, and he is afraid to make the test."

"Why is he, Mr. Russell?"

"He is afraid to make the test on a human being."

"Yes, Billie," broke in the professor, "I am afraid. I have tried it time and time again on dumb animals, but now that a real chance comes, I haven't the nerve to do it."

"What is there to lose?" asked Russell.

"I might kill you."

"What if you did? Look at me. I am an old broken man with only a year left at the utmost. Suppose your test does fail? What have I to lose, while, if it did prove successful, I have everything to gain. See this photo. It is of me, taken when I was twenty-one years old. I'll give you $100,000 to make me look like that once more. Oh, how I long to feel the hot, red-blooded stream of youth go coursing through my veins once more. I'll give you a $150,000 if you will make the test."

The long speech was too much for the feeble man. He wavered and sank into a chair. The photo dropt from his talon-like fingers.

Marie picked it up in astonishment.

"Oh, look! What a handsome man. It seems impossible."

Mr. Russell smiled weakly. "I know what you were going to say, Miss Straus. Never mind I know that I'm ugly now. Isn't old age a wonderful thing to turn beauty into ugliness and nobody sees him do it?"

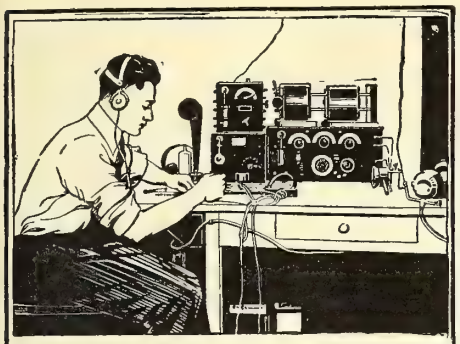
"Please, father, give Mr. Russell the elixir."

"No, Marie; I cannot do it."

It was then that Billie saw the chance.

"Mr. Russell, will you please excuse us for a second or two? I think I can help you."

"Certainly. Do everything you can to help me. I will reward you."



IT will pay you to learn Radio by our new and comprehensive method in a few months of evening study. We prepare you to meet all the new requirements for first grade commercial license, and obtain position paying $125.00 a month and expenses. Moderate tuition fee.

Write for Booklet B

Y. M. C. A. RADIO SCHOOL

Marcy Avenue, Near Broadway
Brooklyn, N. Y.
Telephone Williamsburg 3800

McLean Radio Storage Battery ONLY **$19.75**



Used with audion amplifier. Gives constant, dependable supply of juice for longer time than any other similar battery. One charge lasts two to three months, and any battery station will recharge for a few pennies.

Lasts 5 Years

Dry cells of equal strength which would cost $150.00 for the same period are troublesome and unreliable; copper or sulphate batteries also are undependable.

The McLean Radio Storage Battery, made especially for radio operators, is always on the job; gives no trouble. It is simple and convenient and easily transported anywhere. We offer a limited number of these splendid batteries at the low price of $19.75. Shipped prepaid upon receipt of price, or C. O. D. if you prefer. Order now!

McLEAN STORAGE BATTERY CO.
723 Frankfort Street **Cleveland, Ohio**

MEMORIZE CONTINENTAL CODE ALMOST INSTANTLY

Our method is THE short cut.
Successfully used by thousands.
"What They Say About It" Free. Master the Code and you overcome the only obstacle to quick success.

Chart and Instructions, 50 Cents

C. K. DODGE
Box 300 **Mamaroneck, N. Y.**

Audion Control Unit $15.00

Type A1, absolutely reliable, can be used with every known circuit. Cabinet size 8½x6¼x6½", Mahogany finish, contains Vacuum tube socket, filament rheostat, grid condenser, grid leak and filament switch. Whole back of cabinet swings open, giving ready access to interior.

At your dealer or from us.

K. & G. WIRELESS SUPPLY CO.
Dept. 15A **152 Chambers St., N. Y.**

LEARN WIRELESS

At the **OLDEST, LARGEST** and **BEST EQUIPPED** school of its kind in New England. Thousands of satisfied graduates all over the world. Splendid opportunities in the Merchant Marine. Day and Evening classes. Start any Monday. Illustrated Prospectus for the asking.

EASTERN RADIO INSTITUTE
899E Boylston St. **Boston, Mass.**

"I would like to speak to you in private, professor," said Billie.

As soon as they were outside the study Billie took the professor by the arm.

"I got that raise in salary and came to claim Marie tonight. I suppose you would consent, but I have a scheme to offer right now. *I will give Mr. Russell the elixir.*"

"*You?*"

"Yes, *me.* If you will permit me. Here is a chance for both of us to make good. You get $150,000 if you will sell me enough elixir to make Mr. Russell young again. You give me a bill of sale. I will sell it to him and take all the blame. This arrangement lets you out of all responsibility. Is it a bargain?"

The professor pondered long, and then replied:

"It is a bargain, but I will hate myself for the rest of my life, when I think that after all my years of research I was afraid to back my own faith. Come, we will tell Mr. Russell."

Together they re-entered the study.

"Mr. Russell, I have sold the elixir to Billie. He will deal with you."

"Thank goodness for that," exclaimed Mr. Russell, trying to spring up in his excitement. He was too weak, however, and fell back heavily.

"Sir, sit still. You shall have your wish," said Billie, getting down to business. "It will cost you just $200,000. Are you willing to pay the price?"

"Yes! Yes! Bring me pen and ink. I will make you out a check."

The writing materials were brought out and old Mr. Russell made and signed a check with hands hardly able to hold his pen. Handing it to Billie, he begged:

"Now, hurry up and give me the elixir."

Professor Straus entered the study with a glass of water and fifteen drops of the elixir. These he handed to Billie, while Russell watched excitedly.

Billie added the drops to the glass of water and, handing it to Russell, said:

"Drink it. Drink the drink that Ponce de Leon came to discover. Drink away seventy-five years of your life."

Clutching the glass with hands that threatened to spill the precious fluid with their shaking, Russell drained the glass to the very last drop.

Professor Straus, Billie, and Marie crowded closer as Russell dropt back once more into his chair. For two long minutes that seemed as hours to Billie the elixir showed no effect, and then a wonderful change started.

It seemed that old age was falling from Marco Russell with surprising quickness. The bent body straightened, and the face discarded its cadaverous look. The eyes began to shine and fill out their sockets. The long claw-like fingers filled out and before five minutes had past Marco Russell stood before them a handsome man of twenty-five.

"*Oh!* What a handsome man he is now!" exclaimed Marie. Russell looked at her and smiled.

"I might add that you are a remarkable and handsome girl."

Marie blushed and glanced at Billie in confusion. The idea of a man nearly a hundred years old passing pretty compliments. The thought past thru Billie's brain that Marco Russell would bear watching, for he remembered the saying, "There's no fool like the old fool." Yes; he would keep an eye on him.

Chapter Three

Two weeks past by, during which time Billie Hoyt was a very busy young man. The $50,000—his share—received from Marco Russell had completely changed his view on life. He had already severed his connection with the firm of Bronx and Wegan, and was now in search of more aged men with money to trade for youth and the elixir. The most important event



HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competion is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

American School of Correspondence
Dept. H-126 **Chicago, U. S. A.**

American School of Correspondence,
Dept. H-126, Chicago, Ill.

I want job checked — tell me how to get it.

.....Architect $5,000 to $15,000	.....Lawyer $5,000 to $15,000
.....Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Photoplay Writer $2,000 to $10,000
.....Certified Public Accountant $7,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telephone Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....Telegraph Engineer $2,500 to $5,000
.....Electrical Engineer $4,000 to $10,000	.....High School Graduate In two years
.....General Education In one year	.....Fire Insurance Expert $3,000 to $10,000

Name.....

Address.....

RADIO CORPORATION OF AMERICA
RADIOTRONS

IT is generally admitted that the evolution of the PLIOTRON marked a stride forward in VACUUM TUBE design. It was therefore to be expected that when the same engineers designed RADIOTRONS—the Radio Corporation's new tubes for detection and amplification purposes—they would embody the latest knowledge in vacuum tube practice.



Radiotron U. V. 200
Price $5.00

RADIOTRON U.V. 200, the gas-content detector and tone-frequency amplifier, is in every respect a tube of superior characteristics, and is in no wise to be confounded with former types. It is particularly adapted for amplifying in one or two stages the telephone currents in vacuum tube receiving sets. Manufactured by an entirely new process, it possesses a degree of uniformity and constancy which has never been equaled by any gas-content tube. Equally important is the fact that RADIOTRON U.V. 200 requires only ONE STANDARD PLATE BATTERY to energize the plate circuit. Voltages between 18 and 22½ give the best results for detection.

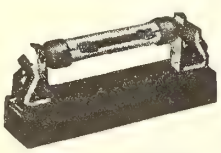
A particularly good combination is the use of one U. V. 200 as a detector, and two additional tubes as tone-frequency amplifiers. U. V. 200 shows unusual results in standard regenerative circuits.



Radiotron U. V. 201
Price $6.50

RADIOTRON U.V. 201, a newly-designed Pliotron, meets the demand for a tube suitable for radio—and tone-frequency amplification as well as for detection. RADIOTRON U.V. 201 is recommended for multi-stage amplifiers employing three to six stages of tone-frequency amplification, or for amplifiers using several stages of radio-frequency and several stages of tone-frequency amplification, in cascade. It is a tube of "Navy" characteristics. Every experimenter will want it as well as RADIOTRON U. V. 200.

PLEASE NOTE that the demand for RADIOTRONS temporarily has exceeded production but we have taken steps to increase production to the point where immediate shipments can be made to Customers. Orders are necessarily, however, filled in rotation. Dealers should make reservations by wire.



Standard Grid Leak

LIST PRICES

Radiotron U. V. 200	$5.00
Radiotron U. V. 201	6.50
Standard Tube Sockets	1.50
Grid Leaks, Mounted	1.25
Grid Leak Units Only	.75
Grid Leak Mountings	.50
Intervalve Transformers	7.50
Burgess "B" Batteries	3.50



Standard Vacuum Tube Socket

The Radio Corporation's tubes are covered by patents dated November 7th, 1905, January 15th, 1907, and February 18th, 1908, as well as by other patents issued and pending. Tubes licensed for amateur and experimental use only. Any other use will constitute an infringement.

See your nearest dealer for literature on Radiotrons. If he has none write us direct.

Address all orders and inquiries to:

SALES DIVISION, COMMERCIAL DEPARTMENT
RADIO CORPORATION OF AMERICA
233 Broadway, New York City

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.
Positively such a good Telescope was never sold for this price before. **Eastern Telescopes are** made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ **feet in 4** sections. They are nicely brass bound, with scientifically ground lenses. **Guaranteed by the maker.** Every sojourner in the country or at the seaside resorts should certainly secure **one** of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope **just** as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.
EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.

SUCCESS OPPORTUNITY
UTTMARK'S NAUTICAL ACADEMY RADIO SCHOOL

Offers a thorough course in all branches of wireless telegraphy. Radio Operators earn at the start $125.00 per month, and first-class board, etc., free.

Our school prepares you for your license in three to four months. Positions guaranteed to first-grade licensed operators.

Day and Evening Classes

8 State Street, New York, N. Y.
Phone, Bowling Green, 8079

tho was his approaching wedding. This function was to be held the coming Saturday. It was now Friday afternoon, and he had much to do.

Russell had been a frequent caller at Marie's house lately, and it bothered Billie not a little, for Russell seemed to be head over heels in love with Marie. Billie trusted Marie absolutely, but the night before, when he had thought Russell too attentive, he asked her about the matter. Her reply had reassured him somewhat, for she had told him that Russell was a joke, and that she could never think of him, except as the very old man she had seen in her father's study. She said that on several occasions he had tried to make love to her, but she had soon put him into his place. Of late he had kept his distance.

Tonight Billie was on his way to her house in answer to a telephonic summons from Marie. She said she was in trouble with her father. He was just about to do something terrible.

At last he arrived, and Marie took him into the study. As usual, Marco Russell was there.

"Billie, what do you think father is going to do?" she asked.

"I haven't the least idea."

"He is going to make himself young with the elixir, and I don't want him to do it. That's the reason I 'phoned for you."

"Why don't you want me young again, Marie?" asked the professor.

"Just because I want you as you are, my dear old father."

"You are selfish, Marie."

"No, I am not, father. Billie, see what you can do with him."

"It will do you no good, Billie, so save your energy. I have here in my hand ten drops of the elixir, and here it goes." Before any one could interfere he had tost down the contents of the glass and stood smiling as the wonderful transformation took place.

"Hooray!" he shouted as he saw his reflection in a mirror. "Hooray! Now we are all young once more. Let's celebrate."

Russell grasped the professor's hand.

"Congratulations, professor. It's great to be young after you have had the experiences of old age. Yes, let's celebrate. Let us also celebrate Billie's and Marie's wedding. I came prepared for just such an event. Billie, will you go out to my car and get the big hamper I left in it?"

"You bet I will!" exclaimed Billie, who had entered into the spirit of the thing, and whose estimation of Russell was now at par. "I'll be right back in a jiffy."

Billie returned in a few minutes, loaded with the heavy hamper. Russell took it from him and placed it on the study table. A view of its contents showed a delicious lunch, and several bottles of wine.

"We will eat, drink, and be merry. We will do it now, for who knows what the morrow may bring. Here, Billie, is a glass of rare old vintage, my own private stock. Drink it down."

Other glasses were filled and the party drank to the coming wedding, and to the elixir.

"Don't you like it, Billie?" asked Marie. Suddenly her face went as white as chalk. "*Oh!* My God! What is the matter with you, Billie? Mr. Russell, what have *you* done to Billie?" With a wild scream she fainted and fell to the floor. No wonder, for standing in clothes that had suddenly grown too small for him, and which gave him a grotesque look as they fell in folds and rolls, was Billie Hoyt, three minutes before the man of twenty-one, now a mere gawky boy of six. As Billie realized what had happened, he shrilled out in boyish rage: "Russell, you are a crook! You gave me the elixir in that glass of wine. I'll——"

"Tut, tut, little man," interrupted Russell sarcastically. "See the pretty kitty? Take it and run along and play with it and don't bother your elders. Perhaps you had bet-

ter run home to your mamma, for I think she needs you."

Marie opened her eyes. One look and she was again senseless. Russell stooped and lifted her from the floor to kiss her, while the professor looked on in dumbfounded amazement.

Billie rushed at Russell and struck him with puny fists.

"Let her alone, you crook. She is my promised wife," he shrilled.

Russell shoved him aside and placed Marie tenderly in a chair.

"Ha, ha; your promised wife. You make me laugh, little one. What will she do with a kid like you? Bring you up?"

He picked up a glass of wine and prest it to Marie's lips. Billie dashed it aside.

"What are you trying to do? Make a baby of her?"

Russell smiled craftily. "Rather not. Do you think that I am a fool? Marie is going to stay exactly as she is. She suits me best that way."

Marie drank another proffered glass of wine and opened her eyes. She smiled at Billie weakly.

"I know what Russell is trying to do, Billie. By removing you he thinks that he can win me, but he never will. I'll wait until you grow up again."

"Wait fifteen years?" asked Russell. "That's a long time, Marie. You'll change your mind, I'm sure."

"Never," she exclaimed angrily, "and don't you call me, Marie; go away from me. You're a brute and I hate you. Father, what are you going to do about it?"

The professor seemed to come out of a deep study.

"Rather remarkable, Marie. I'll have to look into the matter. Yes, yes." He walked slowly out of the study, mumbling to himself the monosyllabic words, "Yes, yes."

Marie flared up. "You double-dyed crook, what have you done to my father?"

"Not a thing in the world," smiled Russell. "There's just merely something wrong with his upper story. He'll come out of it."

Chapter Four

Billie, his head in a whirl from the terrible shock, hurried home as best he could and threw himself upon the bed to think.

He was certainly in an awful fix now, a mere boy in body, but with a man's brain, which only aided in adding to his mental agony.

He must surely lose Marie now, for it seemed out of the question that she would wait for him to grow up. Horrors, she would be thirty-three if she did that, just fifteen years his senior. No; there was no hope in that direction. He must use his head, and beat Russell at his own game. How would he accomplish it? It surely looked like a hopeless undertaking. True, he had a grown man's brain, but the child's body would handicap him badly. However, the prize was worth working for, and he would do his best. At last he dropt asleep, and when morning came more trouble stared him in the face. He had no clothes in which to make an appearance. What should he do? For a few moments he sat and pondered, and then rang the bell. Soon some one was heard outside his door, then a knock and the familiar voice of Mrs. Barnes, his old landlady.

"Do you wish anything, Mr. Hoyt?" she asked.

"Yes. Will you please come in a moment?" replied Billie, jumping into bed and covering up.

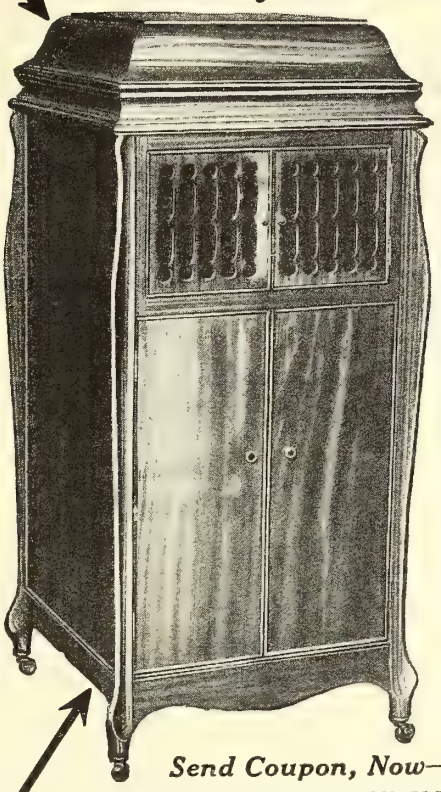
"What is the idea?" he heard her muttering as she entered the room.

"Why, where in the world is Mr. Hoyt?" she asked, looking hard at Billie.

"I am Mr. Hoyt, or rather what is left of Mr. Hoyt." Mrs. Barnes walked angrily to the bed.

(*Continued on page* 1039)

YOU Can *Easily* BUILD This PHONOGRAPH



TREMENDOUS SAVING IN COST

You don't need to be a cabinet maker. We have made it an easy and pleasant job with

Our Simplified Plans We furnish blue prints, diagrams, motor, ready-built horn, cabinet pieces and all metal parts complete. You do the assembling, **6 models to choose from.** A few hours' work, and you will have as fine a type of phonograph as any produced, and at a price away below what you would pay in a store.

KEEP THE SAVINGS IN YOUR POCKET

Machines play all records, have a wonderful tonal quality, excelled by none. No need now for any family to be without a phonograph because of the cost. THE MAKAFONE solves the problem. BUILD IT YOURSELF AT LESS THAN ONE-FOURTH REGULAR COST, but equal to the high-priced cabinet machines. Free Records with each outfit. SEND TODAY FOR FREE CATALOG and full particulars of our wonderful offer. *Many a manufacturer got his start in this way. Why not you? Build machines and sell to your friends.*

Agents Attention You can make and sell *these* machines from our plans at a profit of $50 to $75 each. Others are selling two and three a week. Here is your opportunity to make big money and become independent. Pleasant and profitable work.

Send Coupon, Now—To-day

MODERN PHONOGRAPH SUPPLY CO.
443 Springer Bldg., 313 So. Clinton Street, Chicago.

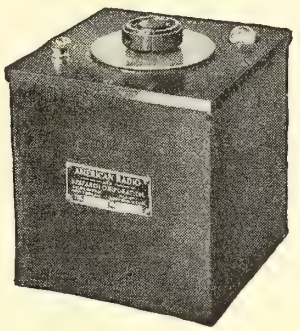
Modern Phonograph Supply Co.
443 Springer Bldg.
313 So. Clinton St., Chicago, Ill.

Gentlemen: Please send me full particulars of you Makafone proposition, without obligation to me.

Name.....

Address..... State .....

Do You Know That—



The Amrad Wavemeter is the only practical low-priced Wavemeter for the Amateur?

By using an Amrad Wavemeter you can easily comply with Government regulations?

To determine the wave of your transmitter, all that is necessary is to place the Amrad Wavemeter in inductive relation to the transformer primary and turn knob until maximum illumination of pilot lamp is obtained, then read the wave length in meters direct from the dial?

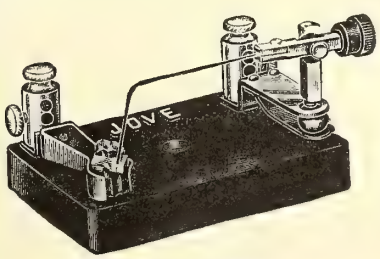
American Electro Technical Appliance Co.

235 Fulton Street *Dept. E. S.* *New York City*

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c



(GHEGAN PATENT)

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

Send stamp for new edition 42E Catalog.

J. H. BUNNELL & CO., 32 Park Place, New York

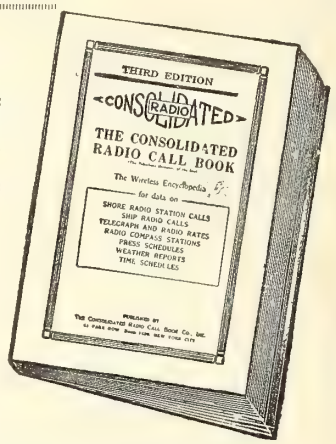
The Third Edition of the

Consolidated Radio Call Book

Very Greatly Enlarged—Will Be Ready January 5th

192 pages. (32 pages more than 2nd edition,) better paper, stiff covers etc.

Some of the special information contained in the new book: Radio rate sheet (charges to and from vessels, etc.); Cable rates; Table for finding cable charges to various points; Weather reports and hydrographic reports of the world; Time signal section of the world; American radio compass stations; French radio compass stations; British radio compass stations; Canadian radio compass stations; General information section; International abbreviations; High power radio stations of the world; Press schedules of spark stations.



The Consolidated Radio Call Book is the only book in print officially listing all the Radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.

Every New Amateur Call Is Listed

SPECIAL—Given Free with Each Copy

A Wireless Map of the World **in colors** is given absolutely free with each copy. This map shows the locations of all the high powered RADIO stations in the world, including the time signal stations. In addition it tells at a glance far away any of these stations are. Of greater interest are the time zones, which enable the amateur to compute instantly the correct time for the zone in which he is located from any time signal station.

The second edition of 10,000 copies was exhausted in ten days. The book is on press now and will *positively be ready* on January 5th. Order direct or reserve your order from your favorite dealer

Price $1.50 Prepaid

Either Direct from us or for sale by the following responsible Dealers:

American Electro Tech. Appliance Co.,	New York City
American Hardware Stores,	Bridgeport, Conn.
Atlantic Radio Supply Co.,	Boston, Mass.
Bamberger & Co., L.,	Newark, N. J.
Benwood Specialty Co.,	St. Louis, Mo.
Brode Electric Co.,	Los Angeles, Cal.
Bunnell & Co., J. H.,	New York City
California Electric Co.,	San Francisco, Cal.
Catton, Neill & Co.,	Honolulu, T. H.
Chicago Radio Apparatus Co.,	Chicago, Ill.
Cutting & Washington Radio Corp.,	New York City
Dewey Sporting Goods Co.,	Milwaukee, Wis.
Doubleday-Hill Electric Co.,	Pittsburgh, Pa.
Electro Importing Co.,	New York City
Findley Electric Co.,	Minneapolis, Minn.
Fuller Co., Seth W.,	Boston, Mass.
Holt Electric Utilities Co.,	Jacksonville, Fla.
Hovey, A. T.,	Boston, Mass.
Jenkins, Lester I.,	New Bedford, Mass.
Katzenbach & Co., F. S.,	Trenton, N. J.
Kluge, Arno A.,	Los Angeles, Cal.
Krause & Co., A. F.,	Detroit, Mich.
Manhattan Electric Supply Co.,	New York, Chicago
McCarthy Bros. & Ford,	Buffalo, N. Y.
McClurg & Co., A. C.,	Chicago, Ill.
Meter Electrical Construction Co.,	Oshkosh, Wis.
Meyberg Co., Leo J.,	San Francisco, Cal.
Mohawk Electrical Supply Co.,	Syracuse, N. Y.
New Era Shop	Milwaukee, Wis.
Newman-Stern Co.,	Cleveland, Ohio
Nola Radio Co.,	New Orleans, La.
Noll & Co., E. P.,	Philadelphia, Pa.
N. S. W. Bookstall Co.,	Sydney, Australia
Paramount Radio Supply Co.,	Atlantic City, N. J.
Parks, Henry Francis,	Butte, Mont.
Pearlman's Book Shop,	Washington, D. C.
Pennsylvania Marconi Wireless School,	Philadelphia, Pa.
Piedmont Electric Co.,	Asheville, N. C.
Pioneer Electric Co.,	St. Paul, Minn.
Pitts Co., F. D.,	Boston, Mass.
Post Office News Co.,	Chicago, Ill.
Precision Equipment Co.,	Cincinnati, Ohio
Radio Distributing Co.,	Newark, N. J.
Radio Electric Co.,	Pittsburgh, Pa.
Radio Equipment Co.,	Boston, Mass.
Radiolectric Shop,	Cleveland, Ohio
Reuter Electric Co.,	Cincinnati, Ohio
Riverside Laboratory,	Milwaukee, Wis.
Saunders Co., Geo. S.,	Boston, Mass.
Schmidt & Co., Rudolph,	Rochester, N. Y.
Shaffers',	Norfolk, Va.
Shotton Radio Mfg. Co.,	Scranton, Pa.
Smith Novotoy Electric, Inc.,	Charlotte, N. C.
Southern Electrical Supply Co.,	San Diego, Cal.
United Radio Telegraphers' Assoc.,	Baltimore, Md.
Western Radio Electric Co.,	Los Angeles, Cal.
Whitall Electric Co.,	Westerley, R. I.
White & Boyer Co.,	Washington, D. C.
Williamson Electric Co., H. E.,	Seattle, Wash.
Wireless Mfg. Co.,	Canton, Ohio
Wireless Press,	New York City
Wireless Shop,	Los Angeles, Cal.
Young & McCombs,	Rock Island, Ill.
Young Men's Christian Assoc.,	Los Angeles, Cal.
Zamoiski Co., Jos. M.,	Baltimore, Md.

Published by

Consolidated Radio Call Book Co., Inc.

41 Park Row, New York City

Genuine

BAYER

Aspirin

Always say "Bayer"

Unless you see the name "Bayer" on tablets, you are not getting genuine Aspirin prescribed by physicians for 21 years and proved safe by millions. Directions in package.

Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid.

ACID STOMACH

Gases
Sourness
Indigestion
Heartburn
Flatulence
Palpitation

Just as soon as you eat a tablet or two of Pape's Diapepsin all the stomach distress caused by acidity will end. Pape's Diapepsin always puts sick, upset, acid stomachs in order at once. Large 60c case—drugstores.

PAPE'S DIAPEPSIN

FREE



$20

Violin, Hawaiian Guitar, Ukulele, Guitar, Mandolin, Cornet, Tenor Banjo or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.

SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 613 CHICAGO, ILL.

The Elixir of Life

(*Continued from page* 1037)

"Don't try to kid me, young feller. Don't you suppose I know Mr. Hoyt? He has boarded with me for the last five years."

"I am not trying to kid you, Mrs. Barnes. I am Billie Hoyt. See those clothes scattered all over this room?"

"Yes, those are Billie's clothes."

"Well, he only had one new suit to his name didn't he?"

"Yes."

"Well, there it hangs over that chair. Do you recognize this scar on my forehead? Do you know this ring that is far too big for my finger now? I am Billie Hoyt. I can tell you what I said to you in the hall last night. I was in a hurry too."

"Mercy me! If you are Billie Hoyt, what in the world has happened to you?"

"I was the victim last night of a scientific fraud just like a story in the Arabian Nights. I was set back about fifteen years of my life. What I want you to do is to buy me some boys' clothing and bring it to me here. You'll find the money in that coat. Please keep my secret from the rest of the boarders. Tell them that Billie Hoyt has left on a business trip."

"Mercy me, mercy me!" exclaimed Mrs. Barnes as she got the money and left the room. "Mercy me, the poor boy."

Chapter Five

At Professor Straus' home things were not progressing very smoothly for Marie. The shock of Billie's calamity had unstrung her nerves to such an extent that she had locked herself in and refused to see any one.

Two or three times her father had knocked at the door. Marie was angry with him and feigned sleep. Somehow or other she could not look up at her father, since the change, with the same feeling or respect. He was no longer her dear old gray headed, absent-minded father that she had had to look after as a mother would. She could not think of him as her father for he seemed an entirely new person to her, so she paid no attention to his knockings.

Time and again she thought over poor Billie's plight. Her father was directly responsible for all the suffering his elixir had caused. If he had only let well enough alone and not trifled with the mysterious secrets of life, knowing he had no right to do so, everything would now be all right, and it would be her wedding day with Billie. Poor boy, how she felt for him. She knew that he was suffering as she was. Russell—ugh! How she detested his handsome face. He was a sneak. No wonder he was a millionaire many times over if he had been as ruthless in his business methods as in love.

She would show him. He should never marry her. She would remain an old maid the balance of her life if she couldn't get Billie.

A loud knock sounded on the door and interrupted her brooding.

"Oh, what is it?" she asked peevishly.

"It's your father. Billie is in the study and wants to see you."

"Tell him I'll be right down."

In the study, Billie, drest in a new suit of knickerbockers built for a boy of six, was seated in the big chair and evidently on pins and needles.

As Marie entered the study he jumped and ran to embrace her. Marie stooped to kiss him, and as if the irony of the thing had suddenly dawned upon her, Marie exclaimed:

"Oh, Billie, you poor little boy. It all seems so impossible. Can't something be done?"

Are You Sour on Society?

Does it look to you as though everyone were against you? Do you feel like rebelling against everything and everybody? Are you sour on society, disgusted with men and hateful with women? If you are, you are bankrupt in health, and lacking in manly vigor and mental courage. There's something wrong—something, perhaps, you wouldn't want anyone to know. It's a gloomy place to the despondent, hopeless, wreck who finds it hard to make his way in the world—who finds himself slipping, faltering, failing in everything he undertakes.

You need not go on in this way battling with the world. I can help any man who is lacking in mental strength, bodily vigor, or physical stamina. I can aid in restoring the impotent. I can give you back your dissipated manhood. I can give you new courage, increased vigor, more pep.

Thousands of Letters Praising Strongfortism

I get hundreds of letters every day telling pitiful stories of failing health and strength, of lost energy, of weakness and despondency. To those I send a message of cheer and hope. They take my Course. They gain in manly vigor. Ambition comes back. Then they write me again—joyful letters telling of wonderful transformations. Thousands acclaim me a benefactor.



LIONEL STRONGFORT
The Perfect Man

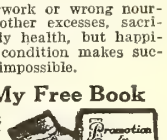
Strongfortism creates in its followers a new outlook on life, a new inspiration for higher things—a desire to live, to have a home, to rear a family, to love and be loved. Through building up a perfect body, where perhaps was only a frail shell before, it gives a man leadership, it wins him promotion and position, salary and success. It enables him to attract others, to win admiration and love, to be the one preferred socially and in the business world.

The Strongfort System is Beyond Physical Culture

I am not merely a muscle-developer, an ordinary instructor in physical culture. I am a great deal more than that, for I have developed a scientific system for rescuing men from the degradation of disease, I have devised a means **without the use of drugs or medicines**, of picking up from the gutter of despondency and hopelessness men who have, through overwork or wrong nourishment or other excesses, sacrificed not only health, but happiness, whose condition makes success in life impossible.

I Want to Send You My Free Book

I want to give you an insight into my wonderful method by sending you my highly interesting and valuable book. **"Promotion and Conservation of Health, Strength and Mental Energy."**



Don't lose a minute. Send a 10c piece for postage, etc., to my address. Tell me your ailment. I will reply promptly—you'll devour the truths found in my book and you will see at once that a new era of life is within your grasp.

LIONEL STRONGFORT
Physical and Health Specialist
Dept. 196 Newark, N. J.

FREE CONSULTATION COUPON
Absolutely Confidential

Mr. Lionel Strongfort—Dept. 196, Newark, N. J.,
Personal—Please send me your book, "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY," for postage on which I enclose a 10-cent piece (one dime).

Send me special information on subjects marked X below, without in any way obligating me.

..Colds	.Stomach Disorders	..Skin Disorders
..Catarrh	..Constipation	..Impotency
..Hay Fever	..Biliousness	..Great Strength
..Asthma	..Torpid Liver	..Falling Hair
..Obesity	..Indigestion	..Weak Eyes
..Headache	..Nervousness	..Pimples
..Thinness	..Poor Memory	..Blackheads
..Rupture	..Rheumatism	..Round Shoulder
..Lumbago	..Gastritis	..Lung Troubles
..Neuritis	..Heart Weakness	..Female Disorders
..Neuralgia	..Poor Circulation	..Weak Back
..Flat Chest	..Increased Height	..Muscular Development
..Deformity (Describe)	..Successful Marriage	..Advanced Course
..Insomnia	..Easy Childbirth	..Healthy Children
..Vital Depletion	..Despondency	..Manhood Restored
..Youthful Errors		
..Short Wind		
..Flat Feet		

Here mention other subjects not listed above:

.....

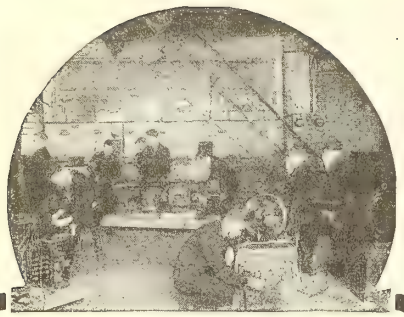
Name.....

Age.....Occupation.....

Street.....

City..... State.....

S. & I.



Actual Life-Size Electrical Apparatus

is constantly used in our instruction to help students master the theory and practice of electricity. It's part of our thoroughness. You can become an Electrical Expert in one year or learn an electrical trade in six months.

Wonderful opportunities are open to you to win splendid success in this fascinating, uncrowded field. Study with this great Electrical School and learn by actual practice on complete working equipment in our large electrical laboratories. We teach you to become a good electrician and a trained specialist qualified and ready to step into a highly paid position.

Write for Catalog and Details of our "Earn While You Learn" Plan

Mark the coupon for the course you are interested in and full information will be sent.

School of Engineering of Milwaukee,
Dept. S-18, 373 Broadway, Milwaukee, Wis.

Without obligating me, please furnish details of the course or courses marked below.

[ ] Electrician, 1 year.
[ ] Electrotechnician—1 to 3 years.
[ ] Electrical Engineer (3 years. B. S. Degree.)
[ ] Armature Work (3 to 6 mos.)
[ ] Automotive Electricity (3 to 6 mos.)
[ ] Electrical and Mechanical Drafting (6 to 12 mos.)

Name.....
Address.....
City.....State.....
Age.....Education.....

Radio Operators

May Become

Shore Station Managers
Traffic Managers
Radio Inspectors
Radio Construction Men
Radio Instructors
Radio Engineers

at salaries ranging from
$1,500 to $10,000 Yearly

ACT NOW

Call or Write for Illustrated Booklet

Y. M. C. A. RADIO SCHOOL
152 E. 86th Street
NEW YORK, N. Y.

"Best Radio School in the East"

RADIO CLUB PINS

Special folder of designs and prices in addition to regular School pin catalog free on request. Be sure to see these new numbers which will put new life in your club.

METAL ARTS CO.
Dept. 12 Rochester, N. Y.

"Sit down, dear," Billie said in his shrill, boyish treble. "Sit down and I'll explain our only chance."

For an hour the two conversed in whispers and at last Billie took his leave. He paused at the door and said:

"Remember now, dear, and don't lose hope. I think I have the right solution. In the meantime let them have their own way. The happier Russell gets the harder he will fall."

When Billie left Marie he had tucked under his arm a wicker basket containing the elixired kitten.

For a month Billie kept out of sight. Marie mist him sorely, but it comforted her to know that he was working day and night to solve a knotty problem for their own happiness.

Russell's calls grew closer and closer together until it seemed to Marie that he was living with her father.

One night the professor called Marie into the study, when Russell was there.

"Marie, it is high time you got over your infatuation for a six-year-old boy. You should give a little of your time to Mr. Russell here. He has honored me by asking for your hand in marriage and I have told him 'yes.'"

Marie started back in amazement. "What? I marry Russell? Never."

"Yes you will, Marie. Mr. Russell is very wealthy. He has promised me that he will give me a large sum of money with which to carry on my experiments. Think what that will mean to me now. With the elixir I can ward old age away forever. I can master all the secrets in the universe."

"But, father, I don't love Mr. Russell."

"What if you don't? He will teach you to love him. It's the chance of a lifetime for any girl. Think what it means to your father."

Marie remembered Billie's parting instructions to favor them. She would play a little for time and watch her father. Marie sensed that there was something the matter with her father lately. She looked at Russell. He was staring at her father, as a cat looks at a bird before the spring. She had the answer. Russell had her father completely under his strong willpower. He could make him do as he willed him to do.

"Well, what are you going to do?" asked her father in a strange tone.

"I cannot marry Russell."

The professor looked at Russell appealingly. There flashed something between the two. Turning to Marie, her father said sternly.

"You are trying to disobey me. You will marry Russell this coming Saturday night at 9 o'clock right here in this study. I am tired of listening to you moon around over Billie Hoyt. You act foolishly. The idea. A grown woman making herself sick for the love of a six-year-old boy. Do you understand that you marry Russell at 9 o'clock Saturday night?"

"Y—es."

"Then you are a good girl and you are making me happy."

Russell came towards her and held out his arms.

"Go away from me, you brute. Don't you dare to touch me. I will obey my father, but——"

"That will do, Marie. Go to your room," ordered her father sternly, a strange look in his eyes.

Sobbing as if her heart would break, Marie obeyed.

Chapter Six

Saturday, Marie's wedding day, with the man she hated most in the world, arrived and still no Billie. She had told him over the 'phone of the scene in the study, and he had told her that he would not fail her. She couldn't find out just what he intended to do. He said he didn't know himself, but he said not to worry. She was trying

"They WORK while you sleep"



Best Laxative for Men, Women and Children.
10, 25, 50c—drugstores.

How To Revitilize Wornout Exhausted Nerves

Your nerve power depends on plenty of good, rich, red blood of the kind that organic iron—Nuxated Iron—helps make. Nuxated Iron is like the iron in your blood and like the iron in spinach, lentils and apples, while metallic iron is iron just as it comes from the action of strong acids on iron filings. Nuxated Iron does not injure the teeth nor upset the stomach; it is an entirely different thing from ordinary metallic iron. It quickly helps make rich, red blood, revitalize wornout, exhausted nerves and gives you new strength and energy. Over 4,000,000 people annually are using it. Beware of substitutes. Always insist upon having genuine organic iron—Nuxated Iron. Look for the letters N. I. on every tablet. Sold by all druggists.

NUXATED IRON
For Red Blood Strength and Endurance

Deafness



Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums

"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable.

Write *today* for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.

WILSON EAR DRUM CO., Incorporated
382 Inter-Southern Bldg. LOUISVILLE, KY.

SMALL 110 V-D. C. MOTORS $3.50 each

These motors are slightly used, but in first class running condition. Suitable for Rotary Spark Gaps, Buffers or general experimental work. Have only about 75 so act quick. Cash with order. Money refunded if not satisfactory.

KLOTZ-BAUMANN CO., Inc.
1876 Broadway New York City

Packard



Back up that wireless outfit of yours with the Packard Transformer.

It is absolutely the most powerful transformer built for amateur purposes under the government regulations.

Distances covered by present owners of the Packard put it in a class by itself.

Exceptionally high voltage (13,200) gives the kick necessary to send from 450 to 900 miles.

We will be glad to send you any information on these transformers you may desire.

The Packard Electric Company Warren, Ohio

Wireless Transformer

Thirty Day Special

AUDION CONTROL PANEL

Price $6.25 Prepaid

Polished Fomica panel size 4x6½ in. B battery control switch, Rheostat, tube socket, 6 binding post, and Grid Condensor, all metal parts polished nickel plated, use V. T. or Auditron bulb.

One Step Amplifier, Panel size 4x6½ in. Price $12.50 Prepaid.

Two step Amplifier, double filament controls. Panel size 6½x8 in. Price $22.50 Prepaid.

Send for complete literature; it's free

KEYSTONE RADIO COMPANY
MANUFACTURERS
Drawer 307 Greenville, Pa.

Advance Notice

Our new line of STANDARDIZED RADIO SPECIALTIES will be ready within a few days. Send for our New Bulletin 152C.

WIRELESS EQUIPMENT COMPANY,
INCORPORATED
188-190 Greenwich Street, New York

Arnold **Loose Couplers**

Combination Loose Coupler Parts and accessories.

Send 3c stamp for literature which is sure to interest you.

J. F. ARNOLD **2082 Lexington Av. N.Y. Established 1910**

PITTSCO

RADIO EQUIPMENT

Our catalog No. 22 illustrates everything in wireless. Send 10 cents in stamps for it.

F. D. PITTS CO.
Boston, Mass.
12 Park Square Dept. D

[RADIO] Mail Order SERVICE

A complete stock and prompt deliveries is a combination you can't beat. Any radio instrument mailed postpaid anywhere. Try our service. *Send 10 cents for catalog.*

KELLY & PHILLIPS
312 Flatbush Ave., Brooklyn, N. Y.

$12.50

NEW 1920 RED HEAD PHONES

We announce the new model of the famous Red Head Radio Receivers, greatly improved, 3200 ohms, $12.50 the pair.

THE NEWMAN-STERN CO.
Dept. E. E. Cleveland, Ohio
Distributors for DeForest, Murdock, Signal, Bunnell and other famous lines.



GET ONE NOW

We have Receiving Transformers from $6.95 to $50.00. Order now and get better results. Send 2-cent stamp for bulletins 105 and 111 showing short and long wave tuners of the worth while kind.

Colby's Telegraph School, Auburn, N. Y.

to follow his advice, but still the day past on in an agony of misgivings and suspense. What if he failed her in the last minute?

At 8 o'clock that night a maid, who by the way was a new addition to the household and supplied by Russell, arrayed Marie in her wedding finery and told her that she looked too sweet for anything.

Marie choked back a sob as she entered the study. She shuddered when she saw Russell smiling at her.

Professor Straus seemed ill at ease and seemed to be laboring under a severe strain. It seemed as if he was trying to do or say something and was unable to find the proper words to express himself.

The preacher arrived and still no Billie. Heavens, would he never come? In an agony of fear Marie saw the hands of the clock stand quivering at five minutes to nine. If Billie did not come inside of five minutes she was lost.

"Well, Marie, guess it is time for the wedding," said the professor. "It's nearly 9 o'clock."

Like one in a dream, Marie found herself facing the preacher, felt Russell reaching for her hand and then heard the question:

"If any one knows a reason why this marriage should not be carried on let him speak or forever hold his peace."

Suddenly Marie opened her eyes with a start, for a deep, full-chested man's voice had shouted:

"Yes, I do! Stop the marriage!"

She gave a glance at the study door and then fainted dead away. Standing there, a sneer on his handsome face was Billie Hoyt, not a boy of six in knickerbockers but a full-grown man of twenty-one, and by the look in his eyes, ready for battle.

Russell stared at him dully and stooped to pick up Marie. Billie was ahead of him, however, and shoved him aside as easily as a puny child.

"Get out of the road, grandpa," he sneered. "Let a man pick up his own promised bride."

Russell's face flushed red with anger. With a snarl he struck at Billie. There seemed something wrong. He gave a groan and dropt into the easy chair. Marie handed him a glass of water, which he drank greedily. What in the world was coming over him? Ten minutes before he had felt the stream of youth go coursing through his veins, felt strong and happy; now he felt sick and shaky, felt some strange foreboding. He glanced at the mirror. His voice croaked out.

"Billie Hoyt, what have you done to me? Look at me! I am an old man."

Billie laughed. "That's why I called you grandpa. Listen to what I've got to tell you before you have your man James carry you home. When you doped me up you thought that you had put me out of the way for good. I knew better, after I had taken that elixired kitten and had seen it come out from under the influence of that stuff and inside of five minutes, grow old and die. I know then that in order to keep young you must keep taking that stuff. You didn't know that. Well, I took Marie into my scheme and had her remove the elixir from the laboratory and put some other green fluid in the test tubes. Instead of getting your drops of elixir, you have been taking green water. Besides that I found a neutralizer for the elixir, and when Marie gave you that glass of water a minute ago, you drank it. So good-night, Russell, you had better get home while going is good."

"Professor, I brought a marriage license along with me, and Marie and myself will be married within ten minutes. Tomorrow the elixir will leave you, and things will be as they should be."

"Thank God for what you have done, Billie," exclaimed the professor gratefully. "That man Russell had me under his willpower."

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help you. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6177-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE — Spanish
Sheet Metal Worker	Poultry Raising — French
Navigator	Automobiles — Italian

Name_____

Present Occupation_____ 1-28-19

Street and No._____

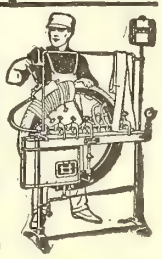
City_____ State_____

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2212 Fourth St. Waupun, Wisconsin

Signals Come in One Clean, Clear Note With Brandes Matched-Tone Headsets

A PAIR of binoculars with each eyepiece perfectly focused brings the detail of the distant landscape into range of your vision. Likewise Brandes Matched-Tone Headsets, with their earpieces tuned in exact unison, bring the weak and indistinct signals within easy range of your ears.

You could not see clearly with binoculars if the eyepieces were not each perfectly focused. Likewise you cannot hear signals clearly with headsets unless the earpieces are perfectly matched in tone.

This feature is found only in

BRANDES
Matched-Tone
HEADSETS

They are guaranteed to be better for clearness, sensitiveness, distance and comfort than any other headsets on the market. If you want to know real headset satisfaction try a Brandes Matched-Tone Headset. They are made in three styles to cover every type of wireless work.



"Superior" weight 14 ozs. complete with head band and polarity indicating cord. Price $8.00.

Here is our offer: Order a pair of our receivers. Try them for ten days in comparison with the phones you have now. If they aren't superior for clearness, sensitiveness, distance and comfort than what you are now using, return them to us and back comes your money immediately and without question.

Send 5c for catalog E

C. BRANDES, Inc.
Room 814 32 Union Square
NEW YORK CITY
Wireless Headset Specialist

"I knew that something was wrong with you, father, or you would never have tried to make me marry Russell."

"Go ahead and marry her, Billie, and may God bless you both. As for me, my children never again will I fool with the elixir. I've learned a lesson. It is one I'll never forget. Don't try to trifle with the laws of the universe."

[THE END.]

Man-Made Falls Develop 100,000 H. P.

(*Continued from page* 981)

a head of 168 feet at a speed of 200 R. P. M. The generators develop current at 4,000 volts potential, which is later stept up thru transformers to 100,000 volts for transmission over copper wires many miles in length.

At the receiving points along the line, the current is stept down thru transformers, and then converted into direct current by means of motor-generators, as shown clearly in the accompanying illustration.

The total horse-power developed by this plant would require over 100,000 horses, filling a road extending from New York to Boston, a distance of 185 miles air-line.

Millions of Horse-power Going to Waste at Niagara Falls

From Niagara River but 26 per cent. of the total flow is diverted for generating electricity. Engineers estimate that 60 per cent. might be diverted without marring the scenic beauty of the falls.

There is practically no variation in the flow of this river throughout the year, making it ideal for hydro-electric development. Millions of horse-power are now going to waste. A treaty with Great Britain limits the amount of power that can be developed now.

After ten years of contention and a serious drain on the coal and oil fields throughout the country, the door has been thrown open for "white coal" to serve industry and the home by the signing of the water-power development bill. The vast water-powers of the country may now be utilized, says C. D. Wagoner, of the General Electric Company.

Fifty million horse-power comprises the total, both steam- and water-generated, now in use in the United States. It is conservatively estimated that as much more can be developed by utilization of the water power resources. The Department of the Interior has placed the potential water power at 60,000,000 horse-power of which but 10,000,000 is now developed. This saves the country upwards of 33,000,000 tons of coal annually.

Assuming that a steam-produced horse-power generated daily for only 12 hours thruout a period of twelve months represents the consumption of five and one-half tons of coal, the substitution of 50,000,000 horse-power from water should make an annual saving of 275,000,000 tons of fuel and avoid the movement of 7,000,000 freight cars. The economic gains, if we made use of our falling waters, would be tremendous, yet there is in service today but 10,000,000 horse-power developed by hydro-electric plants.

Cannot Substitute for Coal in All Cases

It is not contended that water power can entirely take the place of coal. In some instances a substitution for "black coal" cannot be made, but as a supplement

No Seals-No Secrets —*But Service!*

Inspection of the interior of any Radio apparatus bearing the mark:

GREBE RADIO

reveals design and workmanship fully in keeping with its outward appearance.

GREBE RADIO apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service. Our interest in the purchaser does not terminate with the sale.

Ask your dealer to show you our line of super-grade apparatus. If he doesn't carry it, write us—mentioning his name—for catalogue.

A. H. GREBE & CO., Inc.,
70 Van Wyck Blvd., Richmond Hill, N.Y.



Z. R. V. Variometer for $6.50
Short Wave Lengths
Complete catalogs of Radio Apparatus sent for 6 cent stamps.
CLAPP-EASTHAM COMPANY
131 Main St. Cambridge, Mass.

The Corwin Dials

are now used exclusively by the Radio Distributing Co. and all manufacturers whose apparatus is of a superior nature.

If you want indicating dials for superior performance, buy the Corwin Dials. Black composition, white filled engraving, beveled edge.

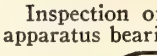
3" Dial.....$0.75. With Knob....$1.30 Postpaid
3⅞" Dial..... 1.00. With Knob.... 1.70 Postpaid

We are distributors of the better class of radio apparatus and offer a superior service on products manufactured by Acme, A. R. Co., Murdock, Clapp Eastham, Moorhead, etc.

Send 10c. for latest catalog describing above dial and all Radio Apparatus.

A. H. CORWIN & CO.
4 W. Park St., Dept. E,1, Newark, N. J.

$10 Brings This Latest Mode L. C. Smith or a Remingto TYPEWRITER



Thoroughly rebuilt in our fac tory by the famous "Young Process." Fully guaranteed. Easy terms. N interest. FREE TRIAL. We hand all standard makes. Write for detail
YOUNG TYPEWRITER CO., Dept. 49, Chica

it will add greatly to the total, pull down the average cost per unit, set electricity to work in the home far more extensively than at present.

Dr. Charles P. Steinmetz, chief consulting engineer for the General Electric Company, who amazed the world a short time ago by his map and figures showing the total water power of the country, compiled by checking up the total rainfall with the various elevations of the United States, warns against too general a belief that the power of our water may ever completely replace the use of coal and oil for power purposes.

Other engineers estimating the effect of the federal bill claim that it will open up at least 4,000,000 horse-power of additional electric energy, and that already about 50 applications for the use of 750,000 horse-power have been filed in Washington. The development of federal water power will, in addition to this, open up 4,000 miles of rivers to navigation.

This is not the whole story of the price we pay for steam traction. Not only are our steam locomotives using up 25 per cent. of all the coal mined in the country yearly, not to mention a great deal of fuel oil, and doing this inefficiently, but the distribution of railway coal requires a tonnage movement amounting to about 20 per cent. of the total revenue-producing freight ton-mileage of our land lines. This is not hard to understand if we recall that there is, first, the coal car's journey from the mine to the railway coaling station; next, the fuel's travel on the engine tender; and then, the mileage of the empty coal car bound back to the colliery and hauled, of course, by steam power. Could the steam locomotive be eliminated, and electric haulage employed instead, we could handle as much freight as we did in 1918, and effect, at the same time a saving of probably 123,000,000 tons of coal.



Send for a Copy of Our Manual of Wireless Telegraphy

We now have ready for distribution our Manual of Wireless Telegraphy. It contains 200 pages, fully illustrating and describing the many instruments used in Radio. 45 pages cover general instructions, diagrams, station calls, tables, codes and other information identified with the art.

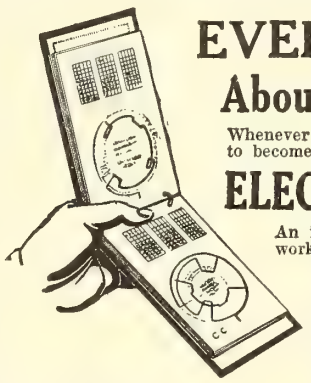
The book is printed on high finished paper with a two-color cover and measures 9x5¾ inches.

Due to the scarcity of paper, the high cost of publication, and in order that the Manual may get into the hands of those most interested in Wireless, we ask 25 cents for it, give a coupon receipt for the amount, which coupon can be applied on a future purchase.

Get Your Copy Before the Edition Is Exhausted

MANHATTAN ELECTRICAL SUPPLY CO. INC.

17 Park Place, New York — 114 S. Wells St., Chicago — 1106 Pine St., St. Louis — 604 Mission St., San Francisco



EVERYTHING You want to know About A. C. Motors and Repairing

Whenever any question arises regarding motors, or if you are anxious to become a specialist on electrical motor work, you need the

ELECTRICAL WORKERS FRIEND

An invaluable collection of diagrams and instructions for electrical workers, students, amateurs, etc.

This book contains 66 motor diagrams with complete instructions for rewinding and reconnecting A. C. Motors. Shows how to put each coil in the slots, giving all internal and external connections. For reconnecting they cover all practical changes showing which diagram to use for the change wanted. Bound in loose leaf form for handy reference. The only complete book of its kind on the market. So simple anyone can understand. It is helping thousands of other workers—it will help you too, as hundreds of testimonials prove.

SPECIAL PRICE, COMPLETE $4.00. Order today. If desired we will ship C.O.D. by Parcel Post.

YOU CAN EARN YOUR COPY FREE

We offer all owners of the Electrical Workers Friend a commission of 50c on every book they help us sell. All you have to do is show your book and recommend it. You can earn the full price of one of these books in a few days. Write immediately for full particulars—this offer is limited.

SMITH & SMITH PUB. CO. 1524 Lowrie St., N. S. Dept. B, Pittsburgh, Pa.

SUCCESS In Practical Electricity by Burgess-Trained Man

MY POLICY

My policy is TRUTHFULNESS in advertising and to give an HONEST and RELIABLE SERVICE. I offer NO FREE INDUCEMENTS but I promise to give you INSTRUCTION, HELP and ADVICE, the kind that is helping hundreds of men and boys to succeed. In other words, my policy is to B² (be square).

YORKE BURGESS, Supt.
Burgess Electrical School
Dept. C, 745 E. 42nd St., Chicago, Ill.

On page eleven of the Burgess Catalog, L. S. Dotsen of Platte City, Mo., tells how he put into practice what he learned through the Burgess Home Instruction Method of Practical Electricity.

Among other work he **repaired** and **installed motors** with absolutely no failures and the **Boss Never Knew He Was On His First Job.**

If you are interested in electricity either as a beginner or as a practical man who wants to advance, you should read Dotsen's letter and the others in the Burgess Catalog.

ELECTRICITY TAUGHT BY A PRACTICAL MAN

A Home Study Course

BURGESS B² SERVICE

INSTRUCTION

The instruction is no cut and dried book plan, but is actually prepared with a view of fitting the individual. In this way one who is slow has the same advantage as others.

COMPLETE ELECTRICAL OUTFIT

Including Apparatus, Tools and Material, is supplied with the course without extra charge.

ELECTRICAL DRAFTING

This is a part of the regular work and certain drafting implements and materials are furnished students without any additional charge.

ELECTRICAL SLIDE RULE

I have written 30 lessons on this subject which are now included as part of the regular course in addition to the lessons on Electricity and Drafting. I am also supplying a Slide Rule and leather case to each student without charge.

A FAIR AND SQUARE STATEMENT

I have been training ambitious men, both young and old, in practical electricity for a number of years by my Home Instruction Method, and would like to send you my catalog, which tells exactly what I do and **HOW I DO IT.** It also tells why, when and where my students succeed and **HOW THEY DO IT.** The catalog costs you nothing—it obligates you in no way whatever, but, for your own good send for it, as it contains things you should know.

YORKE BURGESS, Supt.
Dept. C, 745 East 42nd St. BURGESS ELECTRICAL SCHOOL Chicago, Ill.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section ten cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the March issue must reach us not later than January 22.

The Circulation of Science and Invention is over 140,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York City, N. Y.

Auto Accessories

Tire Agents. Exclusive representatives to use and sell the new Mellinger Extra-Ply Tires. (No seconds.) Guarantee Bond 8,000 miles. Wholesale prices. Sample sections furnished. Mellinger Tire Co., 980 O k, Kansas City, Mo.

Blueprints. Automobile Armatures. See ad under "Electrical." Charles Chittenden.

Fords start easy in cold weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene, using our 1920 carburetors. Increased power; styles for all motors; can attach them yourself. Big profits to agents; money back guarantee; 30 days trial; Air Friction Carburetor Co., 1511 Madison St., Dayton, Ohio.

Auto Motor Supplies—Buick, Michigan, Stoddard-Dayton, Cadillac-Overland, E. M. F. Continental and Buda Motors, all types, $50 each and up. Special high-tension, 2 and 4 cylinder magnetos $9.50 each. Electric and gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Aeronautics

Boys make a model aeroplane that will fly. Easily made at small cost. Write for circular. Aero Shop, 658½ Hurlbut Ave., Detroit, Mich.

Motor Engines and Dynamos

Small motors and generators: ¼ hp. AC $26.50; ½ hp., $38.50; ¾ hp. AC $67.50. Battery charging sets; charging lighting and moving picture arc generators; motors for all phases of current. Prompt delivery; wholesale prices. Write for late catalog. Address Motor Sales Dept. (12), West End, Pittsburgh, Pa.

Steam Engines, one horse power, $18.00. James Chambless, Jasper, Ala.

Motorcycles—Bicycles

Don't buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 1601, Galesburg, Kans.

American Made Toys

An opportunity for Home Workers on small scale and manufacturers on large scale to make American Metal Toys. Army, navy, machine guns, cannons, warships, Indians, cowboys, wild animals, whistles, bird-whistles, religious designs and other toys and novelties. Greatest chance for industrious people to have an independent business. Enormous demand for cheap toys offers unlimited field and great future all over United States and foreign countries. Experience or tools not necessary. Hundreds and more made complete per hour. Casting forms, complete outfit from $3 up. We buy these goods, paying fixed prices. Attractive prices offered for painted goods. A strictly business proposition. No one need apply unless he means business. Booklet and information furnished free. We have no sales agents and we warn against worthless and cheap imitations. Toy Soldier Manufacturing Co., 32 Union Square, New York.

Salesmen Wanted

Live Wire Salesmen to sell absolute essential to garages, service stations, mechanics. Good territory still open. Only men who can handle our proposition exclusively need apply. Liberal commissions. State fully first letter qualifications, experience; give at least two references. Automotive Publishing Co., 438 South Dearborn St., Chicago, Ill.

Salesman. Side or Main line, to sell low priced 6,000-mile guaranteed automobile tires; 30 x 3½ nonskid sells for $13.95; other sizes in proportion. Good money-making proposition for live wires. Master Tire Co., 1414 So. Michigan, Chicago.

Salesmen. Earn $3,500 to $10,000 a year. City or Traveling. Experience unnecessary. Quickly qualify through our amazing system. Free employment service to members. Send for Salesmanship book, list of lines and full particulars. Nat. Salesmen's Training Ass'n., Dept. 158A, Chicago, Ill.

Business Opportunities

$35 Profit Nightly. Small capital starts you. No experience needed. Our machines are used and endorsed by Government institutions. Catalog free. Atlas Moving Picture Co., 459 Morton Bldg., Chicago.

If you want to sell or exchange your farm, unimproved land, city property or patent, write me. John J. Black, 194th St., Chippewa Falls, Wis.

Bates Dynamic Appeal in Literature and Sales Letters, brings profits. All want it. Book proof and facts free to Advertisers. Bates Better Way Advertising, Dept. 41, Springfield, Ohio.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New Ideas. Investigate. Particulars free. Metz, 313 East 89th St., New York.

Oklahoma Farms. Write for free agricultural booklet. Board of Commerce, Shawnee, Oklahoma.

Breed Canaries. Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $2,000 necessary. Will allow expenses to Baltimore as explained. Address, Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

3,384 Moneymaking Plans. Formulas. Trade-Secrets. "Encyclopedia Business Opportunities." 3 volumns $1. Ideal Book Shop, 5501-EV North Robey, Chicago.

Repair Leaky Cisterns. Practical Cement Worker's complete, guaranteed, instructions. $1.00. Lewis H. Jacks, Medford, Oregon.

"Money-Talks." The Business magazine published for progressive people. Send for sample copy. P. O., Box 236-B, Newark, New Jersey.

REAL HONEST TO GOODNESS START. That's what I've given hundreds of Agents. Small Manufacturers with limited capital, desiring to make their own high-class, big selling Specialties in all lines. With my Correct Formulas they soon realized that manufacturing is where the money is. My Valuable Literature descriptive Cocoanut Creme Custard, Allmixt Cake, Vanilla Concentrate, Chocolate Milk Beverage (powdered). Non-alcoholic flavors—Pie fillers—Cero fruit butter, Magico windshield cloths, Ovitone doubles egg production. Latest washing tablets, powders, and hundred other valuable manufacturing propositions for stamp. Muller Chemist, Tampa, Florida.

Big money in your spare time manufacturing letters for signs; no experience—free particulars. H. F. McPherson, 675 Brown Ave., Butler, Pa.

Turn Your Spare Time Into Money for that apparatus you want. Start a profitable, permanent home business. Steady weekly income. No investment but your brains and spare time. Positively no soliciting, agency proposition. Write today. Address Opportunity, Box 175, Fredonia, N. Y.

For $5 I'll write a circular letter so strenuous, it will have to bring you business. Cash with order. Rosenblum, Advertising Expert, 1482 Broadway, N. Y. Telephone Bryant 2653.

I made $30 a Week evenings with a small Mail Order Business Home. Free Booklet tells how. 2c postage. Alex Scott, Cohoes, N. Y.

Be Independent. We teach by mail how to manufacture unexcelled toilet goods. Particulars free. School of Cosmetics, Box C, Omaha, Neb.

Enter a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

Make splendid income right at home as Real Estate Service Expert. No capital or experience required. No course of lessons to study. Just use the successful SIMPLEX PLANS and get quick results. Write today. Send no money. We mail Plans for Free examination. If you keep and use them to build an independent business of your own, pay only $10 for complete plans. Otherwise, remail them within ten days and pay nothing. Act Now and get 12-volume "Real Estate Encyclopedia" free. Simplex Company, Dept. 101, 1133 Broadway, New York.

Man for Sale. Best bid gets me, single, white, healthy business man, age 39. Will go any place. Do anything that's right. Write for reference. A. M. Sanderson, Palestine, Texas.

Agents Wanted

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Agents make big money because sales may be made in every home. Our modern aids to home sanitation have an appeal that cannot be resisted. A brush, mop or duster for every need. Liberal commissions and good territory. North Ridge Brush Company, 127 Clark St., Freeport, Ill.

World-beating stylographic fountain pen. Satisfaction assured. $1.50. Agents Wanted. Morrison Co., Princeton, Indiana.

Agents wanted to sell hosiery. Everybody wears. Samples and instructions free. Hosiery House. Tappan, N. Y.

Agents—$40-$100 week; free samples; gold sign letters; anyone can put on store windows; big demand; liberal offer to general agents. Metallic Letter Co., 433-Z, N. Clark, Chicago.

$6000.00 a year is your profit from 4 sales a day. Davidson sold 96 one week. No experience needed. The Aladdin light is a sensation wherever introduced. 5 times as bright as electric. Won Gold Metal. Farmers have the money, they need this light and 9 out of 10 will buy. Also big opportunity in small towns and suburbs. Excellent spare time and evening seller. No capital required. Sample on free trial. Write for agency proposition while territory still open. Mantle Lamp Company, 507 Aladdin Bldg., Chicago.

Agents—Our soap and toilet article plan is a wonder; get our free sample case offer. Ho-Ro-Co, 138 Locust, St. Louis.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Beginners complete Mail Order System. EX. Box 1005, Atlantic City.

Insyde Tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts; quickly applied; cost little; demand tremendous; profits unlimited. Details free. American Automobile Accessories Co., Dept. T-1981, Cincinnati, Ohio.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Agents. 200% profit. Wonderful little article; something new; sells like wildfire; carry in pocket; write at once for Free Sample. Albert Mills, Gen. Mgr., 2559 American Bldg., Cincinnati, Ohio

Help Wanted

Silvering Mirrors. French Plate taught. Easy to learn. Immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Missouri.

Become Automobile Experts. Boys-Men. $45 weekly. Learn while earning. Write Franklin Institute, Dept. F-806, Rochester, N. Y.

Universal Shorthand Course (Pitman) makes stenographic experts in 36 lessons. Efficiency guaranteed or money back. Helps users of other systems increase pay. Easy terms. Write for Booklet 12. Universal Shorthand Course, 6609 Kimbark Avenue, Chicago, Ill.

Stop daily grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 48, Marion, Indiana.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Men Wanted for detective work. Experience unnecessary. Write J. Ganor, former U. S. Gov't Detective, 135 St. Louis.

Be a Mirror Expert. $3 to 10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Be a Detective. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. Write American School of Criminology, Dept. B, Detroit, Mich.

Detectives earn big money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write, American Detective System, 1968 Broadway, N. Y.

Volume VIII.
Whole No. 94

Science and Invention

H. GERNSBACK, - EDITOR
H. WINFIELD SECOR, - ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D., - ASSOCIATE EDITOR

FEBRUARY
1921
No. 10

A Floating City

WE illustrate an interesting suggestion from a German contemporary, which the editor thereof terms a "Utopia of Karl Ammon," who probably got his idea from Jules Verne's "Floating City." The point is made that in the development of airplanes and dirigibles, great advances have been made in the art of producing light structures which at the same time are strong. This lightness is in the very essence of airplanes and dirigibles, and now in the present project, it is proposed to apply it to the development of a new mode of sea transport.

Four ships, each larger than the "Imperator" are decked in and provide simply room for the working crews for the machinery and for the motive power, and for some or all of the requisite fuel. Thru the body of each ship, starting at the deck, there is an inverted funnel-shaped structure, at whose apex near the keel, is a steel hemisphere forming one member of a massive ball and socket joint. A great platform or deck over fifteen hundred feet square, is carried by the four ships, the entire weight of the great structure resting on the four ball and socket bearings within the four ships.

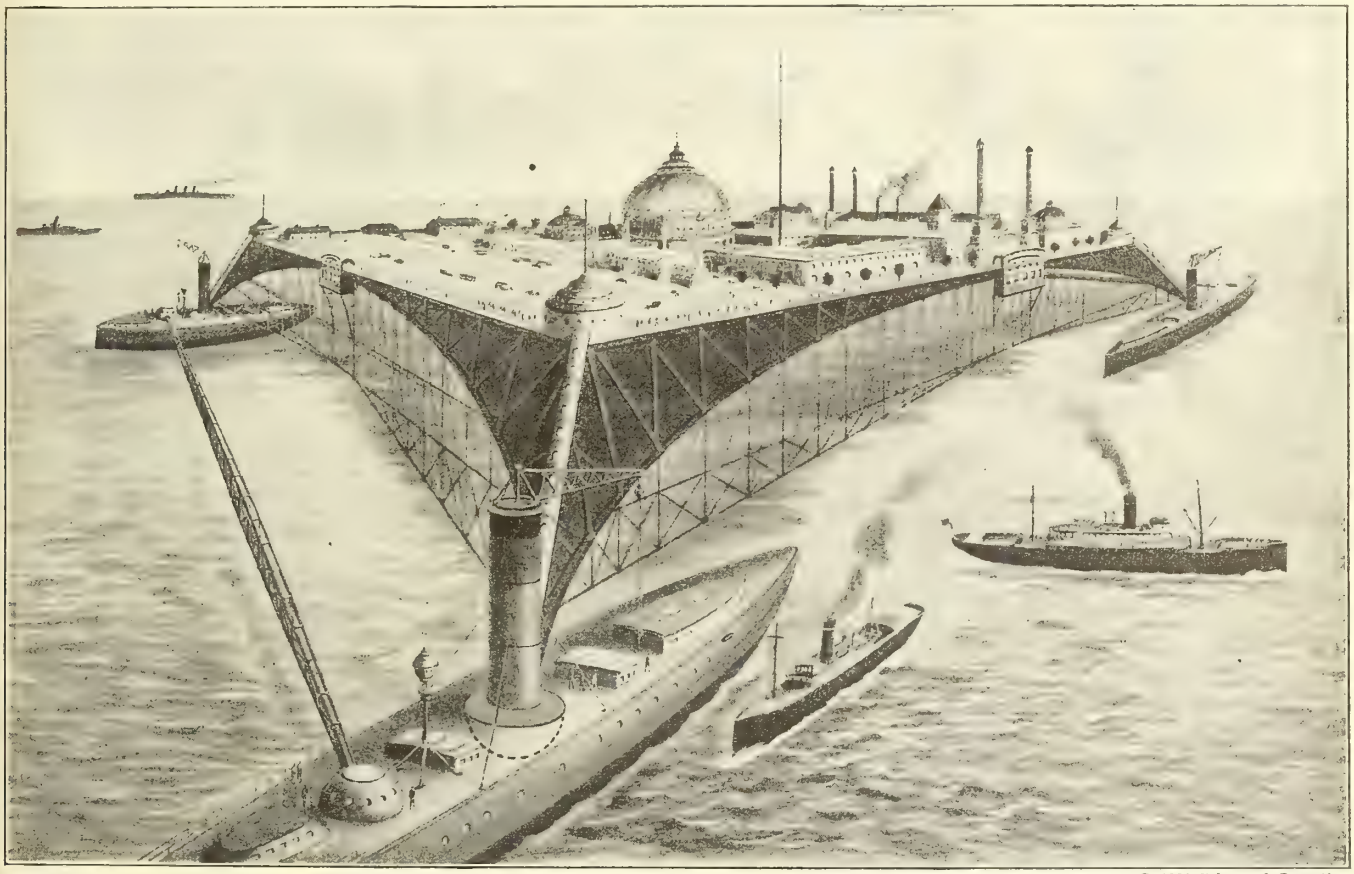
An auxiliary thrust strut is used to keep each pair of ships parallel. The result of all this is that the great platform will have very little motion in the heaviest sea way; the bearings on which it rest are in the part of the ship where the motion is the least and its length of side will also operate to minimize the motion.

On the deck, the imagination of the inventor exercises itself in the construction of hotels and other structures which may be accommodated on so large an area. It will be noticed that it is practically one-third of a mile square. Houses, shops, bathing establishments, theatres, a wireless station and the local telephone service are all supposed to be supplied, and there is to be a printing press to publish a daily paper and special announcements.

In short the proposer wishes to construct an actual *floating city*. Naturally it is claimed that there will be no sea sickness, altho one is free to doubt this. It is said that the traveler will no longer have the feeling of confinement to a small area, but that he or she can spend hours walking about the great deck, which it is claimed will take half an hour to walk around. The mere view of the raging sea from this practically motionless platform high above it will be a wonderful sight it is said.

Of course provision is made for any quantity of freight, automobiles and the like. Out of the funnel-shaped opening in each ship rises a great steel pillar and to this the trusses of the superstructure are secured. All the motion of the platform therefore that arises from the ship is the comparatively slight up and down

(*Continued on page* 1141)



© 1921 Science & Invention

A Floating "Atlantic City" May Be the Realized Dream of Tomorrow. The "City" Is Built on a Huge Platform Nearly One-Third of a Mile Square and Supported by Four Giant Steamships. The Supporting Towers Are Flexibly Mounted in the Holds of the Vessels.

Swiftest Things on Earth

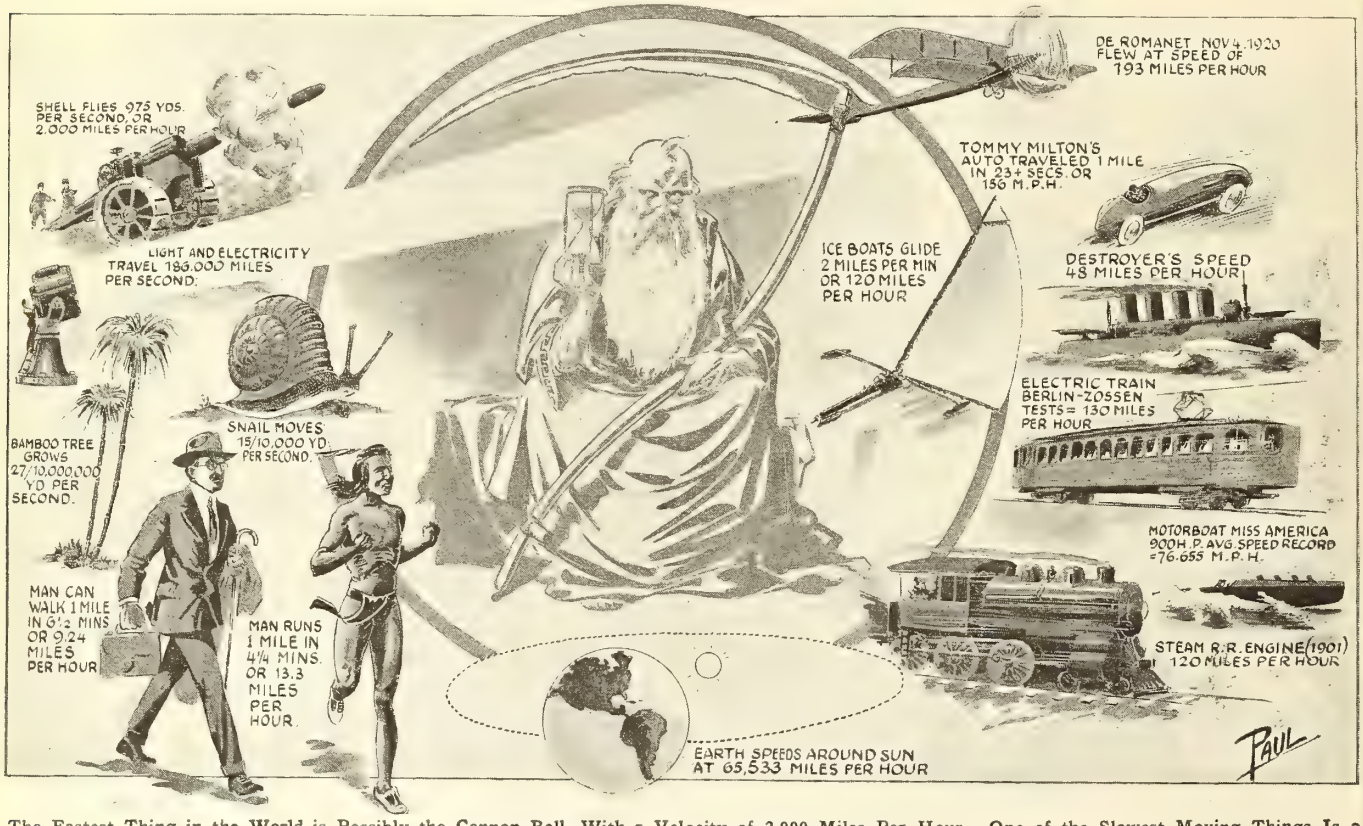
IT is interesting indeed to compare some of the slowest moving things on earth with those which travel the fastest—the fastest thing we know, of course, being radiant light, and one of the slowest things, the human thumb nail which grows 2/1,000,000,000ths of a yard per second.

high horse-power just for the sake of demonstrating high speed in a race, but it is only one-half the horse-power developt by the Maple Leaf-V, which not only was 50 per cent longer in hull measurement, but carried four 450 horse-power Sunbeam engines.

The best speed attained by Maple Leaf-V,

necting New York and Chicago and other large cities to-day. These flyers develop speed in the neighborhood of 70 to 80 miles an hour, and average considerably lower than this.

Sixty miles an hour, or mile-a-minute speed has been proven and is now considered the safe high speed limit for passen-



The Fastest Thing in the World is Possibly the Cannon Ball, With a Velocity of 2,000 Miles Per Hour. One of the Slowest Moving Things Is a Tree Growing, or Also the Human Thumb-Nail.

Next, we may here consider tree growth, the bamboo tree growing at the extremely slow rate of 27/10,000,000ths of a yard per second. Now comes the proverbially slow snail which moves at the average rate of 15/10,000ths of a yard per second.

A man has walked in a record test, one mile in 6½ minutes, equivalent to the rate of 9¼ miles per hour. A man can run, as records show, at the rate of one mile in 4¼ minutes or at 13½ miles per hour. A man has skated at the surprising speed of one mile in 2'1/5 minutes, or about one half as fast as an express train.

The Fastest Boats

Next, we come to fast boats. One of the fastest vessels we know of, is the naval destroyer. Recent high speed tests have demonstrated that one of these ultra-powerful submarine spotters and destroyers can tear thru the open sea at the rate of 42½ knots, which is equivalent to 48 statute miles per hour. The gasoline-engine propelled motorboats of the hydroplane type have gradually outdistanced all other vessels which propel themselves thru or over the surface of the water.

The past year, *Miss America* eclipsed all international rivals and establisht a new world's record with an average speed of 76.655 miles per hour. This was the average of six tests,—three with and three against the stream current. This remarkable motorboat was built just large enough to carry the engineer and pilot, and was powered with two 450 horse-power Liberty motors. This may seem like tremendously

was during her trials when she attained 62.4 miles per hour. *Miss America* has a one step hydroplane hull, and reached a maximum speed in some of her runs, of 77.698 miles per hour, or almost 80 miles an hour.

One of the fastest things in the world capable of carrying a man, is the ice boat. Well built ice boats have attained a velocity of two miles a minute or 120 miles an hour on the Shrewsbury river course. These glide over the ice on runners, propelled by the wind blowing against a large sail. It is an exciting and adventurous sport. Our large ocean liners attain a speed of 26 to 30 miles an hour, but the average of the smaller passenger-carrying vessels is from 10 to 20 miles an hour.

High Speed Railway Trains

Railway trains, strange to say, have not shown us anything new in speed,—even those of the present day! It is peculiar indeed to note that (as pointed out by one of the consulting engineers of the largest locomotive concern in America), it is not considered or shown to be economical or practical at all, to drive a modern steam railway engine and train at a speed in excess of 100 miles per hour. Probably the fastest speed at which a steam engine and train ever flew over the rails, was in 1901 over a five mile run in Florida, when an engine and train attained a speed of 120 miles an hour, or 2 miles per minute. This speed record has never been exceeded, and has not even been approached by the far-famed "20th Century" railroad flyers con-

ger trains, whether on short or long runs for the past ten years, and those who have traveled by rail to any extent, know that this is about the highest speed rate on the average, tho the writer has traveled between Philadelphia and New York and clocked the speed with a stop-watch, when a mile was made in 34 seconds, or at the rate of 108 miles an hour for a distance of a few miles.

The fastest speed attained by electrically driven trains, either with locomotives or with motors on the coaches themselves, is 130 miles per hour, recorded in the tests made some years ago on the German electrified railway between Berlin and Zossen. The trains were tried with various shapes of wind shields fitted on the forward car in an endeavor to reduce the terrific wind resistance encountered at such high speeds, and finally, the trains showed a speed of 130 miles per hour over a measured distance, the highest ever attained by a railway train so far as we know.

Automobiles have carried man over the face of the earth at next to the highest speed ever attained. Tommy Milton, during the past summer, in his famous Duesenberg racing car clipt several seconds from the former world's motor records, including those of De Palma and flew over the measured course at the terrific rate of one mile in a little more than 23 seconds. This brings the speed of man's travel on earth up to 156 miles per hour, and to travel any faster than this, at least at the present time, we have to consider the airplane.

(*Continued on page* 1145)

A Niagara of Bubbles

IT is indeed rather astounding when one visits a large number of theatrical productions and sees the various widely diversified scenic effects, each one representing a new mark of genius. Undoubtedly one of the finest effects obtained in the production "Tickle Me," is obtained thru the use of soap and water. Not alone does it excel in scenic splendor, but is scientifically a feature well worth noting.

This play is the vehicle in which Frank Tinney is starring at the Selwyn Theatre, New York. The effect when the curtain rises is a stage flooded with soap bubbles, millions of them, which come pouring down a long flight of steps, as well as on both sides of the stage. There seems to be no end to them and billions of them are produced in a very few minutes. Of course, the bubbles are very small, probably not averaging over an inch in diameter, but their production in wagon-load quantities results in a scene of splendor hard to forget.

Colored lights play on them constantly, wonderfully enhancing the display. The girls in the play are then seen to romp around in this fairy-like ocean of seething bubbles. Shortly, out of the conglomeration of bubbles, one of the girls appears and descends the long stairway to the stage, pushing aside the white foamy wall until she reaches the stage proper.

The delightful comedy incorporated in this show and the pleasing costumes will not be discust in this brief description. The scientific question now arises as to how these bubbles are formed.

"Back stage," before the curtain rises, one can see the scene being hurriedly put in place. The scenic background consists of five distinct sections, each of which has a double tank approximately one foot high, one foot wide, and eight feet long attached to it. The tank itself is divided longitudinally into two compartments; the lowermost one being about 1½" deep and separated from the upper one by a sheet-iron partition perforated with countless small holes.

On top of this partition are placed shavings of Ivory soap and communicating directly with it is a small trough allowing water to be poured into the tank from behind the scenes. Hundreds of pounds of soap are used every day in the presentation of this novel feature.

To the lower compartment is connected a pipe leading to a motor-driven wind turbine or pump as the illustration shows. Every two tanks are connected to a blower and arranged on the same background prop. The center tank has its own air blower, however, and is placed at the head of a stairway leading to the stage. In back of this center tank is a small platform fitted with a trap-door. A ladder leads to this platform so that at the opportune moment a girl can ascend the ladder, push aside the trap-door and at the same time wend her way thru a dense maze of soap bubbles, down the central stairway.

Of course, the audience does not see how this is done. They only see a girl appearing from the midst of the bubbling mass. So simple is the operation of the apparatus that it takes but a few minutes to fit it up and flood the stage with the rolling billows of bubbles. A gallon of water is used in each tank and poured into the trough after the motors operating the blowers have been started; immediate action results, and the white foam pours from the top of the tanks, which, of course, are left open.

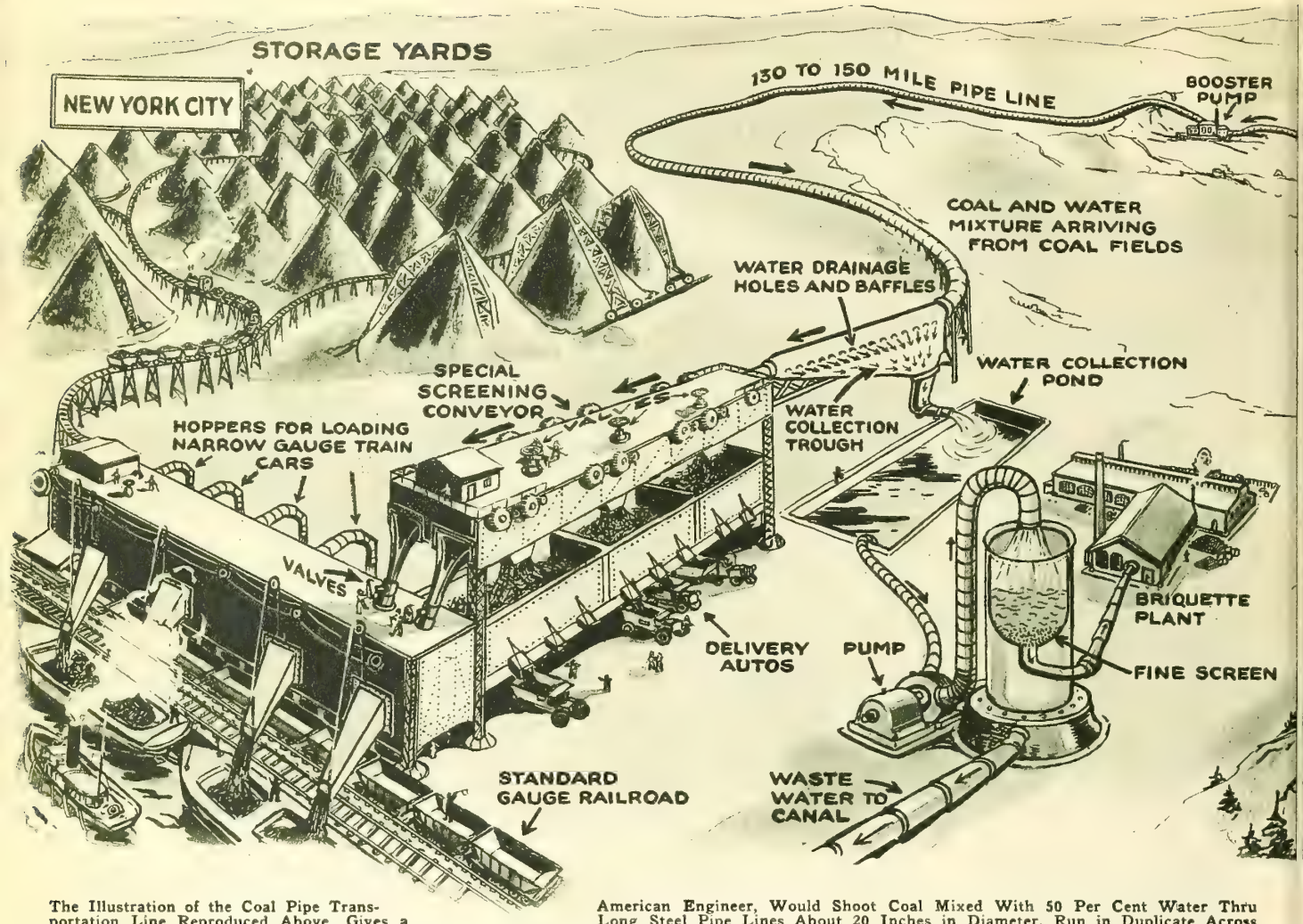
Down the stairway these bubbles roll and spread all over the stage, while all five tanks contribute toward the production of great quantities of beautiful bubbles which roll down over the wall. A short time later, the curtain rises upon the scene.

At the close of the act, another strange occurrence takes place. Armed with brooms and brushes, the stage attendants flatten or pat out the bubbles and sweep them into a receptable provided for the purpose which is located under the stage and whose mouth opens on a level with the stage floor.

The bubbles must wet the stage you will say. Of course, they do, but even this has been protected with a canvas covering, the canvas being removed at the end of the act to allow for subsequent scenes to be erected and is replaced before the stage attendants leave the theatre so as to dry out over night. The fact that the holes in the partition dividing the tank are so small, and as the blower is operated before the water is poured into the tanks, prevents the water from flowing down into the blowers, the air pressure being too great to allow any water which might possibly pass thru the tiny holes passing down into the blowers.



"Novelty" Is the Word That Truly Describes This Scene from a New York Theatrical Production, "Tickle Me," in Which the Chorus Girls Wade and Dance Thru a Veritable Sea of Soap Bubbles and Foam. The Scene Is Exceptionally Striking and Beautiful When Illuminated by Myriads of Colored Light Rays. Electric Blowers Produce the Foam From Bits of Soap Mixed with Water.



The Illustration of the Coal Pipe Transportation Line Reproduced Above, Gives a Clear Idea As to How Mr. R. P. Bolton, An American Engineer, Would Shoot Coal Mixed With 50 Per Cent Water Thru Long Steel Pipe Lines About 20 Inches in Diameter, Run in Duplicate Across the Country Direct from the Coal Mines to the Centers of Distribution. From the Pennsylvania Coal Regions to New York is About 130 Miles Air-Line Distance, as Mr. Bolton Pointed Out in An Interview, But the Distance Might Be Somewhat Longer When the Pipe Line Is Built, As It Is His Idea to Have the Pipe Run Along the Railroad Right-of-Way Which Would Solve Two Important Problems: First, It Would Undoubtedly Mitigate the Heavy Expense of Purchasing An Entirely New Right-of-Way for the Line; and, Second, It Would Automatically Share In the General Maintenance and Protection Afforded by the Regular Railway Personnel, Thus Preventing Tapping of the Line. The View Above Shows How the Water Is Separated from the Coal Thru Openings in the Pipe. This Water, Which Contains, of Course, a Large Amount of Coal Dust and Particles, Discharges Into Large Collection Ponds.

Piping Coal from Mine to City

By REGINALD PELHAM BOLTON
CONSULTING ENGINEER, NEW YORK CITY

THE fuel supply of a great community may be regarded as a vital necessity, second only to that of a supply of water. The latter has long been recognized as a problem to be solved only by the united action of the people, and the vast investment by the metropolis upon its present water system, although unremunerative from a mere monetary standpoint has been endorsed by public opinion on the ground of its necessity. In view of the disturbing conditions of coal shortage which now recurs every winter it would seem that concerted action should also be taken in this problem of fuel supply. The present system of coal delivery has reached a condition of inadequacy that has in recent years become a menace to the health, yes even to the existence of the population. It is the outcome of *undirected growth*. The transportation, handling and delivery to the consumer, are complicated; they require the accurate inter-relation of railroad, harbor and truck operations; they are dependent largely upon vicissitudes of weather in our variable climate, and they employ a variety of agencies, each adding a quota to the cost of the vital material, the expense of which has now risen to a point where its use becomes a luxury to the larger part, which is also the poorer part, of our population, let it be said.

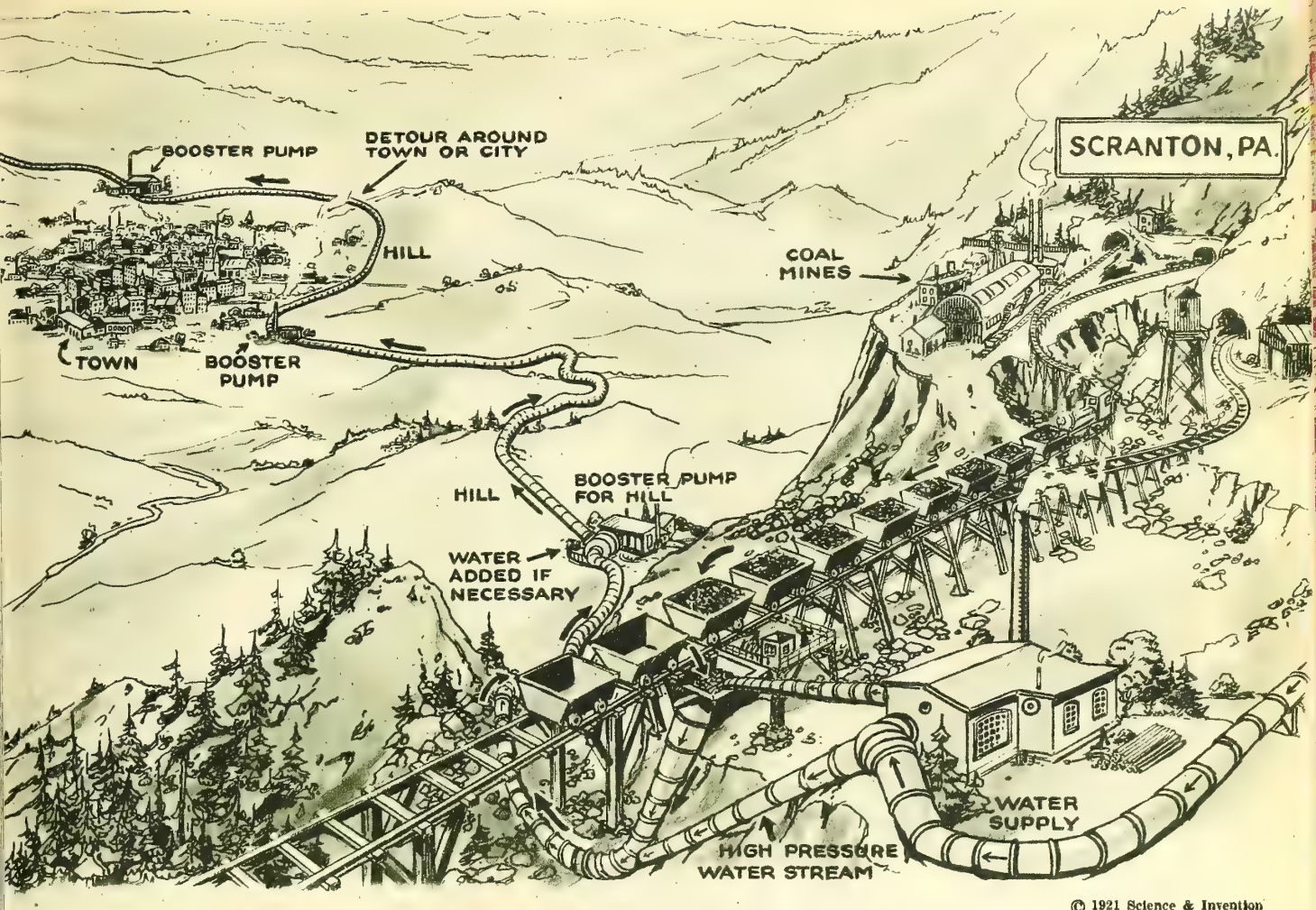
Piping Coal

The bold idea here advanced by an American engineer, Reginald Pelham Bolton, for piping coal from the mines direct to the large industrial and social centers, may seem quite absurd or far-fetched to many of us. However, similar long pipe lines have been in use for a number of years for transporting oil and it undoubtedly will come as a surprise to most people to learn that the Standard Oil Company has had for some time a pipe line 1,500 miles in length carrying oil from Texas oil fields to Philadelphia, Pa., and Bayonne, N. J., great oil distributing centers. This line is composed of a steel pipe 8 inches in diameter, and the oil is forced into the pipe at a pressure of 900 pounds per square inch at the start of its journey. At frequent intervals, there are relay pumping stations along the line which pump the oil so as to keep up the pressure thru the line.

The coal pipe-line transportation scheme advanced by Mr. Bolton and recently submitted to the Mayor of New York City, who has referred it to the city engineering staff, is shown clearly in the accompanying illustration.

This important element in our domestic existence has in fact become as precarious as it is expensive. The exigencies of the city are not provided for in advance. The supply of coal is produced in response to trade demands, no provision is exercised to forestall excessive cold weather and such a situation is always liable to occur as was the case in 1918, when a severe spell of frost bound up the harbor just when the need for fuel was at the maximum. Our system of fuel delivery, more complex than that of water supply but almost of equal importance, is being conducted in a haphazard and uncertain manner at enormous expense and with grave anxiety to the community. The situation cannot improve but must grow increasingly complex as time advances and population increases, unless some new system be adopted that will simplify the methods of transportation, effect a reduction in expense and freedom from weather vicissitudes, and above all will provide an adequate provision in advance for the fuel needs of the city.

It seems time to consider whether some more adequate methods of dealing with this situation, and its probable future increase cannot be found. The fuel best suited for the purpose of domestic heating and the majority of the smaller industries is anthracite (hard coal).



© 1921 Science & Invention

The Pond Water Containing the Coal Particles, Is Then Pumped Into Separating Machines, Where the Water Is Separated from the Coal Particles and the Fine Particles Are Led Off Thru Pipes Into a Briquette Plant, Where the Coal Dust Is Mixed With a Binder and Comprest Into Briquettes of Various Sizes. By Means of Suitable Conveyors or the Usual Railway Distributing Systems, the Incoming Coal at the Receiving End of the Line Can Be Stored in Large Piles As Shown, and Is Also Fed Into the Usual Pockets for Truck Delivery and Is Also Distributed Into Boats at the River Front. The Coal Is Fed Into a Large Hopper at the Mine, Where Water at 800 to 900 Pounds Pressure Is Forced Into the Pipe Line by a Suitable Pump in the Manner Shown—the Coal and Water Mixture Proceeding on Its Way Aided by Gravity, As the Pipe Line Has a Steady Fall From Its Starting Point to the Receiving End. Suitable Centrifugal or Other Pumps Are Placed Along the Line to Boost the Coal and Water Stream. The Coal Would Move at the Rate of 7 Feet Per Second, or Take 27¼ Hours to Make the 130-mile Journey.

Coal Mines but 110 Miles from Delivery Point

Scranton which is near the center of the Pennsylvania coal beds is only about 110 miles in a straight line from Hoboken. The present system of transportation of this fuel, the consumption of which now amounts to about 7 millions of tons per season, is by rail to tidewater, where the coal is transferred to scows, and carried by water to the several parts of the city. It is unloaded to relatively small storage bins on dealers' premises, thence is redelivered to horse-drawn wagons and motor trucks, and by them is hauled to, and often re-handled, at the ultimate point of consumption. The problem thus considered seems to present itself in four features: (1) Supply (2) Transportation (3) Storage (4) Distribution.

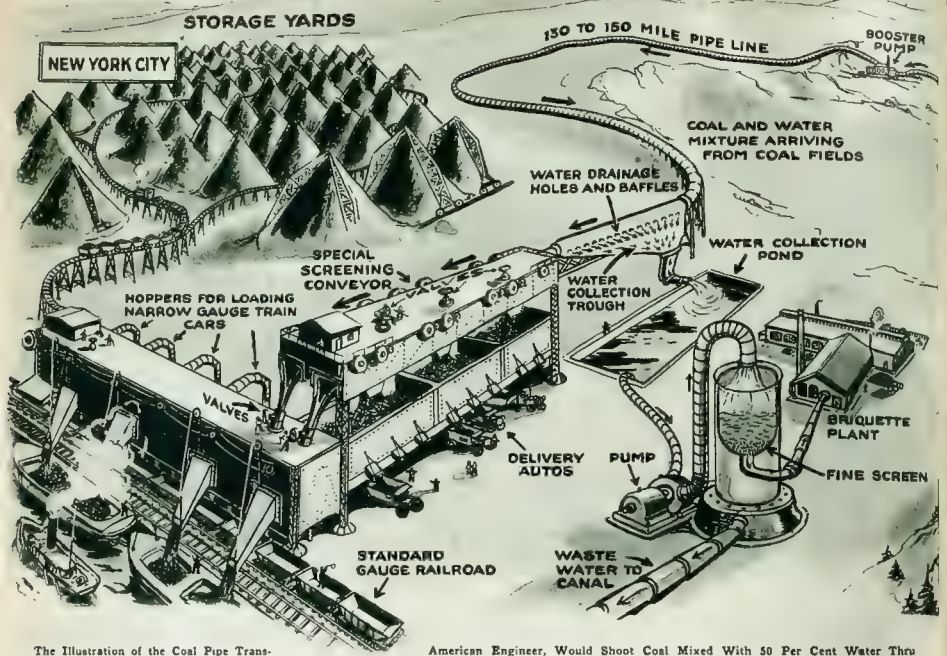
Transportation—Shall We Pipe Coal to Consumers?

It does not follow that the present system of rail transportation of fuel to the City of New York is the only available or the most efficient method. The movement of such a vast quantity of coal over a relatively short distance is an undertaking which may warrant other means of operation. The burning of coal for the purpose of hauling loaded coal cars, and further use in the return of empty cars to the coal region as well as the employment of cars needed for other purposes must be considered in comparing the advantages or cost of other methods of transportation. Attention is directed by the evident limitations and the uneconomic character of our present methods, to the possibility of the transportation of fuel with water in pipe-lines, which was suggested before a technical audience by Mr. Geo. C. Orrok in 1918. This method was originally proposed and was successfully tested more than a quarter of a century ago by the late W. Andrews. It seems to present no impracticable features, as the transportation of soil and stones in the process of hydraulic dredging demonstrates. It involves very simple means and materials—A head of water, steel piping of moderate proportions, coal broken below a given size, and some means of separating the liquid and solid materials at the point of delivery. The fuel has been found to travel satisfactorily with water in proportion of 50 per cent of the total volume, in the pipe and in that proportion and with a sufficient head of water the capacity of a single steel pipe 20 inches in diameter would be six millions of tons in a year. The installation of such a pipeline in duplicate, would offer less difficulty and far less expense than a water conduit as it could probably be laid on the surface, following some railroad right of way. The grade is all in the direction of the flow. It is to be observed that recent experiments have also demonstrated the feasibility of transporting fuel in pipes, by means of an air blast, when the material is in a dry and powdered condition. Fuel in that form can be transported in pipes of as small a size as three inches in diameter. Great interest is now being exhibited in the process of pulverizing low-grade fuel for power purposes, which may render available for such service the vast stores of lignite, as well as making it possible to utilize the wastage of coal mining. The process of pulverization is simple, and could be conducted economically at the mines, with power produced by burning the small or waste grades of fuel. The larger sizes would thus be released for transportation by the pipe line method.

Storage of Coal

This part of the subject has an importance quite apart from the question of production or transportation, as a precaution against the danger of shortage, and the protection of the poorer part of the population from the excessive prices they are compelled to pay for their small supplies of fuel. The effect of a large storage would be beneficial to the operation of the mines, affording the means of more regular mining, and continuous employment during slack season.

The storage of a whole season's supply involves no very large area of land, even if the material should be, for protection against fire, divided into a number of sections. Seven million tons would, if piled to an average height of 25 feet occupy a ground area of about 2 miles in length by 1,000 feet in width, a space readily available in the Hackensack meadow district. A complete system would involve individual storages in the several boros of the City, thereby affording a desirable security against the effects of ice and delays due to water transport in the harbor.



The Illustration of the Coal Pipe Transportation Line Reproduced Above, Gives a Clear Idea As to How Mr. R. P. Bolton, An American Engineer, Would Shoot Coal Mixed With 50 Per Cent Water Thru Long Steel Pipe Lines About 20 Inches in Diameter, Run in Duplicate Across the Country Direct from the Coal Mines to the Centers of Distribution. From the Pennsylvania Coal Regions to New York is About 130 Miles Air-Line Distance, as Mr. Bolton Pointed Out in An Interview, But the Distance Might Be Somewhat Longer When the Pipe Line Is Built, As It Is His Idea to Have the Pipe Run Along the Railroad Right-of-Way Which Would Solve Two Important Problems: First, It Would Undoubtedly Mitigate the Heavy Expense of Furchasing An Entirely New Right-of-Way for the Line; and, Second, It Would Automatically Share In the General Maintenance and Protection Afforded by the Regular Railway Personnel, Thus Preventing Tapping of the Line. The View Above Shows How the Water Is Separated from the Coal Thru Openings in the Pipe. This Water, Which Contains, of Course, a Large Amount of Coal Dust and Particles, Discharges Into Large Collection Ponds.

Piping Coal from Mine to City

By REGINALD PELHAM BOLTON
CONSULTING ENGINEER, NEW YORK CITY

THE fuel supply of a great community may be regarded as a vital necessity, second only to that of a supply of water. The latter has long been recognized as a problem to be solved only by the united action of the people, and the vast investment by the metropolis upon its present water system, although unremunerative from a mere monetary standpoint has been endorsed by public opinion on the ground of its necessity. In view of the disturbing conditions of coal shortage which now recurs every winter it would seem that concerted action should also be taken in this problem of fuel supply. The present system of coal delivery has reached a condition of inadequacy that has in recent years become a menace to the health, yes even to the existence of the population. It is the outcome of *undirected growth*. The transportation, handling and delivery to the consumer, are complicated; they require the accurate inter-relation of railroad, harbor and truck operations; they are dependent largely upon vicissitudes of weather in our variable climate, and they employ a variety of agencies, each adding a quota to the cost of the vital material, the expense of which has now risen to a point where its use becomes a luxury to the larger part, which is also the poorer part, of our population, let it be said.

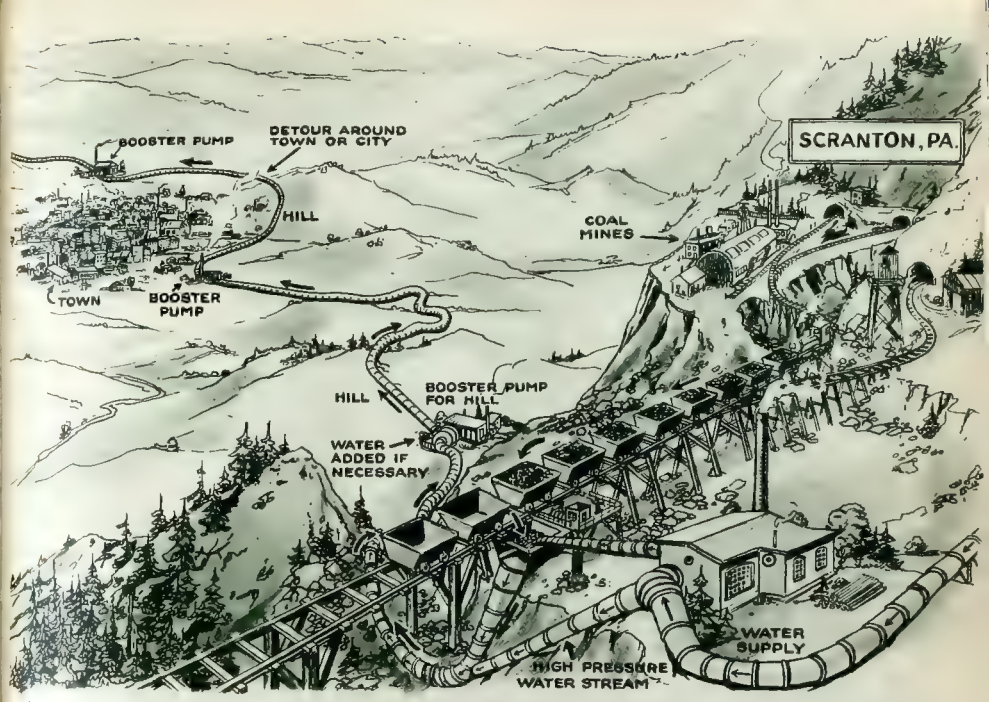
Piping Coal

The bold idea here advanced by an American engineer, Reginald Pelham Bolton, for piping coal from the mines direct to the large industrial and social centers, may seem quite absurd or far-fetched to many of us. However, similar long pipe lines have been in use for a number of years for transporting oil and it undoubtedly will come as a surprise to most people to learn that the Standard Oil Company has had for some time a pipe line 1,500 miles in length carrying oil from Texas oil fields to Philadelphia, Pa., and Bayonne, N. J., great oil distributing centers. This line is composed of a steel pipe 8 inches in diameter, and the oil is forced into the pipe at a pressure of 900 pounds per square inch at the start of its journey. At frequent intervals, there are relay pumping stations along the line which pump the oil so as to keep up the pressure thru the line.

The coal pipe-line transportation scheme advanced by Mr. Bolton and recently submitted to the Mayor of New York City, who has referred it to the city engineering staff, is shown clearly in the accompanying illustration.

This important element in our domestic existence has in fact become as precarious as it is expensive. The exigencies of the city are not provided for in advance. The supply of coal is produced in response to trade demands, no provision is exercised to forestall excessive cold weather and such a situation is always liable to occur as was the case in 1918, when a severe spell of frost bound up the harbor just when the need for fuel was at the maximum. Our system of fuel delivery, more complex than that of water supply but almost of equal importance, is being conducted in a haphazard and uncertain manner at enormous expense and with grave anxiety to the community. The situation cannot improve but must grow increasingly complex as time advances and population increases, unless some new system be adopted that will simplify the methods of transportation, effect a reduction in expense and freedom from weather vicissitudes, and above all will provide an adequate provision in advance for the fuel needs of the city.

It seems time to consider whether some more adequate methods of dealing with this situation, and its probable future increase cannot be found. The fuel best suited for the purpose of domestic heating and the majority of the smaller industries is anthracite (hard coal).



© 1921 Science & Invention

The Pond Water Containing the Coal Particles, Is Then Pumped Into Separating Machines, Where the Water Is Separated from the Coal Particles and the Fine Particles Are Led Off Thru Pipes Into a Briquette Plant, Where the Coal Dust Is Mixed With a Binder and Compreat Into Briquettes of Various Sizes. By Means of Suitable Conveyors or the Usual Railway Distributing Systems, the Incoming Coal at the Receiving End of the Line Can Be Stored in Large Piles As Shown, and Is Also Fed Into the Usual Pockets for Truck Delivery and Is Also Distributed Into Boats at the River Front. The Coal Is Fed Into a Large Hopper at the Mine, Where Water at 800 to 900 Pounds Pressure Is Forced Into the Pipe Line by a Suitable Pump in the Manner Shown—the Coal and Water Mixture Proceeding on Its Way Aided by Gravity, As the Pipe Line Has a Steady Fall From Its Starting Point to the Receiving End. Suitable Centrifugal or Other Pumps Are Placed Along the Line to Boost the Coal and Water Stream. The Coal Would Move at the Rate of 7 Feet Per Second, or Take 27¼ Hours to Make the 130-mile Journey.

Coal Mines but 110 Miles from Delivery Point

Scranton which is near the center of the Pennsylvania coal beds is only about 110 miles in a straight line from Hoboken. The present system of transportation of this fuel, the consumption of which now amounts to about 7 millions of tons per season, is by rail to tidewater, where the coal is transferred to scows, and carried by water to the several parts of the city. It is unloaded to relatively small storage bins on dealers' premises, thence is redelivered to horse-drawn wagons and motor trucks, and by them is hauled to, and often re-handled, at the ultimate point of consumption. The problem thus considered seems to present itself in four features: (1) Supply (2) Transportation (3) Storage (4) Distribution.

Transportation—Shall We Pipe Coal to Consumers?

It does not follow that the present system of rail transportation of fuel to the City of New York is the only available or the most efficient method. The movement of such a vast quantity of coal over a relatively short distance is an undertaking which may warrant other means of operation. The burning of coal for the purpose of hauling loaded coal cars, and further use in the return of empty cars to the coal region as well as the employment of cars needed for other purposes must be considered in comparing the advantages or cost of other methods of transportation. Attention is directed by the evident limitations and the uneconomic character of our present methods, to the possibility of the transportation of fuel with water in pipe-lines, which was suggested before a technical audience by Mr. Geo. C. Orrok in 1918. This method was originally proposed and was successfully tested more than a quarter of a century ago by the late W. Andrews. It seems to present no impracticable features, as the transportation of soil and stones in the process of hydraulic dredging demonstrates. It involves very simple means and materials—A head of water, steel piping of moderate proportions, coal broken below a given size, and some means of separating the liquid and solid materials at the point of delivery. The fuel has been found to travel satisfactorily with water in proportion of 50 per cent of the total volume, in the pipe and in that proportion and with a sufficient head of water the capacity of a single steel pipe 20 inches in diameter would be six millions of tons in a year. The installation of such a pipeline in duplicate, would offer less difficulty and far less expense than a water conduit as it could probably be laid on the surface, following some railroad right of way. The grade is all in the direction of the flow. It is to be observed that recent experiments have also demonstrated the feasibility of transporting fuel in pipes, by means of an air blast, when the material is in a dry and powdered condition. Fuel in that form can be transported in pipes of as small a size as three inches in diameter. Great interest is now being exhibited in the process of pulverizing low-grade fuel for power purposes, which may render available for such service the vast stores of lignite, as well as making it possible to utilize the wastage of coal mining. The process of pulverization is simple, and could be conducted economically at the mines, with power produced by burning the small or waste grades of fuel. The larger sizes would thus be released for transportation by the pipe line method.

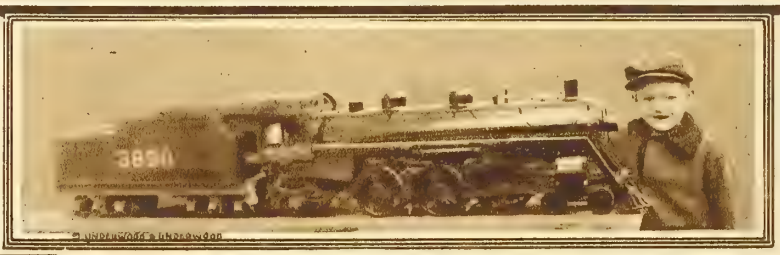
Storage of Coal

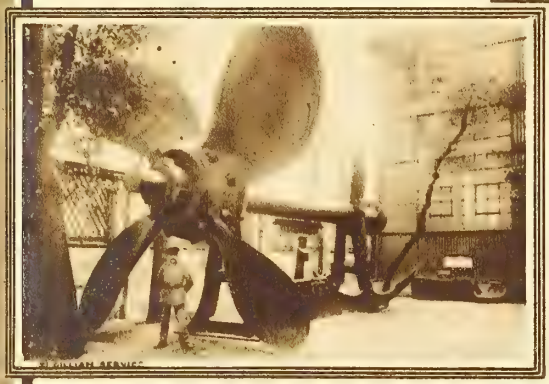
This part of the subject has an importance quite apart from the question of production or transportation, as a precaution against the danger of shortage, and the protection of the poorer part of the population from the excessive prices they are compelled to pay for their small supplies of fuel. The effect of a large storage would be beneficial to the operation of the mines, affording the means of more regular mining, and continuous employment during slack season.

The storage of a whole season's supply involves no very large area of land, even if the material should be, for protection against fire, divided into a number of sections. Seven million tons would, if piled to an average height of 25 feet occupy a ground area of about 2 miles in length by 1,000 feet in width, a space readily available in the Hackensack meadow district. A complete system would involve individual storages in the several boros of the City, thereby affording a desirable security against the effects of ice and delays due to water transport in the harbor.

SCIENCE

This Miniature Locomotive Is Perfect in Every Detail. A Miniature Reproduction of a Modern Boston & Maine, Pacific Type Passenger Locomotive, Remarkable for the Completeness of Its Details, Has Been Built by Norman E. Beers, a Machinist in the Employ of the B. & M. Yards in Ayer, Mass. The Model Has Been Almost Two Years in the Making. This Photo Shows Raymond Beers, the Creator's Son, Beside the Model.





Ocean Liner's Huge Screw. The Enormous Size of this Giant Ship Screw Can be Realized by Comparing It With the Man Standing Beneath. The Photograph Was Taken in Hamburg Where the Screw Was Made for One of the Giant Ocean Liners. The Screw As a Means of Propulsion for Vessels Was First Used in China Centuries Ago. The Device Was Greatly Improved on by the Middle of the Eighteenth Century and in 1841 John Ericsson, the Famous Swedish-American Mechanician Successfully Employed Steam in Screw Propulsion.



Miss Peggy McPoil Off for a Joy Ride in Her "Automobile" Which Was Built by Her Daddie — William McPoil. The Car Can Go Sixty Miles on One Half Gallon of Gasoline—That Is Sixty Miles at the Cost of Fifteen Cents. To Construct and Fully Equip the Car Mr. McPoil's Expense Was One Hundred and Seventy-Five Dollars. To Complete the Outfit Peggy Was Presented with a Leather Coat. Photo Shows Peggy Saying Farewell to Daddie.

A Freight-Car Auto Truck! To Solve the Problem of Freight Congestion, An Enterprising Firm of Long Island City Automobile and Auto Truck Body Builders, Built This Auto Truck Freight Car Body, Which Has Proved Its Usefulness. It Is Designed to Carry Big Loads.

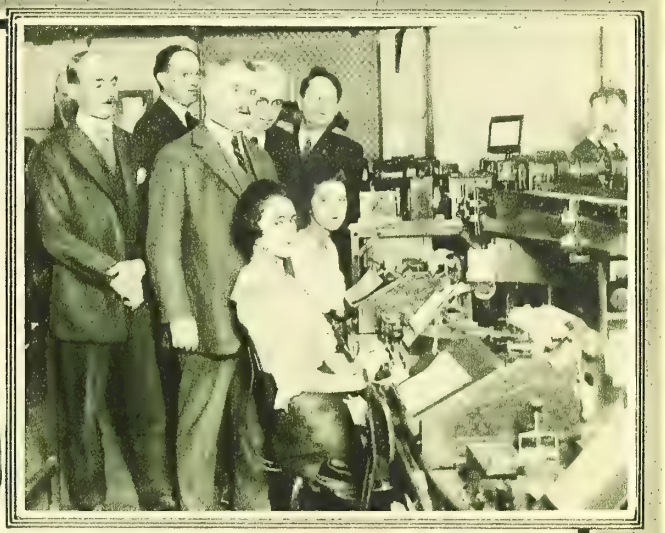


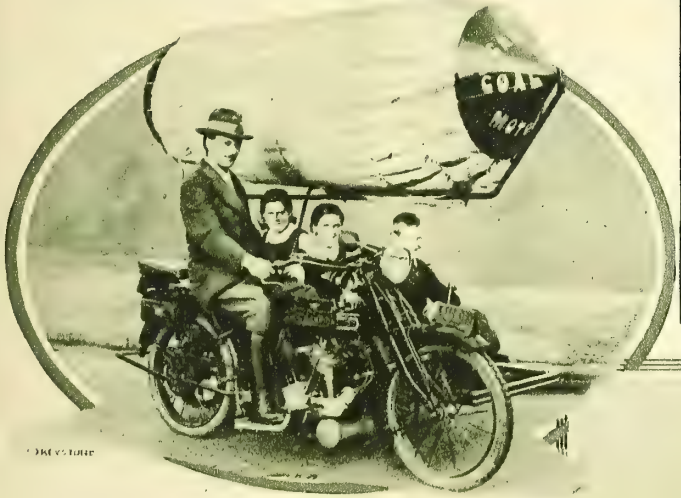
What Do You Think Created This Magnificent Display Against the Black Mantle of Night? Not Fireworks—But An Illuminated Airplane Which Maneuvered About—Dipping, Gliding, Looping the Loop, and What Not. The Camera Has Preserved for Us a Beautiful Picture of the Resulting Display—Better Than the Human Eye—Owing to the Cumulative Effect of All the Light Paths. The Photographic Plate Shows Them All—While the Spectator Sees But One of These Light Paths at a Time.



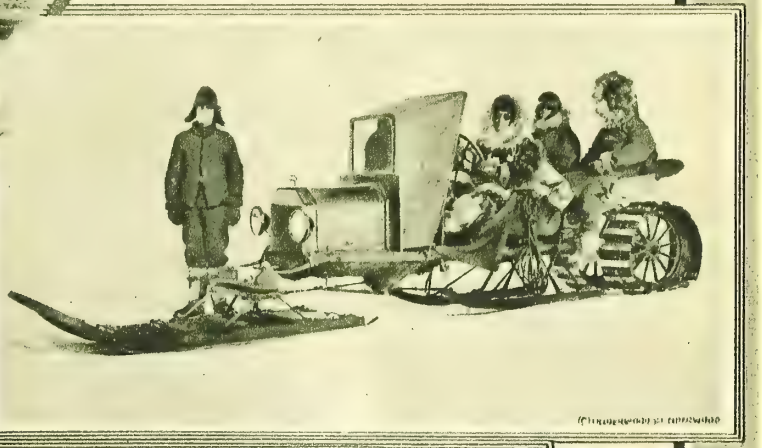
IN PICTURES

Direct Wire Communication Between New York and Seattle Was Inaugurated by the Western Union Telegraph Company Recently. Officials of the Company, Representatives of New York City and of the Chamber of Commerce Witnest the Sending and Receiving of the First Messages Over the Wire, Which Is 3,381 Miles Long. The Messages Are Sent and Received on Automatic Typewriters. A Tape Runs from the Typewriter to an Electric Sending Machine. This Photo Was Made in the Western Union Telegraph Company's Operating Room in New York.



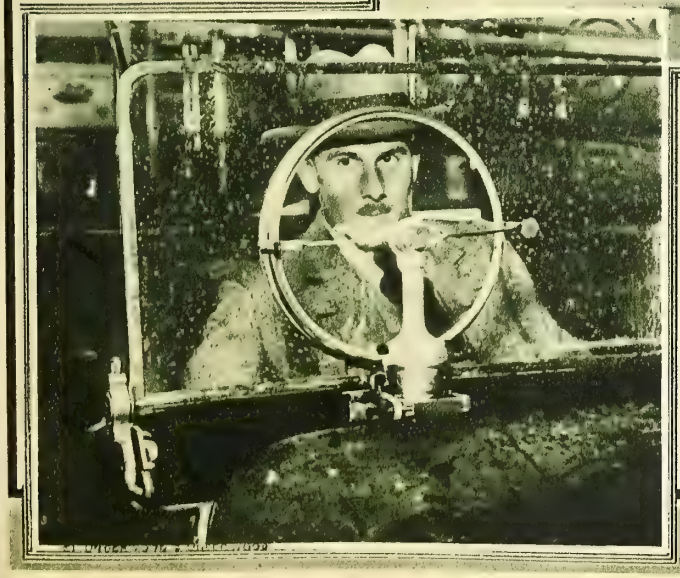


A New Motor-Cycle Novelty With Side Car Driven on "Coal Gas." The First Motor-Cycle and Side-Car Driven by Coal Gas. The Cost of Running Is Two Cents for Ten Miles. It Has Been Driven 100 Miles and Works Very Satisfactorily. The Photo Shows How the Side-Car Can Be Used As a Pleasure, As Well As a Commercial Car. The Passenger Body Is Placed Under the Bag That Carries the Gas.



The "Flivver" Put to the Test in the Bleak North. The "Ford" Bids Fair to Become As Popular in the Snow-Covered North As It Has in More Temperate Climes, Following the Successful Operation of a "Motor Sled," Propelled by the Ford Motor, at Nome, Alaska. The Sled Is Capable of Traveling At Speeds Up to Thirty Miles Per Hour. The Motive Power Is Transmitted to the Rear Axle, Which Is Arranged to Drive Two Wide Slat-Covered Wheels. The Front Sled Is Pivoted and Enables the Driver to Easily Steer the Novel Vehicle.

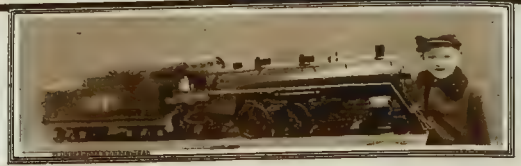




Type of Snow Plow to Keep New York Traffic Open. The Police of New York City Are Already Receiving Instruction in the Operation of Snow Tractors, Built After the Lines of the Army Tank, Which Are Expected to Keep Traffic Moving This Winter. Plows Are Either Attached to the Front of the Tractors, Which Are Only of Twelve Horse-Power, or Are Pulled Behind Them. It Is Expected That the Tractors, Large Numbers of Which Have Been Obtained and Will Be Stationed at Various Fire Houses, Will Clear All City Streets in One Day.

A Rotary Windshield for Autos. This Rotary Windshield Was Displayed at England's Biggest Auto Show. When One Side of the Glass Becomes Dirty or Covered With Rain, It Can Be Whirled About and the Dirty Side Wiped Off and the Clean Side Used, Until It Is Time to Turn It Around Again. For Those Not So Fortunate As to Possess One of These Whirling Discs for Their Auto, They May Try Rubbing a Little Glycerine on the Windshield Glass. This Is Said to Prevent Snow and Rain Reducing the Clearness of Vision.

SCIENCE



This Miniature Locomotive Is Perfect in Every Detail. A Miniature Reproduction of a Modern Boston & Maine, Pacific Type Passenger Locomotive, Remarkable for the Completeness of Its Details, Has Been Built by Norman E. Beers, a Machinist in the Employ of the B. & M. Yards in Ayer, Mass. The Model Has Been Almost Two Years in the Making. This Photo Shows Raymond Beers, the Creator's Son, Beside the Model.



Ocean Liner's Huge Screw. The Enormous Size of this Giant Ship Screw Can be Realized by Comparing It With the Man Standing Beneath. The Photograph Was Taken in Hamburg Where the Screw Was Made for One of the Giant Ocean Liners. The Screw As a Means of Propulsion for Vessels Was First Used in China Centuries Ago. The Device Was Greatly Improved on by the Middle of the Eighteenth Century and in 1841 John Ericsson, the Famous Swedish-American Mechanician Successfully Employed Steam in Screw Propulsion.



Miss Peggy McPoil Off for a Joy Ride in Her "Automobile" Which Was Built by Her Daddie — William McPoil. The Car Can Go Sixty Miles on One Half Gallon of Gasoline—That Is Sixty Miles at the Cost of Fifteen Cents. To Construct and Fully Equip the Car Mr. McPoil's Expense Was One Hundred and Seventy-Five Dollars. To Complete the Outfit Peggy Was Presented with a Leather Coat. Photo Shows Peggy Saying Farewell to Daddie.

A Freight-Car Auto Truck! To Solve the Problem of Freight Congestion, An Enterprising Firm of Long Island City Automobile and Auto Truck Body Builders, Built This Auto Truck Freight Car Body, Which Has Proved Its Usefulness. It Is Designed to Carry Big Loads.





What Do You Think Created This Magnificent Display Against the Black Mantle of Night? Not Fireworks—But An Illuminated Airplane Which Maneuvered About—Dipping, Gliding, Looping the Loop, and What Not. The Camera Has Preserved for Us a Beautiful Picture of the Resulting Display—Better Than the Human Eye—Owing to the Cumulative Effect of All the Light Paths. The Photographic Plate Shows Them All—While the Spectator Sees But One of These Light Paths at a Time.

IN PICTURES

Direct Wire Communication Between New York and Seattle Was Inaugurated by the Western Union Telegraph Company Recently. Officials of the Company, Representatives of New York City and of the Chamber of Commerce Witnest the Sending and Receiving of the First Messages Over the Wire, Which Is 3,381 Miles Long. The Messages Are Sent and Received on Automatic Typewriters. A Tape Runs from the Typewriter to an Electric Sending Machine. This Photo Was Made in the Western Union Telegraph Company's Operating Room in New York.





A New Motor-Cycle Novelty With Side Car Driven on "Coal Gas." The First Motor-Cycle and Side-Car Driven by Coal Gas. The Cost of Running Is Two Cents for Ten Miles. It Has Been Driven 100 Miles and Works Very Satisfactorily. The Photo Shows How the Side-Car Can Be Used As a Pleasure, As Well As a Commercial Car. The Passenger Body Is Placed Under the Bag That Carries the Gas.



The "Flivver" Put to the Test in the Bleak North. The "Ford" Bids Fair to Become As Popular in the Snow-Covered North As It Has in More Temperate Climes, Following the Successful Operation of a "Motor Sled," Propelled by the Ford Motor, at Nome, Alaska. The Sled Is Capable of Traveling At Speeds Up to Thirty Miles Per Hour. The Motive Power Is Transmitted to the Rear Axle, Which Is Arranged to Drive Two Wide Slat-Covered Wheels. The Front Sled Is Pivoted and Enables the Driver to Easily Steer the Novel Vehicle.





Type of Snow Plow to Keep New York Traffic Open. The Police of New York City Are Already Receiving Instruction in the Operation of Snow Tractors, Built After the Lines of the Army Tank, Which Are Expected to Keep Traffic Moving This Winter. Plows Are Either Attached to the Front of the Tractors, Which Are Only of Twelve Horse-Power, or Are Pulled Behind Them. It Is Expected That the Tractors, Large Numbers of Which Have Been Obtained and Will Be Stationed at Various Fire Houses, Will Clear All City Streets in One Day.

A Rotary Windshield for Autos. This Rotary Windshield Was Displayed at England's Biggest Auto Show. When One Side of the Glass Becomes Dirty or Covered With Rain, It Can Be Whirled About and the Dirty Side Wiped Off and the Clean Side Used, Until It Is Time to Turn It Around Again. For Those Not So Fortunate As to Possess One of These Whirling Discs for Their Auto, They May Try Rubbing a Little Glycerine on the Windshield Glass. This Is Said to Prevent Snow and Rain Reducing the Clearness of Vision.

A Radiogenes

By CHARLES S. WOLFE

THE last train up in the evening—it put in its appearance, by the way, at 6:10—brought Mr. William Jones—no degrees—back to his native village.

William had behind him, to his credit or discredit, as you will, four years of roaming, done mostly on sundry tramp freighters. On these hoary-funneled free lances of the deep he had been known as "Sparks" because of the fact that he admitted that he was a wireless telegraph operator. Because of his ready admittance, perhaps, he had seldom been called on to prove it.

The village band was not at the station to greet him. Neither had the populace turned out in force. No one fell on his neck. The only thing that showed any desire to thus greet the prodigal were a dozen empty milk-cans, hurled by a hasty baggage master.

No one had killed the fatted calf. Nor did his father run to greet him while he was still afar off. As a matter of fact, the old man was in his accustomed chair in the kitchen when William and his suitcase blew in, and Dad greeted him with a non-committal "Hello, Bill."

And so, after supper, William wandered out of the front gate and over to the village store to see the boys, as had been his wont before he had journeyed forth to beard the world in its den.

As he closed the gate behind him, his eye fell on the house adjoining, and instantly memory recalled vividly the occupants.

"Fred Ashton," said William to himself, whimsically; "I wonder if he is as mean and shifty as ever, or is he meaner?" For previous and intimate acquaintance with Fred led him to expect the worst from that worthy, and we may note in passing that William was entirely justified.

His keen glance took in the details of the Ashton homestead, and being an observant young man, he noted something that would entirely escape the casual observer.

The rain spouts were gone! The long downward-leading pipes had been removed, leaving only short lengths leading from the roof gutters, and under these, on the ground below, stood barrels to catch the drip.

"Now that's funny," mused William, and then forgot it, as an old pal hove in sight. The affectionate greetings over, the twain hied themselves to the general store.

They found the clan assembled. William had previously learned from his companion that it assembled early of late, for a weighty and engrossing topic needed nightly threshing out. The male population of the village—and of the country at large, for that matter—was deeply interested in the outcome of a pending heavyweight fight for a championship.

One Punch Molinsky and Bruiser O'Brien were scheduled to pummel each other some three nights hence, and each of the Italians had a considerable following. In this particular village the factions, considered numerically, were about equal. Furious and loud waxed discussion, and William soon found that the sinful practice of wagering was not an entirely unknown pastime in these wilds.

Fred Ashton was there delivering freely his opinions of the outcome of the impending mêlée, but all efforts to get him to back his ideas with coin of the realm were futile. To all offers and taunts he merely grinned impudently, and said, "I'll place my bets on the night of the fight, and not before."

When the session broke up that evening, William, perforce, walked home with Ashton. He found him the same arrogant, overbearing Fred of old, and whatever views Bill may have entertained regarding the ability of the two heralded contestants never got aired, for there was simply no place that they could be wedged in between Ashton's ever-expanding monologue.

William bade him a thankful goodnight at the gate, and made his way quietly to his room. His window opened out toward the Ashton residence, and as he sat there in the darkness, puffing a meditative cigarette, an upstairs window in the house across suddenly blazed into light. Watching idly Bill saw Fred enter and seat himself at a table near the window.

Suddenly, with a rather profane ejaculation, William Jones sat bolt upright in his chair, and for the next few minutes he gave Fred his undivided attention.



"And So It Came to Pass That on the Night the Fight Was Pulled Off, Fred Ashton Dropped Into His Chair Before His Instruments and Donned the Headset With Shaking Hands. All Unknown to Fred, in His Carefully Darkened Room a Hundred Feet or So Away, There Sat Also William Jones, Who Chuckled As He Watched Fred's Every Move."

Finally he relaxed, and holding his handkerchief over his mouth, gave way to laughter as nearly silent as he could make it. The tears rolled down his cheeks. "Naughty! naughty!" he gasped, addressing the unsuspecting figure in the lighted room beyond. "Naughty! naughty! Oh, you bad boy!"

For he had established beyond the shadow of a doubt that Fred Ashton was sitting at a table which held one mighty fine wireless receiving set.

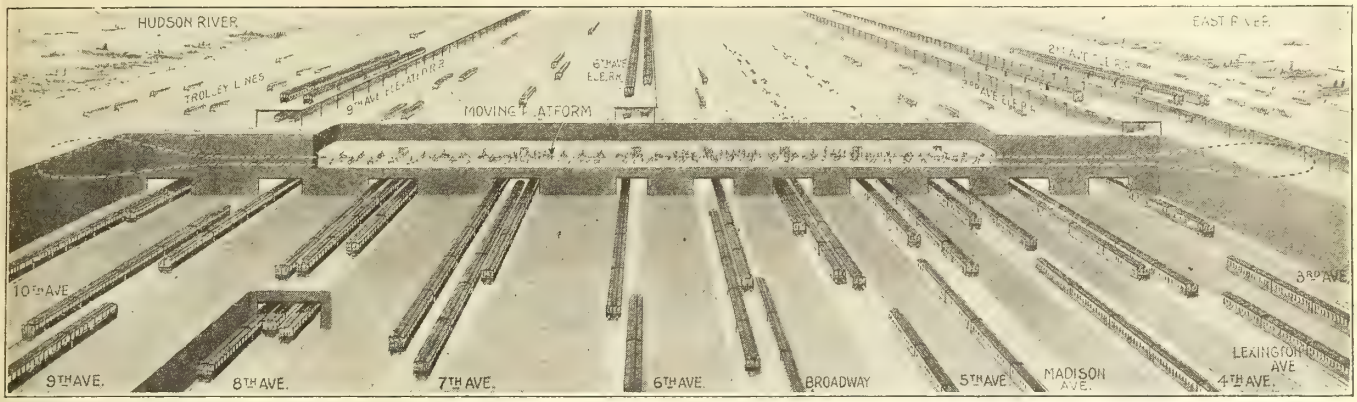
Now several things were clear to Bill. He remembered the rain-spoutless roof, and saw the reason thereof. Master Fred was using it for an aerial. And he saw also the method in the madness that restrained him from making bets until the evening of the fight.

For when the non-resident railroad telegrapher closed the station and departed on the 6:10 every evening, the little village was practically cut off from the rest of the

(*Continued on page* 1133)

New York's Subways a Century Hence

By H. WINFIELD SECOR



A Glimpse of New York's Subway System as it Will Undoubtedly be a Century Hence, Perhaps Within the Next Fifty Years. As Shown, There Is a Subway Operating on Every Avenue Running Along Manhattan Island, Besides Several Elevated Railroads, Which May by That Time be Double or Triple Decked—Not to Mention Double and Triple Decked Streets. A Continuous Moving Platform Has Already Been Designed and Considered to Distribute Traffic Across Town to the Different Subways, Surface and Elevated Transportation Lines.

THE accompanying prophetic drawing by Mr. George Wall shows in a vivid manner a sectional view thru Manhattan Island, when the subways of New York, fifty to one hundred years from now, will undoubtedly honeycomb the entire island. There are at present in some places three, and in some places four arteries of subway traffic running northward along Manhattan Island, narrow as it is. As the artist has clearly shown in the illustration above, the time will undoubtedly arrive, perhaps a great deal sooner than we are inclined to believe, when practically every street will have a subway running below it, underground.

In a recent interview with Reginald Pelham Bolton, a well-known consulting engineer of New York City, and who, it must be said, possesses a far greater range of vision than many of our traffic experts, there were outlined some of the wonderful changes which are undoubtedly in store for the Manhattanites in the years to come—possibly within the next twenty-five to thirty years.

Picking up one of the official subway maps, Mr. Bolton, with a sweep of the hand, stated that the present congestion of the subway lines, the way they are being laid out and built, is not logical, at least so far as the immediate future needs of Greater New York City are concerned. He mentioned that there is entirely too

(*Continued on page* 1129)

My Turret Astronomical Observatory

By HON. JAMES D. HARTNESS

Governor-elect, State of Vermont

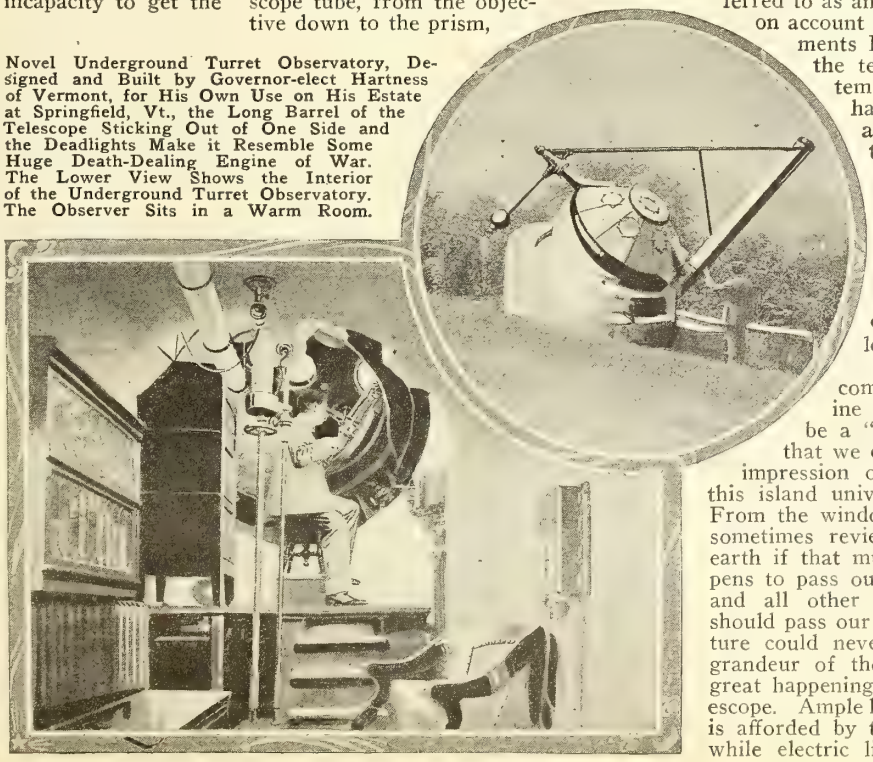
THE Turret Observatory grew out of my experience in the use of a telescope in cold weather. I found that even with the warmest clothing I became thoroly chilled thru at even a moderately low temperature and that when observing in zero weather, to say nothing of still colder weather, which is common to many of our northern states, there was not only great discomforture but also an incapacity to get the best results.

Having had more or less experience in designing machinery, I studied the problem, and after looking over what had been done, I arrived at the conclusion that the turret such as used on a battleship would exactly meet the requirements. Of course the structure of the turret and its mounting had to be designed for this new use. The general result is very satisfactory, at least to an amateur.

The telescope is a refractor, having a ten-inch Brashear objective. The focal length is 140 inches.

The optical train is the same as for the standard telescope, except that a prism is introduced at a point about twenty inches from the eye-piece. Aside from the absorption of this prism, the efficiency of the telescope for optical purposes would be equal to the standard telescope when used with a prism at the eye-piece—the prism at the eye-piece being smaller of course than the one located one-seventh the distance to the objective.

The temperature of the air in the telescope tube, from the objective down to the prism, will be the same as that of the outside air. From the prism into the eye-piece it takes the temperature under the influence of the turret temperature and the inner room. The turret is made of cast iron and weighs one and one-half tons. It is partially jacketed on the inside with wooden lagging. The observing room is kept at a comfortable temperature.



Novel Underground Turret Observatory, Designed and Built by Governor-elect Hartness of Vermont, for His Own Use on His Estate at Springfield, Vt., the Long Barrel of the Telescope Sticking Out of One Side and the Deadlights Make it Resemble Some Huge Death-Dealing Engine of War. The Lower View Shows the Interior of the Underground Turret Observatory. The Observer Sits in a Warm Room.

The Turret Telescope is frequently referred to as an underground observatory on account of the underground apartments I have in connection with the telescope. The whole system of underground rooms has a combined length of about one hundred and twenty feet and the observatory is connected to my residence with a tunnel a little over two hundred feet in length, making it possible to pass from the observatory to my residence in comfort, regardless of the weather.

I believe the time will come when one of the genuine luxuries of the home will be a "window to the skies"—so that we can make and keep a deep impression of the objects comprising this island universe—the visible heavens. From the windows to the street we may sometimes review the greatest show on earth if that much advertised show happens to pass our home, but if that show and all other attractions of the earth should pass our homes, the combined picture could never equal the majesty and grandeur of the celestial show with the great happenings within reach of the telescope. Ample light for the turret chamber is afforded by the deadlights in daytime, while electric lights illuminate at night.

The Radium Institute of Paris

THE Radium Institute of Paris, whose building was not completed when the war broke out, is today the most remarkable among similar establishments actually existing in England or in Germany; as much by the scientific eminence of the managers, Madame Curie and Professor Debierne, as by the perfection of the instruments installed lately in its laboratories.

The Radium Institute is composed of two distinct departments. In one are studied the scientific properties of radium, while the other is devoted to its medical applications. Doctor Regaud, who is in charge of the latter department, which is a branch of the widely known Pasteur Institute, endeavors to cure cancer and tumors by application of Radium and X-rays.

We will first visit the Curie wing. In this laboratory shown to visitors, radioactive bulbs are measured and tested by the piezo electrical quartz method. The operator measures in absolute value the amount of radium contained in each bulb submitted to examination by physicians. In one of the photographs a bulb under test is shown resting on the condenser at the right hand side of the photograph.

In the chemistry laboratories, the visitors may see the prolonged and delicate operations, the numerous fractioning, and repeated crystallizations which are necessary in the preparation of radioactive substances (radium, polonium, actinium, uranium, thorium, etc.). In another photograph Madame Curie can be seen watching the distillation apparatus, in which uranium nitrate is purified, while she is inserting a few milligrams of polonium between two metallic discs. In still another photograph the lamented scientist's wife is shown heating a barium solution containing radium.

The room in which the extraction of *radium emanation* is effected, is the most extraordinary in the Institute. To the left is a cabinet whose sides are lined with lead, in which are preserved the radium compounds. These precious substances are kept in little vials fitted with curved glass tubes, these tubes being connected to mercury manometers. On the day we paid our visit to the Institute $200,000 worth of the precious substance which could have been held in the hollow of the hand was enclosed in a receptacle in the cabinet.

From right to left in the photograph, showing this room, is the group of special pumps of high tension used to obtain a vacuum in the tubes, succeeded by the apparatus for measuring the gas pressure in the emanation vial. The operator, standing in front of this glass gage watches the variations, while the bulbs are being filled. The radium emanations are generally kept in liquid air bottles and the special plant needed for the production of liquid air is installed in the subcellar of the Institute.

An electroscope is used to measure the value of the 24 emanation vials prepared daily at the Institute; the operator using a stop-watch in order to keep the time with great accuracy during the operation.

But owing to the yet unknown effects of these substances upon the human body, the experimenters have to use special tables. These tables are made of oak, and inserted in the joints of the wood are lead screens placed horizontally and vertically to stop the powerful rays during the course of the operations. As can be seen in one of the photographs, the operator introduces the little emanation vial with a tong into a lead tube which makes it harmless for the carrier. In the room where Madame Curie gives her lectures, a view of which appears herewith the following instruments are seen on the table:

In the center, is an amplifier which makes it possible to hear certain particles being emitted by the radium; next come some cathode ray tubes hung on a horizontal wire. On the right are a projection lantern and a coil, with its accessories for the production of currents at high tension used in the experiments made during the lectures.

Among the other elaborate apparatus is the most powerful electromagnet in the world, which has a power of 100,000 gausses.

The X-ray department installed in the Pasteur wing is also remarkable; in one of the X-ray rooms we saw a patient under treatment for a tumor. His head is placed at about 8" from the Coolidge tube which is fitted with a protective screen; the doctor watching the operation thru a window is also protected by a lead screen. In the room where the physician operated on his patient, was an apparatus delivering 120,000 volts for treatment of patients.

To show how complicated are the researches made by the scientists of the Radium Institute a view is shown representing a set used for experiments on X-Ray of long wave length. For these experiments such instruments as gas generators, vacuum pumps, X-ray tubes, and special wavemeters are necessary.

Let us hope that with this remarkable installation the prominent scientists of the Radium Institute of Paris will soon be able to successfully combat the dread disease known as *cancer*.

A Few March Articles

Early Steam Engines, from Hero of Alexandria to James Watt. By Prof. T. O'Conor Sloane, Ph.D., LL.D.

How Big Is an Atom? With Comparative Size Shown in Pictures. By Rogers D. Rusk, M.A.

Rotogravure Printing—The Entire Process Clearly Explained by a Rotogravure Expert. Illustrated.

The Sense of Touch—How We Feel. By Joseph H. Kraus. Illustrated.

Ozone—Its Liquid State. With Apparatus for Producing It. Clearly Shown and Described.

New French and English Tidal Power Projects. Illustrated with Special Pictures.

Crystals—How They Are Formed. With Beautiful Illustrations by William M. Butterfield.

Wall-paper—How and from What It Is Made.—A Real Art. Fully Illustrated with Photos of the Various Processes.

"Home Electrics"—What Makes the Fuse Blow Out. By G. L. Hoadley, M.E.

Why We Grow Bald. By Dr. David J. Calicchio, M.D.

Early Elevated Railroads of New York City. With Some Interesting Photos.

Dr. Pringle Discusses Mind. A Scientific Story of Unusual Appeal. By John De Quer.

Special Rotogravure Feature Pages —"At Home in an Auto"—"How Is Your Mental Balance?"—"New Applications of the X-Ray"—"New Under-Sea Movies"—"Latest Science Happenings"—and Others.

Beside numerous other big feature articles by well-known writers, and all the usual Departments, including Experimental Chemistry, The Constructor, How-To-Make-It, Wrinkles, Home Mechanics, Auto Hints, Popular Astronomy.

German Said to Make Perfect Diamonds

It has taken a German chemist to discover the secret of the diamond. Some time ago there were rumors that an important German firm had not only acquired a patent for the production of these precious stones, but had actually manufactured diamonds in such quantities as to warrant the conviction that yet another of Nature's mysteries has been definitely unveiled.

It is now known that the firm in question is the Dynamite Company, formerly Alfred Nobel of Hamburg.

No details are available as to the nature of the process, though it is believed to differ very considerably from those hitherto tried. I am assured that not only have many diamonds of good size already been produced by it, but also that the cost of production is such that it will be possible to make them very profitably. In quality, too, the artificial stones are said to be equal to any which come from the mines. Indeed, I believe experts have declared the quality of some to be even better than the average natural stone.

The cost of production, of course, is considerable, but is still very much lower than the ruling market price.

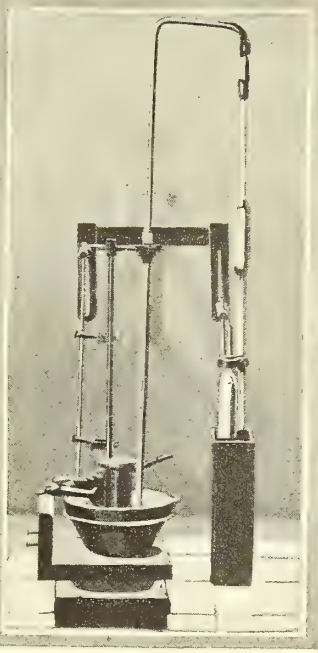
In the diamond market, which is naturally highly interested and not a little alarmed at the news, it is stated today that it is believed the price will be as much as 40 per cent lower.

There has been and is a great business done in diamonds in Germany, and many merchants have large stocks on hand, and they fear a rush to sell may be caused by the prospect of lower prices in other quarters. However, such a fall is not expected, as it is thought that the prices of the artificial stones when they come on the market will be put at a figure only "Just low enough to break the British monopoly," as one merchant said.

The company referred to has not yet sold any diamonds and is producing only at the rate of a few hundred carats daily. Only a few privileged experts have been permitted so far to see the manufactured stones. It is hoped there will soon be a weekly production of between 20,000 and 30,000 carats.



Madame Curie, Who Continued the Search for the Element Radium After Her Husband Died, Is Here Shown Working at a Laboratory Table, Preparing Polonium. Polonium Resembles Bismuth, and Was Separated From Pitchblende by Madame Curie, Even Before Radium Itself Was Discovered. It Is Much More Powerful in Alpha Rays Than Radium, But Its Life Is Only About 208 Days, Whence it Loses Its Entire Activity.



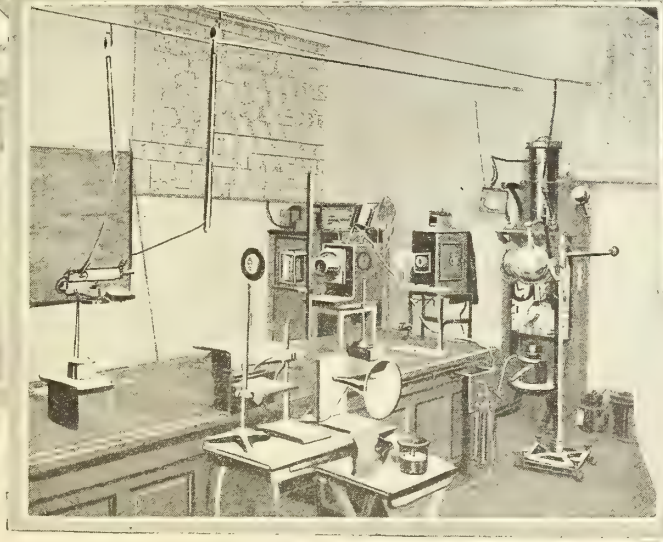
The Phial Shown Above Contains $200,000 Worth of the Costly Element, Radium. So That None of Its Emanations Shall be Lost, it Is Suitably Fitted With Glass Tubes and Other Connected Apparatus, Which Conserve All the Energy Possible. A Square Lead Container Protects the Operator From the Action of This Large Quantity.



Radium Emanation Apparatus for Obtaining the Emanations of Radium and Sealing the Radio-Active Substances Into Glass Containers in the Form of a Gas. In the Lead Safe at the Extreme Left of the Photo Is a Large Quantity of Radium Which Was Dissolved in a Liquid. Connected to the Phial Containing This are Glass Tubes Suitably Fitted With Mercury Containers and the Exhaust Pump Illustrated at the Right Creates a Constant Vacuum, Giving Off a Radium Emanation in the Form of a Gas.



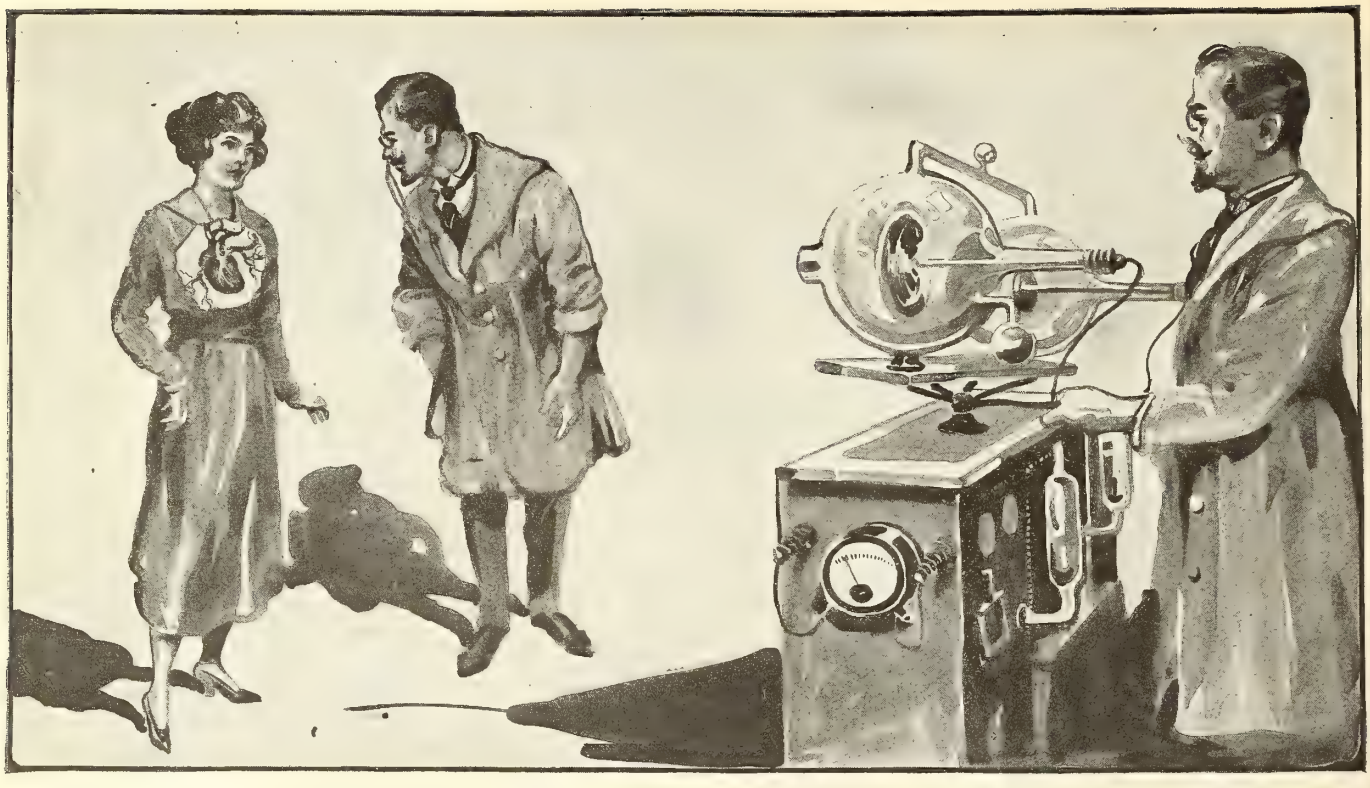
Madame Curie Heating a Uranium Solution. Uranium Activity Was Discovered by Henri Becquerel. M. Becquerel Wrapt a Photographic Plate in Dark Paper and Placed it on a Phosphorescent Substance, Which Was Then Exposed to the Sunlight. By Chance, He Chose a Particularly Phosphorescent Body Containing Uranium.



The Room in Which Madame Curie Carries on Her Famous Lectures on Radium. All Conceivable Forms of Apparatus Which Can Demonstrate the Presence of Radium or Any of the Series of Radio-Active Substances are at Her Command. On the Wall Is Seen a Chart Used in the Lecture Courses.



Apparatus Doubly Fitted With a Lead Screen, Showing the Operator Introducing Radio-Active Tubes Into Phials Which are to be Used for Experimental and Medical Purposes. Generally, Heavier Tubes are Used as Containers as These Filter Some of the Rays and at the Same Time the Tube Is Strengthened.



Tomorrow the Diagnosing Physician Will be Able to Tell Exactly What Ailment You May be Suffering From—Thanks to the "Transparascope." By Employing Vibrations of a Sufficiently High Frequency, Far Higher Than That of X-Rays, for Example, Scientists of Today Believe That it Will be a Relatively Simple Thing to Render an Object Invisible to the Human Eye. The Heart, Lungs, Stomach, et Cetera, Will All be Exposed for the Physician's Inspection Without Recourse to the Knife.

COMING INVENTIONS

The Transparascope

By H. GERNSBACK

Member of American Physical Society

ONCE upon a time the good fairy Hypatia, who had kept Prince Charming from harm thru all his adventures, bestowed upon him a magic cap with these words: "This cap, my prince, must only be used in time of great danger. By wearing it you will become invisible, and thus your enemies will see you not."

Thus run many fairy tales of the past as well as the present. It is a favorite subject not only with children, but with grown-ups as well. But fairy tales have a strange way of coming true these latter days when inexorable science daily blazes away with new wonders, putting in the shade the wildest fairy tales of yesterday. Not only have we the invisible stunt in our fairy tales, but, of course, they do it in the movies, and even on the stage today. Like flying, the art of turning invisible seems to be a secret wish of human nature for some unaccountable reason.

Speaking scientifically, is it possible to make ourselves invisible by any agency known today? We believe we may answer in the affirmative, and the day will surely come in the not too distant future when it will be possible to make our entire bodies, as well as any other object, totally invisible to the eye.

Let us first see what really makes things visible and invisible. Luminous bodies give out light; they radiate light. Illuminated bodies reflect and diffuse light. Some examples of luminous bodies are the sun, a candle, an electric light globe. An example of an illuminated body is the moon or a piece of white paper lying on the table, which we could not see were it not for the diffused light of the room striking it. The paper in this instance throws back the light; thus we see the piece of paper. The case of the moon is analogous.

TABLE OF VIBRATIONS
WHOSE EFFECTS ARE RECOGNIZED AND STUDIED

	Number of Vibrations per Second	
1st Octave	2	
2nd "	4	
3rd "	8	
4th "	16	
5th "	32	
6th "	64	
7th "	128	
8th "	256	SOUND
9th "	512	
10th "	1,024	
15th "	32,768	
20th "	1,047,576	UNKNOWN
25th "	33,554,432	
30th "	1,073,741,824	ELECTRICITY
35th "	34,359,738,368	
40th "	1,099,511,627,776	UNKNOWN
45th "	35,184,372,088,832	
46th "	70,368,744,177,644	
47th "	140,737,468,355,328	HEAT
48th "	281,474,976,710,656	
49th "	562,949,953,421,312	LIGHT
50th "	1,125,899,906,842,624	CHEMICAL RAYS
51st "	2,251,799,813,685,248	UNKNOWN
57th "	144,115,118,075,855,872	
58th "	288,230,376,151,711,744	
59th "	576,460,752,303,423,488	X-RAYS
60th "	1,152,921,504,606,846,976	
61st "	2,305,843,009,213,693,952	
62nd "	4,611,686,618,427,389,904	UNKNOWN

This Elaborate Table of the Known Vibrations Shows How Far Man Has Studied Nature's Great Secrets. Who Knows What Wonders of Science Lie Veiled Beyond the Upper Limit of the Present Vibration Scale?

Certain media, such as water, glass, diamond, air, free space, rock-crystal, etc., are *transparent*. Oiled paper, thin porcelain, etc., are called *"translucent."* Other solids are called *"opaque."* Thus, for instance, stone, wood or gold are termed "opaque," but no body is entirely opaque. Sliced thin enough, all bodies, without exception, become more or less translucent. A thin gold leaf when held against light becomes quite translucent, the light shining thru with a greenish cast.

Light is reflected from smooth, bright surfaces, as is well known, but no matter on what surface the light falls a certain amount of light is always absorbed by all bodies. An analogous case is a water hose turned on a carpet hung against the wall. Most of the water will splash away; in other words, will be reflected. A goodly part will soak into the carpet.

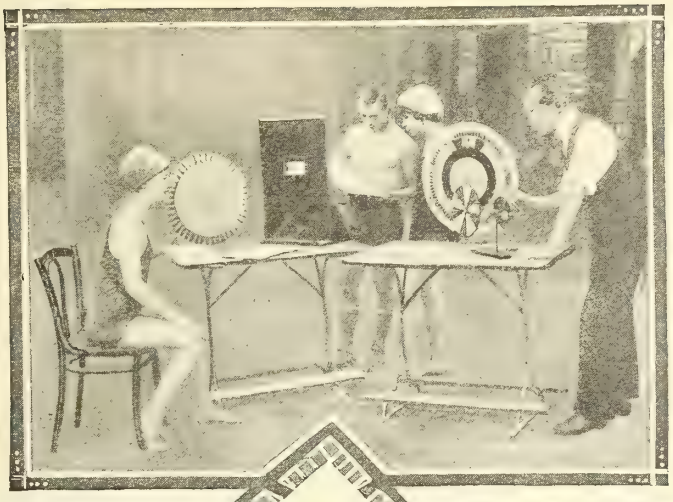
The case with a mirror is very similar. Due to the very small wave lengths of light, even the best mirror to these light waves is very rough and uneven. Therefore, the light is reflected from its unevenness. If a mirror or reflector was absolutely and perfectly smooth, *it would be invisible.* We would simply see in it images of other objects, but the mirror itself could not be seen.

We can now understand why ordinary objects, as, for instance, the human body or a building, are opaque to our eyes, altho we have just seen that light rays penetrate all bodies more or less. If you do not believe this hold your hand between your eyes and the sun. You will see the light shining thru partially. In other words, your flesh becomes partially translucent. We showed already in our April, 1919,

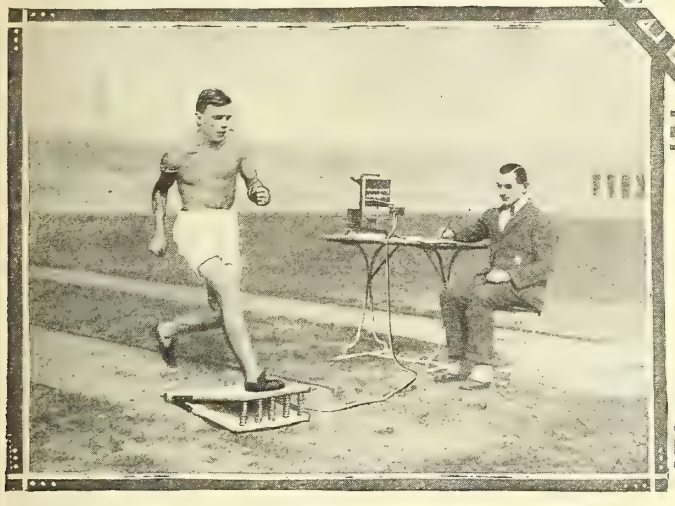
(*Continued on page* 1122)

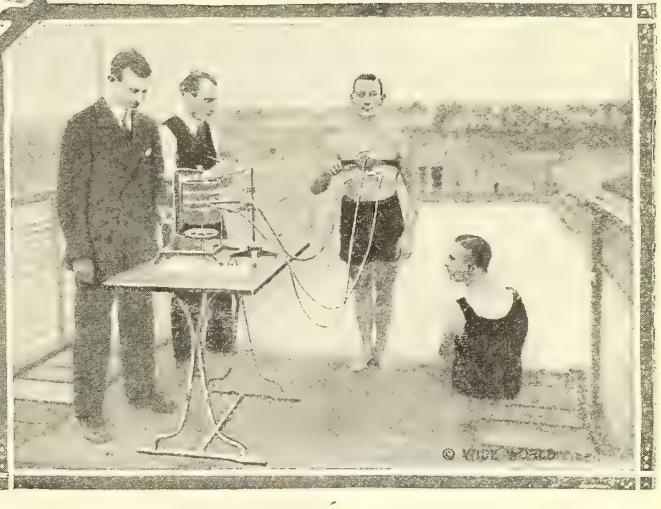
Science Measures the Athlete

DAME SCIENCE has shown her hand in a radical and new departure in some of the European countries, applying new methods to the measurement of the strength and vitality of athletes. The accompanying photographs show the scientific apparatus, most of which is operated by electricity, being used to test the stamina and many other important factors which should always be considered, and which are frequently lost sight of altogether, in amateur athletics at least. Tests for the strength of the eyes as well as for astigmatism and color blindness are included.



Top Photo Shows Young Lady Swimmer Undergoing Scientific Test at German High School. The Colored Targets are Revolved at a Certain Speed and the Effect Visualized by the Contestant Carefully Noted. The Mind Has as Much to Do With the Athlete's Performance, Claims Science, as Has the Body.





Lower Left Photo Shows Electrical Recording Instruments Used in Studying the Various Phases of Jumping.

Below: A High Diver Undergoing Scientific Tests for Lungs and Heart. His Vision Is Also Very Carefully Measured.

Other tests cover the action of the lungs and heart, the quality and degree of hearing, distance and space tests, quickness of thought and decision, fatigue of the muscles, et cetera.

One of the accompanying photos shows several female athletes undergoing tests to determine their fitness to enter a swimming contest.

Another photo shows a swimmer undergoing a thoro test by the scientists, preparatory to making a dive of nearly 100 feet. The heart must be perfectly normal, before the swimmer or diver is allowed to enter any such nerve-straining test or feat as this. He is shown standing at the top of the tower of the swimming school and before being allowed to jump off in his swift plunge toward the pool, he is remorselessly tested by the unfailing instruments for nervousness, pulse and heart action and blood pressure.

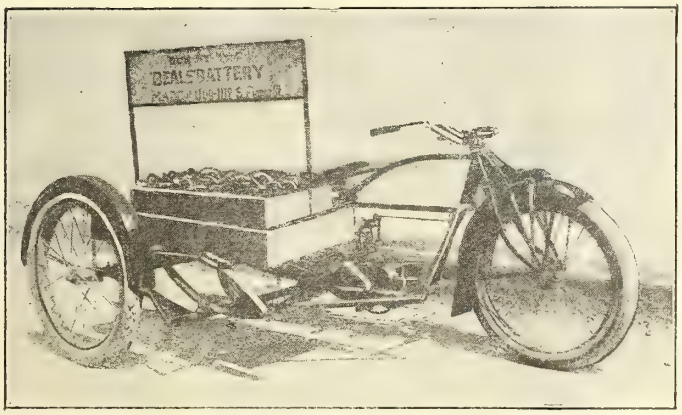
If all of these factors do not check up to normal according to the curves drawn by the needle on the instrument, he is not permitted to undertake the feat.

Another photograph shows a board operating with springs and electrical contacts, ingeniously arranged to determine various important factors in an investigation as to the hindrances encountered in a "broad jump." The spring board with its multiple electrical contacts is connected up to a sensitive register or recording instrument, and the athlete is told to make the jump. The compression of the spring is registered automatically, and also the atmospheric pressure against the body in motion. Then the curves and the position of the body are changed while jumping, so as to eventually diminish atmospheric pressure as much as possible.

Electric Drive for Motorcycles

WE give here a photograph of a successful experiment in driving a motorcycle by electric power. The motorcycle has a side-car, and the side-car carries four storage batteries which furnish the motive power, with space enough left for four additional batteries. The batteries are of the usual automobile starter type of 13 plates per cell; we charge them at 24 volts with a stage connector, therefore the batteries are never removed from the motorcycle.

The motorcycle engine has been removed and a 6-volt automobile starter motor substituted, but it is operated at 12 volts to obtain the necessary power and speed for the requirements of the motorcycle.



Here We Have the Electrically Driven Motorcycle. This Motorcycle Is Driven at a Speed of 15 Miles per Hour or More by a 6-Volt Automobile Starter Motor. The Motor Receives Its Electrical Energy from a Set of 12-Volt Storage Batteries of the Ignition Type.

It travels about 15 miles per hour and is capable of making about eight deliveries per day; it seldom runs down providing it is charged when not in use.

There have been many attempts made to develop a successful, or we might call it a satisfactory, form of electrical storage battery driven motorcycle. We illustrated one several months ago, developed by an English concern, and no doubt some American genius will eventually evolve one which will fulfill the requirements of our motoring public. The electric motorcycle illustrated in the present photograph is not built commercially.

Photograph and description contributed by Mr. Lester C. Beals.

The X-Ray Fluid

By JULES H. STEAN, Ph. D.

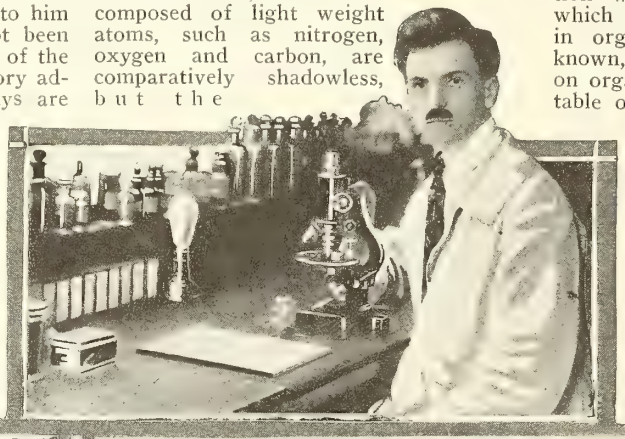
A New Invention That Makes Bodies Transparent

IN the year 1895 when the x-ray was discovered by William Conrad Roentgen, Professor of Physics at Wuerzburg, Germany, the discovery marked a distinct epoch in medical science, and the reported possibilities of what the x-ray was expected to accomplish savored almost of the occult.

Roentgen called his discovery x-ray as the letter x is a representation of the unknown in the mathematical formula. The nature of the x-ray was unknown to him and even today scientists have not been able to determine the exact nature of the mysterious rays. The principal theory advanced at present, is, that the rays are violent ether pulses, set up by the sudden stoppage of the cathode rays, as they strike upon the walls of the tube. In other words, x-rays are considered, in general, of the same nature as light waves, but lie, due to the short wave length, outside the visible spectrum. A definition of the x-ray is: A radiation emanating from a highly exhausted tube when a high tension electric discharge is past thru a vacuum tube. The x-ray is, therefore, the result of a high rate of vibration, of which little is known. These rays can only be recognized upon a sensitized photographic plate, and upon such chemicals as Calcium, Tungstate or Willimite, while the radiation from the x-ray tube cannot be reflected or polarized.

Therefore, radiation from the x-ray tubes produces shadow pictures or radiographs, so that the reproduction on the photographic plate represents only a shadowgraphic form of the body thru which the x-ray has past.

As these rays penetrate all matter according to its density and mass, the picture produced is simply a record which has registered the relative density of the object thru which the rays have past. The picture on the photographic plate will therefore differ in appearance as affected by the density and structure of the object. However, a curious fact remains, that while some substances produce a kind of shadow, others do not, unless the x-ray passes thru a considerable thickness of them. Carbon, for example, with the atomic weight of 12, is practically shadowless when photographed with the x-ray, while glass, containing lead, atomic weight 207, gives a dense shadow. Human and animal tissues, which are composed of light weight atoms, such as nitrogen, oxygen and carbon, are comparatively shadowless, but the bones, which are heavier calcium compounds, produce a marked dense picture with the x-ray photograph.



While the discovery of the x-ray and its action brought valuable information to the medical profession, especially in the examination of the living body, little could be done with the anatomical specimens. A number of specimens for the study of the blood-vessels were produced by injecting metallic salts into the blood vessels and x-ray pictures were produced from those specimens. While this method has a certain value, it cannot be applied with every specimen, as the detail of the tissues is lost. Besides, it is still a shadow picture, which is flat and uninteresting and not the original which can be examined at will from every angle.

Here is where the x-ray fluid sets in and fills a long-needed want in the study of anatomy. X-ray fluid not only penetrates animal and vegetable bodies, but preserves the bodies of the same.

In the years past many attempts have been made to produce a fluid which would make specimens transparent and also act as a preservative. No definite result however has been accomplished.

The action of the x-ray fluid is based upon the principle of refraction. The fluid itself is composed of a number of chemical liquids which surround and penetrate the specimen, making it transparent or semi-transparent at will. It may be considered a law that different tissues or textures have different indices of refraction which differ materially. The law which applies to the index of refraction in organic bodies, and which is well known, may to a certain extent, be applied on organic bodies as follows: If a vegetable or animal body is surrounded and saturated with a liquid whose index of refraction is about one-half of the index of refraction of the body itself, the result is a lesser reflection of light and approximate transparency.

The most difficult part in making animal or vegetable bodies transparent lies in the fact that the texture or tissue, muscle or bone, all have a different index of refraction and this results in some parts acquiring perfect transparency, while other parts appear opaque. This apparent disadvantage, however, is also, an advantage, as we will see.

If a fluid could be found which was able to penetrate every animal or vegetable body evenly, that is, something which would make bodies entirely transparent without being influenced by the different structures, the value would be nil for the simple reason that all the details would be lost and the prepared body would appear much like glass; having lost its prominence which lies in the differentiation of the body structure. *The value of a fluid for this work lies in its power of regulating the transparency of the tissues and structure.*

This can best be illustrated in the cuts. Take for instance the bat. An x-ray would show the bones, while tissue and cartilage would be visible as a shadow only. The x-ray fluid, however, produces an entirely different picture. We see in the photo the skeleton of the animal, parts of the inside body, and in wonderful detail the wings which have changed to thin

(*Continued on page* 1142)



Left: Arm and Hand of a Foetus Which Was Immersed and Preserved in the X-Ray Fluid. This Fluid Renders All Things Transparent and Was Discovered by Dr. Jules H. Stean, a Doctor-Chemist-Psychologist of Alsace-Lorraine Now Residing in Worcester, Mass.

Right: A Bat Immersed in the X-Ray Fluid Which Has Rendered It Transparent. This Discovery Will Revolutionize the Study of Anatomy.

Top View: Dr. Jules H. Stean, Discoverer of Fluid Which Surpasses the X-Ray. When the X-Ray Is Turned Upon Human Hand, It Will Reveal the Bones in Silhouette; Submerge a Hand in the X-Ray Fluid, and Not Only the Bones Appear Clear-Cut and Visible from Any Angle of Approach, But the Veins, Arteries, Muscles and Tissues Will Stand Forth in Well-Defined and Easily Distinguishable Lines. — Photos © by Keystone.

Talking on a "Thread"

UP to the present time sound discs and sound rolls for recording and reproducing sounds, such as talking, etc., have been known under the name of "dictaphone." Mr. E. Stieger, a Swiss engineer, realized the imperfection and disadvantages of such sound-wave producers and tried to find a substitute for these cumbersome media which would be of an extremely compact form and at the same time overcome the disadvantages as to fragility and difficulty with respect to transportation.

All this and still much more has been accomplished by Mr. Steiger, with the invention of the so-called "talking thread" on which even a child may take up and reproduce a conversation without any difficulty. This sound-wave producer is so compact and requires so little space that a thread which carries a five-minute talk may be placed within a watch casing.

It is, therefore, possible to take up and register office dictation as well as correspondence and to send it directly by mail as communications or as a substitute for letters. This "talking thread" is also of especially high value as regards lessons in languages and for communication with blind people.

The thread is not at all liable to be destroyed when encased, used and forwarded, and is not affected by the greatest changes in temperature.

Some of the interesting technical details of the "talking thread" phonograph are described in the American patent issued a short time ago.

To those familiar with the recording and reproduction of speech in the usual phonograph, it is clear enough how this machine might work. But if we cause the recording point or stylus to impress ridges or depressions in the new celluloid thread, and if these undulations, corresponding in pitch and in tone to the variations of the voice, are drawn along under the edge of the reproducting stylus the sounds will be reproduced or translated from the moving thread.

How the "Talking Thread" Works

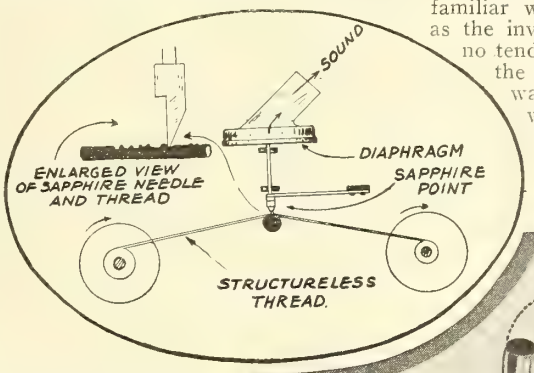
However simple this may be, the moot question arises after a little reflection, as to how the thread always passes back under the reproducing stylus without turning on its axis as it is reeled or unreeled on the spools of the machine.

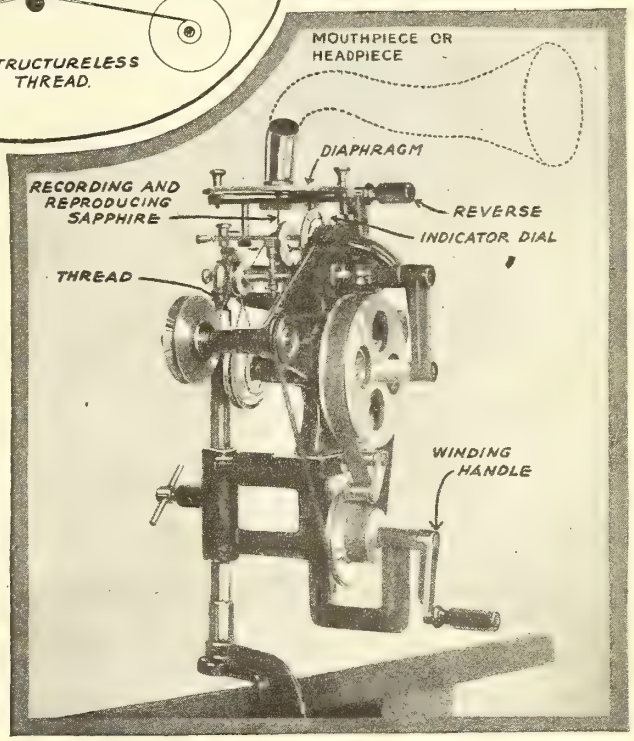
It seems almost incomprehensible that this thread should unreel itself, as the winding mechanism of the machine is reversed, and the thread caused to always keep its *top face* (as we may call it, and which carries the vocal lines or record) uppermost so as to engage the lower end of the stylus which is attached to the diafram of the sound box.

This is accounted for when we come to the description in the patent issued to the inventor, wherein he mentions the all-important fact that the thread used is of a *structureless* nature, that is, similar to the composition of which violin strings are made, which many of us are quite familiar with. Such a thread or string, as the inventor points out, will manifest no tendency whatsoever to twist, hence the same side of the thread will always face outward or uppermost, whichever way you please to call it—both during the recording and reproduction of the voice.

The thread must be made very uniform in diameter, and should also possess an extremely smooth surface, as otherwise there would be heard, of course, noises and other disturbances in the machine when it came to reproducing the voice.

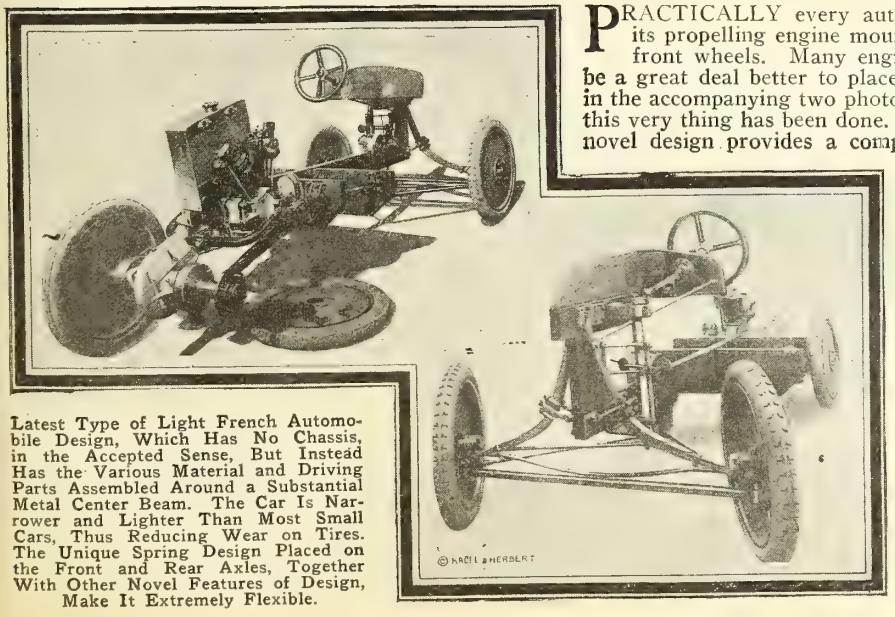
(*Continued on page* 1147)





The Latest Idea in Talking Machines Is Shown in the Accompanying Diagram and Photograph. It Actually and Literally Records Speech on a "Thread," But This Thread Is the Most Wonderful Thread That You Ever Read About. It Is Absolutely Structureless and for This Reason It Will Unwind in One Direction or the Other From the Spools in Exactly the Same Position as That in Which It Was Wound Upon the Spool. The Voice Vibrations are Recorded by a Saffire Needle on the Moving Thread in the Manner Apparent; in Reproduction. These Indentations on the Thread Again Move Under the Needle and Cause the Diafram to Give Forth the Corresponding Sounds.

An Auto Without a Chassis

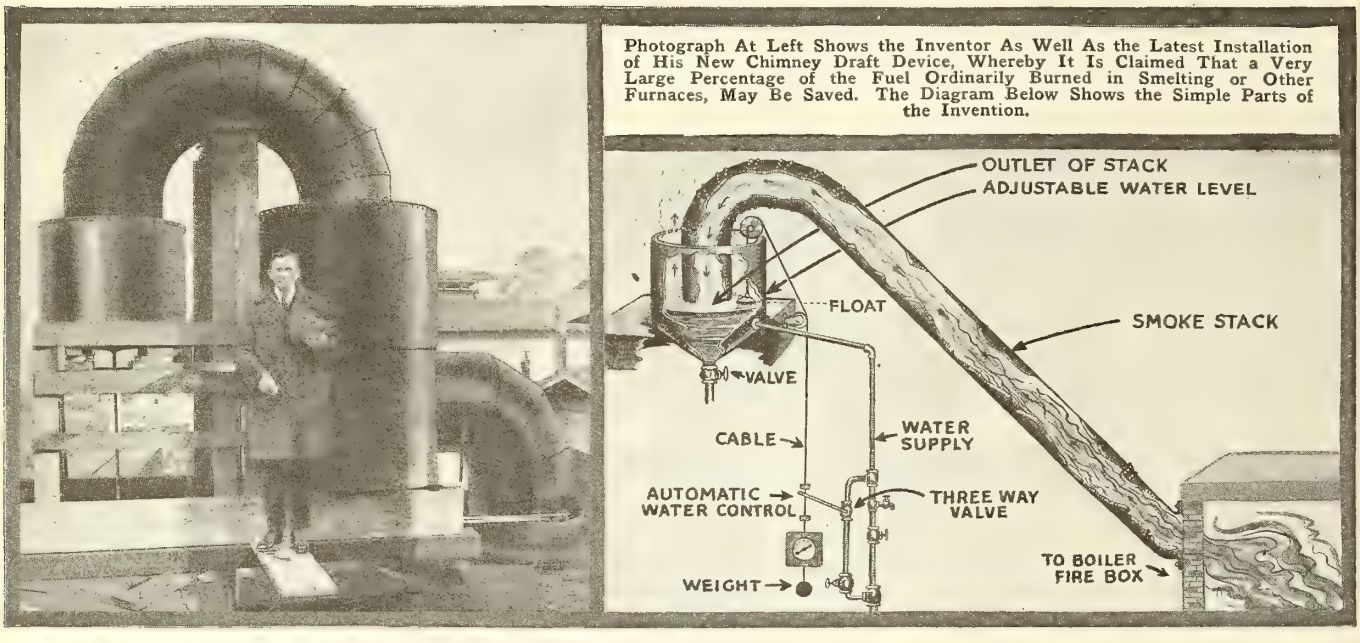


Latest Type of Light French Automobile Design, Which Has No Chassis, in the Accepted Sense, But Instead Has the Various Material and Driving Parts Assembled Around a Substantial Metal Center Beam. The Car Is Narrower and Lighter Than Most Small Cars, Thus Reducing Wear on Tires. The Unique Spring Design Placed on the Front and Rear Axles, Together With Other Novel Features of Design, Make It Extremely Flexible.

PRACTICALLY every automobile that we meet with now-a-days has its propelling engine mounted in the front of the machine or over the front wheels. Many engineers have suggested that it might possibly be a great deal better to place the engine in the rear of the machine, and in the accompanying two photographs of a recent French automobile design this very thing has been done. It is also surprising to note that this recent novel design provides a complete automobile without the body, less the chassis in the usually accepted sense. The machine is assembled around a substantial metal center beam. The front wheels and steering gear are the usual type, while the battery and other gages are mounted on the dash panel as the left-hand photo shows. The two-cylinder engine, with its radiator, mounted on the rear of the machine, drives the differential gear and rear axles thru an enclosed chain drive. Powerful cantilever springs support the rear axle in a very resilient manner, so as to provide extreme flexibility and easy riding qualities. The front axle is likewise given easy riding qualities by means of two long springs in the manner shown in the right-hand photo. This machine is provided with the latest thing in steel wheels and, above all, presents many highly desirable qualifications which would seem to warrant close study by American designers.

New Draft Device Saves Fuel

By HAROLD A. MOORE



Photograph At Left Shows the Inventor As Well As the Latest Installation of His New Chimney Draft Device, Whereby It Is Claimed That a Very Large Percentage of the Fuel Ordinarily Burned in Smelting or Other Furnaces, May Be Saved. The Diagram Below Shows the Simple Parts of the Invention.

THE illustration herewith shows the Anderson draft regulating device, which is said to have been successfully used on a cinnabar furnace in Washington. The principle on which it operates is the regulation of the draft by changing the height of water in a vessel, into whose top the end of the smoke pipe enters, being bent over so as to be vertical. The plane of its end is thus parallel with the surface of the water, and by a float or other similar type of regulation, the water level can be changed so as to modify the draft. The higher the water is, the less draft, and vice versa.

The photograph shows the device as installed in a large cannery plant. The diagram which is made up from the patent drawings, is self-explanatory.

The level of the water is shown quite close to the aperture of the pipe and this really constitutes the outer end of the smoke stack of the furnace.

It is evident that a very delicate regulation of draft can be produced by such a device and a diagram is shown indicating how the automatic feature can be attached. The float, rising and falling, opens or shuts the cock admitting water to the

(*Continued on page* 1141)

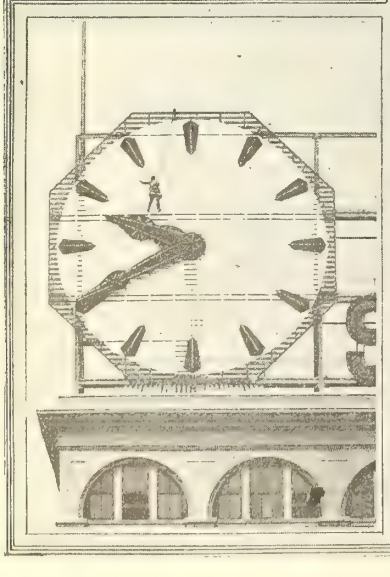
World's Largest Clock

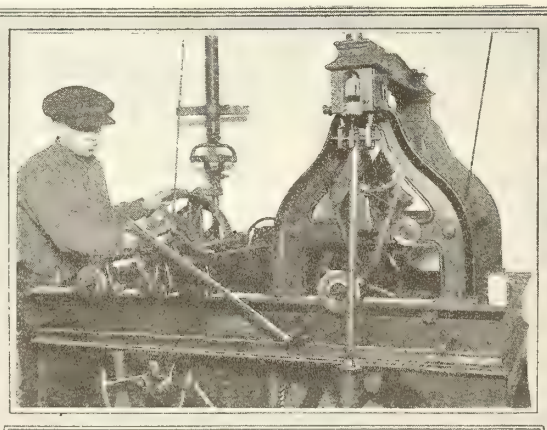
Of the thousands of people who go across and up and down the Hudson River in ferry-boats every evening, between New York and New Jersey, comparatively few, perhaps, realize that the famous Colgate clock which beams upon them from the Colgate factory on the water's edge at the New Jersey side, is the largest clock in the world.

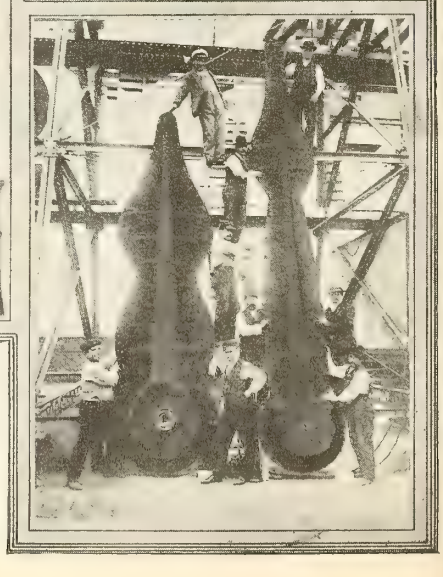
The dial is 38 feet in diameter, and altho it appears solid, it is really built of 6-inch boards placed three inches apart, so as to diminish the wind action. The hour hand is 15 feet in length, and at its widest point is 3 feet 10 inches across. The minute hand is 20 feet long, and has a counterpoise, the two weighing 640 pounds. The tip of the minute hand moves 23 inches per minute, covering in a day a travel of a little over one-half a mile.

The clock is extraordinarily accurate, seldom varying more than 30 seconds in a week. The driving mechanism is actuated by a weight weighing over half a ton. It is regulated by a pendulum 8 feet long, weighing over 400 pounds. A metal frame work, some 4 feet long, carries the movement.

From the clock work which is situated well below the clock, a shaft runs thru the roof to the works back of the dial. These contain simply gear wheels to give the ratio of 1 to 12 to the movement of the hour and minute hands.





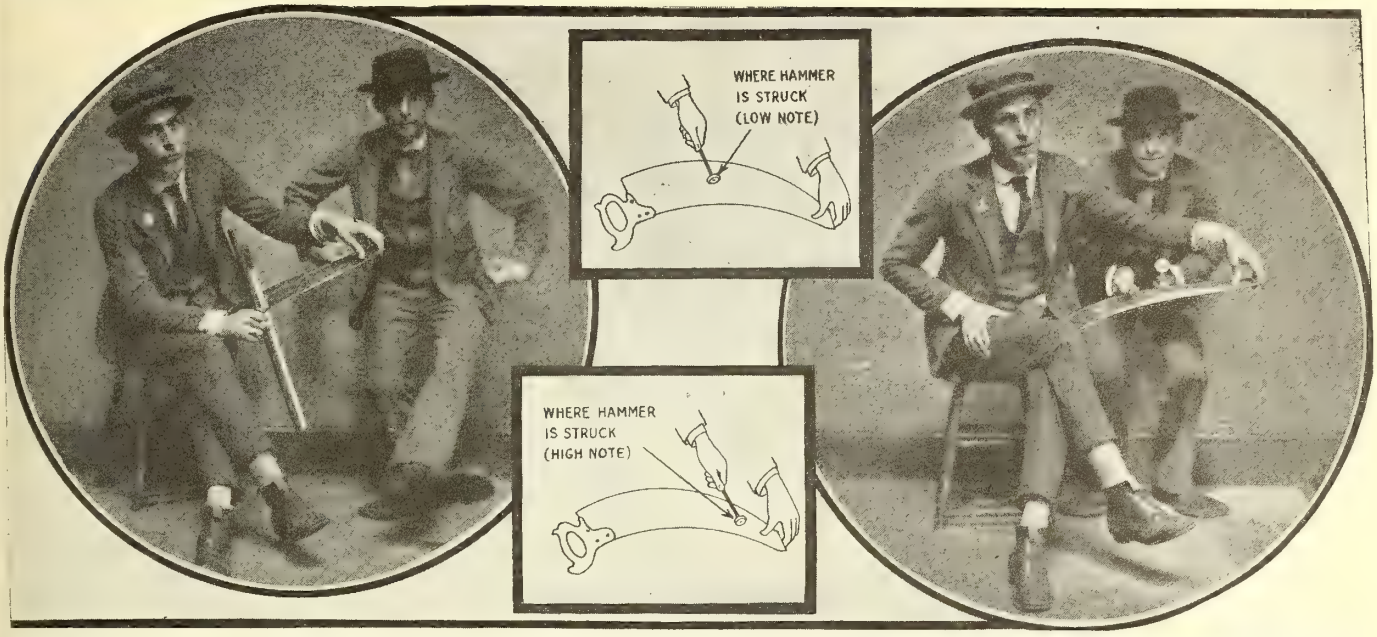


Left: The Giant Clock on the Roof of the Colgate Factory in Jersey City, N. J., Is the Largest in the World. The Dial of the Clock Measures Thirty-eight Feet in Diameter With an Area of 1,134 Feet. It Is Built of Six Inch Boards, Spaced Three Inches Apart, Thus Presenting the Smallest Possible Resistance to the Wind Pressure.

Center: The Clock Mechanism of the Great Colgate Clock. This Represents the Mechanism Contained in a Lady's Minute Watch, But Increased in Size So As to Drive a Mechanism Weighing Nearly a Ton.

Right:- One of the Hands of the Colgate Clock.

Weird Music from a Carpenter's Saw



Music Like That From a Ukulele May Be Produced From Any Carpenter's Saw. In the "Greenwich Village Follies of 1920" One of the Charming Innovations is the Rendition of Several Selections by the Two Artists Shown in the Photos, and the Sweetest Music Imaginable is Produced by Simply Striking the Saw With a Felt Hammer or Else Bowing the Edge With a Violin Bow, Bending the End of the Saw as Well as the Entire Blade to a Different Arc for Each Note. With a Little Practise, You Will Be Surprised How Readily the Successive Notes of the Scale Can Be Played, and With a Sonority Sufficient to Fill a Large Theatre or Hall. Several Saws May Have to Be Tried Before a Real "Musical" One Is Found.

A REAL new musical instrument has been brought to the attention of the public thru the efforts of "Pee Wee" Myers and Ford Hanford in the *Greenwich Village Follies of 1920,* presented by the Bohemians at the Shubert Theater in New York City. This musical instrument is an ordinary carpenter's saw. The saw is of steel and according to Mr. Hanford, it was purchased in a "hock-shop."

During the entertainment, the writer went back stage to the dressing rooms of these extraordinary artists, and the following little history was extracted from Mr. Hanford, relative to his discovery of the common saw as a musical instrument.

"Coming from a western town," he said, "I knew that music could be produced by hammering nails into a board to different depths—the shorter the nail, the higher the tone. When these nails are bowed with a violin or cello bow and set into vibration, they produce a very peculiar note, and with a little practice, a real tune can be played upon these nails.

"Later on when purchasing a saw, I observed a carpenter buying a similar tool. He bent it and struck it a blow with the handle of a knife. The saw that vibrated the best, he purchased. I thought I would try the same scheme, and when I got hold of a saw, bent it in a similar manner and struck it a blow. Again striking it, I noticed that a different sound ensued, the cause of these two differences being that the saw had bent so as to conform with an arc of a different degree.

"Upon arriving home that night, I found that by striking the saw and bending it sharply, I could obtain a complete run of notes from the lowest to the highest, which on this saw was quite poor.

"After obtaining a collection of these carpenters' tools of all shapes and sizes, I experimented with the musical production of sound and obtained very satisfactory results. Later on, various hammers were tried and also the bass viol bow, well resined, was found to produce even finer music than when the saw is struck with a soft hammer.

"Eventually I learned to play this instrument well enough to enter my name on the theatrical circuit, and now I am here."

First, a clear vibration may be obtained all the way up the scale, but it will be found that the higher the note, the nearer to the end of the saw the hammer must strike.

Secondly, the saw may also be bowed with a violin bow and the position of the bow will vary with each note in order to obtain the same volume and quality of the note; likewise bowing nearer the tip gives a note higher than the one just played.

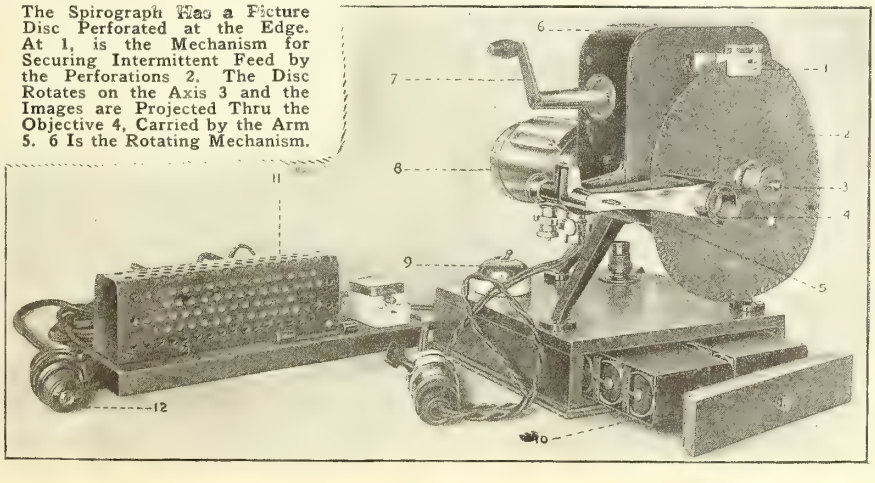
The Spirograph--Home "Movie" Projector

THE ordinary moving picture projector using long films is handicapt by the fact that the films are so combustible as to be almost explosive. The law and regulations of the fire underwriters' association have taken cognizance of this and the use of the moving picture machine is hedged about with quite rigid and necessary restrictions.

In the new Urban projecting machine there is no film. A glass disc 8 to 10½ inches in diameter, the latter it is hoped will be the average size, has photographed upon it, in a long continuous spiral, transparencies of the moving pictures. It is exactly comparable to a phonograph disc. In use, it is mounted on a machine and is rotated, the requisite intermission being produced by a suitable reciprocating mechanism contained in a bracket above the disc, as shown in the cut.

Practically on a level with the axis of the disc, is a projecting lens, which in operation slowly traverses the disc radially, as it rotates, so as to project the views successively upon the screen.

A 10⅜-inch diameter disc will contain 1,300 pictures, which is equal at the regulation spacing, to 81 feet of roll film; but in the roll film, when titles are to be given a good deal of space is lost, as they have to be repeated over several feet of film, so that they involve 15 to 20 per cent pure waste.



The Spirograph Has a Picture Disc Perforated at the Edge. At 1, is the Mechanism for Securing Intermittent Feed by the Perforations 2. The Disc Rotates on the Axis 3 and the Images are Projected Thru the Objective 4, Carried by the Arm 5. 6 Is the Rotating Mechanism.

The Divining Rod-Is It a Fake?

By PROF. T. O'CONOR SLOANE, Ph. D., L.L.D.



A Reproduction of an Old Print Taken from "De Re Metallica," Showing How They Viewed the Application of the Divining Rod 500 Years Ago, for Discovering Precious Metals. The Ancient Author Advises the Readers of His Book to Pursue the Regular Method of Detecting Ores by Digging and Sampling Rather Than to Depend Upon the Divining Rod. The Divining Rod is Not Given Credence by Scientists of Today.

ONE of the best treatises on the much-debated divining rod was presented to the *American Institute of Mining Engineers* in 1883, by the eminent mining engineer, Rossiter W. Raymond. It was publisht *in extenso* in the tenth volume of *"The Engineering News,"* New York City, in 1883. Since then a very valuable paper has been issued by the United States Government under the auspices of the *United States Geological Survey* of the Department of the Interior. The author is Arthur J. Ellis.

There is an astonishing amount of literature on this much-talked-about subject and the eminently unscientific appliance has a large coterie of adherents and of those who believe in its powers. It is claimed that an expert with the divining rod, walking over a subterranean current of water, will be able to detect its presence and exact location by the motion of the rod. This power is extended by many believers to include metals and ores, and it is also claimed that it can be used to detect and trace the flight of criminals.

If it works at all as claimed, we then have in this rod a profoundly unscientific instrument for which science affords not the least theory of such action as claimed for it, and which possesses the peculiarity of being absolutely subject to human control, and subject to very minute—almost imperceptible, muscular movements of the operator.

So true is all this, that a real scientific test of the divining rod is impossible, because its every movement is subject to the movement of the hands of the operator.

The first two illustrations, Figs. 1 and 2, are from photographs showing the operation of the rod. The divining rod is a forked twig. It may be held in the hands in various ways, but the manner shown in the illustrations is typical of the "dowser's" practise. This is the name given those who practise with this instrument. It will be seen in the first illustration that the end of the rod points upward, and in the second cut it is pointing downwards.

Even if the photographs of the hands are minutely studied, practically no change in their position can be seen, but their position *was* changed—they *did* move, and the motion of the rod was entirely due to the voluntary action of the person photographed under the direction of the author.

The action of the divining rod is based on mechanical movements which analyze about as follows, if we use some simple experiments:

To the center of a lead pencil, Fig. 3, a paper index may be secured with paste, as shown. If the pencil is held in the two hands horizontally, the index may be made to wave up and down by the very slight motion of finger and thumb. It can be rotated so as to make the index move up and down exactly as does the free end of the divining rod. The motion of the finger and thumb is easy to see because of the large diameter of the pencil.

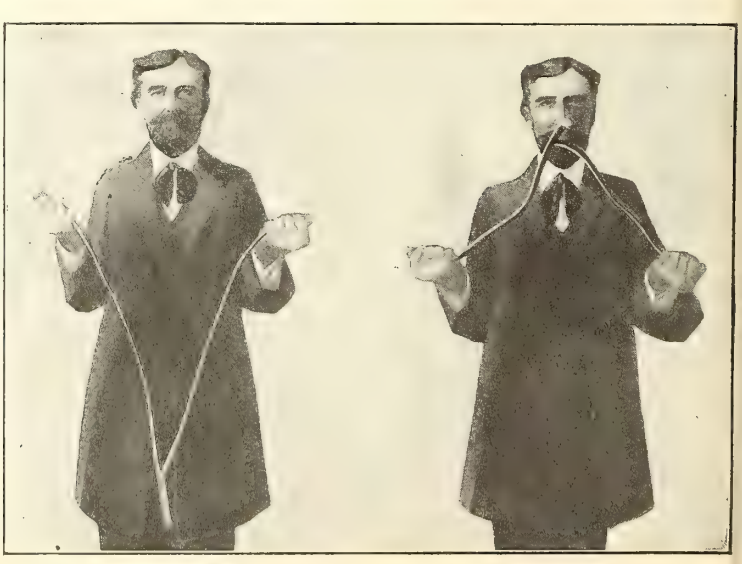
If for the pencil, we substitute an iron wire, Fig. 4, the motion of the fingers and thumbs required to produce the same rotation will be less, altho quite perceptible. Now take a piece of wire and bend it as shown in Fig. 5, holding it in the two hands as illustrated in the sketch. A slight downward pressure on *BB*, or an upward pressure at *AA*, will move its bent end, *C*, up. The reverse pressures will produce the reverse effect. If the bent portions of the wire are exactly in line with each other, as shown by the dotted lines, no effect on *C* will be produced by the changes of pressure just described. If, now, the bent rod is grasped between *A* and *B*, as shown in the illustrations of the real rod (Figs. 1 and 2) and held quite loosely, an almost imperceptible motion of the hands will operate the rod.

If, instead of grasping the wire loosely, it is tightly held, and if it is elastic, it will work still better. Again we may attach an index to a straight elastic rod such as a knitting needle, and by bending it slightly in the clenched hands, holding it in the required way, it will be found to be astonishingly sensitive to the smallest imaginable motions.

The elasticity of the rod plays a definite part in making the motions of the hand practically imperceptible. Now, going back to the rod at Figs. 1 and 2, there we have the ends bent outward as in our Fig. 5. The wood is highly elastic and the slight movements of the hand, which would escape any but the closest observer, will cause the ends of the rod to move up or down exactly as the operator desires.

While the divining rod has been and still

(*Continued on page* 1139)



Figures 1 and 2. To Demonstrate That but a Slight, Unnoticeable Movement of the Hands is Required to Cause the Twig Used by the "Dowser" to Move at Will, Cut a Twig of the Form Indicated. By Noting the Position of the Hands in This Picture, You Will See That the Person Demonstrating the Divining Rod Has Not Turned or Changed the Position of His Fingers to Any Appreciable Extent. Scientists of Today Believe That the "Dowser" Merely Fools Himself.

Is Electrocution Humane?

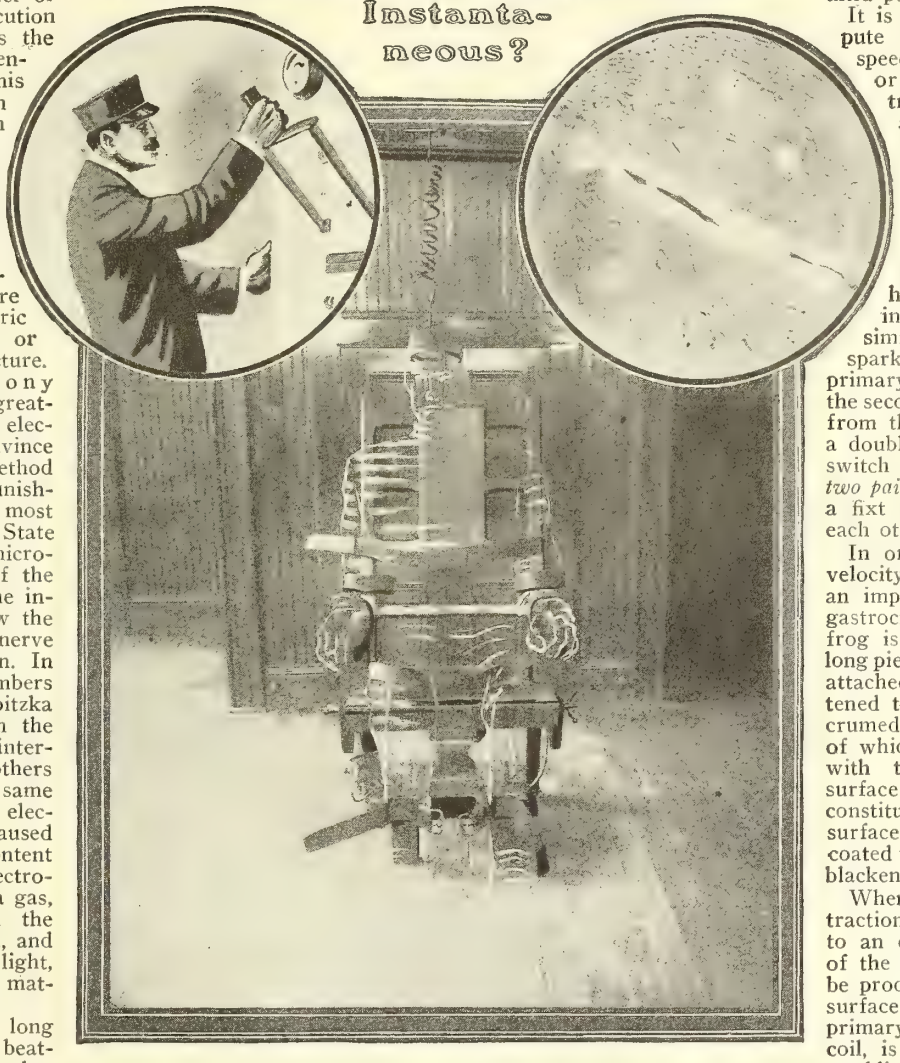
By JOSEPH H. KRAUS

Is Death via the Electric Chair Instantaneous?

WE have often wondered whether or not electrocution really causes the person sentenced to die by this means, any physical pain or mental distress. From facts obtained from persons who had been severely shocked by electricity, we learn that they experience a most excruciating torture. Whether this applies to persons who are killed via the electric route, has been more or less a matter of conjecture.

Dr. Edward Anthony Spitzka, probably the greatest living authority on electrocutions, would convince us that the electric method of applying capital punishment is by far the most humane course for any State to pursue. Years of microscopic examinations of the brain and nerves of the individual failed to show the slightest indication of nerve destruction in the brain. In only a few out of numbers of cases, has Dr. Spitzka discovered a lesion in the brain which has been interpreted by him, and others working along the same field, as being due to an electrolytic action which caused the plasma or fluid content of the blood to be electrolytically converted to a gas, which gas past thru the walls of a blood vessel, and was found as large, light, round areas in the grey matter of the brain itself.

Death often occurs long before the heart stops beating, it having proved that the heart of every human being will continue to beat for a considerable time after the actual death of the individual. This beat produces a slight murmur often heard in the physician's stethescope, and is said to be due to the "animal heart" of the individual. An animal's heart, we all know, will beat or continue to throb even after it has been removed from the body of the animal, if placed in proper solutions advantageous to itself, for instance, one of ordinary salt in water called a physiologic saline solution.



Above Is an Actual Photograph of the Electric Chair In the Death House at Ossining, New York. None Return After Having Passed Thru the Little Green Door and After They Have Been Strapped Into This Chair. In the Upper Right-Hand Insert Is a Microphotograph of the Only Lesion Ever Discovered In a Person Electrocuted. It Appears In the Cross-Section of the Brain Here Shown and Seems to be the Result of an Electrolytic Action Liberating Oxygen From Blood Plasma. The Oxygen Has Penetrated Thru the Blood Vessel Into the Brain Tissue and Is Seen as White Blotches.

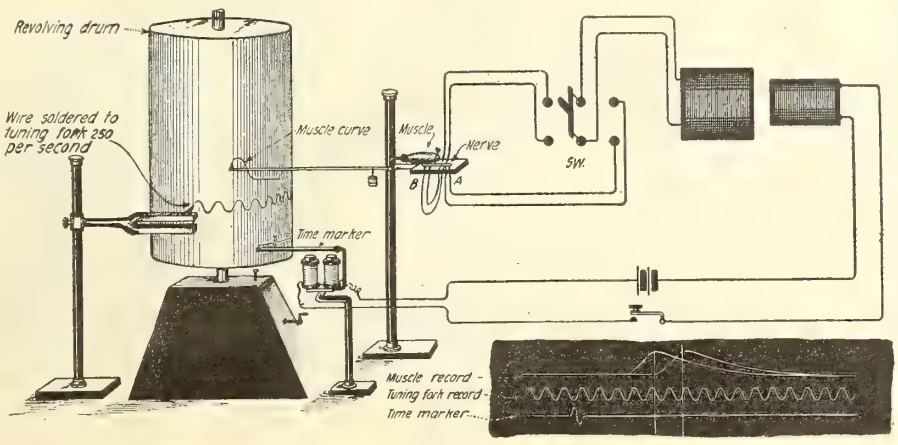
The fact that not even a union between two nerves or a nerve and a cell has been destroyed by the tremendously powerful shock proves that death is practically instantaneous. Such nerve destruction could obviously be seen under a microscope, but up to the present time it has not been found in spite of man's most extensive researches with ultra powerful microscopes.

It is rather easy to compute the difference in speed of nerve impulses or electrical stimulations traveling thru nerves and to compare these figures with those indicating the speed of electricity. We have shown how this is done with animals in the diagram presented herewith. For producing the *shock* a coil very similar to an ordinary spark coil, except that the primary is movable within the secondary, is used. Leads from the secondary pass to a double-pole, double-throw switch where they lead to *two pairs* of small bare wires a fixt distance apart from each other.

In order to measure the velocity of propagation of an impulse thru a nerve, the gastrocnemius muscle of a frog is prepared, leaving a long piece of the sciatic nerve attached. The muscle is fastened to one end of a fulcrumed lever, the other end of which is held in contact with the rapidly moving surface of a revolving drum, constituting a stylus. The surface of the drum is coated with paper previously blackened or smoked.

Whenever there is a contraction of the muscle due to an electrical stimulation of the nerve, a record will be produced on the moving surface. In series with the primary of the induction coil, is a *time marker*, resembling to a very great extent, an ordinary electric bell with the exception of the circuit breaker and which has in place of the clapper, a quill point. This is also placed in juxtaposition with the revolving drum.

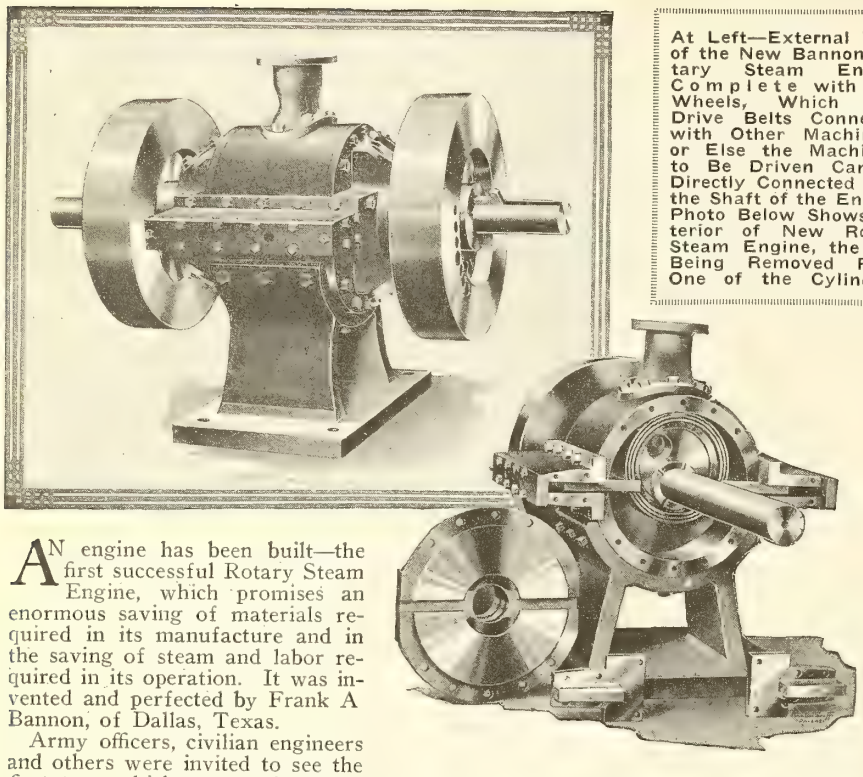
When, now the key in the primary circuit is closed, a current is induced in the secondary of the coil practically instantaneously. At the same time, the time marker produces a vertical notch on the rapidly revolving surface. Tracings are now taken of the contraction first when the double-pole switch is thrown in such a way that the nerve



Here Is Shown a Method of Making a Record for Demonstrating the Speed at Which a Nerve Can Transmit an Impulse. A Muscle Is Fastened to a Recording Device and the Nerve of That Muscle Is Stretched Upon a Board. Here Two Sets of Contacts are Placed In Juxtaposition With the Nerve. When the Switch Is Thrown to the Right the Nerve at A Is Excited Upon Pressing the Key; It Will Take a Definite Time for the Muscle to Contract and Form a Curve on the Record. When the Nerve at B Is Excited, the Time of Contraction Is a Little Shorter. The Distance Between the Two Contacts Is Then Measured and the Difference In Time for the Two Contractions Is Measured by Means of a Tuning Fork; In This Manner the Speed of Nerve Impulse Propagation Is Determined.

(*Continued on page 1143*)

New Rotary Steam Motor



At Left—External View of the New Bannon Rotary Steam Engine, Complete with Fly-Wheels, Which May Drive Belts Connected with Other Machinery, or Else the Machinery to Be Driven Can Be Directly Connected with the Shaft of the Engine. Photo Below Shows Interior of New Rotary Steam Engine, the Cap Being Removed From One of the Cylinders.

AN engine has been built—the first successful Rotary Steam Engine, which promises an enormous saving of materials required in its manufacture and in the saving of steam and labor required in its operation. It was invented and perfected by Frank A Bannon, of Dallas, Texas.

Army officers, civilian engineers and others were invited to see the first test, which was perfect, it is claimed. The engine did all that was expected of it and more. The small motor, no larger than Mr. Bannon's hat, was put on the brake-test and it developed over 17-horse-power!

Another and larger engine was immediately built. It weighed about 600 pounds, was 24 inches high, 18 inches in width and 20 inches long, and when tested at 200 pounds steam pressure, developed more than 75-horse-power on the brake test.

Other engines of varied sizes, and designed for various uses, were built, so that soon Mr. Bannon had perfected engines from 1-horse-power to 500-horse-power and with a range of speed of from the very slowest movement to more than 3,500 revolutions per minute.

Briefly described, the Bannon Rotary Steam Motor is a very compact steam engine and in its construction there is used only about one-fifth the materials of a slide-valve engine of the same horse-power. Its compactness effects a saving not only in the material and labor used in its construction, but also a saving in foundations required and in space in the engine room. The most startling thing about this engine is that it has only three moving parts; an eccentric piston, keyed to the drive shaft, and two sliding gates, which operate with their ends forming contact with the perifery of the piston. These three simple moving parts are the heart and soul of the engine, and any man, whether a mechanic or not, can quickly tear down and rebuild a Bannon engine, because it is so simple and easily understood.

On the shaft of the two-cylinder engine there are two of these eccentric pistons, 180 degrees apart, which balances the shaft perfectly and eliminates all possibility of thrust on any bearing surface. Another startling thing about the engine is that there is positively *no reciprocating action* to overcome and consequently no loss of steam and fuel, which is always experienced in overcoming the reciprocal action of slide-valve engines.

The simple and elementary laws of mechanics have been employed thus for the first time in steam engines. The principle of the lever is employed by having the steam expand against a revolving eccentric piston in such a manner that the leverage of the piston greatly multiplies the steam energy.

This Rotary engine is not at all like a turbine, inasmuch as the turbine derives its power from the Kinetic energy of the steam, while the Rotary engine operates *on steam expansion,* and it will start off with any load that it will carry subsequently; this a turbine was never known to do.

The Rotary engine can be manufactured for less than one-fifth the cost of any other engine of the same horse-power and can be sold at a great saving to the industries putting it in use—for instance, a Rotary engine costing $500.00 will excel in performance any other engine costing $3,000.00 or more, because of the wide range of speeds and the very high speed that it is capable of developing. No belts are required with this engine, for the engine can be coupled directly to the line shaft and this will do away with slipping belts and the waste of energy thus occasioned. The Rotary engine works longer on each impulse of steam than any other engine, for each impulse drives the shaft *three-fourths of a revolution,* and as there are two impulses per revolution in each cylinder an overlap of 90 degrees always results.

Flying As A Coming Sport

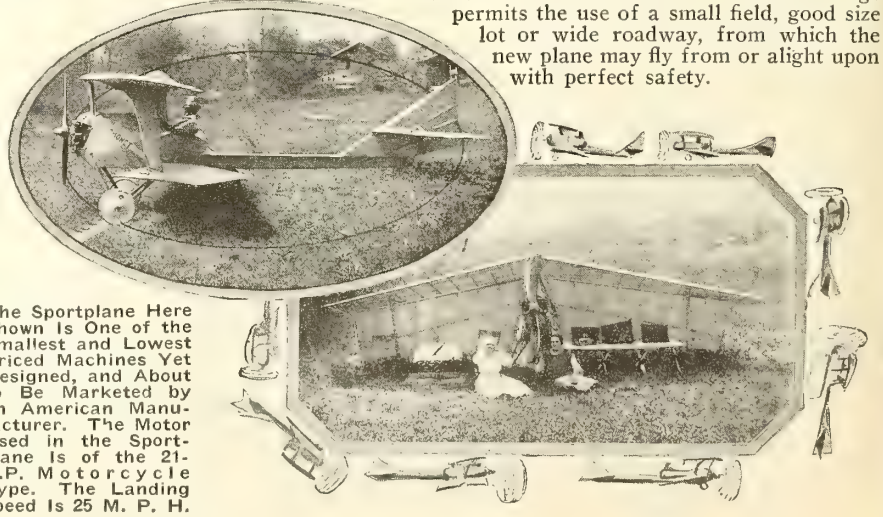
FLYING thru the air, a fascinating sport that has thrilled millions of people thruout the world, will shortly become popular, owing to the foresight of several aircraft builders, who have devoted their efforts to the manufacture of a small, moderate-priced Sportplane, that comes within the reach of a man or woman of moderate means.

$2,000 is the average price of the Sportplane, and the operating cost per hour for fuel is 60 cents; whereas the large airplanes sell from $6,000 upward, with the operating cost for fuel averaging $3.50 per hour.

The Sportplane will require a building or hangar 25 feet wide by 20 feet deep by 7 feet high to house it when not in use. For the city man or surburbanite who may find time to fly only on week ends there is no need to erect the hangar mentioned above, since with ten minutes' work, one person can remove the four wings from the body and keep the Sportplane in a shed 9 feet wide by 20 feet deep and 7 feet high. Reattaching of the wings to body in preparation for flight will require twelve minutes' time, also a one man's job, no assistance being required, and since there are no turnbuckles to tighten, no bolts and nuts used, there is no danger of loosing any parts, since all pins, etc., are attached to the wings by small chains and cannot get lost.

The motor used in the Sportplane is a special 21 H.P. two cylinder-air-cooled, simple and easy to run and very reliable. Its location at the forward end of the plane permits ready adjustment. The parts are easily obtained at most any agency, which are located all over the United States.

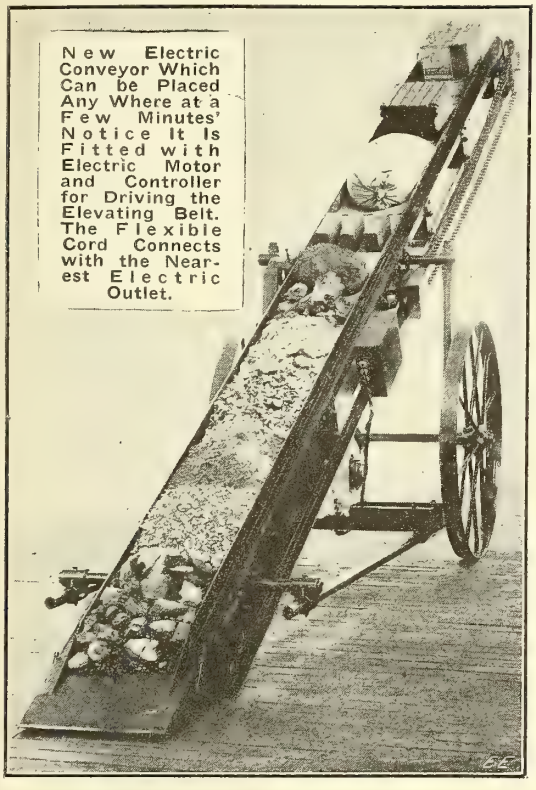
The landing speed of the Curtiss is 38 miles an hour, whereas the Sportplane will land at 25 miles an hour. This advantage permits the use of a small field, good size lot or wide roadway, from which the new plane may fly from or alight upon with perfect safety.



The Sportplane Here Shown Is One of the Smallest and Lowest Priced Machines Yet Designed, and About to Be Marketed by an American Manufacturer. The Motor Used in the Sportplane Is of the 21-H.P. Motorcycle Type. The Landing Speed Is 25 M. P. H.

Portable Electric Conveyor

To secure economical operation and greater efficiency in handling material, labor must be supplanted by machines, and these selected which are best adapted for the particular work. Men with wheelbarrows are too costly to use in storing, moving or loading material, but, at the same time, the old style conveyors required a great deal of labor in shoveling the material up into the receiving hoppers.



New Electric Conveyor Which Can be Placed Any Where at a Few Minutes' Notice It Is Fitted with Electric Motor and Controller for Driving the Elevating Belt. The Flexible Cord Connects with the Nearest Electric Outlet.

A new type of portable electric motor-driven conveyor, which cuts down the labor of feeding one-half, is shown in the accompanying illustration. The most distinctive feature of this machine, called the *Scoop Conveyor,* is the scoop on the feeding end, which can be pushed or completely buried into the material to be conveyed. This makes it possible to simply scrape the material onto the carrying belt instead of lifting it up by shovelfuls into the feeding hoppers of ordinary conveyors. The figure shows a 19-foot 8-inch length scoop conveyor with a 16-inch width of belt and driven by 2 H.P. electric motor.

As may be seen from our illustration, the scoop conveyor is strongly constructed, light in weight, compact and portable. The steel frame holding the rollers and conveying belt is mounted on the wheels so the balance is perfect. One man, by inserting the pipe handles into the ends of the horizontal members, can easily lift and move the machine.

The electric motor or gasoline engine mounted under the frame transmits power to the conveyor by means of a chain and sprocket connection to a shaft extending beneath the conveyor. From a sprocket on the other end of this shaft the power in turn is transmitted to the driving sprocket, located at the upper end of the conveyor.

The carrying belt is a high grade of heavy duck and rubber conveying belt and duck cross strips. These transverse cleats are provided to prevent the material from slipping back down the incline. The scoop conveyor is made in three different sizes, 13′ 8″, 19′ 8″, and 24′. The width of the conveying belt may be either 12″ or 16″.

Now the Flying-Bicycle

M. Paulain, a French cyclist of note, recently won the flying-bicycle contest held on the Longchamps race track, near Paris, France.



Right:—Who Said That a Man Could Not Lift Himself by His Own Energy? This French Cycle-planist Proved It. A Flying-bicycle Race Was Recently Held in France. M. Paulain, a French Cyclist of Note, Recently Won the Flying-bicycle Contest Held on the Longchamps Race Track, Near Paris. A Bicycle, an Upper Wing and a Lower Wing with Supporting Struts and Stays Make Up the "Aivette," as This Peculiar and Interesting Flying Craft Is Called by Its Designer.

The photograph shows the designer and his odd craft, modeled closely on the lines of the familiar airplane.

A bicycle, an upper wing, and a lower wing and supporting struts and stays make up the "Aivette," as the peculiar outfit is named.

The feet working the pedal wheel at greet speed supplies the motive power. After speeding along on a level stretch for some distance sufficient speed is obtained to cause the machine to rise in the air and sail along thru space, until motive power weakens. A distance of 40 feet is easily negotiated with the Aivette, which provides a lot of sport.

Subway Tracks Wear Fast

In a recent issue of New York's enterprising little subway journal, "The Subway Sun"—published now and then by the Interboro Rapid Transit Company, as its headline announces, there recently appeared an interesting article for the education of the subway "straphanger's brigade" and also the "settees," the following interesting information regarding the rapid wear on the track rails.

Listen to the logic of Mr. Theodore P. Shonts, deceased President of the Interboro and formerly Editor of "The Subway Sun":

"The subway is the safest railroad in the world, and we keep it safe. One thing, for example—steel rails. The life of a subway express track rail is about three years, one-third being replaced each year. It is done at night. Such rails on the big steam railroads last about ten years. On sharp subway curves we replace rails in about ninety days.

"We have been using about 38 miles (3,000 tons) of the best 'open hearth' rail a year on the subway, and about 30 miles more on the elevated. Subway rails cost $30 a ton in 1914, but they cost $47 a ton now."



Here's What Happens to a New York Subway Rail After 3 Months' Service on City Hall Loop.

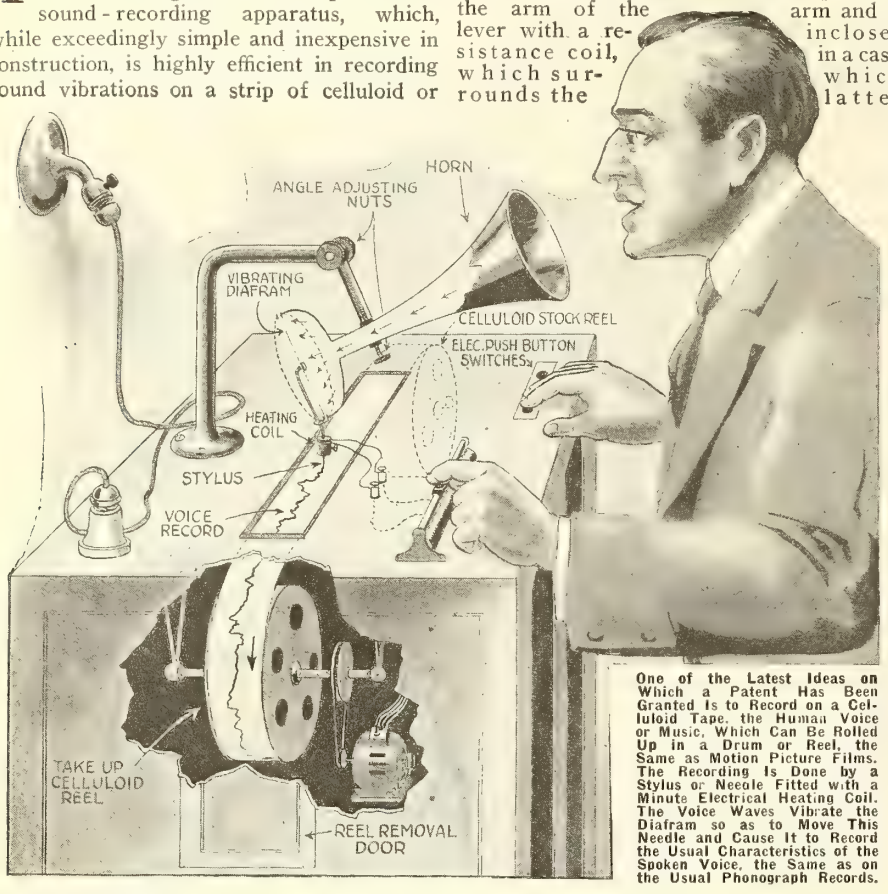
And the accompanying illustration, copied from our estimable contemporary, shows what happens to one of the Interboro's choice steel rails after three months' service on the City Hall loop of the New York subway.

It's a wonder some genius doesn't awaken to the fact that for half a century we have had the same old story when it comes to car rails. There ought to be a way of minimizing the wear, especially on loops or curves, such as by providing auxiliary rails against which wheels on the side of the car could bear as the train negotiated the curve or loop, et cetera. There ought to be another way of designing the rails and improved methods of hardening them. Why not make them hollow and bigger?

Records Sound on Piece of Tape

THIS invention pertains to a new means for recording sounds and provides a sound-recording apparatus, which, while exceedingly simple and inexpensive in construction, is highly efficient in recording sound vibrations on a strip of celluloid or other material and this accurately and delicately so that the variations in the sound are faithfully brought out.

In furtherance of this idea Mr. Christian Moore, the inventor and patentee, provides the arm of the lever with a resistance coil, which surrounds the arm and is inclosed in a case, which latter is adjustably fixt upon the arm thru the medium of a set screw, as shown in the illustration. From this it follows that the resistance coil with its case may be expeditiously and easily fixt in an adjustable manner on the arm of the stylus lever, and hence the position of the resistance coil relative to the stylus may be nicely varied, according to the extent to which it is desired to heat the stylus in order to produce the best recording results on the material of which the strip or body is composed.



One of the Latest Ideas on Which a Patent Has Been Granted Is to Record on a Celluloid Tape, the Human Voice or Music, Which Can Be Rolled Up in a Drum or Reel, the Same as Motion Picture Films. The Recording Is Done by a Stylus or Needle Fitted with a Minute Electrical Heating Coil. The Voice Waves Vibrate the Diafram so as to Move This Needle and Cause It to Record the Usual Characteristics of the Spoken Voice, the Same as on the Usual Phonograph Records.

Manifestly, when the switch is closed and current is sent thru the convolution of the resistance coil, the stylus will be heated and in that way will be adequately adapted to accurately record sound vibrations on or in a strip or body of celluloid or other material suitable to the purpose. It will also be readily seen that by manipulating the switch, or else a rheostat, that the operator is enabled to quickly and easily vary the heating of the stylus and in that way produce the best results in the record-making.

It will further be noted that inasmuch as the resistance coil is carried in a case adapted to be handled as a unit, the resistance coil and its case may be expeditiously and easily fixt upon and as readily moved on the stylus lever when occasion demands.

The machine, as here shown, is provided with current-regulating rheostat, also electric motor for pulling record tape past the stylus and winding it upon drum at left. A suitable needle resting on the moving tape and following the record groove thereon serves to actuate a diafram in the usual manner and thus gives a reproduction of the speech thereon.

One of the interesting aspects of this method of recording vocal or musical selections, lies in the fact that the record in the form of a sliding film or tape is practically unbreakable, which is not the case with the present form of record. Thousands of words can be recorded on a thin and narrow celluloid tape and reeled up in the same manner as motion picture films. These reels can then be mailed or transported otherwise.

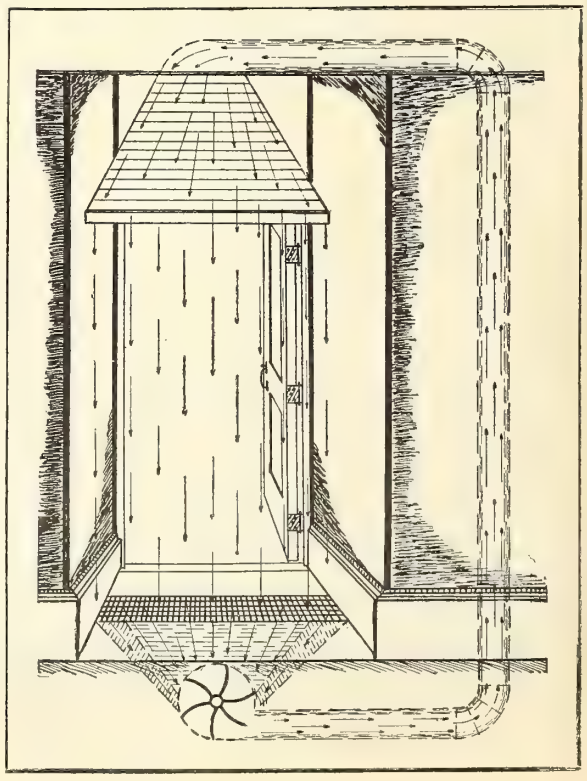
Wind Substitutes Ordinary Door

HENRY H. CUMMINGS, a Boston inventor, has devised a clever scheme for wind to take the place of the ordinary door for the purpose of preventing rain, snow, flies and other insects from entering stores and offices, etc. This invention is commonly known as the "doorless door" and consists of a constantly flowing air current produced by means of a motor-driven fan, situated below or behind a grill in the entrance to the premises and is arranged to draw the current of air downward from the upper portion of the door entrance. The air is then carried thru a duct or tube to a hood above the door and is next discharged downward, thereby creating a complete cycle.

It is a proven fact that when a quarter of a horse-power motor drives a 16-inch fan, which is connected with a duct nine to twelve inches in diameter, which provides a current of air under approximately 3-inch water pressure, a person standing in the doorway will not notice the current.

However, the current thus obtained is sufficient to keep out insects, rain, snow and chill air. Any store or office equipt with a *doorless door* will find a remarkable increase in business, resulting from its use—and better still it costs but *two cents per hour!* This is indeed a great boon to trade and will undoubtedly find great popularity in the business world, inasmuch as it is simple in construction and its cost of maintenance low.

Besides being an effective barrier against insects, rain and snow, this simply constructed doorless door is of clean and neat appearance, thereby actually inviting customers into the store. Most probably, by the time another summer makes its debut, hundreds of these doorless doors will be put into operation; and it will not be until then that its real value will be truly realized,—for no door serving its purpose as well as it does, can be had for such a nominal cost and effect such excellent results. And no longer will this cleverly devised insect and rain barrier be considered a new and novel contrivance, for it will be so extensively utilized that it will be considered as nothing unusual. ROSE HARRIS.



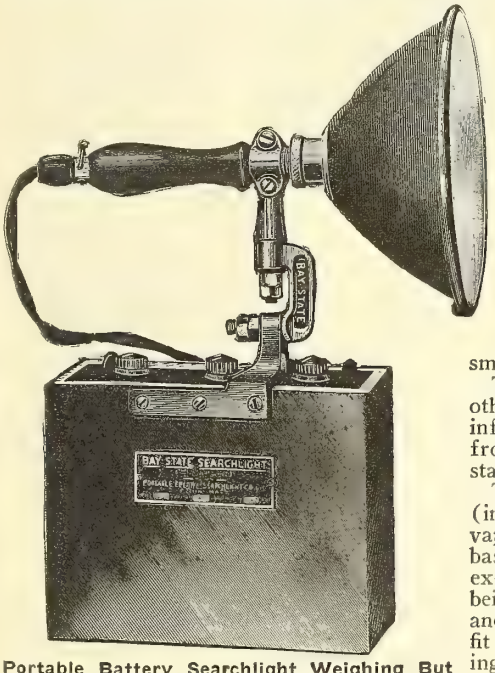
This Doorless Door Devised by a Boston Inventor, Consists of a Constant Current of Air Being Blown Downward by a Motor Driven Fan, and Thence Up Thru a Duct to a Hood Above the Door, Where the Air Is Again Discharged. Thus, a Complete Cycle Is Formed. This Extraordinary Door Prevents any Insects, Snow or Rain from Entering the Premises, and Its Cost of Maintenance Is Extremely Low. It Can Be Used in Both Winter and Summer.

NEW ELECTRICAL DEVICES

BATTERY SEARCHLIGHT FLASHES BEAM 100 MILES.

For use by repair departments in locating and repairing trouble on pole lines, in manholes and for trench work, a Boston concern is now making the portable battery searchlight shown in the accompanying illustration. This is a self-contained searchlight operated by a storage battery, which is of such a size as to permit the use of the lamp continuously for 2½ hours and much longer when burned at different times. The lamp is mounted on the adjustable bracket as shown, which makes it possible to direct the rays where needed. The lamp has a 7½-inch adjustable focus with single shell reflector which, on a recent photometer test the makers claim, gave 453,000 beam candle power. Under ordinary conditions the lamp is said to throw its rays a distance of 2,000 feet, and for signaling purposes the beam can be seen a much longer distance.

The maker points out that the battery can be charged from any direct current



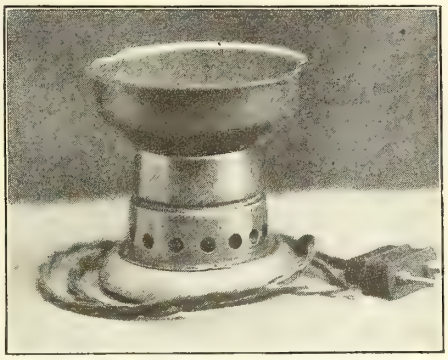
Portable Battery Searchlight Weighing But 16 Pounds, Which Throws Rays Nearly One-half Mile. Its Beams Has Been Seen 100 Miles Away in Actual Government Tests.

house lighting circuit by simply using one or more incandescent lamps as resistance. When recharging from an alternating current circuit, a rectifier must be used. The outfit weighs 16 lb., and can be easily carried by means of the handle provided at the connection of the lamp to its adjustable bracket. This is the searchlight that was used in the recent test from the top of Mt. Washington to Portland, Maine, 67 miles distant. The searchlight, however, was at the time seen by a ship out to sea 97 miles from the top of Mt. Washington. Many of these searchlights were used by U. S. Army and Navy during the war for signaling and multifarious other purposes.

ELECTRIC ATOMIZER PURIFIES AIR.

The electric atomizer here illustrated, otherwise known as an "electric hygienic disinfector and air purifier," is truly a source of health in every home; in fact, it is an up-to-date and modern need for every family, *whether healthy or sick.*

This new device, by constant hot evaporation of the strongest tablet or liquid preparation, produces an effective barrier against all acute and chronic diseases of the respiratory organs. The vaporization of only a few drops of expectorant or soothing remedies, either in liquid or solid form, as also the essences or perfume of flowers,



New Electric Atomizer Provided With Heating Coil in Base, and Very Desirable For Fumigating Sick Rooms, Scenting the Air.

is all that is necessary to obtain an instantaneous purification of the air. Even pure water can be utilized for the purpose of making the room fresh and airy.

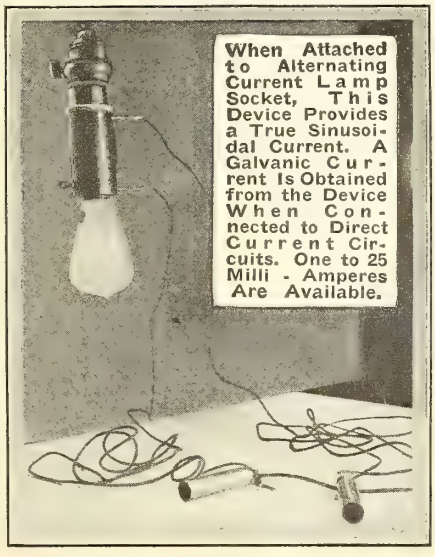
The vapors thus produced constitute a modern healing process and have a soothing and healing effect in coughs, cold in the head, hoarseness, asthma and influenza, and are also most efficacious in the treatment of tubercular affections. These inhalations are indeed much more in advance of the usual oil and water syringes in cases of serious illness, due to the fact that they require all gases evolved to combine with the atmosphere, and thus the purified air will be drawn into the smallest branches of the bronchial tubes.

This remarkable air purifier has also another important use, and that is for the disinfection and elimination of all bad odors from sick rooms, bedrooms, damp floors, stables, etc.

This atomizer consists of a rubber cup (into which the desired liquid is placed and vaporized) and is mounted on a fireproof base. It is made with brass, nickel or silver execution, and is always ready for use, it being necessary to only connect the cord and plug arrangement included with the outfit to any electric socket, thereby furnishing the electric current for vaporization.

LAMP-SOCKET ELECTRO-MEDICAL TREATMENT.

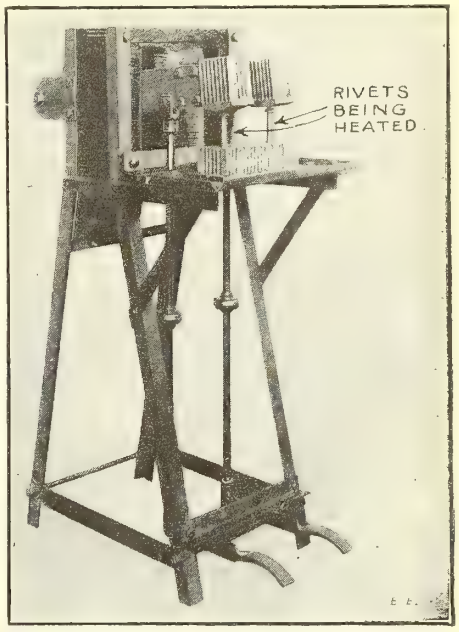
A new and novel outfit has recently been put on the market which permits the using of commercial electric current for medical purposes. It can be attached to any socket, the same as an electric lamp. A regulator slider is provided, whereby simply moving it up and down over a coil of resistance wire wound on a porcelain tube, very fine current graduations may be secured. The resistance coil is protected by a nickel plated case, suitably perforated for heat dissipation.



When attached to an alternating current circuit, a true sinusoidal current is obtained. A galvanic current is obtained from the attachment when connected to direct current. It is possible to obtain from one to twenty-five milliamperes of current, either thru the metal handles or thru the sponges. For ordinary medical treatments, a current varying from ten to fifteen milliamperes is generally used. When attached to a direct current circuit, galvanic current equivalent to 30 to 40 cells is available, and when used on alternating current, as much current may be drawn as that produced by larger and more expensive outfits.

HEATING RIVETS BY "JUICE."

The coke forge and the oil-burning furnace for rivet heating promise to become



The Latest Idea in Rivet Heaters—it Operates by Electricity and Does Away with the Old Coal or Oil Fire and Forge, Besides Giving a Much Greater Output Per Hour.

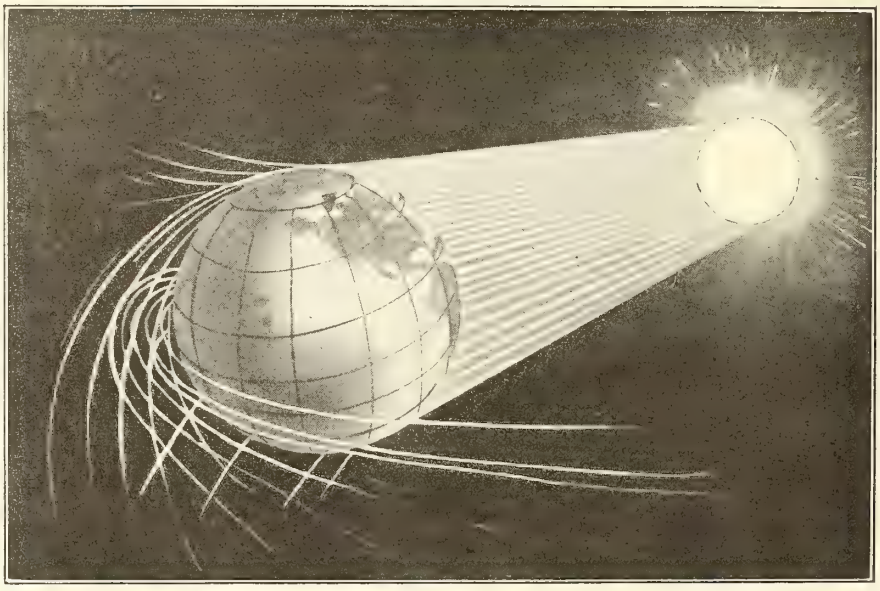
things of the past, now that electrical engineers have devised a new electric rivet heater which in tests has proven much more efficient and economical than the old methods. A great saving of material and time as well as improving the sanitary conditions for the worker are the outstanding features of this new device.

A first glance at this machine gives one the impression of a portrait camera on a tripod. The rivets are placed between two electrodes and this completes the circuit and they begin to heat, much the same as coils in an electric toaster. The electrodes holding the rivets can be operated separately by the use of foot pedals, thus the man operating the machine can take out a heated rivet from one side, replace it with another to be heated and then alternate to the other side for his next heated rivet. A switch on the back gives the variations of current to be needed in heating rivets of different sizes.

This machine is capable of heating 800 rivets per hour, believed to be the maximum number an operator can handle. It is said this number can be increased but at present there is no demand for a quicker heating.—*Photo courtesy General Electric Co.*

The Sun's Unknown Rays

By ROGERS D. RUSK, M. A.



Electrified Particles Shot Off from the Sun Would be Bent Around the Earth in This Manner by the Earth's Magnetic Field.

WHAT mysterious rays does the Sun give off in addition to light and heat? We speak of the Sun as the center of energy of our solar system. It constantly radiates energy in various forms. Not only are light and heat received by the earth, but electric and magnetic disturbances are frequently detected. These are all forms of energy—but what is energy? We only know it thru its various forms, and because our senses do not immediately detect other forms we should not unwisely conclude that they do not exist. Indeed it seems not only possible, but probable, that the Sun is continuously radiating energy in forms we are as yet unable to directly detect, and that the earth is strongly influenced by these unknown rays. The following article aims to explain how this may be the case and to present some experimental evidence already obtained in support of this startling fact.

Students of solar radiation find strange phenomena and curious contradictions which they are unable to explain on the basis of known radiations. The Sun is one of the greatest mysteries of the universe. It has been "burning" for countless ages at a temperature higher than any known flame, and yet it is not consumed. It does not seem to be the slightest bit cooler on the average than when history began. The Sun has periods of variable activity, marked by sunspot formations, when it radiates slightly varying amounts of heat. Strange to say when the Sun is hottest the earth is coolest.

If the Sun is radiating energy without its total quantity becoming less, then it is either an inexhaustible reservoir, or else it must be receiving energy in some unknown form as fast as it is radiating it in the forms we know. This, of course, is only a suggestion of what might be. Where the energy of the Sun comes from, we do not know. We do know, however, that, in so far as we are able to tell, the Sun has not cooled a fraction, and one estimator states that if the Sun's heat decreased so as to change the temperature of the earth by a single degree on the average, there would be a gradual return of the glacial period. The ice caps would creep down from the poles and the earth would become uninhabitable again.

That streams of electrified particles are shot off from the sun and affect the earth was first suggested by Prof. Birkeland in 1896, who attempted to explain magnetic storms and polar auroras by their means. This theory has been advocated by many scientists since and is the most popular explanation of auroras today. It is a well known fact that intense heat breaks up nearly all substances into electrified particles called ions, and the Sun's extreme temperature may even liberate free charges of electricity. If streams of these particles were shot past the earth they would be bent by the earth's magnetic field as shown in Fig. 1. The slower moving particles would be bent the most, and some even would encircle the earth. The possibility of these particles being shot off by the Sun, Lord Kelvin and Schuster denied, and M. Villard, who spent much time investigating the subject, suggested that the electrified particles were liberated from the clouds in our upper atmosphere and the function of the Sun was to liberate these particles by some unknown rays. There has been little confirmation either way as to this, however.

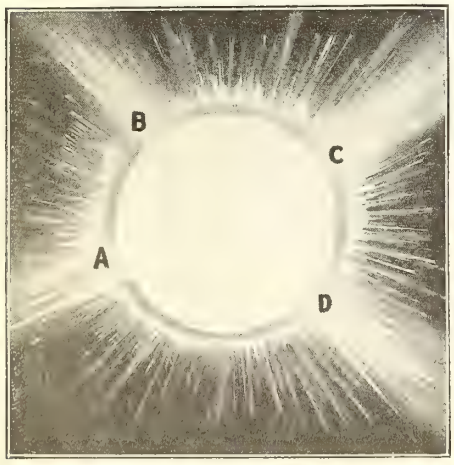
That streams of electrified particles are shot off by the Sun is an apparent fact, but whether these reach the earth or not is the problem to be solved. No one doubts that the heat of the Sun produces intense ionization, and eruptions have been witnest where luminous gas was thrown as high as 400,000 miles from the Sun's surface, traveling at a rate of 250 miles per second. If the luminous gas is thrown off with such violence it seems possible that the electrified particles may be projected much farther.

That such disturbances as these affect the weather on the earth has been believed for many years, and yet no one has ever discovered what the connection is. The sunspots which are also formed at these periods of solar activity disturb the earth's magnetic field. The more numerous the sunspots are, the more noticeable are the variations in the earth's magnetic field. This relation is quite marked and has been studied for nearly seventy-five years. It is also evident that sunspots cause or accompany magnetic disturbances on the Sun, which are intense enough to reach the earth. The most recent contribution to the discussion as to whether sunspots affect the earth's weather or not has been made by Ellsworth Huntington of this country, who finds some interesting relations which suggest the possibility of some unknown ray. He also suggests an explanation of a problem which has long puzzled scientists, one as to why the earth is relatively cool when the Sun is relatively warmest.

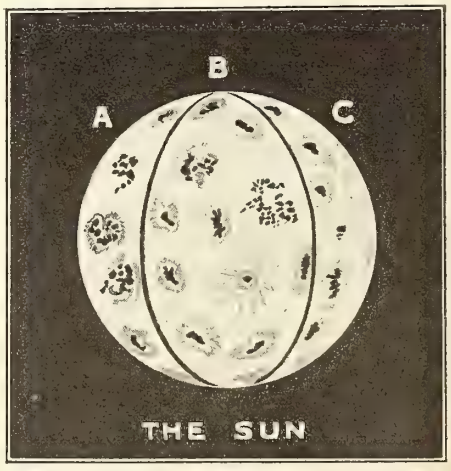
Of course the temperature of the Sun does not vary greatly, but it has long been observed that sunspot activity and other disturbances on the sun rise to a maximum and fall again to a minimum every eleven years. It is at this period of maximum activity that the Sun gives off more heat than at any other time. At the same time the earth is relatively cooler than usual. This is a seeming contradiction, but Huntington suggests that this increased heating of the earth's atmosphere causes an increase in its circulation, and hence makes it seem as if the earth were cooler. There is also the possibility that there may be other agencies at work of which we know nothing, and this is more marked in a further study of the sunspots themselves.

Our atmospheric storms are primarily areas of low barometric pressure which sweep across the country, and these areas of

(*Continued on page* 1144)



Fiery Masses of Ionized Vapor as A, B, C, D, are Frequently Shot Off From the Sun for Hundreds of Thousands of Miles in a Very Short Space of Time. Electrified Particles are Probably Projected Much Farther.



This is the Way Huntington Divided the Sun's Disk Into Three Areas, and Found the Sunspots in the Outer Ones to be More Effective in Influencing the Weather on the Earth.

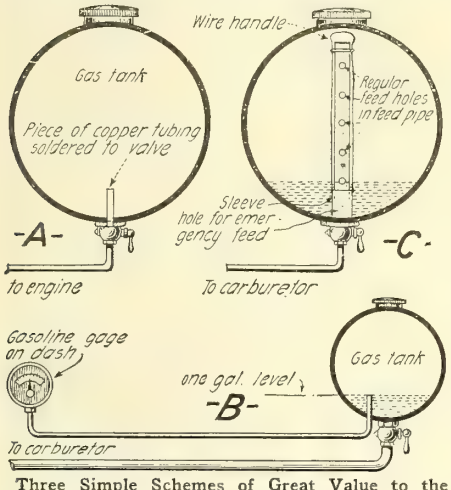
MOTOR HINTS

A "LOW GASOLINE" ALARM
Second Prize $15.00

After running out of gasoline one dark and chilly night, and walking many weary miles, the author has since used a device which gives warning about five to ten miles "this side of a dry tank."

It is very simply made as follows: Remove the gas line shut-off valve from the gas tank. Solder a piece of copper tubing (like that used for gas line) to the inside end of the valve, so it will project into the tank about one inch, as shown in the illustration. Then replace the valve and connect the gas line as before.

This little tube raises the outlet level. In drawing "A" showing the car with this device, the carburetor begins to "spit" at long intervals many miles before the tank is empty. The intervals become



Three Simple Schemes of Great Value to the Motorist in That They Will Serve to Warn Him Ahead of Time That His Gasoline Supply Has Fallen to a Certain Low Limit.

gradually shorter until the engine actually stops, but by this time a gasoline supply can have been found. Of course this idea is applicable only to gravity feed systems. The author used it on a Ford car.

Two optional ideas are shown in drawings B and C, for other low gasoline alarm schemes. For cars fitted with a gasoline gage or dial on the dash, the scheme shown in B will prove valuable. The piece of pipe is added inside the "gas" tank and is cut to a height corresponding to a one- or two-gallon level as shown. Thus, when the gasoline supply indicating needle begins to flutter, the autoist will know that invariably his gasoline has reached the low level.

The scheme shown at C is adaptable to cars having no gasoline gage. It may save a lot of wearisome walking along dark roads when the gasoline happens to give out at an unexpected moment, which, rest assured, happens to many others "besides those in love."

In the scheme shown at C, a pipe feeds the gasoline thru the line in the usual manner. This feed pipe should be fitted very tightly in the valve member in the bottom of the tank. At the lower end of this pipe is a tightly fitted shell, pipe or other member, which can, however, be slid up and down with a little pressure.

A wire handle is soldered or otherwise attached to this "slidable" tube and is arranged to come directly under the filling cap, in the manner shown. Normally, the slidable tube is kept in its lowest position, covering the emergency feed holes in the upright tube.

Contributed by
NORMAN B. TAYLOR.

$50.00 IN PRIZES
Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

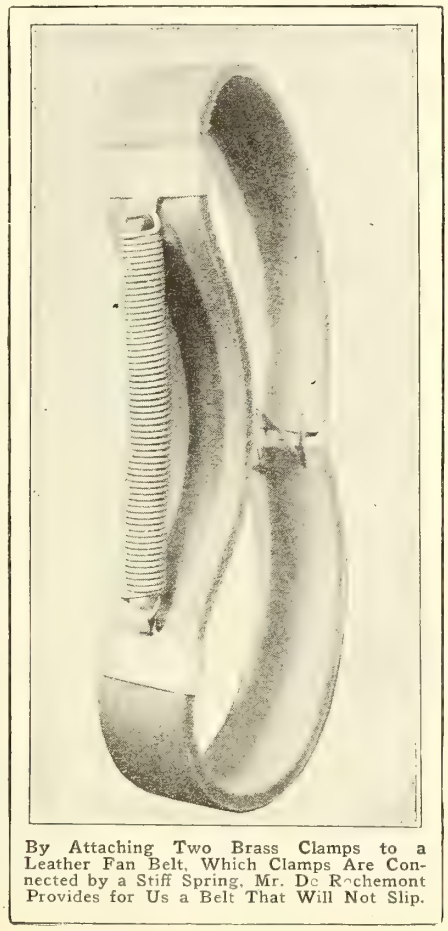
NON-SLIPPING FAN BELT
First Prize $25.00

All autoists know what it means to have the fan belt fail to turn the fan. In some cases it results in ruining the engine.

This device was placed on a Ford fan belt which was so loose that it would jump the pulley. The tightener here described, held the belt fast to the center of the pulley—and after having been run continuously for 18 hours, it was still as efficient as at the start.

As is evident, this device can be easily applied by making two brass or iron fasteners with hooks to clamp over the edges of the belt—setting the clamps with hooks about two inches farther apart than the length of the spring. This causes a tension on the belt at all times and takes up all the stretch that may manifest itself in the belt. Thus it prevents the belt from slipping, regardless of how far the belt itself may stretch. This statement is made from actual and thoro tests.

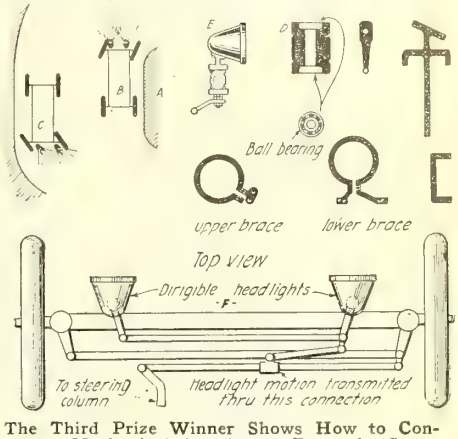
Contributed by
P. H. DE ROCHEMONT.



By Attaching Two Brass Clamps to a Leather Fan Belt, Which Clamps Are Connected by a Stiff Spring, Mr. De Rochemont Provides for Us a Belt That Will Not Slip.

MOVABLE HEADLIGHTS FOR CAR
Third Prize $10.00

The accompanying sketches show how the movable headlight system can be applied to your automobile. Figure "A"



The Third Prize Winner Shows How to Connect a Mechanical Attachment From the Steering Gear of Your Car to the Two Headlight Supports, so That the Headlights Will Swing in the Direction in Which the Car is Turning.

shows the contrast of two automobiles passing each other on a sharp curve of the road. The one with stationary headlights, B, does not throw light on the inside of the road, which might cause an accident; while the other car, C, illuminates the inside of the road, as well as the outside and tends to eliminate accidents while driving at night. As the front wheels turn the lights also turn, and if the car is running straight ahead the lights will also shine in that direction.

Figure "D" shows the parts necessary for the construction of these movable headlights, and "E" shows these parts assembled. Illustration "F" indicates how the steering and moving-light system is connected.

Contributed by
FRANCIS J. LORENZ.

TO KEEP THE WINDSHIELD FROM CLOUDING

A very good method to keep the windshield from clouding is to rub a half and half mixture of kerosene and glycerine on the clouded surface of the glass. A small bottle of this mixture tightly corked and put in a half-pound baking powder can with some waste for packing. Carry this along in the car and when it begins to rain pour a little of the mixture on the waste, and rub over the damp or wet portion of the glass. The mixture causes the water to spread over the glass and not in little drops, which are hard to see thru.

Contributed by ROY R. BARNES.

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

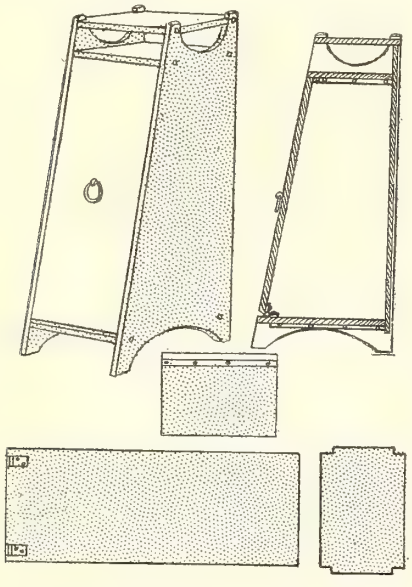
A Soiled Clothes Cabinet

A VERY useful *soiled clothes* cabinet and stand which can be used in the modern utilitarian and decorative fashion, is here shown. It is easily made, being fastened and put together with screws. The height is 32″ with a 12″ square bottom, and it can be made as shown or without these decorative features. A slanting front will be advisable for the purpose of keeping the door closed. Any kind of ¾″ lumber can be used. The fastening screws are 2″x¼″ with button heads. All the cleats will hold better if held with screws as indicated, the cleats being ½″ thick with screws 1″x3/16″ in size.

Ebony finish, or mahogany stain with hard oil finish is a good treatment for this article of furniture.

Window Sewing Cabinet

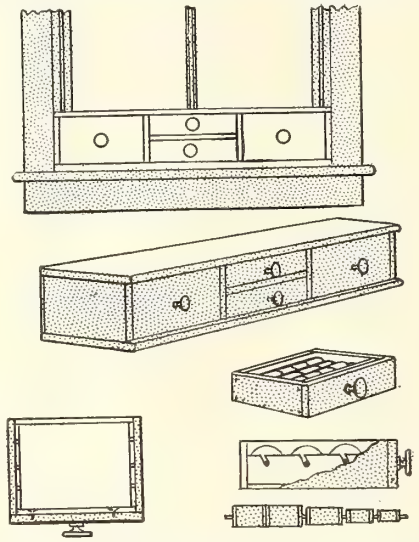
The device shown at the top of the next column consists of a frame fitting the inside of a window and four drawers to contain sewing, knitting, embroidery or other similar materials. The frame also serves



An Ideal Quick Acting and Neat Container for Soiled Clothes Is Shown in the Accompanying Illustration. This Cabinet, Which Has a Door Hinged at the Bottom and Acting in a Self-Closing Manner, Especially When Aided by a Spring, May Be Constructed With Any Thickness of Wood Which the Builder May Have Available. The Author Suggests the Use of ¾″ Wood, but the Cabinet Will Serve Its Purpose Just as Well if the Sides, Back and Door Are Made From ¼″ Stock.

the part of wind shield when the window sash is partly raised. It is made of eight pieces (seven of them ½″ lumber, one ¼″ lumber) nailed together so as to form a top, bottom, back and four openings for the drawers. Each drawer is made by first nailing together the sides, to which a bottom is fitted and nailed in place. Then a front piece of thicker wood is fastened with screws put in from the inside of the drawer as indicated—using ¼″ lumber for the frame, 3/16″ for the bottom and ⅜″ for the front. Brass screw knobs are used for pulls, these screwing in at the front.

As a suggestion for an orderly disposition of sewing materials, etc., we show how spools of thread, darning cotton and the like may be strung on wire rods and then held in slots made in extra wooden pieces on the inside of one or more of the drawers. The thread or cotton can be unwound from the spindles thus made without removing them from the drawer; thus, a whole spool can be exhausted, as

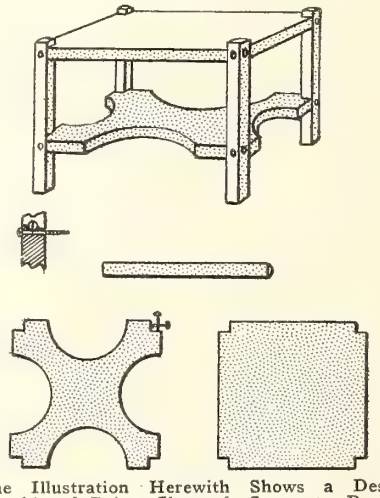


Here Is a Very Useful Window Sewing Cabinet Which the Home Mechanic Can Build From Odd Pieces of Wood. The Knobs for the Drawers Can Be Purchased in Any Hardware Store Very Cheaply and the Drawers Themselves May Often Be Purchased in the Form of Small Boxes, Cut Down Afterward to the Required Size. A Valuable Feature of the Design Here Suggested Is the Racks on Which the Thread Spools Are Supported, and Enabling the Seamstress to Unreel Any Desired Color or Grade of Thread from a Spool Without Moving It From the Rack.

in crocheting, without taking the spool from the rod, or the drawer from the frame, the latter being for the time only part way open.

Tabouret, Table or Foot Stool

A very easy way to make a tabouret, window table or even a durable foot stool is shown below. When these articles are made from the same sized top and bottom pieces, the difference in each being a question of length of legs, it is desirable to saw out all three tops and all three bottoms in two operations, each group being tacked together with long nails driven thru the wood in the corner parts that are to be removed.



The Illustration Herewith Shows a Design Capable of Being Changed, So as to Provide a Tabouret, Table or Foot Stool, Depending Upon the Length of the Legs. If a Table Is to Be Made on This Design, the Shelf and Top Should of Course Be Fairly Heavy, at Least ⅞ inch stock. The Finish Can Very Well Be Mission Stain, Rubbed Down With Oil or Wax, or the Stained Wood Can Be Varnished if the Builder So Elects.

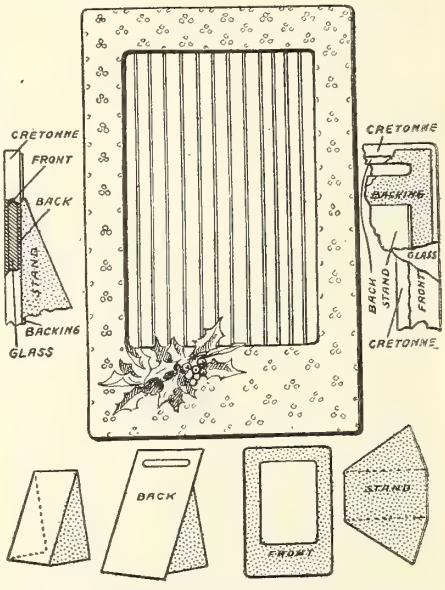
A band or jig saw should be used, following pencil lines ruled on the upper piece of each group. These pieces should be 12″ square at least, and 1¼″ to 1½″ thick. The legs should be square with sides and flush with the top and bottom pieces, 31″ long for table, 16″ for tabouret and 7″ for foot stool.

The screws (3″x¼″) are put in as indicated. Mahogany stain with hard-oil finish will give the mission effect, best suited to pieces of furniture of this character.

Photograph Frame

To make a photograph frame that will stay put, and one that will have a smooth, solid appearance and will be easy to put together, is an ambition prevalent with a very large number of people at the end of every summer season.

Here is a scheme that will satisfy this desire in the form of a frame for the favorite snap-shots obtained in the mountains or at the seashore. The plans are



A New and Attractive Way in Which to Frame Pictures, and Providing at the Same Time a Simple Support at the Rear of the Picture. The Manner of Making the Frame Is Similar to That Used in the Passe-partout Process in Which the Glass Is Almost Entirely Covered by Cardboard Back and Front Pieces, Which Are All in Turn Covered With Paper, Cretonne, Silk or Velvet. Leather Also Makes a Rich and Desirable Covering for a Small Picture Frame of This Type, and May Be Decorated Either With Burned Figures by Pyrography or Else Painted With Colors.

equally applicable to any size or any shape of photo—the choice being with the maker.

The frame employs a kind of passe-partout process in which the glass is almost entirely covered by a thick cardboard back and front piece which are all in turn covered with an ornamental paper, cretonne, silk or velvet.

The figures at the bottom of the figure show the cardboard parts, the glass, back and front pieces, being one size. The edge view at the left shows these parts in place, while the section of the back (at the right) illustrates how the outer finish is first glued round the front opening, as well as the method of gluing at the back when brought round the glass and cardboard. This view also shows the position of the cloth backing and the cardboard stand which is glued to the backing as shown.

Home Electrics

By G. L. HOADLEY, M. E.

THE meter readers of the average operating supply company are paid less as a general rule than the other employes. There are several reasons why this is so. In the first place, the work is light and women can compete with men; second, skilled labor is not required; third, the work is easily learned by any person of ordinary intelligence. The class of help obtainable under these conditions is, generally speaking, untrained, inexperienced, not very conscientious, not very accurate and temporary. Public Utility Commissions have found, after careful investigation that the average householder is justified as a rule in kicking about his bill. Most operating concerns maintain a good-sized adjustment bureau for their customers.

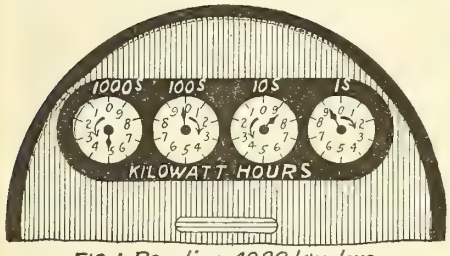


FIG. 1. Reading 4989 kw.-hrs.

To Read the Meter Shown Above, Write Down the Figures Indicated by the Dial Hands in Order, from Left to Right as Follows: 4-9-8-9, or the Reading is 4,989 Kilowatt Hours. But Meter Hands Are Sometimes Misplaced the Same as Clock Hands, as Shown in Fig. 2 Below, and this Phase of the Subject Is Carefully Discust in This Article.



FIG. 2

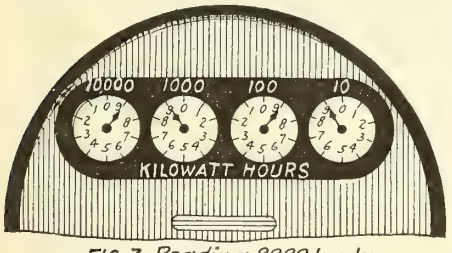


FIG. 3. Reading 8889 kw-hrs.

Two Very Interesting Problems in Reading Meter Dials. 10-100-1000, Etc., Over a Dial Indicates the Value of One Complete Revolution of the Dial Hand.

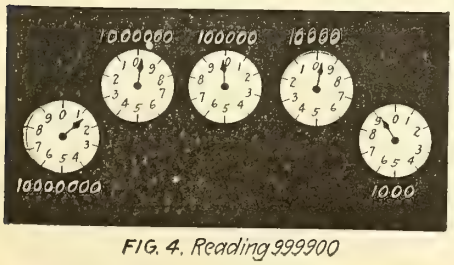


FIG. 4. Reading 999900

Reading the Household Electric Meter

Because of this unfortunate condition of affairs it is highly important that the householder should learn how to read the watt-hour meter.

To the average housewife, a watt-hour meter is somewhat of a mystery; it is a thing she has a wholesome respect for, and perhaps fears as well; and accordingly she holds aloof from it. She is not at all anxious to get another shock, such as she experienced some little time ago perhaps from the electric washing-machine, or possibly from the bathroom fixture.

However, the meter will not give any one a shock ordinarily, unless the cover is removed. Neither is the principle on which it operates so very mysterious. In reality it is nothing but a little motor with a clock mechanism connected to the motor shaft. Now, any adult person can read the time by the clock. It is just as easy but perhaps not quite as simple to read a watt-hour meter. You would not want it known that you could not tell the time of day by the clock; you ought to be able to read just as readily your electric meter and other meters that may be in your house.

There are a large number of watt-hour meters of different shape, size, appearance, etc., but the majority of them have four dials as shown in Fig. 1. The dial on the right reads in units; the next one over to the left reads in tens; the third one over reads in hundreds; and the one on the left reads in thousands. When the hand of the dial on the right makes one complete revolution, it passes over 10 unit divisions and is at zero again. As it reaches 0, the second dial moves up one division, and the register now reads 1 ten, or 10 units. Consider now the second dial. Suppose it makes one complete revolution. it has covered ten 10s or 100 unit divisions, and the third dial moves up one division of the hundreds scale equal to 100 unit divisions. A complete revolution of the third dial hand from the right will move the hand of the fourth dial up one division and register 1,000 unit divisions. To read the meter shown in Fig. 1, write down the figures indicated by the dial hands in order from left to right as follows: 4—9—8—9, or 4,989 unit divisions. Since the kilowatt-hour is the unit indicated by the register, the meter reading is 4,989 kilowatt-hours.

Sources of Error

Do not take it for granted that the figure *nearest* to the dial hand is always the right reading of the dial. In reading a clock, for example, you would not read the hour as 9 o'clock if the minute hand was on V as shown in Fig. 2, even if the hour hand is nearest to IX. So, in Fig. 1, altho the left-hand dial indicator corresponding to the hour hand of the clock, is nearest to 5, you must first look at the next dial to the right (corresponding to the minute hand) and see if it has passed 0. It hasn't, hence, your left-hand dial reading is 4 instead of 5 to which it apparently points. In general, then, if the hand of the next lower dial has just completed a revolution, the hand of the higher dial has past the figure; but, if the hand of the next lower dial has not completed a revolution, the hand of the higher dial should be read as having not reached that figure, even tho it points toward that figure.

Another precaution which should be taken in reading meters is to always check the reading. The hands on adjacent dials revolve in opposite direction, and it is quite easy to mistake the direction of rotation of the dial hand and get a wrong reading. In Fig. 1, for instance, the dial on the right rotates clockwise; the dial next to it rotates counter-clockwise, etc. In making a check reading it is better to start with the right-hand dial and read from right to left, setting the figures down 9894, which, when read backwards, 4,989, should check with the first reading.

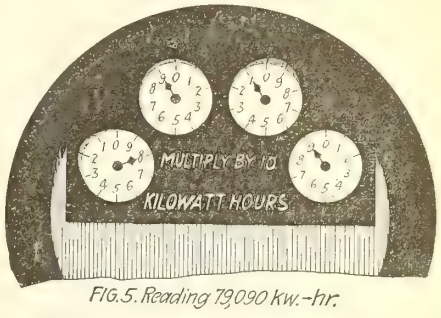


FIG. 5. Reading 79,090 kw.-hr.

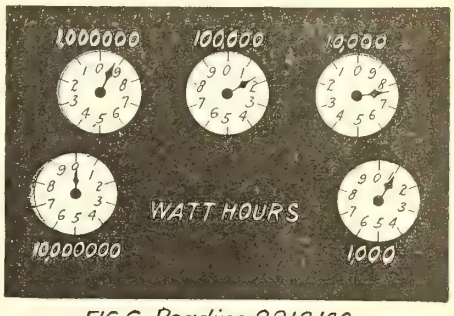


FIG. 6. Reading 9,918,100

The Latest Practise Is to Leave off All Dial Markings as in Fig. 5. Fig. 6 Shows a Typical Case of a Misplaced Hand in the Second Dial from the Right, this Dial Reading 8 and Not 7, as Might Be Supposed.

Different types of meters may have different markings of dial values. 1s or 10s, etc., over a dial as in Fig. 1, indicates the value of each division of the dial. 10, 100, 1000, etc., over a dial, as in Fig. 3, indicates the value of *one complete revolution* of the dial hand. Some types may have five dials,

(*Continued on page* 1144)

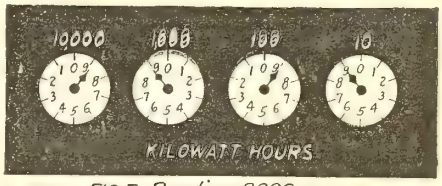


FIG. 7 Reading 8889

Figs. 7 and 8 Illustrate Two More Cases of Misplaced Hands, Which Will Give the Reader Good Practise in Mastering the Reading of His Electric Light or Power Meters.

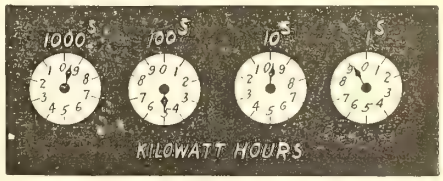


FIG. 8. Reading 9499

Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory

The Magnetism of the Sun

IF any source of light be placed between the poles of a strong electro-magnet and the emitted light be analyzed by an interference spectrometer, it will be noted that the spectral lines emitted by the source are split up into two or more components, differing in the polarization of their light waves. This is called the Zeeman effect. It is not too much to say that all that is known of the nature and intensity of the general magnetic field of the sun and of the special magnetic field existent in sunspots has been found out thru observations of the Zeeman effect when present in certain lines of the solar spectrum. This appears so far to be the one and only method available for the detection and measurement of magnetism in the sun and a most valuable agent it has proved to be at the Mt. Wilson Solar Observatory, where in recent years almost daily observations of the sun's general magnetic field or of special magnetic fields existing in sun-spot regions have been carried on with great success.

Since the Zeeman effect is of such superlative value in detecting and measuring solar magnetism we will consider briefly, how these observations are made at the Mt. Wilson Observatory, how the direction and intensity of the lines of force of any solar magnetic field are determined, and what conclusions have been formed up to the present time in regard to the nature and intensity of the sun's general field and of the intense magnetic fields found in sun-spots.

At Mt. Wilson observations of solar magnetism are being made continuously. This is one of the many fields of research that is being thoroly explored at this great observatory devoted primarily to solar research.

The 150 ft. tower telescope of the observatory is used for these observations of solar magnetism. A coelostat mounted at the summit of the tower reflects a beam of light from the sun to a second mirror from which it is reflected vertically downward to an objective of 150 ft. focal length which forms an image of the sun about 16½ inches in diameter in the observing room at the foot of the tower. This image falls upon the slit of a spectrograph at a height of three feet above the floor and passing thru the slit the light descends to a collimating lens of seventy-five feet focal length which is mounted near the bottom of a well about eighty feet deep which has been excavated beneath the tower. Here exists the even temperature and undisturbed condition of the atmosphere so vital to solar research of this nature.

Beneath this lens is a large Michelson grating of very high resolving power (622 lines to the millimeter). After falling on this grating the light returns thru the collimating lens which now acts as a camera objective and forms an image of the solar spectrum on a plate mounted beside the slit of the spectrograph. In one exposure a portion of the spectrum one meter long can be photographed.

The polarizing apparatus which plays such a vital part in all magnetic observations consists of a Nicol prism built in four sections with a total length of 130 mm. and a thickness of 8 mm. mounted just above the slit of the spectrograph in a stationary position.

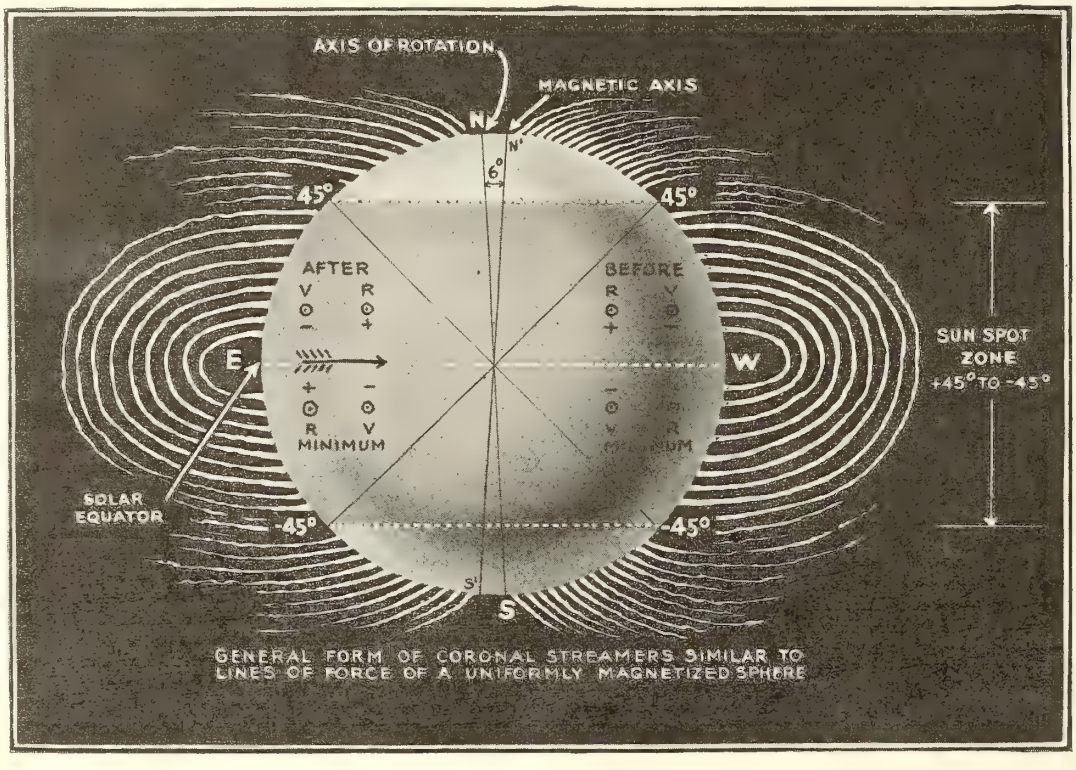
The effect of rotating the Nicol is brought about by means of half-wave or quarter-wave plates, single or compound, used in connection with the Nicol and adjusted above it.

This, then, is the essential equipment for observation of solar magnetism and with it photographic observations of magnetic fields in sun-spots or other portions of the solar surface are made on practically every clear day at Mt. Wilson.

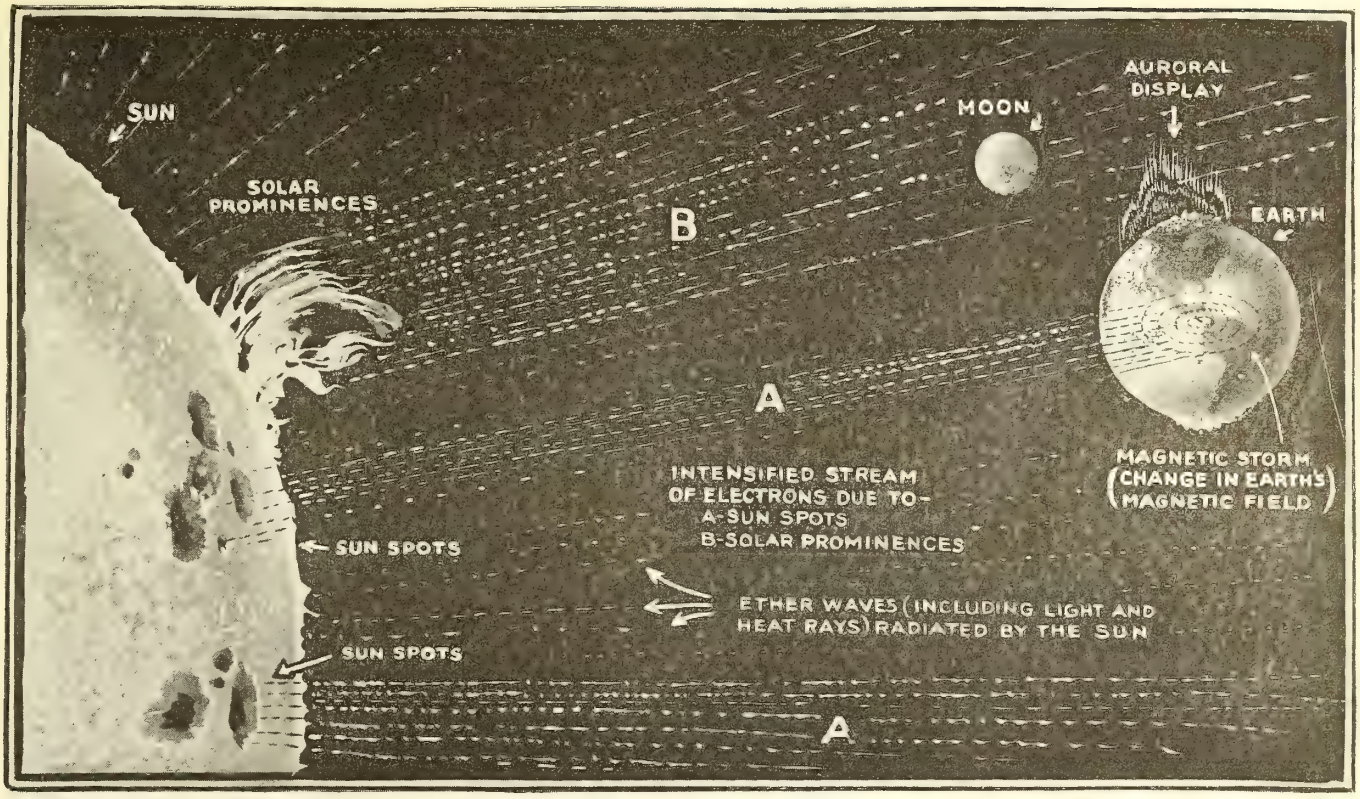
The plates are later measured and reduced and the results of the observations follow from the mathematical reductions which frequently involve long and complicated solutions.

The Zeeman effect may be evidenced simply as a widening or a doubling of normal spectral lines or a splitting up of a line into three or more components. The usual form in which it is observed is that of the Zeeman triplet, consisting of a central line called the p-component, in the normal position of the spectral line, and two outer lines called the n-components, or the red and violet components, symmetrically placed on either side of the central component.

When viewed *along* the lines of force of a magnetic field, the central component of a Zeeman triplet is absent (components of vibration parallel to the field produce no radiation, since a magnetic field has no effect on a charged particle moving parallel to the lines of force). The two outer components, however, are present with equal intensity and are circularly polarized in opposite directions. See Fig. 1. They may be regarded as due to charged particles rotating in circles of equal radius, and in opposite directions at right angles to the lines of force. By means of the Nicol prism and a quarter-wave plate mounted over the slit of the spectrograph it is possible to cut off either outer component and if the apparatus has been so adjusted as to extinguish one component a reversal of current will



This Diagram Shows the Position of the Sun's Magnetic Axis, the Distribution of Lines of Force Outlined by Coronal Streamers and the Distribution and Polarity of Sun Spots Before and After the Last Sun Spot Minimum. Direction in Which Sun Spots Pass Across the Solar Disc Indicated by Arrow. Polarity of Sun Spot Groups in the Two Solar Hemispheres Before Last Sun Spot Minimum Is Shown to the East of the Axis of Rotation; the Polarity of Groups Since the Last Sun Spot Minimum Is Shown to the West of the Axis, V, Indicating That the Violet Component of a Zeeman Triplet Is Transmitted by the Nicol, When Observations Are Made Along the Lines of Force and R, That the Red Component Is Transmitted. The Minus Sign Indicates That the Polarity Corresponds to That of the North Magnetic Pole of the Earth and Positive Sign to the South Magnetic Pole.



In the Illustration Above, the Direct Effect of Sun Spots and Prominences Upon the Earth are Clearly Shown by the Dotted Lines, Each in the Path Taken by the Intensified Streams of Electrons and Ether Particles. Close Observation by Astronomers Has Shown That Whenever There are Noticeable Solar Prominences or Spots on the Sun, the Weather as Well as the Electrical and Magnetic Conditions of Our Earth are Changed or Varied. Coincident With Sun Spots or Solar Prominences, We Invariably Experience Magnetic Storms on the Earth; Thus Magnetic Storms are Thought to be Changes in the Strength of the Earth's Magnetic Field Caused by the Intensified Streams of Electrons Shot Out From Its Spots by Any Unusual Activity of the Sun. The Auroral Displays at the Poles Also are Now Thought to be Due, in Great Part at Least, to These Effects.

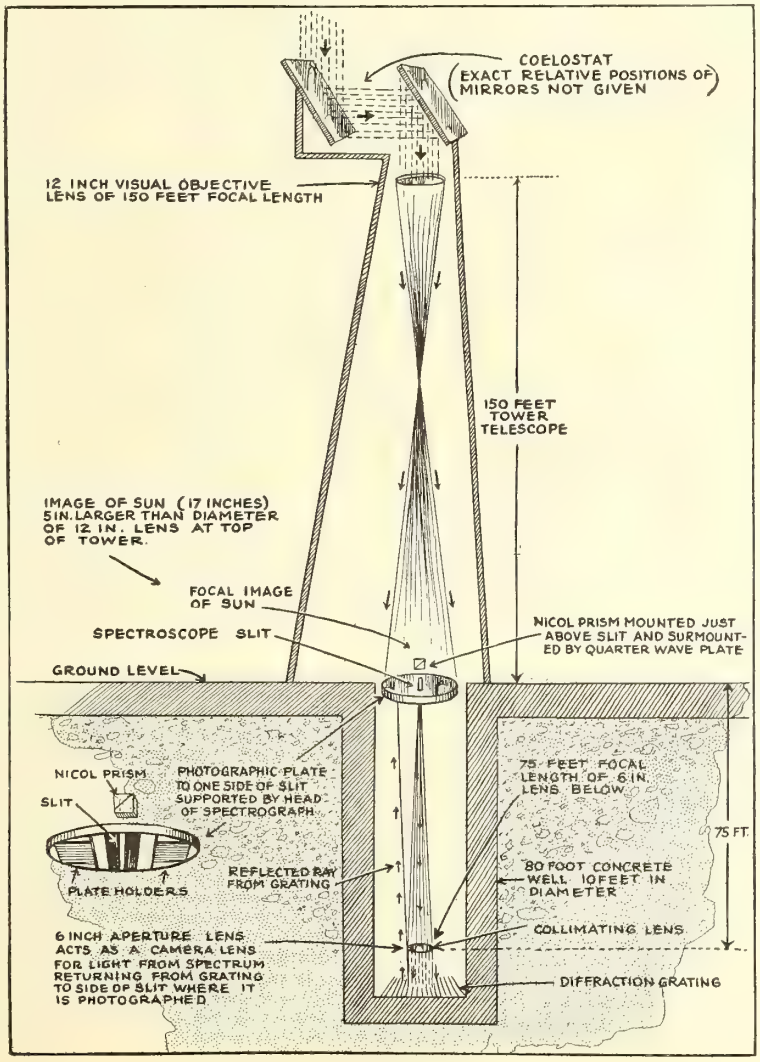
cause this component to reappear and the other to be extinguished. Here then is a means of determining the polarity of the magnetic field when observed *along* the lines of force. If the particles in the region observed are carrying a *positive* charge the component of greater wave length, the *red* component of the Zeeman triplet, will be circularly polarized in a *clockwise* direction; if the particles are carrying a *negative* charge the red component will be circularly polarized in a *counter-clockwise* direction (as viewed along the positive direction of the lines of force of the magnetic field). Evidently all one needs to observe is *which* component is extinguished for a definite position of the Nicol and quarter-wave plate to determine the polarity of the magnetic field.

If viewed at right angles to the lines of force the p-component is present and plane polarized, and its intensity is twice that of the two outer components which are also present and plane polarized but *in a direction at right angles to the plane of polarization of the central component,* since in this position their circular rotations are viewed end on.

If then the three components of a Zeeman triplet are present and the central component is twice as intense as the two outer components, the observer knows that his line of sight is at right angles to the lines of force of the magnetic field.

For intermediate positions it is possible to determine the polarity up to

(*Continued on page* 1124)

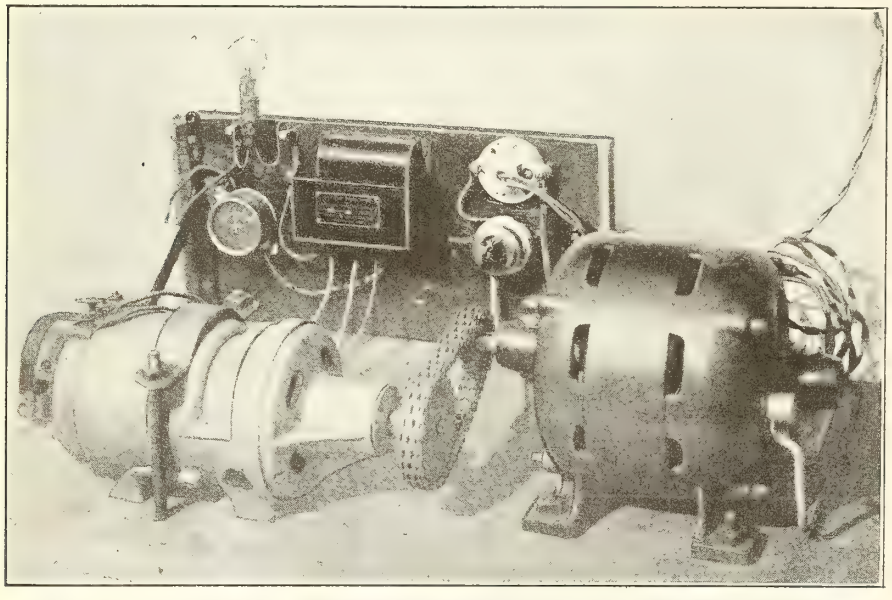


This Sectional View of the Huge 150-foot Tower Telescope Erected at Mount Wilson, Cal., Gives a Clear Idea of the Startling Dimensions of This Wonderful Instrument Created by Man and Used Particularly for Studying the Electrical and Magnetic Conditions of the Sun. By Means of a Specially Timed and Accurately Rotated Set of Mirrors at the Top of the Telescope Tower, the Sun's Image Is Constantly Reflected Downward Upon the Spectroscope Disc and Slit on a Level With the Ground Floor. Any Part of the Sun's Image Can be Focust Thru the Nicol Down Thru the Narrow Slit and the Solar Beam Passing Thru the Slit Is Focust Thru the Six-Inch Lens at the Bottom of an 80-foot Well on to the Diffraction Grating. The Rays of Light Reflected From This Grating, Pass Back Thru the Lens and Come to a Focus at the Plateholders on Either Side of the Slit at the Ground Level, Where the Images of the Reflecting Spectrum Rays are Photographed, and Thus Recorded for Further Careful Study and Research. The Magnetic Changes and Polarities on the Sun, and Particularly in Sun Spot Regions, are Analyzed by Means of the Zeeman Effect, Well Known to Students of Physics and Electro-Magnetism.

Charging Ignition Battery at Home

By H. C. PETZWAL

THE accompanying photo will make the idea clear, and the specifications are as follows: The 110-V. A. C. motor running at 1,750 R.P.M. is connected with a silent chain to a (second-hand) automobile lighting generator, ratio 1 to 1.4 which reduces the generator speed to 1,250 R.P.M. The output of the generator at that speed is about 12 amperes at 8 volts. A cut-out is placed in the A.C. line to prevent the battery from discharging thru the generator in case the A.C. motor should stop, and also an ammeter to indicate the rate at which the battery is being charged. Any cut-out can be used as the speed of the generator is constant and there is no need of a control in its field circuit. The two charging clips are attached to the binding posts, which in the illustration carry a miniature lamp and which should be marked plainly positive and negative.



To Make a Battery Charging Set Like the One Shown, Procure an 8-Volt Dynamo, Delivering About 10 to 12 Amperes, and Arrange to Drive It With a Belt or Chain by Means of a 110-Volt A.C. or D.C. Motor.

In case of doubt as to which terminal of the battery is positive, simply connect up the clips without starting the generator, press the points of the cut-out together for an instant and watch the ammeter needle, if it shows *discharge* the connection is correct, should it show *charge,* reverse the charging clips on the battery. The capacity of this set is sufficient to charge any ordinary 6 volt battery; I have in fact put on as many as three of them in parallel with satisfactory results. For the drive I consider the silent chain the best, tho either a round or flat belt can be used with suitable pulleys. The driving motor does not necessarily have to be ¼ H.P.; ⅛ H.P. being sufficient to drive most of the generators. The working speed varies with the different makes, some of them going as high as 2,000 R.P.M.

The cost is not prohibitive as one can purchase all the parts in the second-hand shops, an automobile wrecking shop being the best. My whole set cost $8.75 not including the motor, which I also use to run my small lathe and grinder.

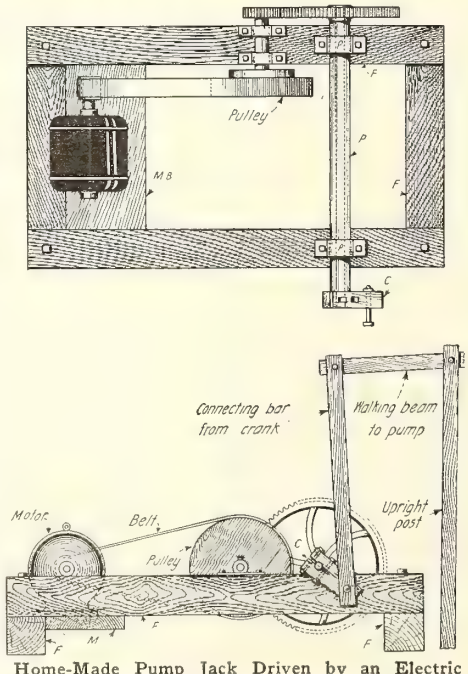
A Motor Driven Pump Jack

By FLOYD C. WELSH

HEREWITH are some drawings of a pump jack for use with an electric motor which was made from parts of an old cream separator; in most instances this will work the pump slowly enough without the necessity of a countershaft. A jack of this sort has been in use for some time, pumping water for about fifty head of live-stock.

The frame "F" is made of four pieces of 4"x4" timbers bolted together at the corners. A plank "M. B." is used as the motor base and is fastened firmly in front of one of the cross-pieces. The bearings are of babbit metal and cast in the ends of pipes P. P., which are fastened to the frame with iron clamps. The pipe for the main gears should be long enough to project two or three inches past the frame so that a box covered with tin or other waterproof material may be placed over the jack, to protect both motor and belt from rain.

A shaft for the large gear long enough to reach 2 inches beyond the pipe may be obtained from almost any dealer in machinery supplies. The pipe for the small gear and shaft (which are usually made in one piece) must be rather small so as to allow for attaching to it a pulley, made up of several thicknesses of thin boards screwed together. These boards are cut round and bolted together solidly, care being taken to make the grain of the wood run in different directions. The pulley thus formed is then bolted to the side of a worm-gear found on all cream separators.



Home-Made Pump Jack Driven by an Electric Motor. The Parts Are Made from Wood and Iron Pipe.

The crank is made of a block of hardwood with a hole bored in one end, large enough for it to slip freely over the end of the long shaft. The end of the wooden block is then split with a saw and the crank is fastened to the shaft by clamping its jaws together with two bolts. A hole 1/16" smaller than the diameter of the bolt to be used for attaching the connecting bar is bored in the other end of the crank shaft and the bolt is put in place and secured with a lock nut. The length of stroke of the pump is regulated by the position of the upright on which the walking-beam works.

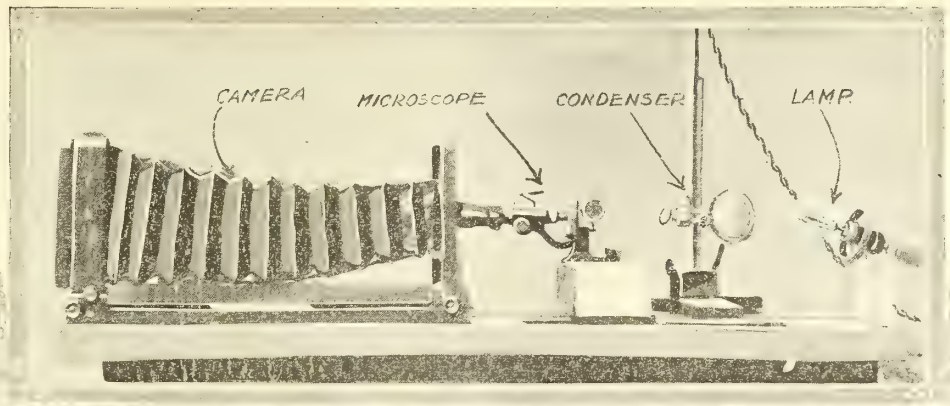
If this jack is properly enclosed to protect the motor, belt, and gears from rain or ice, it is always ready in any weather.

If desired instead of attaching the walking beam rigidly to the pump, a bolt may be inserted into the handle of the pump and a slot cut into the walking beam so as to enable the beam to be placed in position with the bolt. This allows for a certain freedom of motion at the pump handle and such accurate figuring as in the first case is not necessary. The pump, nevertheless, will move up and down with each motion of the walking beam. All bearings should be kept constantly lubricated.

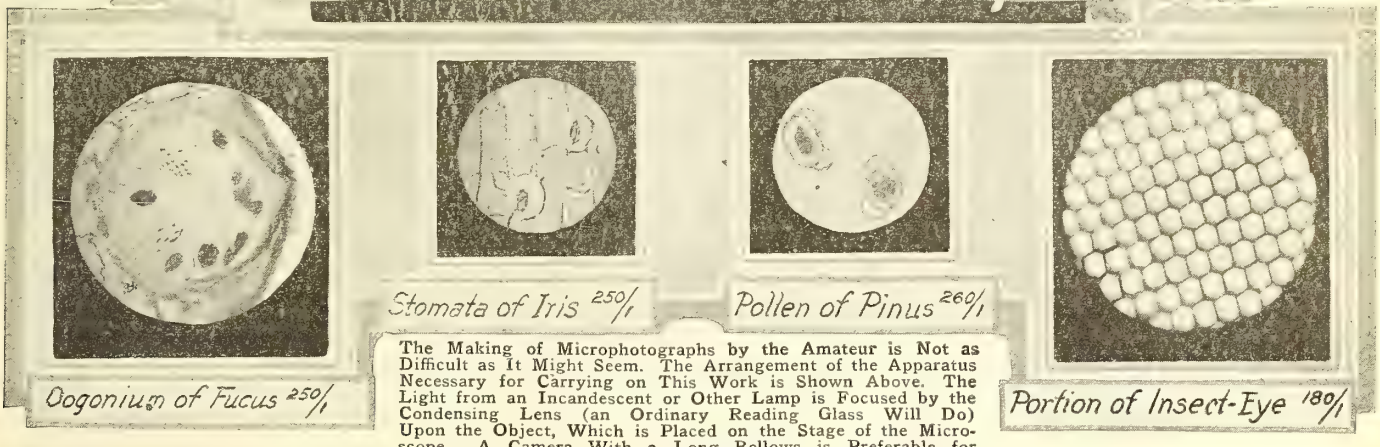
Making Microphotographs

By DR. E. BADE

PHOTOS taken with the microscope are dependable and more exact than drawings and are much superior to them if they are taken in the correct way. A peculiar thing in this branch of photography is, that photographic objec-



round-bottomed flask commonly used in chemical laboratories. It is made from thin glass; has a nearly spherical body and a long, narrow neck. The flask is nearly filled with water so as to leave about half an inch of the neck filled with air. Cork the flask; place



The Making of Microphotographs by the Amateur is Not as Difficult as It Might Seem. The Arrangement of the Apparatus Necessary for Carrying on This Work is Shown Above. The Light from an Incandescent or Other Lamp is Focused by the Condensing Lens (an Ordinary Reading Glass Will Do) Upon the Object, Which is Placed on the Stage of the Microscope. A Camera With a Long Bellows is Preferable for This Work.

tives of any description are not used. All that is necessary is a good serviceable microscope, a camera box with bellows extension of adequate length, with its ground glass, and a plate holder. All this is shown in the cut. Upon the photographic table there is an ordinary camera having a double or triple bellows extension, firmly fastened to a table, along with the microscope and electric light.

Unscrew the lens of the camera, or take out the lens board. Make a similar board with a small hole about three-fourths of an inch in diameter. Take a short strip of light-tight cloth, roll into a cylinder which is just large enough to slip easily over the microscopic eye-piece, and let it be sewn together. This cylinder, which should be about three inches in length, is attached to the inner side of the board just made, so that it fits firmly and is light-tight as well.

Next a support for the microscope is to be provided. The right height of this support is found by trial and then a small box is made or procured and filled with weights so that it will not tip when the microscope is inclined in a horizontal position. Another important detail is to provide the box with some kind of a device which locks the base of the microscope firmly to the box.

But before microphotos can be taken, slides must be secured. These can either be bought or made. Sections of the substances to be photographed, that is very thin slices, are cut with a razor blade. They are treated with alcohol of 30 per cent., 45 per cent., 60 per cent. strength, stained if desired with eosine, etc., and finally placed in 95 per cent. and then in absolute alcohol. The section should remain at least from one to two hours in each alcohol bath. After it has been placed in absolute alcohol, it is placed in xylol, which removes all of the alcohol, and this substance lightens and hardens the object. Now comes the final step. The object is placed on a glass slide, a single drop of balsam dropt on it, and the cover-glass carefully lowered upon the object and a slight weight placed upon it to press out any superfluous balsam. Then the slide should remain in a horizontal position until the balsam has hardened.

When the slide has been made photos can be made from it. It is placed upon the stage of the microscope and clamped in place by the two springs. Now look thru the microscope as usual and find the particular section desired to be photographed. When this has been accomplished, place the microscope on the box, clamp it tight, and incline it so that it lies horizontal. Take off the camera lens and substitute the board carrying the cloth cylinder, slip the cloth cylinder over the upper part of the microscope, and turn the substage mirror to one side; it is not needed.

Since better photos can be made with artificial light than with sun light, and since the artificial light can be better regulated to suit the picture on hand, it has been found advisable to take such photos only at night. The illumination is always constant, it never varies from day to day, and therefore fewer pictures are spoiled either thru over- or under-exposure.

For enlargements up to 150 diameters a 40-watt lamp is sufficient. For larger diameters it is advisable to take a nitrogen-filled lamp of at least 75 watts, better still is a 100-watt lamp. Place the lamp in line with the microscope and at least a foot and a half away from the slide. If the lamp is placed too near the slide, it will heat the balsam, and if the balsam is not thoroly dry and hard, then the object and the cover glass will move and spoil the picture.

In order to prevent the object and the cover glass from moving, in other words, to prevent the balsam from becoming too hot, a globular bulb is inserted between the microscope objective and the source of light. This globular bulb may be a on the ringstand or other holder, and arrange the bulb to intercept the light rays of the electric light bulb before they reach the microscope. This bulb will not only absorb a great part of the heat rays, but it also concentrates and focuses more light upon the object glass and so throws more light thru it, thus increasing the illumination.

When the ground glass on the camera has been illuminated as brightly as possible by the light passing thru the microscope, then take the ground glass out and begin focusing with a small hand lens, held in the plane of the plate-holder. When the lines are seen sharp and distinct thru the lens, the object is in focus and a picture can be taken. Focusing, of course, is done with the micrometer screw found on the microscope. The object cannot be focused sharply any other way.

After this has been done as accurately as possible and focusing should be done very carefully, place a piece of cardboard between the light and the microscope so that it is cut off. Then place the plate-holder in the camera, pull out the shutter and remove the cardboard. This will expose the plate. The time of exposure varies slightly with the object to be taken, and also varies directly with the square of the lineal magnification. All microphotos are time exposures, and the shortest time exposure is approximately five minutes, except for very transparent objects, taken with a low power, which require about three minutes. Development and fixing is done as usual.

The arrangement shown is adapted for transparent and translucent objects, and the majority of microscopic subjects fall under these heads. A totally opaque object will naturally give only a silhouette. But in the classes named transparent and translucent objects are included the vast majority of subjects which will interest the microphotographer.

Glass Tubing Notes

By CHARLES S. WOLFE

THE chap who dabbles in chemistry, and even the general experimenter, is likely to find himself quite frequently faced by the necessity of doing some more or less difficult stunt with glass tubing. Usually he can't do it. The magazines seem rather to avoid the subject, altho the editor did give us an article that took us as far as a T making.

As a rule, the local drug store will be able to furnish you tubing—in not over 12-inch lengths, and as old as the hills. This won't do you much good. Have a try at the chemical supply houses, it will pay you to wait a bit for delivery for the "newest" tubing you can obtain.

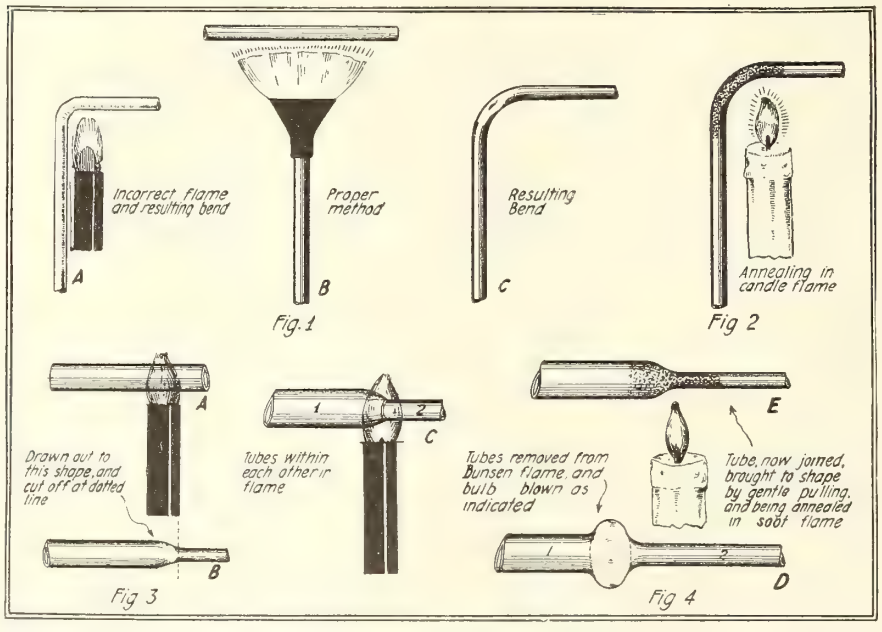


Fig. 1-A Shows Incorrect Way of Bending a Glass Tube; Fish-Tail Burner for Making Easy Curve Shown at B, and at C the Resulting Bend. The Bend Is Annealed in a Sooty Flame Such as That from a Candle, Fig. 2. Fig. 3 Shows Method of Joining Two Tubes. Fig. 4 Shows Fusing and Annealing of the Final Junction between the Two Glass Tubes.

I'm a little lucky along these lines, for there is a shop making barometers and apparatus of that nature within a few miles of me. I get tubing there in about 5-foot lengths of almost any diameter up to 1 inch. Look about your locality, and you may find such a place within striking distance. If you do, and your work does not specify an exact diameter or wall thickness, you will get the stuff quite cheaply. Five cents a length is the usual charge to me. Here is the secret. Tell them you can use odd sizes. These places take their glass "as it comes," that is, all sizes, and every car is sure to contain a lot of stuff that is of no earthly use to them. Use these, and the cost will be slight.

The commonest operation is the simple bend. The straight flame from the Bunsen is most often used, and it is not at all suited for the work. The glass gets hot in one little spot in such a flame, and you get your bend all at once, so to speak. It buckles rather than bends. I used to turn out some rare curves, regular forty-five degree drops. Equip yourself with a fish tail tip—cost about a quarter—and you will make graceful, sweeping bends, because a larger surface is made hot and pliable.

Lots of us, in spite of advice, make our bend and let it go at that. The glass just cools off. Every piece so done is not reliable. More, the chances against it standing up to its job are big. You must *anneal* your work. Burying in hot sand would do the trick, but the handiest method is to *soot* the work, which causes it to cool slowly. Many authorities tell us to shut off the air on our Bunsens until we get a yellow flame, doing the sooting in that. If I waited for my Bunsen to make soot enough to anneal a job, my arms would be numb from holding the glass. I take it the Bunsen family members all behave about alike, so most of you will have the same experience.

Have at your hand an ordinary tallow candle. Here is a real efficient soot producer. Get your work out of the flame and into the candle smoke, and SOOT it. Emphasis because it's hard to get too much on. Then lay it on the asbestos mat to cool.

Don't be without three or four of these circular mats. They cost ten cents each.

Another little point to observe is that it is necessary to keep the work turning while in the flame. This is a cinch when you're working on the middle of the piece, but it is far from comfortable when you have an end to deal with. The chap who works at the business rigs up a support that holds the glass, and twirls with the palm of his hand. You can work out the simple support for yourselves.

Some time you may wish to seal one tube within the other. Not such a hard job to do, providing beauty is not an essential of the finisht product. It takes quite a bit of practise to make those joints look good, but you can get away with a serviceable seal readily. If both tubes fit into each other nicely, it's simple. If not, it's up to you to make 'em. And there is where appearance usually gets it in the neck.

First take your larger tube, having it considerably longer than the finisht article is to be, and make a constriction by getting the glass to the right temperature, pushing it slightly together first, and then drawing out. Don't draw too darned hard, or you'll find yourself under diameter when you cut for joining. At that, it's a trick, frankly, that calls for practise, because the first time you try that constriction stunt you'll find the tube, instead of going nicely together to give the needed thickness of wall, will do its best to look like a lightning flash. You'll know what I mean when you try it. Keep her turning is the answer to this, and that calls for *PRACTISE*.

Having your constriction of the proper size, insert the smaller tube, get 'em hot, and you'll notice their tendency to stick together. Also to bend out of shape. As they get hot, they wiggle in an alarming manner.

The professional proceeds thusly. He keeps them revolving with the palm of his hand until they are pretty well fused. Deftly he removes them from the flame, turns them nearly vertical, and blows into the open end gently. The joint becomes a bubble. But even as the bubble forms, he pulls with his free hand, bringing the tubes back to size. (I brought my first twenty or so to a complete close when I tried it.) Then he blows again, and pulls. This he does several times, thoroly fusing the tubes. Then into the soot they go, straight as a die if it's professional work, and all bent out of shape probably, if it's yours.

Lantern Slides

"Tracing cloth and waxed paper are usable as lantern slides, altho their limited transparency produces a rather dark field, and the texture of the material shows plainly," says R. G. Hudson, of Kenyon College, in *Science*. Mr. Hudson has experimented with substitutes for glass lantern slides, giving special attention to slides which could be prepared quickly for temporary use.

He found that a satisfactory slide could be made by drawing figures or diagrams on thin white paper with india or colored ink. After the ink had become thoroly dry both sides of the paper were brushed over with a light-colored penetrating oil. The thin glazed white paper used for duplicating typewritten letters serves admirably for the paper and a light neatsfoot makes a satisfactory oil. These paper slides may be inserted in cardboard holders and with suitable projecting apparatus the results are all that could be desired.

The effect of the oil is to increase greatly the transparency of the paper and when new the texture of the paper is quite imperceptible. Figures of lesser sharpness can be made with a fountain pen or even with a pencil. Diagrams and pictures of appropriate size may be cut from magazines or bulletins and treated with oil as outlined above. These are more satisfactory, of course, if no printing appears on the back, but for temporary use the printing in many cases will not destroy the usefulness of a diagram.

I have also made good slides in the same manner by treating 3¼ x 4¼ photographic prints with oil. The projected pictures, while less bright than those procured with glass plates, present a softer effect and are especially interesting in the case of portraits. Since the usual photographic paper is quite heavy the lantern must be placed nearer the screen but if thinner paper could be obtained the results would be quite satisfactory if the usual distance were maintained.

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

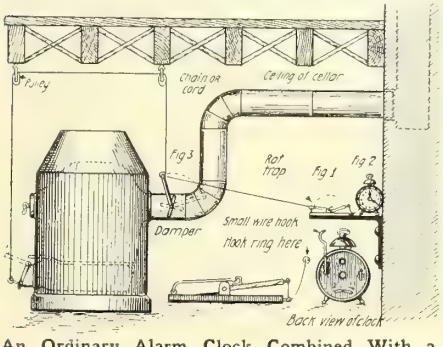
AUTOMATIC FURNACE REGULATOR

After having made and installed a furnace regulator as described herewith, the maker can lie in bed and dream on of the comforts of getting up with the house already warm, instead of getting up a half hour earlier to open the furnace draughts, when the house is cold and chilled.

Procure an alarm clock, a No. 1 rat trap, the kind illustrated in the figure, which sells for ten cents, several feet of small chain or flexible wire cord, two small pulleys and a piece of sheet iron $\frac{1}{8}$″ x 1″ x 6″. This is all the material that is needed. Other dimensions will vary with different furnaces.

A small piece of wire one and a half inches long with a small hook bent on top is soldered to the alarm winding key. A piece of cord is then fastened to the trigger of the trap. The trap is then set when ready to dampen fires for the night and the cord from the rat trap trigger is attached to clock, and the damper is closed.

When this is closed, it will also close the draught door; the alarm is set about half an hour earlier than your hour of arising. When the clock goes off, the key will revolve, pulling the string attached to the trigger, thus springing the trap. This opens the damper and draught door, and allows the fire to burn more rapidly.



An Ordinary Alarm Clock Combined With a Cheap Rat Trap, Solves the Problem of How to Build An Automatic Furnace Regulator. This Device Will Start Up the Furnace An Hour Before You Rise in the Morning, and Have the House Warmed Up Nicely.

Contributed by CARL S. MORGAN.

SECRET WRITING WITH ONION JUICE

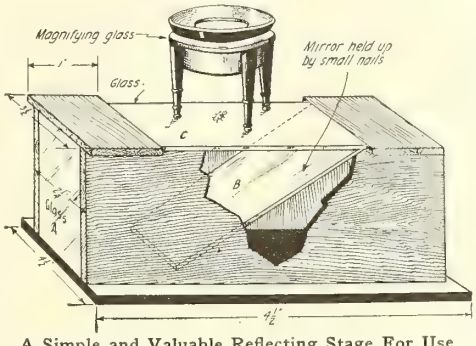
Squeeze the juice of an onion into a very small container. Then with an ordinary pen, dip and write. You will see what you are writing while it is fresh, but as it dries it will become invisible and to the uninitiated the paper will be an innocent blank. Your correspondent, upon the receipt of this invisible note, should heat a tablespoon and after wiping off the soot, rub the spoon's convex surface well over both sides of the paper and the writing will appear clearly in brown.

Contributed by C. NYE.

SECOND PRIZE, $3.00

MICROSCOPE STAND

Here is a sketch of a microscope stand which is very easily made from a cigar box and which aids very much in examining different objects, too small to be seen with the naked eye.



A Simple and Valuable Reflecting Stage For Use With the Ordinary Type of Magnifying Glass. It May Be Constructed From Cigar Box Wood, Together With a Small Mirror and Two Pieces of Glass.

The only materials required are a cigar box, cigar box nails, a glass mirror and a piece of glass.

This is how it works: The light comes in at A and is reflected upward by the mirror B. The object to be magnified is placed on top of the glass C and the magnifying glass is also placed above the object.

Contributed by FLOYD W. RAUSCH.

HOW TO REMEMBER POWER FORMULAS

By the following method the ordinary power formulas may be very easily remembered:

First—Draw four circles.

Second—Divide them in half by drawing a horizontal line thru them.

Third—Divide the lower halves into quarters.

Fourth—In the following order place E^2, E, W and W in the upper halves.

Fifth—Write the word "WIRE" one letter in each lower left quarter.

Sixth—Place the following letters in the right quarters in the following order. R, R, I^2, and I.

After constructing the following form a few times it will never be forgotten. In the first w r equals E^2 and we would of course extract the square-root of the result, this would also apply to number three, W/r equals I^2 and not I.

Contributed by D. BLODGETT.



By Means of These Four Simple Diagrams Which Are Easily Memorized, a Number of the Most Important Electrical Formulae Can Be Kept Always on Tab.

THIRD PRIZE, $2.00

FULL SIZE COPIES WITHOUT A COPYING CAMERA

First rate photographic copies of magazine pictures, cartoons on comic illustrations can easily be made without a copying camera as follows:

If the picture has printing on the back it must be removed. This is best done by splitting the back from the front. Paste a heavy piece of paper to each face of the picture (front and back). When the paste is almost dry pull the two sheets quickly apart and the front half will be found to be separated from the back half.

Remove the picture from the heavy paper by soaking in warm water. After drying the picture iron it with a flat iron and paraffin wax (candle wax will do). This renders the picture translucent.

Place the picture in a printing frame in a dark room with either a sensitive plate or film with the emulsion in contact with the printed side of the picture. Make the exposure by burning a match completely about two feet in front of the frame. Develop the negative in a rather weak developer.



A Simple Process For Making Full-Size Copies of Magazine Pictures, Cartoons or Comic Illustrations Has Always Been in Demand by Every One of Us At Some Time or Other. The Author Describes in the Accompanying Article How to Do This Without a Copying Camera. The Photographic Copy of a Comic Advertisement Here Reproduced Was Printed Without Making the Paper Translucent With Paraffin Wax, and Which Resulted in the Reproduction of the Grain of the Paper.

From this negative, which reproduces every detail of the original faithfully, can be made as many copies as are wanted. The photographic copy here reproduced was made without making the paper translucent with paraffin wax, which resulted in the reproduction of the grain of the paper.

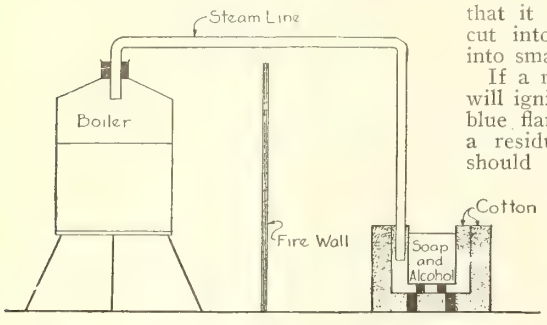
Contributed by
WERNER W. BAUMEISTER.

Fascinating Experiments in Chemistry

By O. IVAN LEE

How to Make "Solid Alcohol"

A tin can of about a gallon capacity is the first requisite for this experiment, and means for heating water in it. A short metal or glass tube, preferably "L" shaped,



Apparatus Set Up for Making "Solid Alcohol."

is inserted in the cork fitting the outlet hole. To this is attached a piece of flexible metallic gas-tubing about six feet long, terminating in a tin can of about a quart capacity. (A lard can is about right.) Punch a nail-hole about an inch from the bottom and put in a couple of short sticks half an inch square. Now place a baking-powder can in the quart can, supporting it on the blocks of wood, and after inserting the free end of the gas-tubing between the tin cans, pack the upper portion of the space with cloth or cotton.

If possible, arrange to have the boiler can and double boiler on separate tables or benches; but if this can not be done, put a large board or metal partition between them. This is to serve as a fire wall against any alcohol vapor from the experiment creeping along the table and catching fire.

Previous to setting up the foregoing apparatus, grate or shave a cake of good white hard soap into small pieces, and dry it in an oven *at a very moderate temperature.* The object is to drive out the large amount of water which all soap contains, without melting the material. This may take some time; but it is better to take longer and be sure the soap is dry, than to try to hurry it and melt it. When the soap is perfectly dry and powdery to the touch, fill the baking-powder can about half full of (denatured) grain alcohol. Since a baking-powder can is not always even water-tight, it is just as well to take the precaution of testing it for leaks with some alcohol. Now get up steam in the boiler, and shortly after steam passes into the space between the two cans, the alcohol will boil. With a spoon, sift in the dry powdered soap a little at a time, stirring continuously. The soap will dissolve, altho the solution may be rather muddy looking instead of clear. Keep adding soap until no more readily dissolves, adding a little alcohol occasionally to replace that which is lost from boiling. If the solution does not boil as easily as at first, cover it up with a little saucer for a while. When as much soap as possible has been dissolved, turn off the steam and let the alcoholic soap solution cool. At a certain point, it will suddenly freeze and become completely solid. When perfectly cold, run a thin sharp knife around the inside of the can, or immerse it for a moment in a pan of boiling water, and you will be able to slide out a white cylinder of "solid alcohol." It looks much like soap, except that it is not quite so hard, and may be cut into convenient-sized cubes or sliced into smaller cylinders.

If a match is applied to one of these, it will ignite readily and burn with a hot pale blue flame for ten minutes or so, leaving a residue of soap. The "solid alcohol" should be preserved in friction-top cans until wanted for use, as otherwise the alcohol slowly evaporates. It is very popular with campers because of its safety and convenience, for after one has cooked a meal over burning "solid alcohol," the soap that remains may be used to wash the dishes!

A Good Secret or Invisible Ink

Almost every one has wished at one time or another for a good secret or sympathetic ink—one that is cheap and easily obtainable, really invisible when written, easy to develop and easy to read when brought out. An ink not generally known which answers these requirements is a solution of chlorid of ammonia, ammonium chlorid, or sal ammoniac as the electrician calls it. It is used for charging the wet batteries for ringing door bells.

SCOUTMAN G.

Dear Walter:

Secret Six commands your presence at the Sign of the Seven Stars at Moonrise.

John wants us to go fishing Saturday. Can you go?

Yours,

Charley

The Secret Summons.

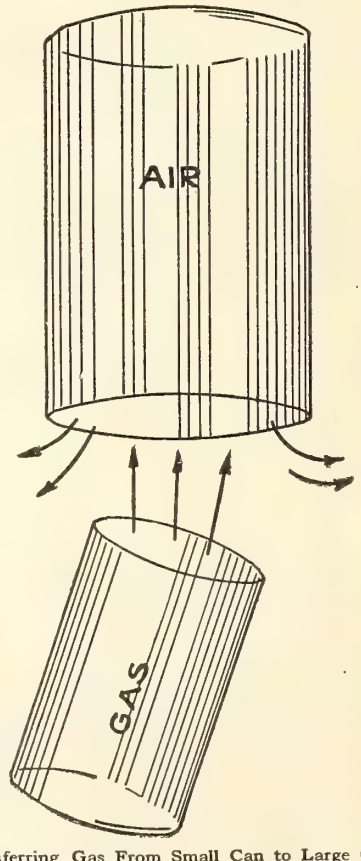
Make a strong solution of this chemical in a clean bottle, get a new pen-point (one that won't scratch) and clean the lacquer from it by scraping, sand-papering or washing in alcohol. Draw or write with the solution on a piece of clean white paper, viewing the writing horizontally against the light to make sure that the pen point has not "skipt." You want a pen which is absolutely dependable and won't miss a dot, since in use you will be writing "blindly."

When the ink has dried, examine the paper again very carefully to see if you can make out any trace of what you have written. Very likely you can. If so, add a little more water to the ink and try again until nothing whatever can be detected on the paper after the ink is dry. The idea is to get the ink of such a strength that it will soak *into* the paper without leaving any tell-tale crystals of sal ammoniac on top.

To bring out the writing, heat the paper written upon *strongly.* This can be accomplished by pressing with a hot flat-iron, or heating in an oven or over any burner. A little practise will soon give you the knack of it. The writing will appear brown to jet black, depending upon the amount of heating, and is absolutely indelible, the lines being virtually burned in.

How to Make a Powderless Cannon

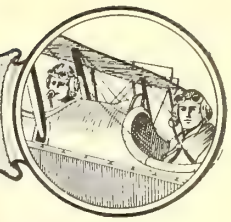
Punch a nail-hole in the bottom of a medium-sized tin can (2 lb. size) with a fairly tight-fitting cover. Take the cover off a smaller (½ lb.) can and hold it *upside down* over a gas-jet. Turn on the gas until the gas (which is lighter than air) has filled the can and overflowed at the bottom. Take the cover off the larger can, then, holding it upside down next to the small can, turn the smaller one right side up under the big one just a moment. (Not forgetting to keep a finger over the hole in the bottom of the big can.) Then slip on the cover of the big can still keeping it upside down, and lay it lengthwise on the ground. Put your foot on the can, take a long breath, and touch a lighted taper to the nail-hole. Results will be immediate, gratifying and harmless.



Transferring Gas From Small Can to Large One. The Bottom of the Large Can Has a Nail Hole Pierced Thru It.



RADIO DEPARTMENT



Grand Opera by Radio

By NELLY E. GARDNER

A BEAUTIFUL woman, of world-wide fame, stood before the wireless telephone, in the Hotel McAlpin, New York City, on the night of December 3rd, and poured into its receiving horn heartstirring notes that were heard by men far at sea. For Madame Louisa Tetrazzini, grand opera prima donna, had offered to sing for the officers and men of the United States Navy. So on that wintry night all naval and commercial vessels that were within 500 miles of New York—providing they had their instruments tuned to the proper wave lengths and had the wireless telephone attachment—enjoyed their own private concert by the operatic star.

Between 9.30 and 9.45 p. m., other radio messages were stopt, so that all ships within the definite radius might listen to the beautiful music, without interruption. During that quarter of an hour Madame Tetrazzini sang four songs—three according to the announced program, and one encore for good measure.



Mme. Tetrazzini Singing by Wireless to the U. S. Navy Sailors. The Sailors Were on Their Ships, at Anchor or Running About the Harbor, or in Navy Yard Buildings, While Mme. Tetrazzini Was in Her Apartment in the Hotel McAlpin, New York. A Radio Telephone Had Been Installed in Her Apartment and Her Voice Was Transmitted Thru the Ether to the Ships and Navy Buildings and Then Amplified Thru Loud-Speaking Telephones. The "Concert" Was a Wonderful Success, the Sailors Reporting They Could Hear the Operatic Star Perfectly.—©Underwood & Underwood.

Just before the clock in her apartment ticked the half-hour, Madame Tetrazzini's manager called the radio-communication office of the Third Naval District, in the Whitehall Building, to make sure that everything was in readiness. When his question, "All ready, Lieutenant?" was answered in the affirmative, the musicians took their places, the prima donna took her place in front of the large receiving horn—and one of the world's greatest wireless telephone concerts was on.

As she threw herself into the "Polonaise from Mignon," it seemed as if the singer had a vision beyond the walls of the tiny room on the sixteenth floor of that New York hotel. She was really sending her song out on the cold seas to the men in blue, and was trying to cheer them with the loving warmth of her voice. After she finished the joyous trills at the end of the selection, her manager immediately stept to the telephone, saying, "Hello, Lieutenant, that is the end of the first song. Wait thirty seconds, and Madame will sing again. All ready. We're off!"

"Mignon" was followed by the "Rondo di Sonambula" by Bellini. In this number, Tetrazzini takes the high "F" sharp, for which she is justly famous. Her third selection was the ever popular song, "Somewhere a Voice is Calling." It was an inspiring sight—to the little group of reporters in the doorway—to see that illustrious daughter of Italy standing before the telephone gazing at the sheet of music in her hand, and striving hard to pronounce plainly the words of our alien tongue, so that all the sea-going sons of America might understand! And it is a pretty safe guess that her song reached many a brave heart, and turned it to the thought of the sweetheart, wife or mother at home.

Madame Tetrazzini is not only a great singer. She is something infinitely greater—a loving, warm-hearted woman, and a "good sport," besides. When her program was finished, she stept to the 'phone, and in broken English, called, "Hello, Lieutenant, you want some more? Well, sure! I'm ready!" Then once more, the singer whose voice can command many dollars on the concert and opera stage, generously and without pay, sent her marvelous notes out to the ears of the thousands of men who were listening eagerly at the other end of the wireless. Again, in high spirits, and slightly out of breath, she called, "It's good? Yes, I am, Oh, 'complimenti.' You speak Italian? Thank you very much. I'm so glad. Very good, all right. My compliments to all the sailors."

Then, last of all, with a twinkle and a chuckle, she called out the latest Broadway phrase that has caught her fancy. You could never guess the final message of the dignified opera star to the young men of America whom she had entertained aboard our great ships! So we'll let you into the secret. Tetrazzini's goodnight message to our men at sea was, "Oh, boy!"

What wonder if some one of them wanted to call back, "Some girl!"

The greatest care was taken in the preparation of the room for this, the world's greatest radiophone concert. Every curtain and ornamentation had been removed. A small upright piano and a few chairs were the only pieces of furniture and the floors were bare. No persons were present during the singing, except her manager and the three accompanying musicians, pianist, cellist and flutist. But clustered in the doorway, where they could see the little woman, but where they could not distract her attention, was a small group of guests and representa-

(*Continued on page* 1136)

Articles to Appear in February Issue of "Radio News"

The Lafayette Radio Station
Two Practical Radio Telephone Circuits
By John Scott Taggart
A Detector and Three-Stage Amplifier for Fifty Dollars
By E. A. White and L. Hopkins
Using an Amplifier as a Detector of Long Waves
By H. K. Dunn
Amateur Radio and Its Future
By Pierre H. Boucheron
How to Wind Duo-Lateral Coils
By W. T. Prather
A New Type of "B" Battery
By Harry Boyce, Jr.

Radio Weather Report



The Photograph Above Shows Mr. E. A. Stewart of the Physics Department of the Kansas State Agricultural College Operating the Powerful Wireless Transmitter and Broadcasting the Latest Weather Reports Via Radio to Thousands of Farmers. This Radio Weather Report is Broadcasted Every Morning at 9.55. All the Farmers Have to do to Receive These Reports is to Install a Simple Receiving Set.

FARMERS will not have to squint at the sky or wait for the paper hereafter to know whether they had better hurry and get in the crops. They'll get the weather by wireless. That is, they will if they care enough about it to put in a receiving set at a trifling cost and teach the hired man or the farmer's boy how to tune it in. E. A. Stewart of the physics department of the Kansas State Agricultural College, has established a wireless weather report service for farmers; the first of its kind. Every morning at 9:55 he sends out the day's forecast. All the farmers have to do is to equip themselves to receive it and it is reported that many have already done so. This picture shows the wireless weather forecast station in operation.

Farmers in general are more or less familiar with the operation and cost of experimental radio apparatus suitable for receiving weather reports as well as standard time signals sent out by the large government stations in various parts of the United States, owing to the radio experimental stations erected and owned by many of their sons.

The amount expended for the receiving set suitable for this service depends, of course, on how elaborate a station it is desired to install. It suffices to say that—thanks to the high sensitivity and reliability of the vacuum tube, or Audion, and its wonderful amplifying properties — small size, efficient receiving sets can be obtained at the present time at surprisingly low prices.

Many, of course, who have a little time and a thirst for experimental science, will undoubtedly find much pleasure in buying the parts and building their own sets, after specifications given in various handbooks available on the subject, as well as from articles publisht in the various radio journals.

New Loud-Speaking Telephone

THE Electro Amplifone here illustrated is effective for interior loud-speaking telephone and radio service. The instrument is adapted to operate on 110 volts D. C. or on a 6 volt storage battery current. It may be used on alternating current in conjunction with a tungar vacuum bulb rectifier. The two sockets in front accommodate two 10 volt lamps for resistance purposes. In the perfected electric control box the resistances are incorporated in the form of a variable potentiometer for 110 volt supply, or a choke coil for 6 volt storage battery operation. The equipment can be used with a hand microphone, chest transmitter or electric tone arm.

With a standard size control box of the type here shown, one up to any reasonable number of loud-talking receivers can be connected up and successfully operated without diminishing the volume of speech in any one receiver, it is claimed.

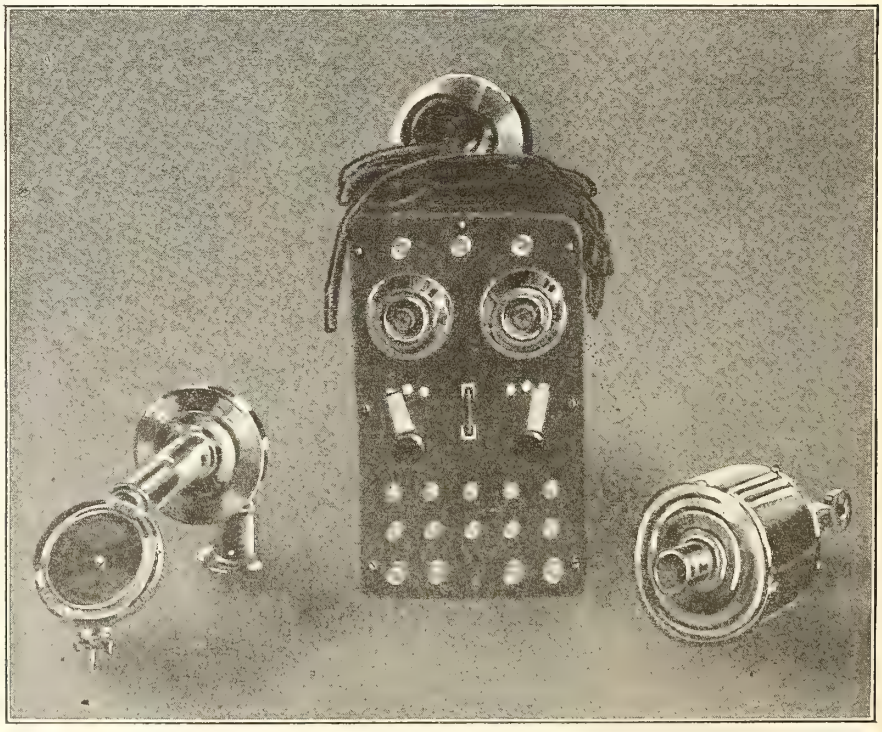
The shunt potential across the transmitter averages 4½ volts when operating this system on 110 volts D. C. The transmitter is of the single button form (granule type) consuming .22 ampere.

The receiver is enclosed in a heavy nickeled spun brass shell, measuring 3x3 inches. The receiver operates with a vacuum between two diaframs.

The receiver consumes 65 milli-amperes; the winding is of the high impedance type. For radio work, the receiver is fitted with the audion transformer enclosed in the shell, adapting it to connection in the plate circuit of an audion. A specially shaped metal horn has been developed for use with the loud-talking receiver. It has already found a large field of usefulness in hospitals and other institutions for such uses as transmitting music to the patients' wards.

The electric tone arm is fitted with an improved form of phonographic reproducer which can be reversed instantly to play either lateral cut or hill and dale records. It has been found by the designers of this apparatus that superior results are obtained by using the non-tapering form of tone arm.

With this loud-talking telephone apparatus installed in a public institution such as an auditorium, an ordinary talking machine used in conjunction with the special tone arm and the control box shown, together with a number of the loud-speaking receivers, as many as several thousand people can be entertained at one time. The makers of this apparatus have also devised a loud-speaking set for use by aviators and show window demonstration sales purposes.



New Loud-Speaking Telephone Which is Adapted for Use on Telephone Circuits as Well as Radio Receiving Circuits. The Combination Tone Arm and Transmitter at the Left is for Use in Transmitting Phonograph Music to Any Number of Loud-Talkers. The Transfer and Control Box is Shown at the Center With Hand-Type Transmitter Lying on Top. The Special Loud-Speaking Receiver Appears on the Right.

The Hall Jet Relay for Recording Radio Signals

By PROF. RALPH D. DONER

EVERYBODY knows that wind blowing over a body of water causes waves, but few persons understand the underlying principles involved, while a still smaller number perhaps are aware that such waves are closely related to the blowing of a flute or an organ pipe and to the recording of radio signals automatically. Let us examine the theory of water waves and see why this is so.

In Fig. 1, we have the motion of the wind represented by arrows. In each trough there is a whirl or vortex "V", rolling along on the surface of the water and "under the wind" just like the rollers in roller-bearings. The small arrows perpendicular to the surface of the water show the action of these air currents on the water, a pressure downward in the troughs, and a suction upward at the crests. Thus it is seen how the wind tends to maintain the waves. This action of the wind may be deduced also from Bernoullis' principle, namely "where the velocity (of the wind) is greatest, the pressure is least, and vice versa."

Suppose now that we replace the water by still air, Fig. 2, and the wind by a jet of air issuing from a nozzle. Here again we will find Nature providing roller-bearings in the form of vortices "V", so numerous and irregular that they form an almost continuous sheet separating the moving jet from the surrounding still air. These vortices begin soon after the jet leaves the nozzle, and are the result of extremely slight irregularities always present when a fluid issues from an orifice. They increase in size because, as we have just noticed, in a trough the pressure is greatest, which deepens the trough, and causes a larger vortex, creating a greater pressure, and so on.

Similarly a crest tends to grow larger and larger. The flapping of a flag is a good example of this, as well as the eddies caused by an oar in water. The result is a sudden break, flare or rupture of the jet. Such a self-stimulating action is said to increase exponentially. This wave form imprest on the jet by these vortices, travels at about half the speed of the air in the jet; hence it is apparent that any particle in the jet tends to vibrate more and more from the natural path of the jet, once it has been started, and this start is extremely small. It is found that the jet breaks when this wave form has attained only a very small amplitude compared with the size of the jet, and the jet appears to be undisturbed almost up to the break itself.

Experiments show that the vibrations of sounds in the neighborhood of the jet, cause these vortices to start sooner, more regularly, and with greater intensity, thus causing the break to occur nearer their orifice, as shown in Fig. 3,—"A" being the natural position of the break, and "B" the position when sound strikes the jet. It is also found that the more intense the sound the nearer "B" is to the orifice; and that the greater the velocity of the jet the sooner the break. Such a jet is called a "sensitive jet," and is similar to the well-known "sensitive flame."

Figure 4 shows how a jet may be made to react on itself by placing a wedge in its path. When it strikes the wedge so as to produce a condensation C_1 this effect travels as sound and strikes the base of the jet at "A", which in turn, when it reaches the wedge, causes a condensation C_2 on the other side, and this impinges as a sound wave at B, etc. The pitch of the sound produced will be found to vary with the velocity of the jet and inversely with the distance to the wedge.

Figure 5 is an organ pipe and differs from the above only in the manner by which the sound is reflected back to the base of the jet, having to travel twice the length of the pipe, WL. It is necessary that the jet have such a velocity that the time taken for sound to travel 2 WL, is the same as for an effect produced on the jet at "N" to reach "W", or at least some simple fraction of that distance, as ½ or 1/3 of NW, thus keeping in step and building up the vibrations. The blowing of a flute is no different in theory, hence no further explanation is needed.

Dr. Hall of Chicago has invented several methods of using this sensitive jet in the recording on tape of wireless signals. The arrangement is shown in Fig. 6. The air jet "J" issues from nozzle "N" and breaks at "A", after passing thru the center of a helical coil "C", composed of fine platinum wire, supported on four posts. The wire is soldered to

(*Continued on page* 1130)

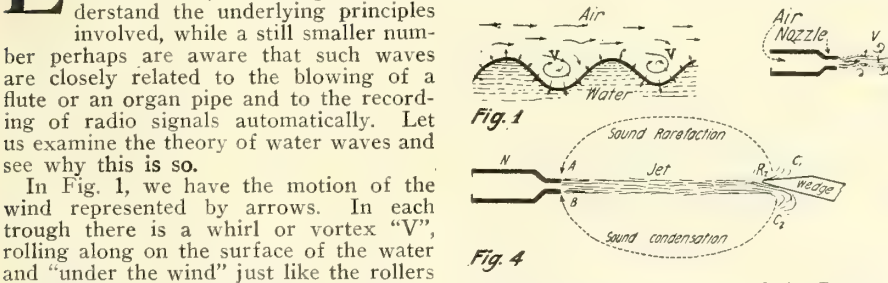


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

These Diagrams Show Some of the Remarkable Actions Taking Place in a Jet of Air, and Which Phenomena Are Taken Advantage of in the "Hall Relay," Which Instrument Has Been Successfully Used in Recording Signals at High Speed Over Distances as Great as That Existing Between Nauen, Germany, and Chicago, Ill.

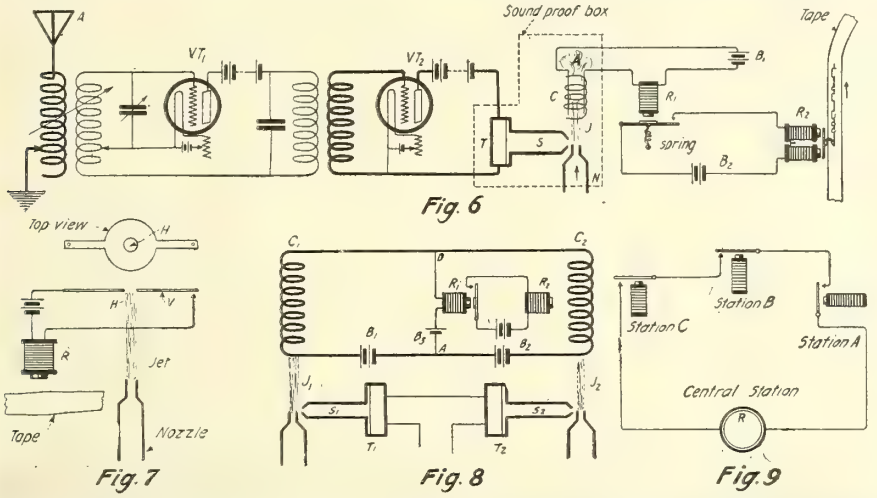
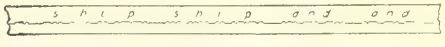


Fig. 6 Fig. 7 Fig. 8 Fig. 9

Several Diagrams Showing How the Comprest Air Jet Relay Has Been Successfully Used, With One to Two Stages of Audion Amplification, in Order to Effect a Tape Record of the Received Signals. Whenever a Sound From the Telephone Receiver T Impinges Against the Jet J, the Flare of the Jet Lowers From A to C, Cools the Wollaston Wire Coil C, Changing the Resistance of the Circuit and Causing Relay R-1 to Actuate the Tape Recording Electro-Magnets R-2.



This Sample of Tape Record Was Obtained While in the University of Chicago, in the Spring of 1919, During the Peace Conference. The Station Copied Was Nauen, Using an Eight-Wire, 400-Foot Antenna, About 150 Feet or More High, and an Audibility of About 60.

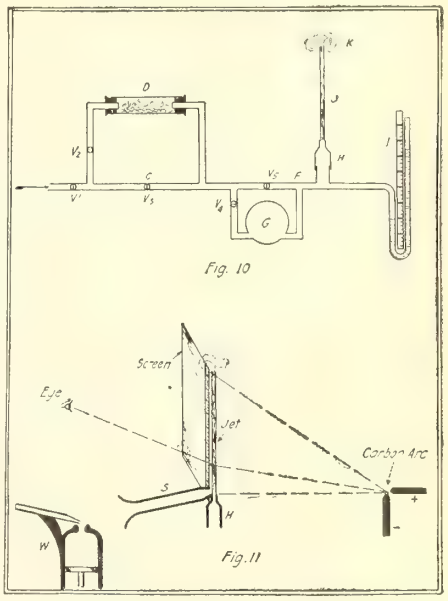


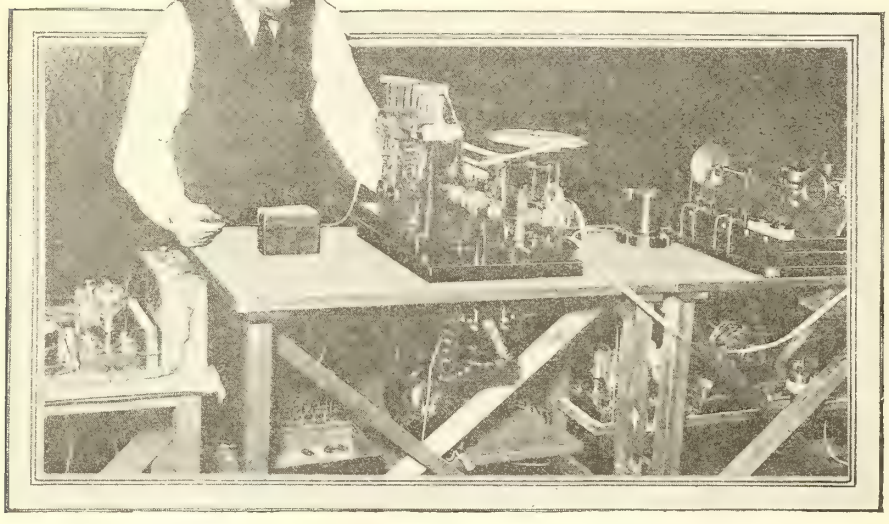
Fig. 10 Fig. 11

Figs. 10 and 11 Show Some Features of the Special Tests Carried Out by Prof. Doner With the Hall Jet Relay. The Fluctuations of the Jet When Acted Upon by Sound Waves From W Were Made Visible on the Screen by Means of a Powerful Light From the Carbon Arc Shown at the Right.

Messages Typed at 100 Words Per Minute Via Radio

THE accompanying photographs show a very interesting and remarkable invention which has recently been completed by Mr. Cresse of Croyden, England, whereby radio messages are typed and interpreted from all parts of the world, so reports claim. The messages are first transmitted to a perforating machine and then to the automatic typewriter at a rate said to equal a speed of 100 words per minute and more.

The inventor recently gave a demonstration at the Royal Society of Arts which was attended by many prominent English radio experts. The accompanying photograph shows the inventor feeding the perforated paper tape to the automatic typewriter.



New English Radio Typewriter Invention by Means of Which Messages Can be Typed at the Rate of 100 Words per Minute or More. The Typewriter is Operated by a Perforated Tape. This Will Mark a Great Step in Advance in the Radio World, as the Ordinary Operator Cannot Receive at a Rate Exceeding 40 to 50 Words per Minute Aurally.

Many inventors in all parts of the world have taken out patents on automatic typewriter arrangements for use in radio, but none of them have ever been able to give a satisfactory demonstration of their perfected apparatus.

Once such a system as this is perfected, it will mean a great deal to radio, as the present system of dot and dash codes, is of course nothing but a makeshift and what radio and electrical engineers want, and have a right to expect to see very shortly, is the perfection and adaptation of an automatic transmitting and receiving apparatus which will send out and pick up at high speed, pre-arranged series of signals, the successive and ever-varying groups of which, will, when interpreted by the receiving machine, cause the letters of the alphabet to be printed on a paper tape or roll, in the same manner as the telegraphic printers now operate over a single telegraph wire between the larger American cities.

Stock Brokers Find Radio Useful

THE accompanying photograph shows one of the latest wireless telephone sets in use in a stock broker's office in Berlin, Germany. With these wireless 'phones, financial and stock reports are radioed over any desired area, depending upon the power of the transmitting set. It is claimed that with this method, the reports are transmitted and received by customers (who, of course have to install a simple radio receiving set in their offices or homes) much earlier than with the usual ticker service by wire.

The photograph shows the wireless 'phone operator sending out stock reports, while the man at the right is shown in the act of receiving radio reports.

Recently, for the first time in the history of Wall Street, the radio telegraph supplanted the ordinary telegraph lines in the carrying on of stock market operations between New York City and Chicago. The wire lines were disrupted by a heavy storm early one morning, and during the final hour of trading on the New York Stock Exchange, one well-known concern conducted business with a firm in Chicago, by wireless.

The arrangement for the service was made hastily with a radio communication service, which will operate wireless between New York, Cleveland, Detroit and Chicago. This service has not been formally opened; in fact, it was an invitation to the opening of the service quite recently, which gave the president of the New York stock concern, the idea of trying the service at once.

The reply was received three minutes after it left Chicago. Several later messages were answered in from seven to eight minutes. In the case of each brokerage house, however, the message had to be telephoned to the radio station in the respective cities and this caused some little delay that could be eliminated by the use of private wires for this purpose. One of the officials of the New York Stock Exchange said he believed that a half minute would suffice for the transmission of an order, with the telephone part of the arrangement working to better advantage.

After the close of the stock market, the operations by wireless were checked up over the private wire between New York and Chicago, and it was found that not a single mistake had been made.



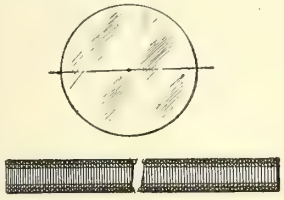
The Accompanying Photograph Shows a Wireless Telephone Installation in Use by a Berlin Broker. Recently Wall Street Stock Brokers in New York City Employed Radio Telegraphy for the First Time in the History of That Famous Street. Stock Transactions "Via Radio" Were Carried on Between New York City and Chicago When a Heavy Storm Disrupted Traffic by Wire. It is Intended to Make This Feature of Radio-Communication Stock Service a Permanent Asset, as Many Thousands of Dollars Have Often Been Lost Owing to Telephone and Telegraph Lines Being Severed by Severe Storms.

LATEST PATENTS

Acoustic Diafram.

(No. 1,356,399. Issued to Simon David Paddack.)

This invention relates to the making of acoustic diaframs. The in-

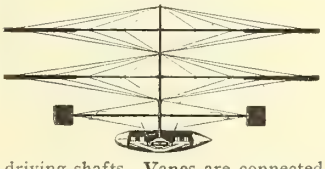


ventor melts together by the use of heat, 40% of shellac, 50% resin and adds to this 10% powdered glass. He then adds enough wax to make a considerable layer of it over the surface of the molten mixture. He then passes blotting paper thru the molten mixture a little wider than the finished diafram and then allows the blotting paper to pass thru heated rollers, which force the powdered glass into the paper making it denser and harder and removes the surplus wax. The resulting diaframs used in phonograph sound-boxes give excellent results.

Helicopter.

(No. 1,350,455. Issued to Peter Cooper Hewitt.)

The helicopter here shown was described in past issues of this magazine. There is a car connected permanently to a shaft thru which pass two driving shafts for the vanes or propellers. These are so arranged that they rotate in opposite directions even when acted upon by only one motor due to the bevel gear arrangement on the motor and

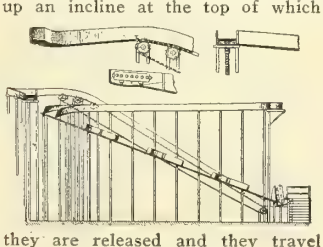


driving shafts. Vanes are connected to incline the car which inclination assists in the forward motion of the machine itself. The propellers are each over 40 feet in diameter and the angle at which they are mounted upon the shaft is variable. Incidentally, these same blades do not start at the axis of the driving shafts but at a considerable distance from them as there is very little thrust obtained near the hub of a propeller.

Pleasure Railway.

(No. 1,356,412. Issued to Frank Aloysius Smith.)

This is a very novel system of providing pleasure by the use of a railway of peculiar design and construction. It consists of a means whereby cars of an elongated shape made to accommodate two persons in a lying down position are hauled up an incline at the top of which

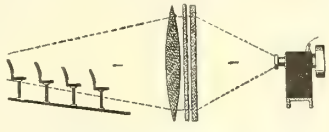


they are released and they travel thru a labyrinth of deflecting vanes. The cars are in full view of the onlookers and amusement is provided for both onlookers and passengers because of the varying positions which the occupants of the car assume. A device is provided whereby the car comes into an upright position at the end of the course, thus assisting in bringing the occupants into an upright position again.

Stereoscopic Movies.

(No. 1,358,685. Issued to William L. Friedman.)

There are several features to this invention which the inventor claims will enable people to view motion pictures and obtain the same sense of relief as is found in stereoscopic pictures. Essentially, the device consists of the regular projector which is placed in back of the screen and projects the picture upon a translucent screen so that those on the opposite side can see it. For this reason the theatre does not have to be darkened to view the picture. In front of the screen is placed a sheet of glass, such as

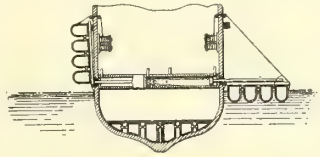


Venetian glass, which has a minutely waved surface but thru which the picture can be seen and in front of the Venetian glass, is a very large lens, the curvature of which is not great enough to create magnification or distortion of the picture and yet sufficient to allow for some slight refraction. The audience can then see the motion pictures in true relief.

Non-Sinkable Boat.

(No. 1,355,937. Issued to John J. Brosnan.)

A method for preventing a boat from sinking and reducing rocking is the subject of this patent. When not in use, frames hinged to the side of the boat are held in an upright position. These frames are provided with casings of sheet steel hermetically sealed and filled with comprest air. The boat in itself is also provided with a false bottom so that any cargo which would be injured or rendered explosive by coming in contact with water can be kept safely because the cargo will continue to float in this false bottom. If the boat has been hit, two

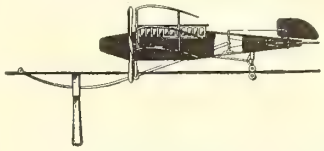


reels play out the rafts or floats and at the same time plungers are forced out by means of air pressure behind respective pistons. This readily holds the frames down near to or on the surface of the water and prevents the boat from sinking; or in case it is used in a storm, prevents excessive rolling and pitching.

Overhead Transportation Apparatus.

(No. 1,355,911. Issued to Rolland C. Riddick.)

This invention aims to provide for an overhead carrier of great simplicity which will allow for quick and economical means of transportation for passenger or freight service. It consists of a conventional airplane construction which will have sustaining qualities and relieve the supporting structure of weight, reduce friction and permit much greater speeds. The idea incorporates many novel automatic controlling mechanisms so as to vary the craft in elevation, and inclinations of the track and also vary the controls for properly rounding curves, the carrier being banked for this purpose, which banking assists

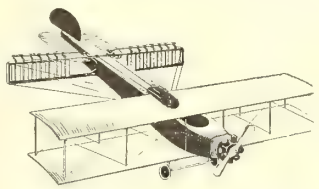


in preventing the tendency of continuing in a straight course. The power for turning the propellers is supplied by means of either electrical or gasoline motors, the latter having their fuel supply within the fuselage-like body of the transportation contrivance; the electric motors could be supplied by power by the usual method, that is, by contact with power rails. Much greater speeds are promised in that friction upon rails is negligibly small, the air friction being the greatest factor which this transportation system has to contend with.

Brake for Airplanes.

(No. 1,356,289. Issued to William Edward Karnes.)

This is a very clever invention the purpose of which is to enable an airplane to stop quickly reducing the landing speed and avoiding collision while in the air. Secured to the tail portion of the fuselage is a frame between the beams of which are a series of vertical shafts provided with cranks at the upper ends, and fitted with blades so designed

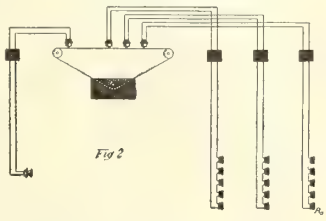


that when closed they slightly overlap each other. Each series of cranks, with their respective crank arms, are connected together by means of a rod and communicate by means of cables to control levers. When the gates are closed, sufficient resistance is offered to bring the machine to a standstill after it has traveled only a short distance.

Amplifiers for Auditoriums.

(No. 1,358,053. Issued to Henry M. Bascom.)

There has always been considerable difficulty experienced due to the fact that when telephonically transmitting sounds, the sounds arrived at the distant amplifier and loud-talker considerably in advance of the sound of the speaker's voice conveyed thru the air. In large auditoriums such a disturbance becomes very disconcerting. The inventor has here produced a means

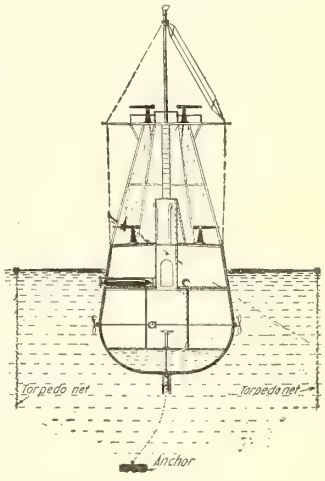


whereby the sound is recorded upon a steel wire or tape and then by properly spacing the take-up coils and regulating the speed of tape travel, and finally amplifying in the usual manner, the speaker's voice and the sound from the amplifiers are heard simultaneously.

Floating Fortress.

(No. 1,350,667. Issued to Julien Ortiz.)

A new form of armored float for use at sea as a means of coast defense is the subject of this patent. Many of these can be anchored at various strategic points along the coast for the purpose of guarding against the approach of enemy seacraft. Each fortress consists of a float which may be submerged if desired and which contains two torpedo tubes and propellers parallel but offset on opposite sides of the diameter of the hull, so that by operating these propellers any torpedo tube may be brought into line

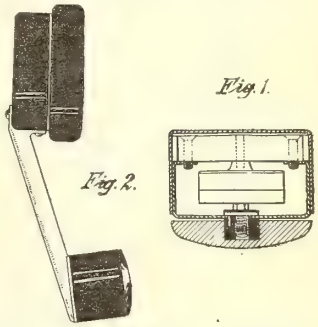


with the enemy craft. Nets are suspended from the outriggers to prevent a counter torpedo attack and two decks are provided with guns. A motor operates ammunition hoists, air and water pumps, etc. The vessel is submerged by introducing water into the lower compartment, or by drawing up the winding chain and thus dragging the entire fortress beneath the level of the sea.

Telephonic Transmitter.

(No. 1,356,190. Issued to Bertram Sydney Cohen.)

This invention is intended to allow for telephonic transmission by

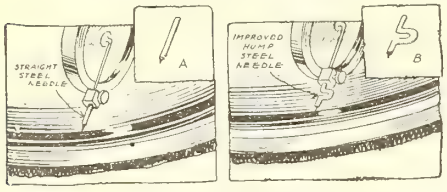


placing the transmitter against the throat of the user and it is operated by the vibrations in the throat instead of by the waves of sound issuing from the mouth. This will be of particular value in places where there are external noises such as those produced by machinery in the neighborhood of the user. It consists of a microphone of the usual carbon granule type. At one end of the transmitter is an insulating disc connected to the microphone via the inserted screw. This when held against the throat of the user permits contact at its center and allows for the compression and release of the carbon granules in the microphone.

What To Invent

By JAY G. HOBSON

THERE are many needed improvements yet to be discovered for the phonograph, because there is much room for improving the tone of the standard talking machine, which is far from being perfect. Considerable profit



Instead of Sticking to a Rigid Type of Phonograph Needle, as Shown at A, Why Hasn't Some Genius Devised a Simple Improved Form of Phonograph Needle Like That Shown, for Example, with a Hump in It? The Steel Needle Seems to Be Too Rigid and Causes Many False Notes and Scratches to Be Transmitted to the Sound Box and Thence to the Amplifying Chamber, Whereas the Hump at B Would Seem to Absorb Some of These False Vibrations.

should result for the inventor succeeding along this line of endeavor.

I have in mind improvements on the sound-box, on the needles, on the records and on the composition from which they are made.

There is not a perfect sound-box on the market today, nor a perfect needle, nor a perfect record. The best sound-box made does not reproduce music as well as it should to give entire satisfaction. A sound-box that will eliminate these faults will be very welcome to the millions of phonograph owners desiring better music from their machines. But to accomplish this great improvement, it will be necessary to keep away from the beaten paths of present sound-box design and originate a construction entirely different from the kind now used.

The best records used are most imperfect. They produce too much surface noise, wear down too soon and are too delicate for general use. An improved record overcoming all these drawbacks certainly will have wonderful success, both musically and commercially.

However, this month's suggestion deals with what I believe to be an improvement on the ordinary steel needle used almost universally today. In my opinion the straight steel needle is too stiff—not flexible enough to eliminate the ever present scratch when playing. To overcome this fault and improve the tonal quality of phonographs in general a distinct departure in needle design should be made. Possibly a steel needle, made with a hump midway between point and end, would do away with the annoying scratch so much in evidence with the straight needles.

This hump, as illustrated, would add greater flexibility to the needle, make it more springy, thereby equalizing the weight of the sound-box against the record grooves, as well as act in the form of a guide when inserting the needle.

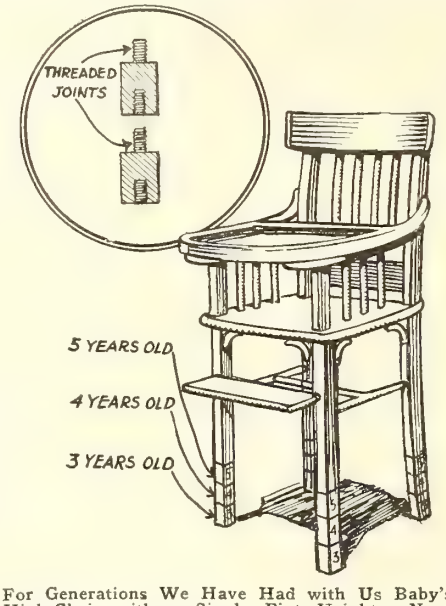
The more flexible the steel needle, the softer will the tone be, and there will be less surface noise from both the needle and record. A design similar to the one described should greatly improve the tone and sell in great quantities.

Improved High Chair

If little babies could talk to their parents and intelligently express themselves on the subject of infantile accessories, I am sure the majority would unanimously vote to banish the present inefficient high chair. With a little explanation, the parent would soon realize the inability of this common design to meet all requirements as desired.

As soon as James Junior is old enough to sit up and say "Da-da," he is placed at the head of the family table in his new high chair, a safe distance from the spillables. A year or two finally passes, when some Sunday morning Daddy finds his mushroom son about grown beyond the confines of his baby chair. His little knees bump against the table and this makes the chair very undesirable to the little rascal, who squirms around peevishly, almost knocking his glass of milk over here, and spilling his gruel over there, until Mama and Papa are so inoculated with the nervous germ that they determine to exile said high chair to yon attic with many other forgotten antiques; or, perhaps, until needed again.

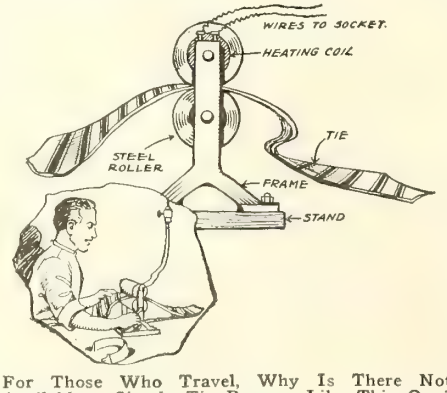
Then, as a makeshift, they employ one of the dining-room chairs, with books and some cushions to provide semi-adult sitting facilities for the young specimen of man. But this arrangement is tricky, under their



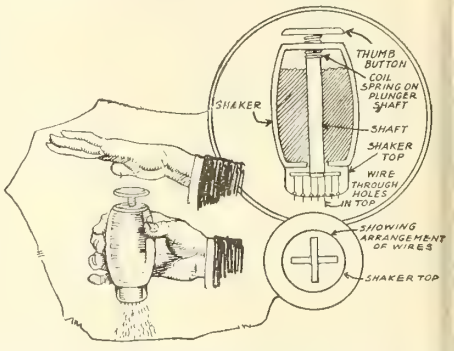
For Generations We Have Had with Us Baby's High-Chair with a Single Fixt Height. Now, Why Is It Someone Has Not Given Us a Simple Adjustable High-Chair Like That Shown in the Illustration, So that as Baby Grows, We Can Simply Remove a Section from the Four Legs and Lower the Chair, Each Section Being Marked with the Different Age Year.

youngster's wiggles, making all sit on pins lest he precipitate himself to the floor. So this condition continues for want of a better improvement.

Here it will be seen an improved high chair is needed badly; one that could be adjusted in height to the age and size of the child using it; one with legs made in sections to be removed and shortened as the child grows larger and older. No doubt one similar to the illustration would be just the trick and undoubtedly something of this kind would soon receive hearty approval from thousands of parents with fast-growing children.



For Those Who Travel, Why Is There Not Available a Simple Tie Presser, Like This One? Something That We Can Hook Up to the Electric Light Circuit and Operate Like Those Large Steam Mangles We See in Steam Laundries.



And Speaking of Salt Shakers, Here Is a New Wrinkle Which Would Seem Valuable Enough to Warrant Its Being Put on the Market. On Damp Days When the Salt Will Stick, You Simply Push on the Shaker Rod Which Loosens the Salt in the Container, and Also Jiggles Some of the Salt Thru the Top by Means of the Needles Shown.

Traveler's Tie Presser

Irons may come and irons may go, but wrinkled ties will be with us forever. The traveling public always have, and apparently always will find it almost impossible to keep their ties and scarfs properly prest, living in hotels, on trains and the like, because these homes-for-a-day accommodations do not provide irons nor pressing service of sufficient worth to get small articles ironed neatly. And in view of this condition, it appears to me a small electric tie presser would capture the hearts of all the "away-from-homes", because it could be quickly attached to the ordinary light socket and the ironing of small articles could be done quickly in the hotel room.

Imagine a compact tie presser made of two small rollers connected movably together, something in appearance like the clothes wringer, if you please. Inside one of these highly polished metal rollers would be secured a resistance coil to supply the necessary heat for pressing the ties drawn between the rollers as shown. The men-folks would not feel so sissy toting a device of this design around, but no possible inducement could get them to carry a lady's small iron. Some day our national publications will offer such a contraption for men thru their advertising, and frugal people will welcome it.

New Departure Salt Shaker

Patents galore have been allowed by the United States Patent Office for salt dispensers, but in all these years of advancement none has succeeded in inventing a perfectly satisfactory salt shaker. Strange as it may appear, every device in use today for this purpose is about as efficient as the old ox-team was for transportation. The next time you dine out, notice the kind of salt shakers used in the café, and notice how perfectly they *don't* work, if the day happens to be rainy.

The trade mark slogan of one prominent salt company says: "It Pours When It Rains," but I happen to know that this is

(*Continued on page* 1132)

Scientific Humor

Or Dante's Inferno.—When it comes to listening to a banker's attempt to explain the mysteries of exchange we prefer to read Einstein on Relativity.
—*Geo. Ulrich, Jr.*

He Who Kicks Succeeds.—Two frogs accidentally fell into a large can of milk. They began at once to struggle for freedom, leaping for the top, but always falling back. One of them very soon became discouraged and began saying: "It ain't no use; it ain't no use." But the other one kept on striving and said: "I'll never give up." When several hours later the frogs were discovered in the milk, the one that said "it ain't no use" was dead, and the other one was sitting on a cake of butter singing, "I'll never give up."
—*B. H. Lyon.*



The Face Value of Astronomy.—Dick: "I don't think that the lecture would have interested you. It was all about sun spots."

Daisy: "Oh, was it? Then it certainly would have interested me, for I have been a martyr to freckles all my life."
—*Sydney Hoffman.*

Off Color.—Professor (in science class): "William, name two complementary colors."

William: "Powder and paint."
—*Shannon Jones.*

Our Office Uses Both Systems.—He (addressing a young stenographer): "Do you use the Hunt system or the Touch system?"

She: "The Hunt system is new to me. Explain it, please."

He: "Well, in using the Hunt system you write one word and 'hunt' for the next one, and in using the Touch system you are always 'touching' the boss for more pay."—*Ben H. Lyon.*



He Might Have Bought a Muffler.—Agent: "I have here a little invention to make the voice carry farther."

Mr. Henpeck: "For goodness' sake, don't tell my wife."
—*V. L. Sloter.*

Domestic Geography.—Teacher: "What are the four seasons?"

Johnny: "Pepper, salt, vinegar and mustard."—*Mildred Webb.*

A New "Spring" Song.—First Scientific Bug: "If I were to take a heavy steel clock-spring and wind it up tightly, then place it in a porcelain dish and dissolve it in nitric acid; where would the energy stored up in the spring go to?"

Second Scientific Bug (thoughtfully): "Why, I suppose it would tend to make the acid 'stronger.'"—*I. Hector Graham.*

Disconnected.—Minister (at close of sermon): "We shall now sing hymn number 389."

Operator (rousing from nap): "The line is busy."—*Harry Humberston.*

FIRST PRIZE $3.00



Still More Wonderful.—Scientist: "This pearl comes from an oyster; isn't that wonderful of nature?"

Freddie: That's nuthin', my sister has a whole string of them that she got from a lobster."—*Adolph F. Lonk.*

He's Probably on the "Star"-board Side.

Twinkle, twinkle, little star,
How I wonder where you are;
High above I see you shine;
But, according to Einstein,
You are not where you pretend,
You are just around the bend;
And your sweet seductive ray
Has been leading men astray
All these years—O little star,
Don't you know how bad you are?
—*Donald Newton.*

A Second Einstein.—Teacher (playing a record): "Johnny, what is it called when four people are singing?"

Johnny: "A quartette."

Teacher: "What is it called when two people are singing, William?"

William (after a moment's hesitation): "A pintette!"—*Joseph Humphrey, Jr.*

ALL jokes accepted and published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

We Really Can't Print This One.—Professor of Engineering (just after a lecture on the construction of bridge piers): "And now who can describe a *coffer dam?*"

Student: "Well, Professor, the other day I walked in the country and saw a cow swallow an apple, and I thought she would *cough her damn* head off!"
—*Russell F. Daniel.*

Monkey Business.—An auto tourist was travelling thru the great Northwest, when he met with a slight accident to his machine. In some way he had mislaid his monkey-wrench so he stopt at a nearby farmhouse where the following conversation took place between himself and the Swede farmer:

"Have you a monkey-wrench here?"

"Naw; my brother he got a cattle rench over there; my cousin he got a sheep rench further down this road, but too dam cold here for monkey rench."
—*Pierre H. Boucheron.*



Sometimes the Thumb "Strikes" Too.—Mr. H.: "Do you know I can strike nails like lightning?"

Mr. S.: "Is that so?"

Mr. H.: "Yes, lightning never strikes twice in the same place!"—*Frank Holi.*

An Eye-Opener.—Holding her close to him, he gazed into the unfathomable depths of her gazelle-like eyes. Acute anxiety was exprest in every line of her fair face. Ever and anon a sigh seemed to rend her being with its intensity, and she gazed into his face as though she would read his very soul.

For many minutes thus they sat, neither speaking, each gazing into the other's eyes.

"Yes," said the oculist at last; "one eye is seriously affected, and, if not treated immediately, will develop a decided squint."
—*No Name.*

We've Been There.—Cop: "Hey there! you can't stop here, you know."

Motorist: "Can't, eh? You don't know this car."—*P. E. Householder.*

Or to Lick a Spoon.—Fair One on board ship: "Captain, don't you think it is cruel to box a compass?"

Captain: "Not any more than to paddle a canoe."
Joe Radomsky.



O. K. Till Their Fuse Blew Out!—Their meeting was mutual. She being immediately attracted by his magnetic personality, while he was not repelled, for his lips soon made contact with hers, and the sparking grew intense. He proposed with lightning-like precision, then they were united. Their friends were electrified. Wasn't it shocking?
—*K. K. Loafbourrow.*

Or Nitric Acid.—Head Nurse: "Rub him well with glycerine every two hours in the daytime."

Foot Nurse: "What shall I use at night, *ni*tro-glycerine?"—*Sterling Gleason.*

A Born Mathematician.—"I saw your sister on the street today."

"Yes? How did she look?"

"I don't know, I didn't see her face."

"Then how did you know it was her?"

"Oh, I'm pretty good at figures."
—*A. F. Lonk.*



Solid Ivory.—Professor (in physics): "Jack, give me a good illustration of density."

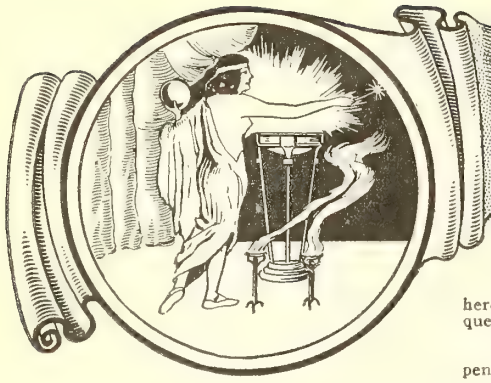
Jack: "I don't know."

Professor: "A very good illustration, Jack."—*Shannon Jones.*

How Does Bird-Seed Work.—A teacher was instructing her pupils in the use of the hyphen. Among the examples given by the children was "bird-cage."

"That's right," encouragingly. "Now, Tommy, tell me why we put a hyphen in 'bird-cage'?"

"It's for the bird to sit on," was the startling rejoinder.—*Mary Braverman.*



THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.

2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.

3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.

4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Which is Heavier—Wet or Dry Air?

(1074) Guy R. Phillips, Camden, N. J., asks:

Q. 1. I have always thought that moist air is heavier than dry air, as seems evident here, where on foggy days the air or clouds of vapor hang low. Nevertheless, prior to all rains, barometric pressure falls. Can you explain this?

A. 1. In the *January* 1921 issue in the article on "Science and the Weatherman," Dr. Scarr, Director of the New York City Branch of the U. S. Weather Bureau, gives the reasons for the fall in barometric pressure, and you will note from that article, that the effect of moisture in the air has very little effect on barometric readings.

In reference to the second part of your query, we cite below the facts indicating the weight of moist or dry air, as given by Prof. F. L. Darrow.

A liter of dry air at a given temperature weighs more than a liter of wet air at the same temperature. This is true for the following reasons:

1—Water vapor is lighter than air. One liter of air at standard conditions weighs 1.293 grams while a liter of water vapor under the same conditions weighs .8043 grams.

2—By Avagadro's hypothesis, "Equal volumes of all gases at the same temperature and pressure contain the same number of molecules."

3—Therefore a liter of saturated air must contain fewer molecules of air, their place being taken by the lighter molecules of water vapor. It is just like mixing oil and water. A liter of the mixture will weigh less than a liter of the water alone.

4—If a liter of dry air is weighed and then allowed to come in contact with water it will become saturated and its volume will increase, thereby making the weight of a liter of the mixture less than it was before.

5—As the air becomes more humid the barometric pressure falls.

If, however, air is saturated with water vapor and its volume is kept constant by artificially increasing the pressure upon it, the weight of a liter will of course be more.

Another fact in this connection is the following: If a gas is confined over water, say when the temperature is 20 degrees Centigrade and the barometer reading is 760 millimeters, then the combined pressures of the gas and the water vapor present will be 760 mm of which 17.4 mm will be due to the water vapor and the balance, or 742.6 mm to the gas. Therefore, only 742.61 760ths of the volume will be gas, while the rest will be water vapor.

Vreeland Oscillator

(1075) A. Walter Ward, Hartford, Conn., writes:

Q. 1. For name of an instrument developing high frequency currents without any moving parts.

A. 1. For obtaining a frequency of 1,000 cycles or more without the use of rotating vibrating or moving parts, results can be obtained by the use of a Vreeland vacuum tube oscillator, or higher frequencies can be readily obtained by the use of an oscillating audion.

Thermo-couple Metals

(1076) I. Cline Boone, Wirtz, Va., asks:

Q. 1. For some general information on thermo-couples.

A. 1. Thermo-electricity is produced by a thermo-couple due to the difference in temperature between the hot and cold junctions of two dissimilar metals. The following substances used in thermo-couples give a thermo-electric power and are capable of increases in temperature to the points specified.

Platinum and platinum-rhubidium compound 90% of the former and 10% of the latter, giving a power of 4.3 microvolts plus .0088, for each degree rises in temperature maximum temperature range zero to 1300° centigrade.

Platinum and 90% platinum 10% iridium—power 11.3 microvolts plus .104 for each degree rise in temperature range zero to 1,000.

Copper and nickel—power 24.4 microvolts plus .106 for each degree rise in temperature range zero to 235°.

Copper and 60% copper 40% nickel—power 42.3 microvolts plus .058 for each degree rise in temperature range zero to 320.

Telegraph Typewriter Query

(1077) Herman Scott, Kansas, sends description of a telegraph typewriter, which he believes to be new:

A. 1. We have looked over your drawing and description of a telegraphic typewriter, and would advise as follows:

It is difficult in the first place, without knowing in what manner you intend to transmit the requisite number of electric impulses over the line to the typewriter, to form a clear idea as to the real worth and efficiency of your device.

From our experience with the Western Electric Co.'s printing telegraph which works with a regular keyboard and printing system quite similar to those found on the standard typewriter, very high speed is attainable as well as great accuracy, and of course, these instruments are not simple by any means.

We think that unless you have in mind or have already devised an accurate and rapid transmitting method or mechanism for sending the requisite number of impulses over the line to actuate the distributing switch at the printing end of the circuit, that there would be considerable time lost in the method you have outlined in order to print the successive letters, which would mitigate against the commercial worth and utility of your machine.

The best advice we can give is that you make an effort thru your patent attorney or else by consulting your local library, to inspect or obtain copies of the patents issued to the Western Electric Co., and on several other systems such as the Morkrum, on telegraphic typewriters, from which you will learn of all the vast research which has been carried on and the details perfected in operating these machines, today.

High speed, such as 60 to 100 words per minute, is the thing the commercial world wants in any device of this character in most cases. Possibly if you write to the U. S. Patent Office, Washington, D. C., they will inform you whether or not they would be in a position to make the search for you and forward the copies of all the patents that have been issued on telegraphic typewriters and printing telegraphs.

OUR readers will have noticed that since the December issue our cover has changed somewhat in appearance. This is due to the fact that we are now using the so-called Offset Process, which is not printing at all, but which is a sort of lithograph process. By this process, the ink is first transferred from an aluminum plate upon which the design is etched onto a rubber blanket, or mat and this rubber "offsets" the ink onto the paper. By this method very much cleaner work results, showing off much better, and a much softer effect is had. Altogether the result is much more attractive and pleasing than the printed process. By means of this process we are also now enabled instead of printing in three colors to print in four, adding one extra color. We hope our readers will like the improvement.

—*The Publishers.*

New Idea in Phonographs

(1078) Charles D. Miller, Chicago, Ill., sends drawings and description of new phonograph which he believes to be superior in many ways.

A. 1. Would advise you as follows concerning the phonograph idea you have described and shown in your drawings.

This idea is not new at all, and to our knowledge, quite a number of patents have been issued in the past ten or fifteen years concerning inventions connected with the production of "talking movies," and many of these patents have described methods of recording the speech on a moving film in the way you suggest, in connection with selenium cells for reproduction, etc.

Unless a very special form of selenium cell or rather a group of them are used, unsatisfactory results will usually be the order in any such speech-reproducing scheme as this. This is so for the main reason that selenium cells possess considerable inertia or lag, i.e., they do not follow the fluctuations of light and darkness as rapidly as the voice fluctuations, and tend to lag behind.

The best apparatus to use for such a voice reproduction scheme is one employing the photo-electric cell, and if you are interested in studying the action of these cells which are far superior to any selenium cell, send stamped and addrest envelope with your request for the maker's name and address to the Editor of this journal.

Interesting Problem in Physics

(1079) E. Idenwider, Meridian, Miss., asks:

Q. 1. There are 2 ships traveling at cannon ball speed, one ahead of the other by a mile. The back ship shoots a cannon ball at front ship. The question is—will the ball catch the ship ahead; if so, how long before it does?

A. 1. Supposing two ships are pursuing each other and traveling at cannon-ball speed (of course an impossibility) and the rear ship fires a shot at the ship preceding, the ship in front will be hit by the cannon-ball if aimed correctly, the reason for this being that the rear vessel and the front vessel are already traveling at a definite speed. The speed of the cannon-ball must then be added to the speed of the rear vessel or the vessel firing the shot, to determine the resultant speed of the ball.

Suppose that the cannon-ball travels at the rate of one unit per hour and both vessels are proceeding at the same rate of speed, then the speed of the cannon-ball will be two units per hour if fired in the direction in which the vessel is going. Of course, air resistances are not taken into consideration. If the cannon-ball is fired at the rate of one unit per hour from the stern of the vessel and the vessel is proceeding at one unit per hour in the opposite direction to which the shot is being fired, the cannon-ball will drop vertically into the ocean.

Newton's law of motion states that a body tends to remain in a state of rest or uniform motion, unless impelled by some external force to change that state. The cannon-ball is already traveling in a state of uniform motion. If a ball is thrown inside or outside of a moving car, it will travel toward the front or the rear of the car regardless of whether the car is in motion or not and no extra force must be exerted to propel it in either direction, the reason being that the ball is already traveling at a certain definite speed and the thrower of the ball increases or reduces that speed, changing in this way, the state of motion.

The Old Way

Factory
Branch House
Salesman
Agent
You

Two Ways of Selling the OLIVER Typewriter

The New Way

Factory
You

The New Way Saves You $36

THE OLD WAY: It cost $36 to sell you a typewriter. Rents of offices in many cities, salaries, commissions and other costly practices — each demanded its share.

THE NEW WAY: We ship from the factory to you, eliminating all wastes. This saves the $36, and it now goes to you. A $100 Oliver costs you but $64. Why waste $36 by buying typewriters the old way?

These Facts Will Save You Money

Note that this advertisement is signed by The Oliver Typewriter Company itself. It is not the advertisement of a concern offering second-hand or rebuilt Olivers of an earlier model. The Oliver Typewriter Company makes only new machines.

The old way, as explained above, was wasteful and wrong. So people have welcomed our new economical plan and our output has multiplied.

We offer for $64 the exact machine which formerly sold at $100. This is our Model Nine, the finest typewriter we ever built. It has the universal keyboard, so any stenographer may turn to it without the slightest hesitation and do better work more easily.

And it has dozens of superiorities not found elsewhere. For instance, it has far fewer parts. This means longer wear, and naturally few or no repairs.

This Oliver Nine is a 20-year development. If any typewriter is worth $100, it is this splendid model.

It is the same machine used by great concerns such as United States Steel Corporation, National City Bank of New York, New York Central Lines, Otis Elevator Company and hosts of others. Such concerns demand the best. Yet they are not wasteful.

FREE TRIAL

Merely clip the coupon below, asking us to send a free trial Oliver. We do not ask a penny down. When the Oliver arrives, try it out. Put it to every test. Compare its workmanship.

Then when you are convinced that the Oliver Nine is all we claim, and you prefer it, pay us at the rate of $4 per month.

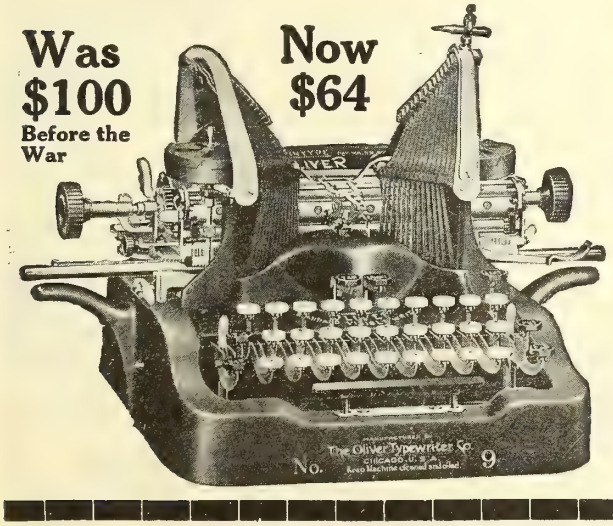
During the free trial, you are not under the slightest obligation to buy. If you wish to return it, we even refund the outgoing transportation charges.

Used typewriters accepted in exchange at a fair valuation.

Or, if you would rather know more about our plans before ordering a free-trial Oliver, check the coupon for our amazing book entitled, "The High Cost of Typewriters—The Reason and the Remedy." We accompany it with our beautifully illustrated catalog describing the Oliver Nine.

Was $100 Before the War

Now $64



Canadian Price, $82

Mail Today

The OLIVER Typewriter Company

672 Oliver Typewriter Bldg., Chicago, Ill.

THE OLIVER TYPEWRITER COMPANY
672 Oliver Typewriter Bldg., Chicago

☐ Ship me a new Oliver Nine for five days free inspection. If I keep it, I will pay $64 at the rate of $4 per month. The title to remain in you until fully paid for.

My shipping point is.....
This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book — "The High Cost of Typewriters — The Reason and the Remedy," your de luxe catalog and further information.

Name .....

Street Address .....

City..... State.....

Occupation or Business.....



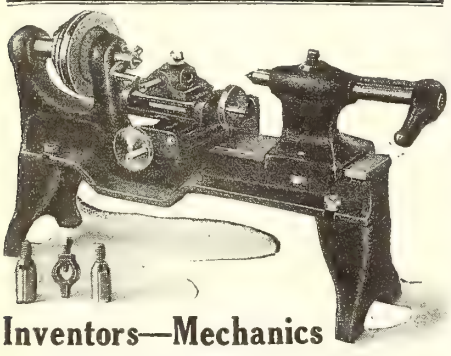
ONLY $8.45 Sent on Approval

For Actual $18 Value—Tenor-Banjo, Banjo, Banjo Mandolin, or a $15 Banjo Ukelele for $6.45

Sensational, direct-from-the-factory price. SUPERTONE instruments, guaranteed 10 years.

No. 2 Tenor-Banjo, No. 3 Banjo and No. 4 Mandolin have 11 in. heads; nickel-plated hexagon brackets and tail pieces; fine calf-skin heads, nickel-plated shell, both edges spun over steel wire. Artistic scroll heads, finished in mahogany. Worth $18.00. Our rock-bottom, direct-from-the-factory price only $8.45 each; No. 5 Banjo-Ukelele, 7 in. head, same style, only $6.45. Make big money. We want customer agents everywhere. Send order today. We ship C. O. D. with privilege of examination. If not worth $15 to $18, do not accept it. Hurry! This offer may not appear again.

Chicago Musical Instrument Mfg. Co.
Desk 802 602 W. North Ave., Chicago



Inventors—Mechanics

HERE'S THE LITTLE LATHE YOU'VE WANTED AT THE PRICE YOU'VE WANTED TO PAY

23.75 F.O.B. NEW YORK

Compound Slide Rest Included!!

Send for Circular

PRODUCTION EQUIPMENT CO., INC.
Machine Tool Dept.
5 Union Square New York City

NEW MOTOR BARGAIN

GENERAL ELECTRIC

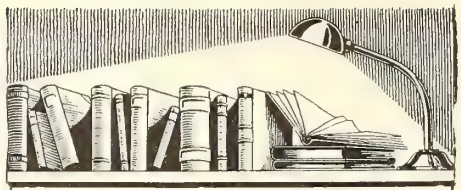


1/4 HP Motor 110 V. A. C. 60 cycle single phase, 1750 Speed. Complete with Cord, Plug and Grooved Pulley.

Will operate $23.50 Washing Machines, Sewing Machines, Small Lathes, Grinders, Bottle Washers, Etc. Satisfaction guaranteed or money refunded.

Illustrated catalog of motors and supplies FREE

HYRE ELECTRIC CO.
631 South Dearborn Street Chicago, Ill.



BOOK REVIEW

CYCLOPEDIA OF APPLIED ELECTRICITY. Eight large volumes, profusely illustrated. Flexible covers, size 6 x 8½, occupying 10½" shelf space. Publisht by the American Technical Society, Chicago, 1920.

This cyclopedia is a general reference work on the subject of electricity, with over 2,000 engravings contained in its eight volumes. Its authors and collaborators are men well known in the scientific world because of their achievements in the field of electricity; and its authorities, the best.

The subject is entered into in great detail and this slight review merely gives a relatively few topics found in this exhaustive work.

Volume I—In the first volume the "beginnings of electricity" start the reader and student at the correct point by explaining the natural magnet

The subject is entered into a great detail and the places where it is found in greatest abundance, together with its varied uses.

Artificial magnets of the horseshoe and bar type are then discust together with the laws of unit pole strength, induction lines of force, and in fact all the detailed knowledge desired. This, however, is at the same time simple enough for a lay reader to understand. The dipping needle is also given considerable discussion.

A little further in the work, static electricity with its varied functions, discharge effects, screens, together with instruments for measuring, are described and the countless formulas are also added, which make calculation a very simple matter. Wherever possible, water analogues have been used to help simplify the subject. Upon completion of this chapter, electricity and magnetism, and the methods of measuring E. M. F. are considered. Thereupon various resistance circuits and the definition of words referring to magnetic effects and resistances, formulas and tables come in for their attention.

Heaters and electric lamps are also included in this part. Then the varied subjects of the laws of induced currents, chemical effects, radio-activity and radio are considered in order. Direct current dynamos, together with their windings, controlling devices and measuring devices, spot welding and transformers, occupying an important position. A very important and interesting chapter on the principles of direct current dynamos together with the formulas for calculating practically any unknown; each calculation having an example which can readily follow is provided. This includes calculation for the commutation and the time interval required for this commutation and number of poles, etc. Methods of preventing sparking by means of compensation are shown, and motors employing the same principles are described. Questions after each chapter are an added attraction to this elaborate work, making it suitable for even the young student.

The make-up of storage batteries of all sorts are then entered into; the volume ending with review questions on the subjects.

Volume II—The second volume treats mainly upon the subject of alternating current machinery. In this is included alternators, rectifiers, and induction motors. Many formulas and tables allow for calculations in which, of course, a good knowledge of algebra and general mathematics is desirable but not required, as examples of the more important calculations are given.

Most of the types of windings are included and the formulas for quick calculations are added, so that time for performing these is reduced to a minimum.

Volume III—This deals with the design of direct current motors. Every conceivable type of pole design is given and the advantages of each discust. The shaft bearings are also taken into account. Tables for voltage drops, shunt and series types as well as large charts are scattered thruout the book, illustrating clearly armature windings of all types.

Small motor design is then added, including automobile starting motors, and also the design of small transformers, the laws of which can be worked out very readily and the construction developt with practical results.

Volume IV—Electrical measurements are first explained. Then a chapter for everybody who has current in his house; curve drawing instruments and recording instruments are, of course, included. Follows a very exhaustive treatise on electromagnets, the method of calculation for any type, together with the pull under actual working conditions.

The use of electro-magnets is dwelt upon and a short concise review of induction coils, both for radio and X-ray work, and the Tesla transformer filling a much-needed want are given.

Industrial forms of controllers, elevators and railway signaling, each in a chapter of its own, complete this volume.

Volume V—In this book there is given a scientifically correct work on wiring methods, in which numerous minor details such as splicing of wires

(*Continued on page* 1108)

AGENTS $85 to $100 WEEKLY

ALL OR SPARE TIME



You—yourself—can positively make $85 to $100 a week. 70,000 Already Sold

I want men, hustling, energetic, ambitious fellows, anxious to make money, who are willing to work with me. Not for me, but with me. Are you that kind? I want you to advertise, sell and appoint local agents for the biggest, most sensational seller in 50 years—THE ROBINSON FOLDING BATH TUB. **Demonstrating Tub Furnished.** Here's a truly wonderful invention—nothing like it. Makes instant appeal. Sells easily. Gives every home a modern, up-to-date bathroom in any part of the house. No plumbing, no water-works needed. Folds in small roll, handy as umbrella. Self-emptying, positively unleakable. Absolutely guaranteed for 10 years. Remember, fully 70 per cent of homes have no bathrooms. More than 70,000 already sold.

FREE Demonstrating Tub FREE

Three sales a day means $90 a week. Breeze of Idaho, made $400 profit in 30 days. Rev. Otto Schulze, Mo., got $1,600 to date. Burkholder, Mont., orders $1,072 in 17 days. Hamlinton of Wyo., made $60 first two days. Hundreds like that. Pleasant, permanent, fascinating work. Write a post card. Let me write you a long letter. No experience needed, no capital. Your credit is good if you mean business. But you must be ambitious, you must want to make money. That's all. Write a postcard now. I want to pay you $85 to $100 every week.

THE ROBINSON CABINET MFG. CO.
36 Factories Building Toledo, Ohio

MADE TO MEASURE

Express or Postage Prepaid



$13.50

This offer is one of the biggest, most generous ever made by any tailoring house. It's your one big opportunity to get a finely tailored-to-measure 2 piece suit with box back, or any other style, superbly trimmed and cut in the latest city style for only $13.50.

We're out to beat high tailoring prices

You save $8 to $11. Why not **save 50%** on your next suit? Remember we guarantee style, fit and workmanship or your money back.

Big Sample Outfit FREE

Write us today and we will mail you **absolutely FREE** our beautiful illustrated pattern book showing dozens of the latest city styles and designs, also many large size cloth samples to choose from. Don't delay; we urge you to act quick; today.

The Progress Tailoring Co., Dept. 428, Chicago

1/4 H. P., 110 volts, A. C., 60 cycle, single phase, 1750 R. P. M. MOTORS

LARGE QUANTITIES NEW WASHING MACHINE MOTORS

These are of standard manufacture and carry the full factory guarantee. Shipped in original boxes. Complete as cut. Suitable for operating Coffee Grinder, Cream Separators, Bottle Washers, Air Compressors, Small Lathes, Etc.

Mail $5.00 cash or Money order. We will send C.O.D. subject to full examination. Money Back Guarantee.

Bargains in Small Motors and Generators. Write for Catalogue. Special Quantity Prices-Value $37.50

$22.75 Each

MANUFACTURER'S DISTRIBUTER

CHAS. H. JOHNSTON - Box 12 W. E., Pittsburgh, Pa.

EASIEST SHORTHAND





Learn in 5 evenings home study; then acquire speed with K. I. Shorthand. **Amazingly simple, easy.** Approved by experts. Write dictation, messages, etc., **rapidly as spoken,** after brief pleasant practice. Favorite method for personal use; make notes at lectures, meetings; keep confidential diary. Big help in any profession or business; aid in your career. Used in Army, Navy, courts, commercial schools; by public and private stenographers, teachers. Silent cost. **K. I. Shorthand—for busy people, including YOU. Proof Lessons, Guarantee and Brochure with Testimonials free, postpaid. Address:**

KING INSTITUTE, EP-300—Station F, NEW YORK CITY

STAMMER NO MORE

Kill the fear of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Order a copy today. **THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago, Illinois**

CLIP THIS COUPON



Chicago Technical College
245 Chicago "Tech" Bldg. Chicago, Illinois

Without obligation on my part, please send, free and postpaid, instructions on how I can become an expert in subject marked below.

[ ] Architectural Drafting
[ ] Machine Drafting
[ ] Electrical Drafting
[ ] Structural Drafting
[ ] Sheet Metal Drafting
[ ] Topographic Drafting
[ ] Surveying
[ ] Designing
[ ] Contracting—Buildings
[ ] Auto. Engineering
[ ] Aero. Engineering
[ ] Gas Engines
[ ] Plan Reading—Buildings
[ ] Estimating—Buildings
[ ] Plan Reading—Machinery
[ ] Plumbing—Estimating, Etc.
[ ] Heating and Ventilating
[ ] Steam Engineering

Name.....
Address.....
Post Office.....
College or Home Study. State which..... State.....
Free Lesson when inquiry is for Draftsmanship or Plan Reading.

Learn Draftsmanship At Home

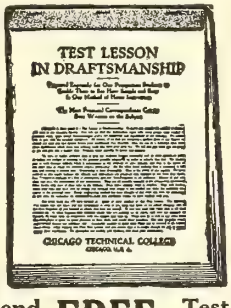
GET the facts about the Chicago "Tech" courses in Draftsmanship (or any of the other big paying professions listed on the coupon) which you can master quickly by spare time study at home. Salaries paid draftsmen today are the highest in history because trained men are scarce. Not enough to go around and hundreds of big jobs waiting. Industries of all kinds—manufacturers, architects, railroads, electrical plants, etc.—need proficient men for their drafting departments. Experts in this profession earn $60 to $150 weekly.

No matter what you are doing, this is your big chance. We will send you without obligation or expense a Free Test Lesson (read details of this liberal offer below). See how well qualified you are before you spend a cent. Look into these opportunities today. Learn how a Chicago "Tech" course will make you the man chosen from among many. Clip that coupon—NOW!

Experts Teach You the Methods They Use

The Chicago "Tech" method trains you under experts who will equip you for an important position in the shortest practicable time. You learn exactly the methods which they themselves use in their own practical work. They prepare you to rank with draftsmen of long experience. They give you the training required in men who aim to hold important executive positions and draw high salaries for their expert advice and service.

Why plod along and be content to take orders from men who know the "Hows" and "Whys" of a big job? You have it in you to *give* orders, once your trained knowledge gives you the confidence to assume charge of the men who do the actual work. The training in Draftsmanship which you get from Chicago "Tech" experts fits you to step right out and earn a big salary. You do not need to resort to guess work. Nothing can halt you—for you will KNOW your subject.



Send for FREE Test Lesson

Shows you how well qualified you are for draftsmanship. Other schools ask you to enroll and send money first. We send the free lesson first. Read it — practice the exercises—no obligation. Decide for yourself whether you want to take the course or not.

FREE OUTFIT

With our home study course is included a complete set of high grade instruments, drawing board, T-square, etc. Same as leading draftsmen use. Credit given if you already have an outfit.

18 Practical Courses You Can Master Quickly

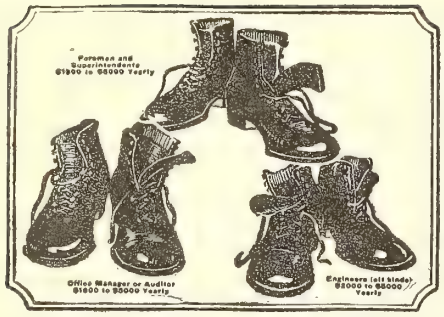
If you want to take up and master quickly any other technical study, the coupon above lists a number of professions that pay handsome salaries. If you cannot come to the college, you will get the same course—the same thorough individual instruction by mail. No matter where you live, your lessons are directed and every exercise examined and corrected by experts. Every point is made clear. You progress as quickly as your work proves that you have mastered each lesson.

No matter which course you decide to take, you learn just what you need to know from practical men who familiarize you with the things that make you worth a large salary. With the practical knowledge gained from a Chicago "Tech" course, you will be the man wanted—the man who is pushed ahead, because you know why things should be done and how to do them. You can start at a good salary and win quick promotion.

Decide Today—Then ACT Now is the time to get the facts about any one of these Chicago "Tech" courses. Find out how hundreds of ambitious men have paved the way to high positions merely by using their spare time to prepare for bigger work. Just put X in the square on the coupon opposite the course you want to know about—sign and mail the coupon. This information costs you nothing—so Act Today.

Chicago Technical College 245 Chicago Tech Building CHICAGO, ILLINOIS

CLIP THE COUPON NOW



Learn to Fill BIGGER Shoes!

NO matter what kind of work you are doing now, a set of these great home study books will quickly fit you for a bigger and better paying job. We will send any set you select for one week's free examination, and if you want to keep them you pay only the special reduced price, at the rate of 75 cents a week. This is your opportunity to make more money—grasp it NOW. Use these books and a little spare time and LEARN TO FILL BIGGER SHOES.

Pay-Raising Books at Greatly Reduced Prices

Accountancy and Business Management. 7 vols., 2700 pages, 1000 pictures. Was $52.50...Now $29.80
Carpentry and Contracting. 5 volumes, 2138 pages, 1000 pictures. Was $37.50.....Now 24.80
Civil Engineering. 9 volumes, 3900 pages, 3000 pictures. Was $67.50.....Now 39.80
Electrical Engineering. 8 volumes, 4100 pages, 3300 pictures. Was $60.00.....Now 34.80
Automobile Engineering. 6 volumes, 2600 pages, 2000 pictures. Was $45.00.....Now 24.80
Machine Shop Practice. 6 volumes, 2300 pages 2500 pictures. Was $45.00.....Now 24.80
Steam and Gas Engineering. 7 volumes, 3300 pages, 2500 pictures. Was $52.50.....Now 29.80
Law and Practice (with reading course). 12 volumes, 6000 pages, illustrated. Was $97.50. Now 49.80
Fire Prevention and Insurance. 4 volumes, 1500 pages, 600 pictures. Was $30.00.....Now 19.80
Telephony and Telegraphy. 4 volumes, 1728 pages, 2000 pictures. Was $30.00.....Now 19.80
Sanitation, Heating and Ventilating. 4 volumes, 1454 pages, 1400 pictures. Was $30.00....Now 18.80
Drawing. 4 volumes, 1578 pages, 1000 pictures, blueprints, etc. Was $30.00.....Now 19.80

Send No Money
Shipped for 7 Days' Trial

Write the name of the books you want on the coupon and mail it today. We will send the books at once, express collect and you can use them just as if they were your own for a whole week. If you decide you don't want to keep them, send them back at our expense.



75c a Week

If you like the books, as thousands of other men have after examination, just send us $2.80. You can send the balance of the special reduced price the same way—$3.00 each month (75 cents a week).

Start right now and learn to fill bigger shoes. There will be a better job looking for you if you do. Be ready to meet it when it comes. Send the coupon now.

American Technical Society
Dept. X-252 **Chicago**

American Technical Society, Dept. X-252, Chicago, U.S.A.

Please send me set of.....

.....

for 7 DAYS' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3 each month until I have paid the special price of $..... If I decide not to keep the books I will return them at your expense at the end of one week. Title not to pass to me until the set is fully paid for.

Name.....

Address.....

Reference.....

Book Review

(*Continued from page* 1106)

and cables and all forms of light or power wiring for store or factory, concealed in either wood or metal molding, conduit (flexible or rigid), and steel armored flexible cable are described; numerous charts depict the various methods.

This chapter is completed with the subject of switchboard and panels whose wiring also occupies considerable attention.

A treatise on the planning of wire installations makes this book desirable for electricians engaged in such work. Large blue-print drawings dealing with wiring and electrical signals, cause the study to be greatly simplified. A chapter on Underwriters' requirements giving the exact details of any form of installation completes the volume. Enough cannot be said about this latter chapter in this limited space.

Volume VI—In the sixth volume electric lighting first attracts our attention; method of determining candle-power, and then—incandescent, carbon, Nernst lamps, mercury vapor type and other forms of tube lighting follow in order.

Reflectors of practically all types having basic ideas, are then discust, together with reasons for the choice of certain lights. Store, interior lighting, industrial plant lighting, flood lighting, home lighting and street lighting—all occupy respective positions. Railway car lighting and the method of control is then added, demonstrating many features not generally known to individuals and to a great extent unfamiliar to electricians.

A radical and novel addition is a chapter for the chemist, on Electro-chemistry, which is bound to attract favorable notice and undoubtedly wide use will be made of the simple diagrams given therein to conduct experiments in miniature.

Volume VII—This brings us to the seventh volume which is considerably more technical and intended more or less for the Electrical Engineer. After a profuse discussion on power stations and switchboards, together with dynamos and other electric machinery, electric welding is entered into, showing the advantages of this method, the time and cost involved and the process for producing the results desired.

Cutting by the arc and also gas torches, such as oxy-acetylene, are included, and last but not least *thermit*, and its uses. The types of welds and tools employed are, of course, necessary adjuncts found in this work.

Volume VIII—In the eighth and last volume of the Cyclopedia of Applied Electricity, electrical transmission and methods of installation, together with distribution, pole guying, conduit arrangements, and in fact every form of electrical transmission detail that would ever be required is given in this exhaustive study. The forms of electrical railway control, methods of testing and power-house arrangements, together with the electrification of steam railways naturally occupy many pages.

The work ends with a glossary in which the definitions of words used in the text are given in simple language and reference is made to the volumes in which information desired may be found. The cyclopedia is scientifically correct, and is as free as possible from unnecessary mathematical formulas; also technical phrasing is omitted wherever possible.

Diagrams and curves, together with practical examples, are greatly helpful in explaining the subject. Inasmuch as the work is modern, written by undoubted authorities in their respective fields, its reliability can be vouched for. One regretful omission is the lack of a discourse on the subject of Telephony, but even in view of this the Cyclopedia remains almost priceless to its owner.

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY FOR 1920. Cloth cover, 1,148 pages, 33 illustrations, size 8¼ inches by 5¼ inches. Publisht by the Wireless Press, Ltd., London.

This excellent work covers in detail practically every branch of wireless telegraphy and telephony, describing fully the latest accomplishments in these interesting fields of human endeavor.

In the first half of the book are contained the record of the development of wireless telegraphy, radio laws and regulations of all countries of the world and the names of land and ship stations, giving their geographical positions, their call signals, wave lengths, and the nature and hours of service, etc.

The latter half of this book is devoted mainly to the call letters allotted to land and ship stations, radio-communication and meteorology, wireless with relation to time, and arrangements current in various countries. Useful radio data, nautical measures, companies engaged in the commercial development of radio-telegraphy and radio-telephony are also given.

A biographical section of leading men in the wireless world, including obituary notices, followed by a review of the latest radio publications, constitute the concluding portion of the work. This valuable reference book should be found in the library of every radio operator, both amateur and commercial.

(*Continued on page* 1110)

Government Overcoats

All wool Government overcoats, slightly worn, but in first-class condition. These coats have been renovated, cleaned and pressed and a first-class tailor would ask $75 to make one from the same class of material. Men's sizes from 36 and up. The small sizes will make the warmest coat your boy ever wore and are just the thing for school. Any of these coats should wear for 5 years. Our price $8.75.



These coats dye a beautiful black or dark blue, which we will have done for you if you so request by the largest dyers in Chicago for $2.75 additional to the first cost of $8.75, but the cost of dyeing must accompany your order.

As a matter of good faith mail us a deposit of $1, balance on delivery. We always ship overcoats by express, unless otherwise instructed.

$8.75 Each

KINGSLEY ARMY SHOE CO.,
3852 Cottage Grove Ave., Dept. K-90, Chicago, Ill.

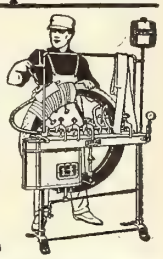
AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers

Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.



FREE Book

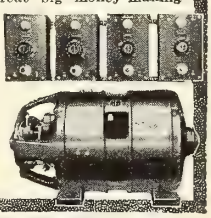
"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2201 Fourth St. Waupun, Wisconsin

Big Profits in Battery Charging with the HB 32-Battery Charger

Make $2,000 to $3,500 a Year

Small cash payment brings you this HB 32-Battery Charger. Almost a year to pay balance on easy terms. You can build a great big money-making battery charging business with our help. No electrical knowledge or training needed. Cash profits for you. Get this machine when winter offers biggest opportunities. Write for information TODAY.



Hobart Brothers Company
Box 23E, Troy, Ohio
Successful manufacturers since 1893



You can be quickly cured, if you

STAMMER

Send 10 cents for 288-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering 20 yrs. **B. N. Bogue, 775 Bogue Bldg., 1147 N. Ill. St., Indianapolis.**

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER **LONGMONT, COLO.**

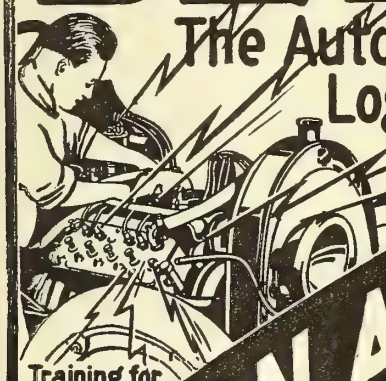
DETROIT

The Auto Center is the Logical Place To

LEARN AUTOMOTIVE ELECTRICS

The Right Way To Get Into The Automobile Business

Come to Detroit, the Automobile Center, and Learn at the Factory Endorsed School



It is necessary to understand both the electrical and mechanical ends of the business in order to be successful. They go together.

THOUSANDS OF MEN WANTED

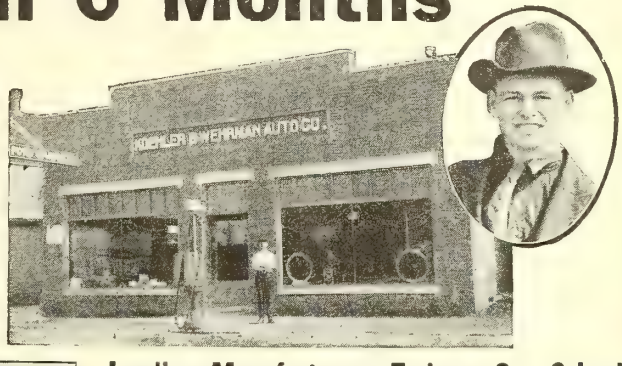
In addition to the constant demand for real trained men in the production end, ten million or more autos, trucks and tractors in use in America must be kept in repair. You can start a garage, repair shop or service station of your own. Or operate, repair and sell tractors and automotive equipment used on the farm. Experts are needed to install and do service work on lighting systems. They must know gas engines and automotive electricity thoroughly. Salesmen that understand the mechanical and electrical part of the automotive machinery are winning big success. More brazing and welding shops, more Tire Repair Shops, are needed. There is no other line of business where a man can go out and do what our graduates do, in such a short time.

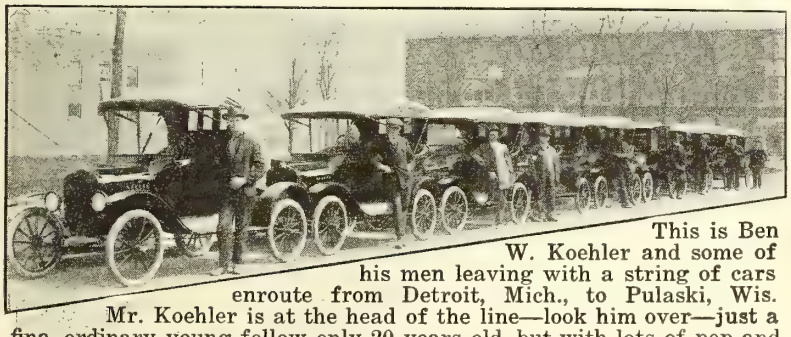
This Small Town Garage Paid

$10,000 Profit in 6 Months

BECAUSE it is managed by a man who understands his business.

This is 20-year-old Ben W. Koehler of Pulaski, Wis., and the garage of Koehler and his partner, $93,810 worth of business in six months with a profit of $10,000. Mr. Koehler is an M. S. A. S. graduate. Koehler learned the automobile business the right way. He came to Detroit. Ninety-four per cent. of automobiles are made in Detroit district. The greatest automobile experts are here.





This is Ben W. Koehler and some of his men leaving with a string of cars enroute from Detroit, Mich., to Pulaski, Wis. Mr. Koehler is at the head of the line—look him over—just a fine, ordinary young fellow only 20 years old, but with lots of pep and an M. S. A. S. training.

You Can Start a Business of Your Own, Too

just as Koehler did. Very little capital is required and you can always get that if you have the training. Koehler is only one of the thousands of M. S. A. S. graduates who are making good.

FREE CATALOG Let us tell you of the wonderful opportunities in the Auto, Truck and Tractor business. Let us tell you the right way to get a business of your own. One that will bring you $500 to $1,000 per month. Let us tell you of the thousands and thousands of graduates who are making good. Let us tell you of the **factory outlined** and factory indorsed course, and why Detroit, the heart of the auto industry, is the logical place for you to learn. Send for Free Catalog Today.

Leading Manufacturers Endorse Our School

Many of them assisted in outlining our courses. They know it is right.

Packard Motor Car Company — Made in America

Detroit, Mich. U.S.A.

May 4, 1920.

Mr. L. B. Fisher,
Route No. 7, Box 181,
Paducah, Ky.

Dear Sir:

This will acknowledge your letter of May 1, addressed to the attention of Mr. Vincent.

I would advise you to enter an auto school, as I believe you would get an all-around experience quicker than working either in a Factory or Garage. I understand that the Michigan State Auto School have turned out some very good men, and I do not believe you would make any mistake in attending this school if you wish to become thoroughly experienced in the automobile business. In this school you would get an opportunity to work on all different kinds of cars, and you would also have instructors who could explain the different parts, etc.

Yours very truly,
PACKARD MOTOR CAR COMPANY.
J. D. Wilson,
Ass't to Vice-President
of Engineering.

MICHIGAN STATE AUTO SCHOOL

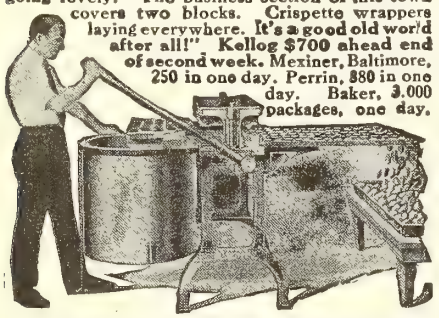
"The Detroit Auto School" — *"Endorsed by all Leading Manufacturers"*

662 Auto Building
3729 Woodward Ave. **Detroit, Mich., U.S.A.**

$365.75 ONE DAY!

Ira Shook of Flint Did That Amount of Business in One Day

Making and Selling Popcorn Crispettes with this machine. Profits $269.00. Mullen of East Liberty bought two outfits recently, and is ready for third. Iwata, Calif., purchased outfit Feb. 1920. Since, has bought 10 more—his profits enormous. J. R. Bert, Ala., wrote; "Only thing I ever bought equaled advertisement." J. M. Pattilo, Ocala, wrote: "Enclosed find money order to pay all my notes. Getting along fine. Crispette business all you claim and then some." John W. Culp, So. Carolina, writes: Everything going lovely. The business section of this town covers two blocks. Crispette wrappers laying everywhere. It's a good old world after all!" Kellog $700 ahead end of second week. Mexiner, Baltimore, 250 in one day. Perrin, 880 in one day. Baker, 3,000 packages, one day.



WE START YOU IN BUSINESS

Little capital, no experience. Furnish secret formula

Build A Business Of Your Own

The demand for Crispettes is enormous. A delicious food confection made without sugar. Write me. Get facts about an honorable business, which will make you independent. You can start right in your own town. Business will grow. You won't be scrambling and crowding for a job. You will have made your own place.

Profits $1000 A Month Easily Possible

Send post card for illustrated book of facts. Contains enthusiastic letters from others - shows their places of business, tells how to start, when to start, and all other information needed. It's free. Write now.

LONG EAKINS COMPANY
253 High Street Springfield, Ohio

MEN WANTED



Mechanically Inclined
—to send for my big illustrated 72-PAGE BOOK—**FREE!**

It tells how in a few weeks you can earn from $150 to $400 a month in the Auto and Tractor business. ***Be Your Own Boss.*** At small cost learn to be an expert mechanic by the Sweeney System of working on real cars. ***Use tools not books.*** Simply send your name and address today, a post card will do, for our Free book and 27 photographic reproductions of machine shop work, etc. **Let's Go---Write Now!**

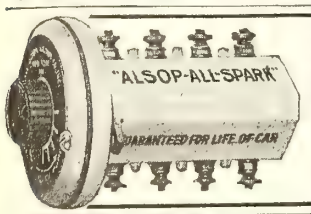
EMORY J. SWEENEY, President

LEARN A TRADE—Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
138 SWEENEY BLDG. KANSAS CITY, MO

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. **Guarantee Bond for 8000 Miles.** (No seconds). Shipped prepaid on approval. Sample sections furnished. Donot buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.,
901 Oak St. Kansas City, Mo.



Saves Gasolene
Prevents Carbon and Missfires. Will fire old or cracked spark plugs. *Write for Governments Tests*

ALL SPARK IGNITION CO.
13 X Water St., New York

BE AN EXPERT
Penman
Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. **Complete outline FREE.** Write C. J. Ozment, Dept. 44. St. Louis, Mo.

Book Review

(*Continued from page* 1108)

AIDS TO ELECTRICIANS' EXAMINATIONS—QUESTIONS AND ANSWERS. By Samuel J. Thackaberry. Paper covers, 79 pages, size 4¼" by 6¾". Publisht by Aaron Shapiro, 222 E. 64th St., New York City, N. Y.

This book covers every question that could possibly be given in an electrician's examination, together with its answer, all in a clear and concise manner. A few of the many practical questions and answers contained in this book are as follows:

Q. If you had to install 250-watt gas-filled lamps with shades over them what kind of sockets would you use?

A. Mogul sockets, which have no fiber lining.

Q. Is it necessary to ground the base frames of 250-volt motors?

A. No. The base frame must be insulated from the floor or from their supporting surface.

Q. What kind of insulation on the wire in metal moulding?

A. Rubber covered, single braid.

This book, as its name implies, is truly an aid for electricians in their examinations, and the wealth of information contained therein, will not fail to convince the reader of its real value.

MR. TOUCH-BUTTON, OR THE HOME OF BEAUTIFUL IDEALS. By Nancy Berry. Paper covers, 48 pages, 40 illustrations, size 7½" by 10". Publisht by Country Life, Ltd., 20 Tavistock, St., Covent Garden, W. C. 2, England.

This book, written by a child authoress, is a tale for children, describing an all-electric house, in which electricity is applied to every conceivable labor-saving device and comfort-increasing contrivance in the home.

The story itself, is written in an interesting and fascinating manner, and we are wafted upon the wings of electricity, to a wondrous house wherein every demand of our adventure is promptly fulfilled.

This book can truly be enjoyed by children of all ages, and it describes to the youthful readers, the many and varied advantages of an electrically equipt home, wherein every modern electric contrivance is found; such as vacuum cleaners, indirect lighting and loud-speaking telephones.

WHO'S WHO IN AMERICA—1920-1921. Vol. 11. Cloth covers, size 5½ by 7¾ inches, 3,302 pages. Publisht by A. N. Marquis & Co., Chicago.

We have received Volume 11 of "Who's Who in America," a work which has had a long and honorable career, and which really sets the pace for all similar books of contemporaneous biography.

The first volume was for the year 1899-1900 and contained 827 pages with 8,602 biographies. Since then it has grown, the proportional growth being most marked in the early editions. And now, in Volume 11, there are 3,302 pages with 23,453 biographies, of which biographies 2,514 appear in no previous issue. Increasing at this rate, it would seem as if it would surely reach a prohibitive size, but the subjects of its text keep dying, and that is what saves it; because it is a dictionary of only living people. Back references are given to former volumes for those who have died. It therefore is a complete modern American biographical dictionary in its full set of 11 volumes, and any library possessing such a set, should preserve it carefully.

The work has become an absolute standard and is based on the following rule which we quote from the foot of its tenth page, "Not a single sketch in 'Who's Who in America' has been paid for—and none can be paid for."

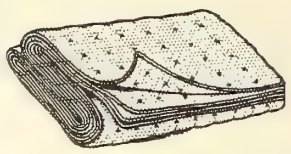
SELENIUM CELLS AND HOW THEY ARE MADE——By Samuel Wein. Fully illustrated. Paper covers, size 6 by 8½ inches. Publisht by The Progress Publishing Co., New York.

This little pamphlet contains a quantity of information about the element selenium. This subject is acquiring increased importance, and is exciting more interest day by day; therefore, we believe the book, which is a very thorough compendium of different processes and terms of the subjects with numerous illustrations of the cells, will be favorably received by our readers.

Selenium is a conductor of rather high electrical resistance, but whose resistance is reduced by exposure to light, to which it is very sensitive, and this sensitiveness opens a possibility for the construction of very interesting electrical apparatus.

(*Continued on page* 1112)

EXTRA HEAVY ARMY COMFORTS



$3.75 AND $2.40

Weight 7 to 8 pounds, size 66x76. Stuffed with the purest of white cotton. Extra heavy covers, mostly Khaki in color, with a small per cent. of floral designs. Beautiful extra strong comfort that are more serviceable than comforts costing from $8 to $11. These comforts were issued just one month before the Armistice was signed, and many never left the supply depots. All in practically first-class condition. Our price $3.75 each.

We also have several thousand comforts of the same kind and size of the above which are soiled, but in good wearing condition, free from holes and rips, at $2.40 each. These are classed as No. 2 comforts and if you prefer this one be sure to state you want comfort No. 2.

As a matter of good faith mail us a deposit of $1, balance on delivery. We always ship comforts by express, unless otherwise instructed.

KINGSLEY ARMY SHOE CO.
3852 Cottage Grove Ave., Dept. X-90, Chicago, Ill.

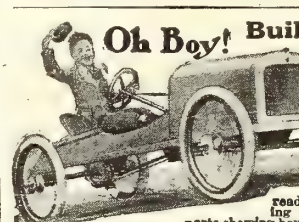
12 Months to Pay

Enjoy your 1921 "Ranger" at once. Earn money for the small monthly payments on **Our Easy Payment Plan.** Parents often advance first small payment.
FACTORY to RIDER wholesale prices. Three big model factories. **44 Styles,** colors and sizes in our Ranger line.
Delivered FREE on 30 DAYS TRIAL. Select bicycle and terms that suit—cash or easy payments. *Ex. prepaid.*
TIRES lamps, horns, wheels, parts and equipment at half retail prices.
SEND NO MONEY—Simply write today for big, Free Ranger Catalog and marvelous prices. Special Rider Agents offer.



Mead Cycle Company Dept. C-107 Chicago

Oh Boy! Build This Car

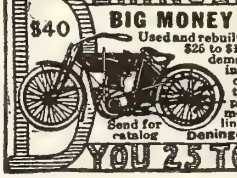


This nifty little car driven by gasoline motor can be built by any boy. New 1921 plans, bigger, better than ever, now ready. Send 30c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO. 158 Sypher Bldg., Toledo, Ohio

DENINGER WILL SAVE

BIG MONEY SAVINGS FOR YOU



Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $6.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog

Deninger Cycle Co., Rochester, N.Y.

YOU 25 TO 50 DOLLARS

Learn Autos and Tractors

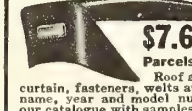


Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O

You Can Save $50.00



$7.65 and up
Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

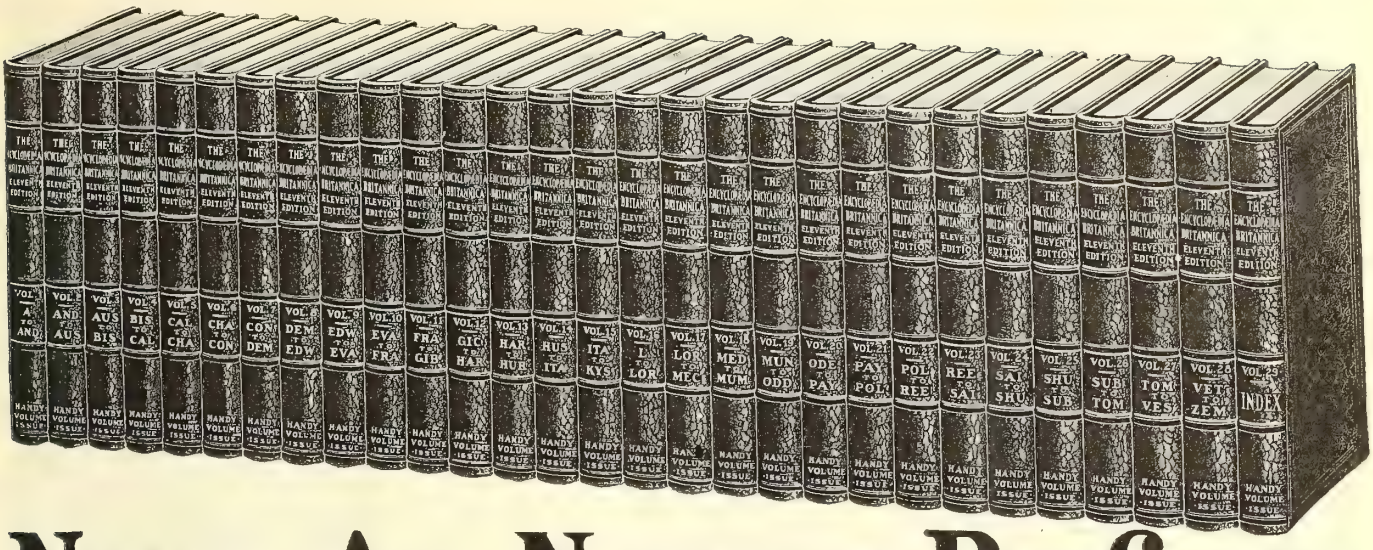


Cleartone Phonographs
$4.00 to $200.00 Retail

Our Sundry Dept. offers Needles 39c per thousand. Motors $1.35 to $14.75 each. Tone-Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84-page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 501B East 19th Street, N. Y.



Now As Never Before

You Need

THE ENCYCLOPÆDIA BRITANNICA

The ending of the great war brought a tremendous stimulus into every field of human thought and activity. In science—medicine, engineering, chemistry, physics, agriculture and aviation there have been epoch making discoveries and inventions. Art—painting, sculpture, music, literature and the drama have received their share of this new, vigorous interest. There has been a marked renaissance of reading. The industries have felt the stimulus in the demand for greater production, although business has had to contend with serious problems of labor and finance. There has come a new and intensified interest in social service, education and a new spirit in religion. People are taking a greater interest than ever before in athletics, in sports and games. As a direct result of the war and the participation of the United States in world affairs, there has been aroused a great incentive to the study of history and of foreign countries, their peoples, government, products, resources, customs and commerce. This tremendous quickening of thought and activity puts upon every man and woman a great responsibility to understand the meaning of the present day developments in science, art, industry, economics and politics. The necessity for authoritative, comprehensive and unprejudiced information has never been so great. The Encyclopaedia Britannica, known for one hundred and fifty years as the standard authority and the greatest guide to accurate information among English speaking peoples, furnishes the foundation of knowledge most needed by the business man, the manufacturer, the worker in the industries, the scientist, exporter, importer, student of world affairs, the social worker and teacher.

Is America on the brink of a panic? Will underproduction and lack of labor prevent a panic? Will the cost of living fall abruptly? Will wages continue high? Is the fall of the Bolshevist regime in Russia imminent? Will Germany fulfill its peace treaty obligations?

By means of the extraordinary articles in the Encyclopaedia Britannica on economics, industries, politics, government, labor and capital you will be able to obtain a clear insight into the problems of today. The Britannica will aid you to understand the issues brought up in the political campaigns for President, on prohibition, on suffrage, on tariffs, on currency, waterways, transportation and on government ownership.

A Treasure Chest of Knowledge

The Britannica is a complete library of knowledge on every subject. It discusses in a way that you can understand every branch of science, industry, literature, art, religion, inventions and engineering; history and race development; war and peace; architecture, astronomy, chemistry, sociology, education, steam, electricity, geology and geography, biography, law and physics. You and your family will find in the Britannica a liberal education. In answer to the hundred questions which every day come to your mind and to your wife's and children's minds, it will tell you more about everything than you can get from any other source.

The Britannica in Women's Affairs

The Encyclopaedia Britannica gives to the woman fundamental information on politics, on economics, child welfare, domestic science, on foods and their relative values, on hygiene, sanitation, home decorations, furniture, rugs and furnishings. As an educational influence the Encyclopaedia Britannica is supreme. As an aid to children in school it is indispensable to supplement, interpret and broaden their knowledge on the subjects which they are studying.

Printed on the Famous India Paper

These sets are printed on the genuine India paper—the beautiful, light, strong, thin but opaque sheet, which has proved an ideal medium on which to print the Encyclopaedia Britannica, because it makes this great work more compact, much more convenient to handle and more inviting to read.

MAIL COUPON TODAY

Mail to us today the attached coupon with your name and address and we will send you, postpaid, our 128-page illustrated booklet, which will give you full information about the Britannica and what it will mean to you and yours to have such a great work in your home; also, how we are able to sell it to you at so low a price on such liberal terms of payment.

Orders accepted from any point within the United States.

$1.00 DOWN

29 Volumes
44,000,000 Words
30,000 Pages
500,000 References
Complete Latest Edition
Balance in small monthly payments

SEARS, ROEBUCK AND CO.,
CHICAGO.

Sears, Roebuck and Co., Chicago, Ill.

Gentlemen:—Please send me, postpaid, your illustrated book, No. 26S, giving full information about the Encyclopaedia Britannica. Also tell me what I will have to pay for a set of the Handy Volume issue of the Britannica printed on genuine India paper.

Name .....

Postoffice .....

R. F. D. No..... Box No..... State.....

Street and No.....



LEARN MUSIC AT HOME!

Play by Note
Piano, Organ, Violin, Cornet, Guitar, Banjo, Mandolin, Harp, 'Cello, Trombone, Flute, Clarinet, Piccolo, Saxophone, Ukulele, Sight Singing, Hawaiian Steel Guitar, Harmony and Composition, Tenor Banjo, Drum & Traps

Music no longer difficult! New plan makes it easy to learn by home study. Positively easier than with private teacher. Faster progress. You will be able to play your favorite instrument in a few short months! More than 250,000 men, women and children have learned by our method. You, too, can learn in your spare time. We guarantee it.



H. S. Whittmack, New York, writes: "I compliment you on your wonderful system. Did not know one note from another, but in a short time have mastered the piano and am now composing music."



Louise Bowles, Epworth, Va., writes: "Received my teacher's certificate. I highly recommend your school and wouldn't take anything for the help it has given me."

Lessons FREE

We want to have one pupil in each locality at once to help advertise our home study method. For a short time, therefore, we offer our marvelous lessons **FREE**. Only charge is for postage and sheet music which is small. Beginners or advanced pupils. **Write** for amazing free book giving all the facts and particulars. Send a postal to-day!

Instruments supplied when needed, cash or credit.



C. N. Pitts, Macon, Ga., writes: "Have completed your course on violin. Now have 15 students."

U. S. School of Music
1332 Brunswick Bldg.
New York City

Play the Hawaiian Guitar

Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs and other effects that make this instrument so delightful. The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Your tuition fee includes a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 complete lessons and pieces of music.



Special arrangements for lessons if you have your own guitar.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK

I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc., etc.

Name .....
Address .....
Town..... State.....E. E.

Write Name and Address Clearly

Write It With a 'Vulcan'



Red or Black "Vulcan" Ink Pencil

The **only** perfect, non-leakable ink pencils at moderate prices. Long or short.

Order today, Postpaid

$1.50

Absolute necessity to any business man or woman. Promotes efficiency. Unequalled for general writing, billing, ruling and manifolding. Made of pure vulcanized rubber with non-corrosive, durable writing point. Lock-Cap prevents leaking. Extra size, 8 ins. black only, $1.75. *Agents Wanted. Big Profits.*

J. F. ULLRICH & CO., 161 Washington St., N.Y.

$10 Brings This Latest Model **L. C. Smith or a Remington**

TYPEWRITER



Thoroughly rebuilt in our factory by the famous "Young Process." Fully guaranteed. Easy terms. No interest. FREE TRIAL. We handle all standard makes. Write for details.

YOUNG TYPEWRITER CO., Dept. 59, Chicago

Book Review

(*Continued from page* 1110)

"THE HOW AND WHY OF RADIO APPARATUS." By H. Winfield Secor. Cloth bound, size 6¼ x 9¼ inches, profusely illustrated. Publisht by EXPERIMENTER PUBLISHING CO., New York City, N. Y., 1920.

This book undoubtedly, presents the radio subject as it should be given; clearly, concisely, and with the least mathematics possible in a work so thoroly covering the principles of nearly every conceivable radio apparatus.

It will be remembered that there are comparatively few "radically different" pieces of radio apparatus and the instruments which are coming into the market at the present day are only revivals of some of the older types. The author of this work explains and illustrates both the older and newer types of instruments, and presents them in the same pleasing manner which characterizes his numerous magazine articles.

Among the subjects covered are induction coils, the transformer and method of operation, explained by water analogies and numerous diagrams for the hookup; condensers for transmitting, a table of inductivity factors accompanying them, which enable anyone to readily compute the size of condenser required for any definite purpose.

The description of spark gaps and other radio transmitting devices such as helices, etc., and of their method of operation, brand this book as the only one for the amateur radio man and the best one for the professional, where an all-around knowledge of the field is desired. On the subject of radio transmitting inductances alone, there are no less than nine distinct types given, each so remarkably simple, that the student can readily construct any himself.

The author has attempted and succeeded in rendering the subject of radio in as few well-chosen words as possible, omitting technical phrasing except where impossible, in which case, a thoro explanation of the words used is given.

Eleven different types of variable condensers are shown and nine different detectors and hookups for each type. All the various types of telephone receivers; 13 drawings of radio amplifiers, crystal, vacuum tube, and relay types are given.

The method of making and calculating wave meters is treated upon at length. Antenna construction details together with the Fire Underwriters' requirements and in the last three chapters, the calculation and measurement of inductance is made simple enough for any reader to understand, if he will but put a little conscientious effort forward in that direction.

All of the devices mentioned herewith are given in simplified diagrams suitable for constructive purposes and an appendix containing tables for and formulas of spark coil dimensions, closed and open core transformer data, glass plate condenser data, high potential condenser data, and various wire and harmonic tables and tabulated voltages according to sparking distances of coils are included.

The work is very well written; with clear, understandable type on good quality paper, and is ideal for all radio men whether beginners or adepts.

We quote from the notice of this book given in the columns of the *London Electrical Review:*

"The writer of this little volume points out an important fact to his readers and also to other authors. A volume on wireless telegraphy cannot be complete. A student must read all books on wireless telegraphy which he can possibly obtain in order that his knowledge shall be complete.

"The author is an experimentalist himself—an enthusiast. One sees it in every line, and it is that which gives the volume a certain appeal which somehow rarely is found in this country. In America the amateur is catered for as he is in no other country. The literature at his disposal stimulates his interest."

ORGANIC PHOTOGRAPHIC DEVELOPERS—By Samuel Wein. Cloth covers, size 6 by 9 inches, 128 pages, two indexes. Publisht by Forty-Second Street Commercial Studio, New York.

This is a very convenient manual, giving the names and formulas of a very large number of photographic developers. In many cases, the manipulations and processes required to manufacture them are given in some detail, and the field seems to very fully cover many of the compounds described. Sometimes the patent is called upon, and sometimes scientific publications, for the description.

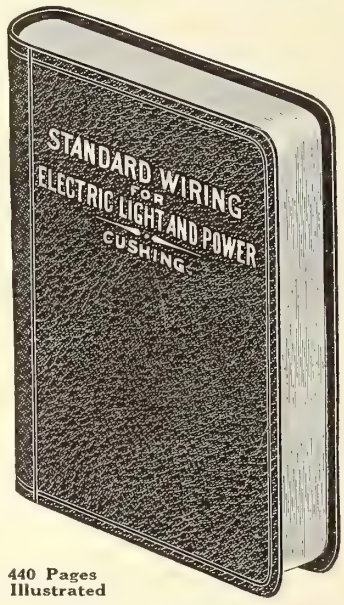
The book shows a great amount of research and painstaking on the part of the author. When the compounds involving the benzol series are reached, graphic formulas are given as required.

The second section of the book is devoted to the use of the different developments and other photographic processes such as developing, factorial development, bleaching and intensifying, and toning. A considerable section is devoted to the diazotype process, and the much debated subject of direct positives has a chapter.

One interesting chapter describes the making of plaster plaques, by the aid of photographs.

(*Continued on page* 1114)

LEARN WIRING
AND EARN $75 A WEEK
THIS BOOK WILL MAKE YOU AN EXPERT WIRE MAN



440 Pages
Illustrated

The National Authority on Wiring for Twenty-seven Years

All the necessary rules, tables and illustrations needed for every kind of inside and outside wiring and construction for both direct and alternating currents, in accordance with the Underwriters, Rules. The most complete and accurate book on wiring published.

Leather Cover. Pocket Size. $3.00
Sent on Receipt of Price

H. C. Cushing, 10 W. 40th St., New York

"Type It Anywhere—Yourself"



The FOX
(7 pound)
Portable Typewriter

Speed, ease of operation, durability, and portability, are inherent qualities of the **"Baby Fox" Portable.**

Take it with you wherever you go—on the train, in your home, anywhere—it is always at your service for better letters, more easily written — more easily read.

SWIFT—EFFICIENT—DURABLE

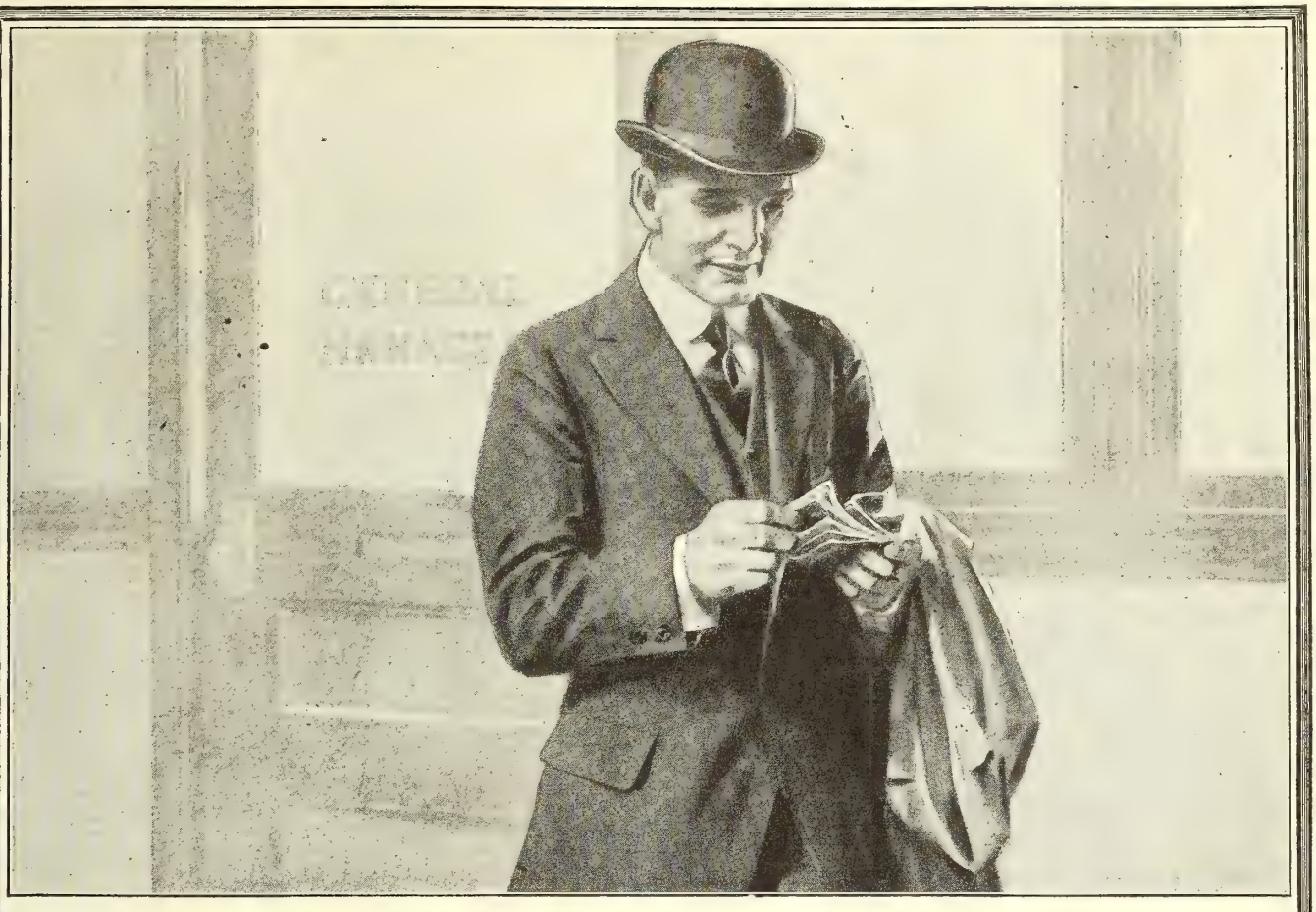
Send for a Catalogue
FOX TYPEWRITER CO.
634-666 Front Ave., Grand Rapids, Mich.

Make Your Own Machine For Telegraphing Pictures

Something never offered before—secret, blue print and complete instructions for most marvelous invention of the age. Machines easily and inexpensively made from material and simple articles already in the hands of every experimenter. Will transmit pictures, maps, drawings and handwriting. This picture transmitted on set of these machines. Only $2. Send today.



L. J. LEISHMAN CO.
Dept. T Ogden, Utah



"At Last—A *Real* Job and *Real* Money"

"And if only I'd started earlier, I could have had them five years ago. I didn't realize at first what spare time study would do for a man. Taking up that I. C. S. course marked the real beginning of my success. In three months I received my first promotion. But I kept right on studying and I've been climbing ever since."

Every mail brings letters from some of the two million students of the International Correspondence Schools, telling of advancements and increased salaries won through spare time study.

How much longer are *you* going to wait before taking the step that is bound to bring you more money? Isn't it better to start *now* than to wait five years and then realize what the delay has cost you?

For 29 years the I. C. S. have been helping men and women out of routine drudgery into work they like—helping them to win advancement, to have happy, prosperous homes, to know the joy of getting ahead in business and life.

One hour after supper each night spent with the I.C.S. in the quiet of your own home will prepare you for the position you want in the work you like best.

Yes, it will! Put it up to us to prove it. Without cost, without obligation, just mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6178-B, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ Pharmacy
☐ Electric Wiring	☐ SALESMANSHIP
☐ Electric Lighting	☐ ADVERTISING MAN
☐ Electric Car Running	☐ Show Card and Sign Painting
☐ Heavy Electric Traction	☐ RAILROAD POSITIONS
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ Business Correspondent
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Toolmaker	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Public Accountant
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ Common School Subjects
☐ MINE FOREMAN OR ENGINEER	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ STATIONARY ENGINEER
☐ PLUMBING AND HEATING	☐ Textile Overseer or Supt.
☐ Sheet Metal Worker	☐ AGRICULTURE ☐ Spanish
☐ Ship Draftsman	☐ Navigator ☐ Autos
☐ Traffic Management	☐ Poultry Raising ☐ Banking

Name_____

Present Occupation_____ Business Address_____

Street and No._____

City_____ State_____

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada 1-1-21



Take this Short Cut to Accomplish Your Ambition

The field of electrical engineering offers wonderful opportunities for trained men to direct and carry out great industrial and commercial projects. Study here. Receive a thorough training. Become an

Electrical Engineer

with B. S. Degree in 3 Years

Ninety instructors, expert in their lines, form our faculty. They are leading hundreds of ambitious young men to sure success. Why not you? Full provision for making up deficient high school credits. "Earn while you learn" if you wish.

Mail the coupon, now, for full details.

School of Engineering of Milwaukee,
Dept. SI-I—373 Broadway, Milwaukee, Wis.

Please send me your free illustrated catalog on Electrical Engineering and give me the detail of your "Earn While You Learn" system.

Name .....

Address .....

Town .....State.....

Age .....Education .....

ON CREDIT DIAMONDS WATCHES



Send For Catalog

DIAMONDS WIN HEARTS

Special Bargains in Diamond Engagement Rings and Solid Gold and Platinum Wedding Rings, Diamond-Set

Also a splendid assortment of the new engraved, pierced Rings, White and Green Solid Gold, fine brilliant Diamonds; Diamond La Vallieres, Bar Pins, Ear Screws, Scarf Pins, Cuff Links, Watches, Wrist Watches, etc. Send today for Catalog and make your selections. We pay all shipping charges.



Credit Terms on purchases of $5 or over, one-fifth down, balance in eight equal amounts, payable monthly. **LIBERTY BONDS ACCEPTED.**

LOFTIS BROS & CO. ESTD. 1858 — **The National Credit Jewelers** Dept. K22 108 N. State St. CHICAGO, ILL. STORES IN LEADING CITIES



SKINDERVIKEN TRANSMITTER BUTTON

Made in several styles for experimenters and radio men. Battery style for wireless telephone and amplifier use. Price *with complete instructions* $1.00

Mechanical Stethoscope



PRICE $5.00

Detects knocks and trouble in all running machinery. *Test the motor of your car.*

GENERAL SOUND TRANSMISSION CORP.
Room 507 2 Rector Street New York

Book Review

(*Continued from page* 1112)

SIR WILLIAM HERSCHEL — By the Rev. Hector Macpherson. One illustration. Cloth covers, 5 by 7½ inches, 78 pages. Publisht by the Macmillan Co., New York.

This is a most convenient biography of the great astronomer, German by birth and English in his career. It is publisht by the same concern to whom the Life of Faraday, just reviewed, is due; and by giving his personal characteristics, the book is made excellent reading. A portrait of William Herschel forms the frontispiece.

INDUCTION COILS IN THEORY AND PRACTISE — By Prof. F. E. Austin. 40 illustrations. Cloth covers, 5 by 8½ inches, 64 pages. Publisht by the author at Hanover, N. H.

This seems a very practical book. The mathematics used and the formulas given are all quite elementary, so that it is well adapted for those who have not had the advantage of a full course in higher mathematics. The illustrations are exceedingly clear and to the point. It is arranged as a text book, being divided into sections, called lessons.

THE PRINCIPLES OF WAR—By General Foch, Commander-in-Chief of the Allied Armies. Two illustrations, with maps in pocket cover. Cloth covers, 5½ by 8¼ inches, 372 pages. Publisht by the H. K. Fly Co., New York.

This is a very good presentation of the great French general's famous classic. While it seems as if such a book must be technical, it is so admirably written that it makes excellent reading. It would be presumption in us to even review a book by the "Wonder of the World War," a man whose ability was equaled by his modesty and elevated character. Some interesting illustrations are given.

ELECTRIC WELDING—By Douglas T. Hamilton and Erik Oberg. Fully illustrated. Cloth covers, size 6 by 9¼ inches, 294 pages. Publisht by the Industrial Press, New York.

Electric welding is only beginning to take its proper place in industry, and we anticipate that every year it will be more and more developt in its widening field. This book gives some wonderful examples of what is done today, in which work the different kinds of welding, spot, arc and other types, are very fully treated, with numerous illustrations. It is one of those books which, while on its face it looks technical, really makes interesting reading in these days, when all are supposed to know something of technology.

INDUSTRIAL CO-OPERATION — By Dr. Charles P. Steinmetz. Paper covers, 5 by 7½ inches, 28 pages. Publisht by the Industrial Extension Institute, Inc., New York.

Dr. Steinmetz, who is one of the leading physicists and mathematicians among the electricians of America, is well known also as a student of sociology, and in this little pamphlet he treats a subject that is very well put. He makes a plea for personal interest on the part of technical workers and for improved working conditions. He includes different forms of profit-sharing and of participation in management.

ROMANCE OF A GREAT FACTORY —By Charles M. Ripley. About 100 illustrations. Cloth covers, 6 by 9¼ inches, 204 pages. Publisht by the Gazette Press, Schenectady, N. Y.

We have just reviewed Dr. Steinmetz's pamphlet. He has been identified for many years with the great Schenectady Works of the General Electric Co., and in this book we have a vivid account of the personnel and of the striking features of the great factory, all presented in the most interesting way.

Numerous illustrations are given and the book is written in a most picturesque and interesting way.

The introduction is by Dr. Steinmetz and in the end of the book is given an example of the shorthand which Dr. Steinmetz uses, and which system was invented by himself. The book is partly for the benefit of the Insurance Association of the Great Works.

ELECTRICAL PHENOMENA IN PARALLEL CONDUCTORS — Elements of Transmission. Volume 1. By Frederick Eugene Pernot. Clearly illustrated. Cloth covers, 6 by 9¼ inches,

(*Continued on page* 1116)

Free Book Containing complete story of the origin and history of that wonderful instrument—the **SAXOPHONE**

Easy to Play Easy to Pay



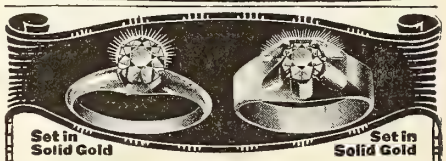
This book tells you when to use Saxophone—singly, in quartettes, in sextettes, or in regular band; how to transpose cello parts in orchestra and many other things you would like to know.

You can learn to play the scale in one hour's practice, and soon be playing popular airs. You can double your income, your pleasure, and your popularity. Easy to pay by our easy payment plan.

MAKES AN IDEAL PRESENT

Send for free Saxophone book and catalog of everything in True-Tone band and orchestra instruments.

BUESCHER BAND INSTRUMENT CO. 604 Buescher Block, Elkhart, Ind.



Set in Solid Gold — Set in Solid Gold

Send Us Your Name and We'll Send You a Lachnite

DON'T send a penny. Just say: "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will mail it prepaid right to your home. When it comes merely deposit $4.75 with the postman and wear the ring for ten full days. **If you, or any of your friends can tell it from a diamond, send it back** and we will return your deposit. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.

Write Today Send your name now. Tell us which solid gold ring you wish (ladies' or men's). Be sure to send your finger size.

Harold Lachman Co., 204 So. Peoria St., Dept. 1252 Chicago

BE A REAL MAN!

LOOK LIKE ONE AND FEEL LIKE ONE



Broaden your shoulders, deepen your chest, enlarge your arms, and get a development that will attract attention. Fill yourself full of energy and be powerful.

My New Book "Muscular Development" Will Explain How

This book is illustrated with 25 full page photographs of myself and of some of the world's finest developed athletes I have trained. It will interest and benefit you greatly.

Send 10c (stamps or coin) for a copy NOW, today, while it is on your mind.

EARL LIEDERMAN, Dept. 202, 305 Broadway NEW YORK CITY

A NEW AND EASY WAY TO PAINT

SIGNS AND SHOW CARDS

OUR PATTERNS DO THE WORK

No experience required. Any one can paint all kinds of signs, banners, cards, etc., on any surface with our new and easy system of lettering. Complete outfit containing six alphabets of letters, assorted styles and sizes from two to twelve inches high, also three sets of figures, etc., not printed but life size patterns cut out of durable tag board which can be used over and over again for years, also brushes, colors and book of instructions, **PREPAID $10.00.** Satisfaction guaranteed.

ACME SALES CO., Empire Bldg., Dept. S., Denver, Colo.



"Lighting Fixtures"

Ready to Hang

(Direct from Manufacturers)

Completely wired, including glassware. New designs.

Send for catalog No. 20

ERIE FIXTURE SUPPLY CO.

Sta. C Erie, Pa.



Publishes cash artassignments, lessons and articles on Cartooning, Designing, Illustrating, Lettering and Chalk-Talking. Criticises amateurs' work. Full of information for artists and art students. Satisfactory or money refunded.

20c a copy, **$1** for 6.

Send $1 NOW. Thrift Stamps Taken

G. H. LOCKWOOD, Editor, Dept. 656, Kalamazoo, Mich.

ALL MAKES



Underwoods, Monarchs, Remingtons, L. C. Smiths, Olivers, Royals, Coronas AT REDUCED PRICES. Prices as low as.... **$20.00**

Write for our Catalog No. 15

BERAN TYPEWRITER CO.
Dept. 21, 58 W. Washington Street, Chicago

$90 TO $125 EARNED PER WEEK by Burgess-Trained Men

MY POLICY

My policy is TRUTHFULNESS in advertising and to give an HONEST and RELIABLE SERVICE. I offer NO FREE INDUCEMENTS but I promise to give you INSTRUCTION, HELP and ADVICE, the kind that is helping hundreds of men and boys to succeed. In other words, my policy is to B² (be square).

YORKE BURGESS, Supt.
Burgess Electrical School
Dept. D, 745 E. 42nd St., Chicago, Ill.

Burgess-Trained Men are not only getting $90.00 to $125.00 per week, but they are earning it. We do NOT promise you will do it, because a good bit depends upon you alone, but the opportunity is there and it is up to you to make the best of it. Burgess Service is so planned that it fits the needs of anyone desiring to succeed in electricity—whether he is a beginner or an experienced man. It gives you the benefit of a lifetime of practical electrical experience.

Send for the Burgess Catalog for complete information.

ELECTRICITY
TAUGHT BY A PRACTICAL MAN

A Home Study Course

BURGESS B² SERVICE

INSTRUCTION

The instruction is no cut and dried book plan, but is actually prepared with a view of fitting the individual. In this way one who is slow has the same advantage as others.

COMPLETE ELECTRICAL OUTFIT

Including Apparatus, Tools and Material, is supplied with the course without extra charge.

ELECTRICAL DRAFTING

This is a part of the regular work and certain drafting implements and materials are furnished students without any additional charge.

ELECTRICAL SLIDE RULE

I have written 30 lessons on this subject which are now included as part of the regular course in addition to the lessons on Electricity and Drafting. I am also supplying a Slide Rule and leather case to each student without charge.

A FAIR AND SQUARE STATEMENT

I have been training ambitious men, both young and old, in practical electricity for a number of years by my Home Instruction Method, and would like to send you my catalog, which tells exactly what I do and **HOW I DO IT.** It also tells why, when and where my students succeed and **HOW THEY DO IT.** The catalog costs you nothing—it obligates you in no way whatever, but, for your own good send for it, as it contains things you should know.

YORKE BURGESS, Supt.
Dept. D, 745 East 42nd St. BURGESS ELECTRICAL SCHOOL Chicago, Ill.

To Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Type Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information Regarding Wire Used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

The book, called the "Burgess Blue Book," is published and sold by the Burgess Engineering Company for one dollar ($1.00) per copy, postpaid. If you wish one of the books, send me your order with a dollar bill, check or money order. I know the value of the book and can guarantee its satisfaction to you by returning your money if you decide not to keep it after having had it for five days.

BURGESS ENGINEERING CO.

Yorke Burgess, Consulting Engineer
750 East 42nd St., Chicago, Illinois

Consulting Electrical Engineering. Power Plants, R. R. Signals, Electric Railroads, Industrial Problems a Specialty.
Information furnished on electrical subjects. Inventions perfected.

DRAFTING



Learn at Home!

Employers everywhere are looking for skilled draftsmen. They are offering splendid salaries, and good positions are always open.

No line offers greater opportunity for advancement. Drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture.

There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving men and women just the training they need for success in Drafting and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6181-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ Pharmacy
☐ Electric Wiring	☐ SALESMANSHIP
☐ Electric Lighting	☐ ADVERTISING MAN
☐ Electric Car Running	☐ Window Trimmer
☐ Heavy Electric Traction	☐ Show Card and Sign Paint'g
☐ Electrical Draftsman	☐ RAILROAD POSITIONS
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ Business Correspondent
☐ Ship Draftsman	☐ BOOKKEEPER
☐ Machine Shop Practice	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Gas Engineer	☐ Traffic Management
☐ CIVIL ENGINEER	☐ Commercial Law
☐ Surveying and Mapping	☐ GOOD ENGLISH
☐ MINE FOREM'N OR ENG'R	☐ STATIONARY ENGINEER
☐ ARCHITECT	☐ CIVIL SERVICE
☐ Architectural Draftsman	☐ Railway Mail Clerk
☐ PLUMBING AND HEATING	☐ Textile Overseer or Supt.
☐ Sheet Metal Worker	☐ AGRICULTURE
☐ Navigator	☐ Poultry Raising ☐ Spanish
	☐ Automobiles ☐ Banking

Name_____

1-1-21

Present Occupation_____ Business Address_____

Street and No._____

City_____ State_____

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada

YOU Can Do YOUR Own SOLDERING and All Metal Repairing With



25c PER TUBE

SOLDERALL A Paste That Turns Into Metal When Heated

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. E,
129 Sussex Avenue, Newark, N. J.

Dealers Send for Quantity Prices.

LOOK FOR TRADE MARK "SOLDERALL"
BEWARE OF IMITATIONS WITH SIMILAR NAMES

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR

Book Review

(*Continued from page* 1114)

332 pages. Publisht by John Wiley & Sons, Inc., New York.

This book is devoted to the mathematical treatment of its topic, using the higher mathematics. It is a very exhaustive book, and will be of great value to those devoted to the higher mathematical development of the electrical theory.

It is the first volume, we notice, and we hope that the second volume will contain an adequate index to which so elaborate a book is entitled.

GEORGE WESTINGHOUSE—His Life and Achievements. By Francis E. Leupp. 12 illustrations. Cloth covers, 6¼ by 9¼ inches, 304 pages. Publisht by Little, Brown and Company, Boston.

This is a vivid presentation of the life of the great inventor—George Westinghouse. It makes excellent reading, going back to the days of his boyhood. It is to be remembered that no one person has so revolutionized railroad work as he has done by his air brake. The personal characteristics of the great engineer are brought out in a number of stories of his relations with his subordinates, showing that while on the surface impetuous and determined, on second thought he was always ready to make amends for apparent hastiness. This book is very interesting, especially to those who have lived thru the days of the development of electricity and the old fight between the alternating and direct current described therein.

CLASSROOM LECTURE NOTES—Automotive Starting, Lighting and Ignition. By R. C. Fryer. Illustrated. Cloth covers, size 5 by 7 inches, 210 pages. Publisht by John Wiley & Sons, Inc., New York.

This book is devoted to the electrical systems on motor cars, including the ignition and starting systems as well as the special circuits for the horn, spotlight and the like. A very interesting series of data gives the firing order and timing of the leading makes of cars; towards the end we are given lessons, each one being largely in the form of questions and suggestions, and at the close of the book a large quantity of useful notes and very clear and excellent diagrams of the electric systems appear.

TRAINING FOR THE ELECTRIC RAILWAY BUSINESS — By C. B. Fairchild, Jr. Illustrated. Cloth covers, size 5 by 7¾ inches, 156 pages. Publisht by J. B. Lippincott Co., Philadelphia.

This book covers the organization, the executive and transportation functions, the engineering department, the administration work and miscellaneous departments of the electric railway organization.

It is largely written from a personal standpoint, and we are sure it will prove quite interesting reading for the large body of men now engaged in the transportation end of the public service corporations.

ESSENTIALS OF ALTERNATING CURRENTS—By W. H. Timbie and H. H. Higbie. Illustrated with photos and diagrams. Cloth covers, 5 by 7½ inches, 374 pages. Publisht by John Wiley & Sons, Inc., New York.

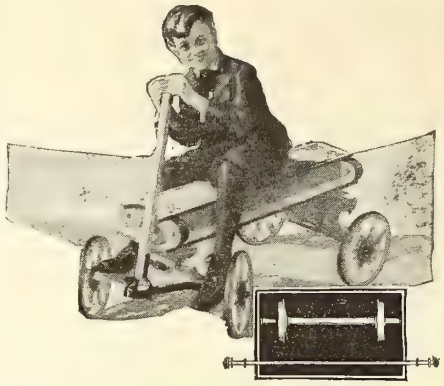
The name of this book indicates the somewhat ambitious spirit on the part of the authors, but on inspection they really seem to have carried out their wishes very well. They have produced an exceptionally interesting, well illustrated treatise on alternating currents; 200 illustrations are included, and at the end of each chapter is given a summary of its contents and a number of problems. The answers to the problems are not given.

AIRPLANE CONSTRUCTION AND OPERATION — Including Notes on Airplane Design and Aerodynamic Calculation, Materials, Etc. By John B. Rathbun. Profusely illustrated. Cloth covers, 5¼ by 7¾ inches, 432 pages. Publisht by Stanton and Van Vilet Co., Chicago.

This book with glossary, but unfortunately lacking an index, impresses one as entirely practical. A very considerable space is devoted to the all important subjects of wing section and aerofoils; head resistance, power and the practical details of training and operating are gone into.

Some of the illustrations of the different maneuvers, such as the famous "Immelmann Turn," are decidedly interesting. One illustration shows a machine flying upside down, so close to the ground that it is impossible to rectify it, the illustration therefore showing the beginning of what proved to be a fatal accident.

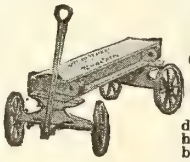
(*Continued on page* 1118)



Cold Drawn Steel Axles

—are used on every **Auto-Wheel Coaster** and **Auto-Wheel Convertible Roadster**—real steel axle rods like those used on railroad cars. THE

Auto-Wheel Coaster *and the* **Auto-Wheel Roadster**







have, with the wire-drawn axles, just enough "give" to take them over rough places. Besides the drawn axles, **Auto-Wheel** wagons have Bessemer-process steel roller bearings, standard automobile-type ash wheels, special hub caps with locking pins, a safety brake and a non-spill steering gear.

The *"Auto-Wheel Spokesman,"* our magazine for boys, tells how you may win one of these wagons in our prize contests. It tells how you may form an **Auto-Wheel** Club. We will furnish members of your club with caps, and send you a Captain's cap. Mail us the names of three coaster wagon dealers in your town, telling which ones sell the coaster with the name **"Auto-Wheel"** on the sides, and we will send you the *"Spokesman"* for six issues, and an **Auto-Wheel** Dime Bank — FREE.

The Auto-Wheel Coaster Co., Inc.
formerly
The Buffalo Sled Company
163 Schenck St., N. TONAWANDA, N. Y.
In Canada: Preston, Ont.
Export Office: 365 W. 23rd St., New York City.

Auto-Wheel
The Boys' Magazine

Start Your Boy on the Road to True Manhood



Help him to get started right by giving him THE BOYS' MAGAZINE.

Send only 25 cents today for a three months' subscription. By accepting this remarkable low price offer you save 35 cents over the newsstand price as the price *per copy* is 20 cents.

This is the formative period of your boy's life. What he will amount to in after years depends largely on what he is reading now. You want him to be wide-awake, progressive—forward-looking—to develop ideas and initiative and to learn to make his own way in the world.

You can make him no better gift than a subscription to THE BOYS' MAGAZINE. This great periodical will give him entertainment, instruction and the inspiration to accomplish big things.

Your boy must keep abreast of the times. What he reads has much to do with what he THINKS and DOES. Guard him against trashy, sensational and misleading stories. Give him the kind of reading which entertains, yet inspires and instructs. THE BOYS' MAGAZINE will develop your boy's initiative, foster right THINKING and right DOING, and make him a manly, moral and courageous boy.

Besides a wealth of splendid stories and special articles each issue contains departments devoted to Electricity, Mechanics, Wireless, Popular Science, Athletics and Physical Training, Editorials, Stamp and Coin Collecting, Moving Picture Plays and Players, Amateur Photography, Cartooning, Outdoor Sports, Illustrated Jokes, etc., etc.

Send only 25 cents, today, for a three months' subscription. We will refund your money promptly and without question if you are not more than pleased with THE BOYS' MAGAZINE. (Remit in stamps if more convenient.) Address

THE SCOTT F. REDFIELD CO., Inc.
5115 Main Street Smethport, Pa.
(THE BOYS' MAGAZINE is on sale at all newsstands, 20 cents a copy.)

LEARN WIRELESS At Home By Mail



Calls Coming In Steadily For National Radio Institute Graduates. Big Concerns in Need of Operators.

MANY attractive positions are now open in Merchant Marine, Commercial Land Radio Service, Radio Supply Factories, U. S. Navy, Aerial Mail and large Business Corporations.

Salaries Up To $3,500 a Year

Exceptional opportunity for ambitious men for promotion to the higher branches of Radio. Our graduates are qualified as Senior Operators, and besides room and board, receive $125 a month to start, which altogether means more than $200. Positions to which they can promote themselves are as follows: Supercargo and Wireless Operator—$175 a month; Radio Mechanic—$1,500 to $2,000 a year; Radio Aid—$6 to $8 per day; Radio Inspector—$1,500 to $3,000 a year; Radio Engineer—$6,000 and more a year; Radio Draftsman—$7 to $10 a day. You can learn wireless the National Radio Institute way, quickly and easily, by mail right in your own home, in your spare time. No previous experience or training is necessary. With our help you can quickly qualify for first grade government license and a fine position.

U. S. Department of Commerce Recognizes N. R. I.

and allows its graduates 5 to 10 points credit when taking the examination for First Grade Government License. This school heads the printed list of reputable Wireless Schools recommended by the U. S. Shipping Board.

Travel Without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs, Wireless offers the chance of a lifetime. On shipboard you are rated as an officer. You need not travel unless you wish, but may secure a position at one of the many increasing land radio offices.

Pay As You Learn

Our plans of payment place a wireless education within the reach of anyone who desires to learn. A small payment down and the small payments made during the course make it possible for you to earn the cost of your tuition while actually learning to be a wireless operator.

New Automatic Wireless Instrument Free

In addition to all necessary text books and other equipment with which we supply you, we furnish FREE to every student our marvelous new automatic Natrometer, which transmits wireless messages in 600 different combinations, and can be regulated to operate at any speed from 1 to 30 words a minute.

It is complete with phones, etc., and is sent you in a neat carrying case. This instrument is operated entirely without the use of aerials and is used exclusively by the National Radio Institute to teach Wireless at home in the scientific way.

You receive the instrument after your enrollment; it becomes your personal property upon completion of our course.

FREE

In addition to our complete course in Radio Telegraphy, every student is given our complete course in modern Radio Telephony. These combined courses enable our students to fill positions requiring a knowledge of both Radio Telegraphy and Telephony. Send the following coupon today for our FREE BOOK containing all particulars.

NATIONAL RADIO INSTITUTE
Dept. 448, 1345 Penna. Ave., N. W.
WASHINGTON, D. C.

MAIL THIS COUPON TODAY

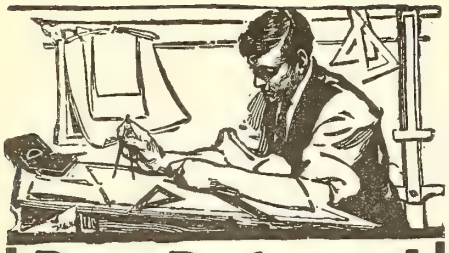
NATIONAL RADIO INSTITUTE,
Dept. 448, 1345 Penna. Ave. N. W.
Washington, D. C.

Send me your FREE book "Wireless The Opportunity of Today." Tell me about your Home Study Course in Wireless Telegraphy and Telephony—the free post-graduate course—and your special Instrument offer.

Name.....

Address.....

City.....State.....



Be a Draftsman!

Make $40 to $100 a WEEK

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $40 to $100 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8¼ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

75c a Week Only $3 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership given free with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-262, Chicago, U. S. A.



AMERICAN TECHNICAL SOCIETY
Dept. D-252
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $3.00 a month until $19.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....

Dont Send 1 Penny

Just send your name and address, size and color and I will send this sweater to you. You don't pay one penny until it is delivered to your door by the postman.

$1.98 DELIVERY PAID



Army Navy

For Men or Women

This is a real heavy winter sweater, made of heavy mixed marino yarn. Slip-over style, with V neck and full length sleeves. Just like picture. Will give excellent wear. Sizes to fit Ladies or Men 34 to 46. **Colors, khaki or navy blue.**

$4.50 Reduced to $1.98

No one has ever reduced price to this extent. It is the biggest money-saving bargain ever offered. We will sell only two to a customer and will not sell to merchants or wholesalers.

Delivery Free Just send your name and address, no money. When the sweater is delivered at your door by the postman, pay him $1.98 for the sweater. We have paid the delivery charges. Wear it. If you don't find it all you expect, return it and we will cheerfully refund your money at once. Order by No. 72.

Dept. Z- 1389
Walter Field Co. 318 S. Michigan Ave., Chicago

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only One Dollar Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah

Book Review

(*Continued from page* 1116)

ARMATURE WINDING AND MOTOR REPAIR—By Daniel H. Braymer. Fully illustrated. Cloth covers, 5½ by 8¼ inches, 516 pages. Publisht by McGraw Hill Book Company, New York.

The title of this book is so comprehensive and clearly put that it makes a review hardly necessary. It is enough to say that its numerous illustrations with data and appendix, with its index supplementing the very practical and full treatment of the subject in the text, justify us in recommending it to those of our readers who have to deal with dynamo and motor repair work and construction on the practical side.

GENERAL SCIENCE—By Otis William Caldwell and William Lewis Eikenberry. Clearly illustrated. Cloth covers, 5½ by 7¾ inches, 404 pages. Publisht by Ginn & Co., New York.

The title of this book indicates an ambition on the part of the authors to cover the entire field of natural science; for of course, when the word "science" alone is used, natural science seems to be, perforce, understood. The book reminds one a little of the famous old "Chemistry of Common Life" which had such an extensive circulation two or three generations ago. The authors seem to have made a very successful effort at producing a readable book and also in covering a wide range of subjects.

SCIENCE FOR BEGINNERS—A First Book in General Science for Intermediate Schools and Junior High Schools. By Delos Fall. Well illustrated. Cloth covers, size 5½ by 7½ inches, 382 pages. Publisht by the World Book Co., New York.

This book is designed for school use and seems to be well adapted for such purpose. The illustrations are quite numerous.

The book has an aspect of practicality, and is intended to be used on the basis of experiment and of field work. The chapters devoted to field work are very nicely put and the work may be called a treatise on the introductory training in natural science.

ELECTRIC RANGE HANDBOOK — Prepared by the Society for Electrical Development. Fully illustrated. Flexible cloth covers, 5 by 6¾ inches, 216 pages. Publisht by the society that prepared the book.

It is a curious fact that while there is no more wasteful method of producing heat than by the electric station operated by coal, the convenience of electric heating and the facilities for turning it on and off as required, so as to eliminate at least one element of waste, have made it a practical thing, whose use is daily extending. A very valuable sheet of electric range data from 100 central stations is annexed to the book, and from that one can learn exactly what can be done with different types of these cooking stoves. The work is written largely from the standpoint of the electric supply station.

UNITED STATES ARMY X-RAY MANUAL—Authorized by the Surgeon-General of the Army. Profusely illustrated. Flexible cloth covers, 5¼ by 7½ inches, 506 pages. Publisht by Paul B. Hoeber, New York.

This volume was prepared under the direction of the Surgeon-General of the U. S. Army, as a text book for instruction in military X-ray work. During the war there was a small manual prepared for use by army surgeons, but this very complete book is now to supersede it. A large introductory section is devoted to X-ray physics; laboratory experiments and new apparatus follow. The dangers incident to X-ray work are given less consideration, perhaps, than might be wished by those who have seen the dreadful effects produced by it on incautious operators. Very complete illustrations are given and a very adequate synoptical table of contents, followed by an index, closes the book.

MICHAEL FARADAY — By J. A. Crowther. One illustration. Cloth covers, 5 by 7½ inches, 72 pages. Publisht by the Macmillan Co., New York.

There is no more lovable character in the modern scientific world than Michael Faraday. A man of pre-eminent fame, he was characterized by the greatest modesty and gentleness of character. In this book, of course, the religious views of the great scientist receive consideration. The great sincerity and the general charm of the man are well brought out. The text is preceded by his portrait.



The Electric Safety Razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."

A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.

Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

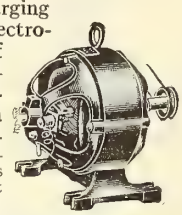
VIBRATING ELECTRIC RAZOR CO.
Dept. 122, Council Bluffs, Iowa

DEPENDABLE **KNAPP** ELECTRIC SPECIALTIES

Dynamo Motor

For Boys **$9.00**

For producing current for inductance coils, recharging storage batteries, electroplating and hundreds of other uses. Well constructed throughout, exceptionally smooth running and highly efficient. A good, strong, durable dynamo that runs as well as a motor without change.

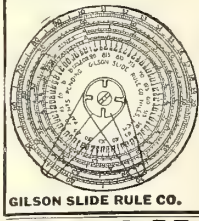


AT ALL LIVE DEALERS

Insist on your dealer showing you the **KNAPP** line—**KNAPP** goods are best. If your dealer cannot supply you, order direct. Send for **FREE** illustrated catalogue showing a complete line of Electrical Motors and Novelties.

KNAPP ELECTRIC & NOVELTY CO.
523 West 51st Street, N. Y. City

THE MIDGET "FIVE-IN-ONE" SLIDE RULE

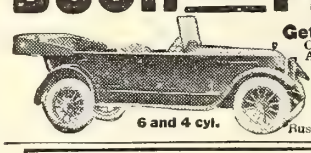


is a combination Mannheim, Log-Log Add and Subtract, Polyphase and Binary Slide Rule. It will instantly add, subtract, multiply and divide any combination involving whole numbers, fractions, decimals and mixed numbers. Gives every possible root and power of every quantity. The graduations are printed on metal, coated with white celluloid and are grease and waterproof. While it is the most versatile calculator ever invented, its operation is simple and easily understood. Diameter 4 inches.

Price with 16 page Instruction Book, $1.50. Leatherette carrying case 50c extra. Catalogue Free. Your money back if you are not satisfied.

GILSON SLIDE RULE CO. Niles, Mich.

BUSH Car FREE



6 and 4 cyl.

Get BIG PRIZE

OFFER and BUSH Auto Agency. Write today. Send your name and address. Write plainly and quickly. Don't wait. Dept. B-10.
Bush Motor Co.
Bush Temple, Chicago



Army Auction Bargains

Tents . .	$4.25 up	Auto Pistol	$26
Saddles .	6.50 "	Army Haversack .	15 up
Knapsacks .	.75 "	White Uniform	$2.50 "
Slickers .	1.85	Army Gun Slings,	30 "

Spring Rem. cal. 30 single shot rifle for model 1906 cart., **$7.77.** Ball cart., **$3.50** per 100.

15 acres army goods. Large illustrated cyclopedia reference catalog—400 pages—issue **1920,** mailed 60c. **New Circular 10c.**

Francis Bannerman Sons, 501 Broadway, New York

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

DEN PHOTOS

Beautiful Girl Models. Snappy Poses. 7 x 10, Mounted 10 x 14. 3 for $2. $5 per Dozen. Postcards, 15 for $1. 50 for $3. 50 Miniatures FREE with FIRST ORDER OF $1 OR MORE.

L. GARVEY, 20-S. Perkins Place, Brockton, Mass.

Formula No. 130
Accepted on these tests



Multiplies itself

The cream multiplies itself 250 times in lather. Thus a tiny bit serves for a shave. A 35-cent tube serves for 152 shaves.



Maintains itself

The lather maintains its creamy fulness for 10 minutes on the face. So it does not need replacement.



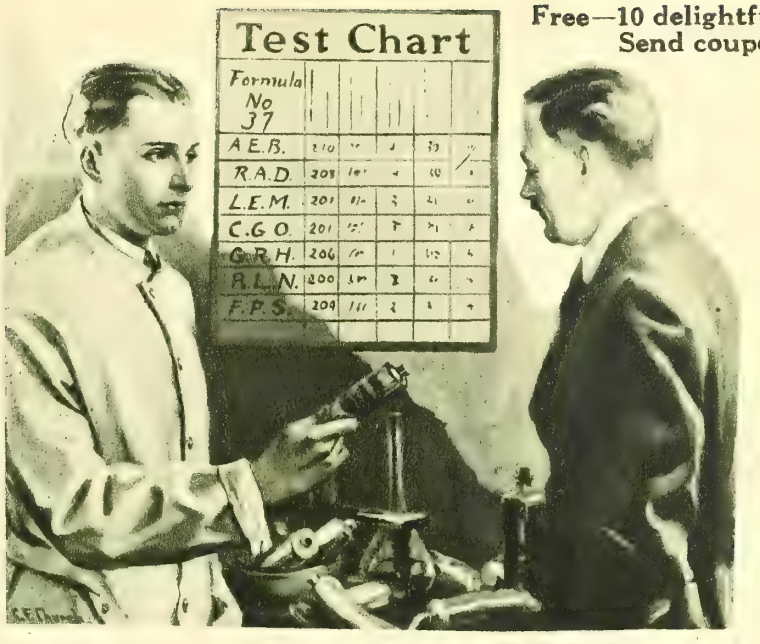
Acts quickly

The average beard is softened in one minute. Within that time it absorbs 15% of water. That is enough to make a horny beard wax-like.



Soothes the skin

It leaves the skin in soft and smooth condition. No lotion is needed. The cream itself forms a soothing lotion, due to palm and olive oils.



Free—10 delightful shaves
Send coupon

We Made 130 Kinds of Shaving Cream

And tested them all—scientifically

By V. K. CASSADY, B. S., M. S., Chief Chemist

Six years ago we started out to make the supreme shaving cream.

Long before, we had attained the finest toilet soap created. The secret lay in a perfect blend of palm and olive oils. Our chief idea was to apply that balmy blend to shaving.

But there were, perhaps, a hundred shaving soaps, and each had its adherents. We tested many of them—found their virtues and their faults. And we started to reach new perfection in each quality desired.

18 months of experiment

We knew soap making well—that's evident. But it took 18 months to satisfy us on a shaving cream.

In that time we made up and tested 130 kinds of soap. The tests embodied five shaving soap requirements. And we persisted until, step by step, in each of them we seemed to reach the limit.

What we finally attained

At last we attained a shaving cream which showed these unique results:

First, great economy. The cream multiplies itself in lather 250 times. Thus a bit of cream—just one-half gram—suffices for a shave.

Second, quick efficiency. The oil on the beard is removed almost instantly. Within one minute the beard absorbs 15% of water. And that's enough to soften a most stubborn beard.

Third, lasting lather. It maintains its creamy fulness for ten minutes on the face.

We had the rest. The palm and olive oils form ideal lubrication. Their lather softens and soothes the skin. So lotions are not needed.

You will be surprised

Now we offer you a shaving soap which millions have adopted. It is based on oils which for 3,000 years have held supreme place for the face. And those oils are blended in a shaving cream which brings the results we state.

You will be delighted with it. Whatever you seek, Palmolive Shaving Cream will exceed your expectations. Whatever you have used, this cream will surprise you.

Send the coupon for a trial tube. Do us the kindness, and yourself the justice, of learning what we have accomplished.

10 Shaves FREE

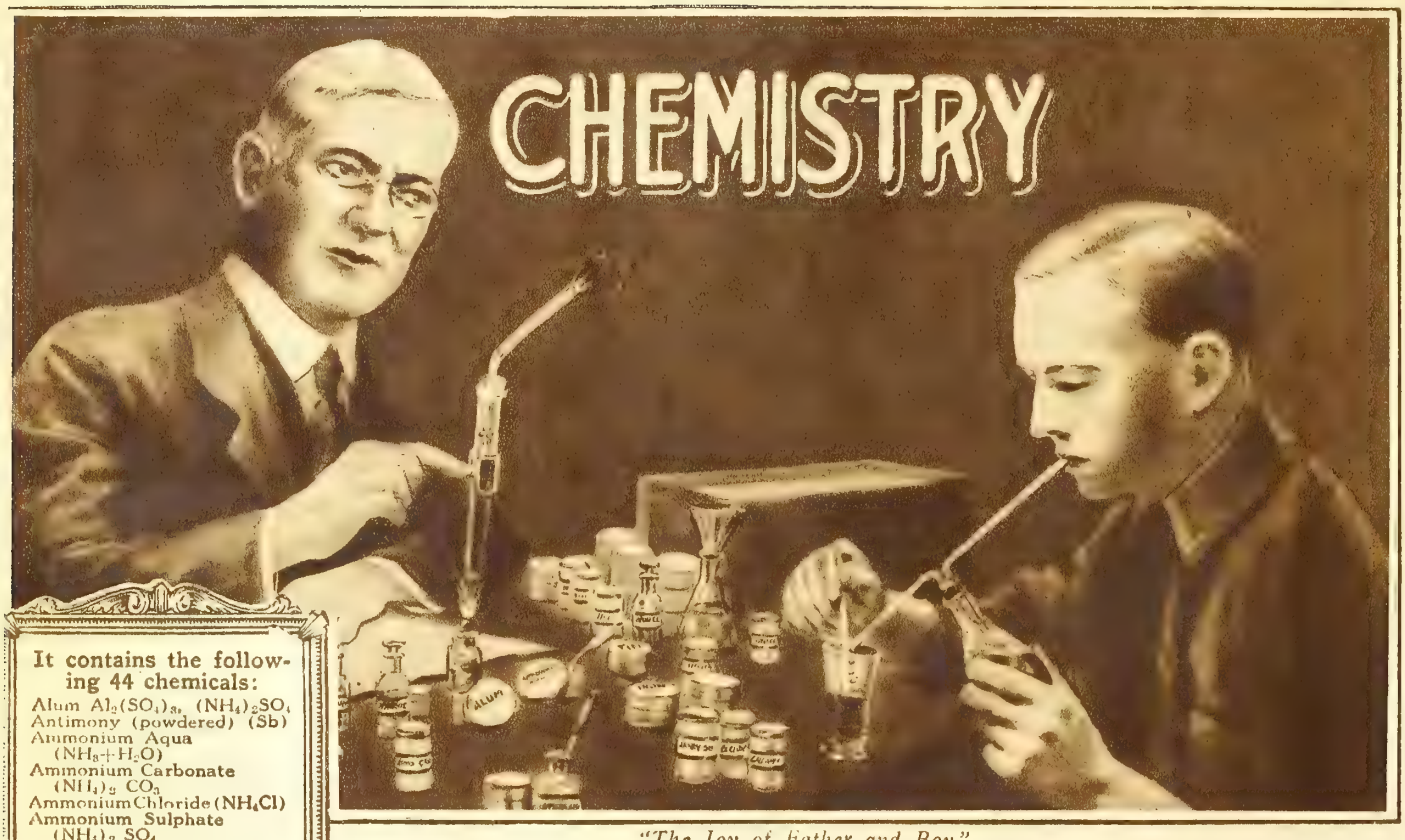
Simply insert your name and address and mail to

Palmolive Company, Dept. 149
Milwaukee, Wis.

.....

.....

PALMOLIVE
Shaving Cream



"The Joy of Father and Boy."

Chemical Laboratory

We present herewith to our friends our new **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform **real** chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

It contains the following 44 chemicals:

Alum $Al_2(SO_4)_3$, $(NH_4)_2SO_4$
Antimony (powdered) (Sb)
Ammonium Aqua (NH_3+H_2O)
Ammonium Carbonate $(NH_4)_2CO_3$
Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2SO_4$
Barium Chloride ($BaCl_2$)
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride ($CaCl_2$)
Calcium Oxide (CaO)
Calcium Sulphate ($CaSO_4 2H_2O$)
Charcoal (Carbon) (C)
Chloride of Zinc ($ZnCl_2$)
Copper Sulphate ($CuSO_4$)
Ferrous Sulphate ($FeSO_4$)
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride ($FeCl_2$)
Iron Oxide (Fe_2O_3)
Lead Acetate Pb $(C_2H_3O_2)_2$
Litmus Paper
Magnesium Carbonate ($MgCO_3$)
Manganese Dioxide (MnO_2)
Mercury (Quicksilver) (Hg)
Nickel Chloride ($NiCl_2$)
Oxalic Acid ($H_2C_2O_4$)
Sodium Bicarbonate ($NaHCO_3$)
Sodium Borate ($NaBO_2$)
Sodium Carbonate (Na_2CO_3)
Sodium Chloride (NaCl)
Sodium Nitrate ($NaNO_3$)
Sodium Phosphate (Na_2HPO_4)
Sodium Sulphate (Na_2SO_4)
Sodium Sulphite (Na_2SO_3)
Stannous Chloride ($SnCl_2$)
Sulphate of Nickel ($NiSO_4$)
Sulphate of Zinc ($ZnSO_4$)
Sulphuric Acid (H_2SO_4)
Tin (Granulated) (Sn)
Zinc (Metal) (Zn)
Zinc Carbonate ($ZnCO_3$)

The following apparata are furnished:

One Standard Washbottle
One Alcohol Lamp
One Conical Glass Measure
One Erlenmeyer Flask
One Glass Funnel
One Delivery Tube
Six Assorted Test-Tubes
One Test-Tube Holder
Ten Sheets of Filter Paper
One Glass Dropper
One Spoon Measure
Glass Tubing
One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.

DESCRIPTION OF THE OUTFIT

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each. See list of Chemicals herewith.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. A list of the 17 pieces of apparata furnished with this outfit is printed also herewith.

The Instruction Book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English system and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the 100 Experiments are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make chemical colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

The Price is $6.75 **Shipping Weight 10 lbs.** **(Can be shipped by Express only)**

TRADE MARK **THE ELECTRO IMPORTING CO., Mfrs.** TRADE MARK
231 FULTON STREET, NEW YORK CITY

"THE LIVEST CATALOG IN AMERICA"

Our big new electrical cyclopedia No. 23 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 80 Big Pages, 300 illustrations, 200 instruments and apparatus, etc. Big **"Treatise on Wireless Telegraphy."** 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 23 measures 6x9. Weight ½ lb. Beautiful stiff covers.

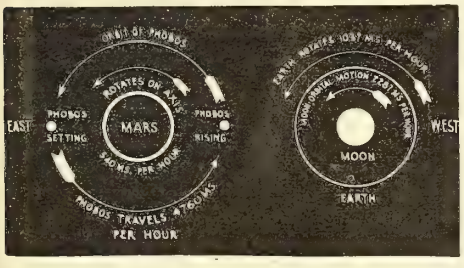
ELECTRO IMPORTING CO.
231 Fulton Street, New York City
I enclose herewith 10 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 23 as described.
NAME .....
ADDRESS .....
STATE ..... S. & I. 2-21

There Is a Moon That Sets In the East

By CHARLES NEVERS HOLMES

THE only moon with which most of us are entirely familiar belongs to our Earth. We are very well satisfied with it, with its splendor, particularly when it is a "full Moon." Indeed, most of us would not become used to *two* large moons in our darkened firmament, until we had observed them many, many times. And even if we still possessed only one moon, and not ten moons like the planet Saturn, it would take us some time to become accustomed to that one moon, were that satellite to *rise* in the *west* and then *set* in the *east.* As we all are well aware, our own Moon rises in the east and sets in the west, and should it suddenly change its habits—rising in the west and setting in the east—some of us might believe that we were losing our minds.

However, if we could be transported to the surface of the planet Mars, we should behold a moon that rises in the west and sets in the east. This peculiar moon is a very small one, estimated to be not more than 50 miles in diameter, and probably not more than 35 miles. It is called "Phobos," and was discovered by Professor Hall, at Washington, in the year 1877. Now, even if Phobos were 50 miles in diameter, it would possess only about 1/43d of our own Moon's diameter, but,



Since Phobos Revolves Around Mars About 9 Times Faster than Mars Rotates on Its Axis, Phobos Travels Faster than the Rotating Surface of Mars, and, Therefore, Sets in the East. Above There Are Comparisons of the Respective Velocities of the Orbit of Phobos, the Rotation of Mars, the Orbit of Our Moon, and Our Earth's Rotation.

since it is very close to the surface of Mars, not quite 6000 miles from that planet's center, whereas our Moon is distant from us 239,000 miles, it would appear larger than our own satellite, although not nearly as bright. In addition to Phobos, Mars has another small moon by the name of "Deimos," but Deimos is a rational moon, rising in the east and setting in the west.

However, it is easy to explain and understand the irrational behavior of Phobos. Phobos is really a very rational moon, but it is situated so close to the martian surface and revolves around Mars so much faster than the planet rotates on its axis, that, inasmuch as the satellite is revolving eastward, Phobos presently disappears from sight or sets in the east. In the case of our own Moon, the terrestrial satellite is so far from the Earth that our Moon falls behind in their movements towards the east, and, accordingly, sets in the west. In other words, there is a sort of race between Mars and Phobos, both revolving in the same eastward direction, and, were we able to watch Phobos from the martian surface, we should behold him traveling much faster than the surface upon which we stood. Then, he would disappear from sight below the eastern horizon of Mars, having set.

Electrical Books Sent to You For One Week FREE

Here are the world's greatest Electrical Books. You can have them for a weeks' Free use in your home or shop. Eight big books, 4000 pages of money-making facts. More than 3000 pictures, blue prints and diagrams that make everything clear as day. Prepared by 28 of the world's master electrical minds in plain every day English that any one can understand. They teach you electricity from the ground up. They explain everything—from the simple wiring of electric bells to the mighty electric machinery you see in the power houses. They save you the money it would cost to go to an electrical school. They save you years of hard work as an apprentice. Old-time electricians say "they are the finest books they ever saw." See our free trial—easy payment offer below.

Master These Subjects

Principles of Electricity; Telephones; Construction, Operation and Repair Dynamos and Motors; Storage Batteries; Alternating Current Machinery; Switch Boards; Armature Winding; Construction and Operation of Transformers; Electrical Measurements; Electromagnets; Induction Coils; Controllers; Electric Elevators; Railway Signaling; Interior and Exterior Wiring; Materials and Methods Used; Underwriters' Requirements; Electric Lighting; Planning Systems; Estimating, Contracts; Specifications; Maintenance; Electrochemistry; Power Stations; Operation and Maintenance; Management of Dynamos and Motors; Electric Welding; Electric Transmission Lines; Distributing Systems; Electric Railways; Construction of Power Plants; New Electrical Devices.

Get in the Big Money Class

Electricians Earn $60 to $100 a Week

The electrical field is seriously under-manned. Thousands of men who *know what's what* are needed right now to fill important jobs such as Sub-Station Operators, Switch-board Operators, Dynamo and Motor Tenders, Installation Experts, Trouble Men and Engineers. The work is fascinating and the pay is big.

Your Future Is in Electricity

Electricity is the greatest force in the world and it is growing greater every day. The whole world depends on the electrician. Think what opportunities this offers to the fellow with a little ambition. You can succeed in electricity. You can have a big job and the big pay that goes with it. These books will show you the way.

Don't Send Money

Prove to yourself how easy it is to master electricity by getting these books for a weeks' free use. Just mail the coupon and the whole set will come to you at once. If you don't like them—if you don't think they will do for you what we claim—send them back at our expense and you won't owe us a cent. If you are satisfied with the books in every way just send us $2.80 as first payment and $3.00 each month, until $34.80 is paid. This is only a dime a day. Most of us waste more than this. Mail the coupon now and get a membership in this Society, **Free.**

Mail Coupon For These 8 Big Books

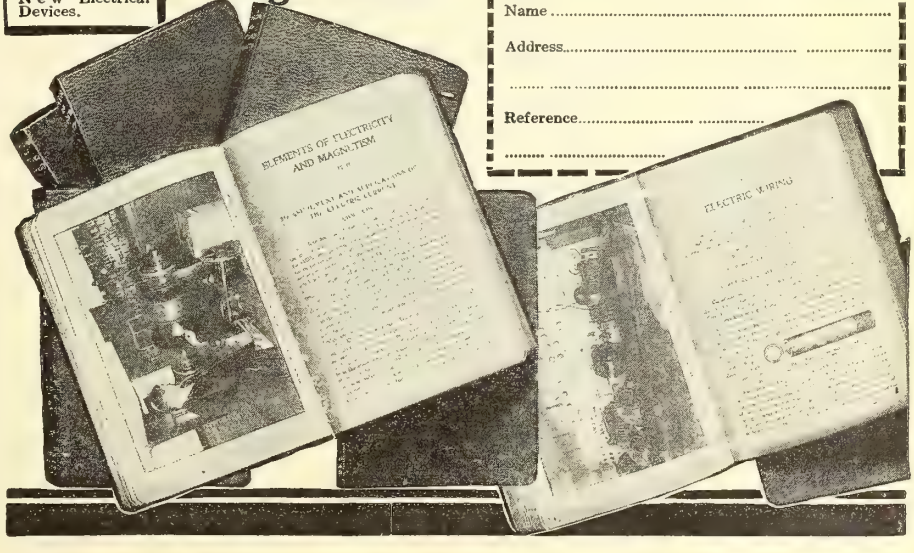
AMERICAN TECHNICAL SOCIETY
Dept. E-252, Chicago

Please send me a set of Practical Applied Electricity in 8 volumes by express collect, for a week's free use. At the end of a week I will either send the books back at your expense or send you $2.80 as first paymont and $3.00 each month thereafter until a total of $34.80 is paid. I understand that I will get a consulting membership in your Society, **FREE** with the books.

Name .....

Address .....

Reference .....



Be a Movie King

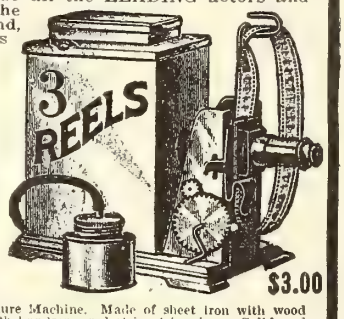


OH BOY! SOME SPORT
Surprise the Bunch—Have a Barrel O' Fun
Own a Genuine Moving Picture Machine

Here's what you've always wanted—a genuine MOVING PICTURE MACHINE—a machine that uses STANDARD FILM—like the Big theatres show—at a price you can easily afford to pay. This is the BIG opportunity—don't MISS it. Read every word, then act quick. Three swell models to select from. Each the best of its kind. All REAL moving picture machines—not toys or magic lanterns, but REAL Movie Machines, that show the pictures on the screen. The Films are supplied to us by the leading film companies in America, and the subjects include all the LEADING actors and actresses that you see and admire in all the big theatres. The "fellers" and girls and the grown-ups, too, will sit spellbound, or roar with laughter at the wonderful, lifelike, real movies you can show them.

Three-Reel Cinematograph

Here is an astonishing bargain. Our latest Model Cinematograph is a whirlwind value. At the price it has everything beat you ever heard of. Here is a genuine Moving Picture Machine, made entirely of metal, solidly constructed, and put together by expert workmen, that you can buy at a price that will simply astound you. It comes equipped with a SAFETY CARBIDE Gas Generator, and can be used to show moving pictures anywhere. The mechanism is so simple it can be operated by anyone. The greatest value in a Genuine Moving Picture Machine ever offered at the price. Think of it! A genuine Moving Picture Machine, using STANDARD FILMS, shipped by express, charges collect, with 3 REELS FREE, for ONLY $3.00; or shipped by parcel post to any address in the world prepaid for $3.25.



$3.00



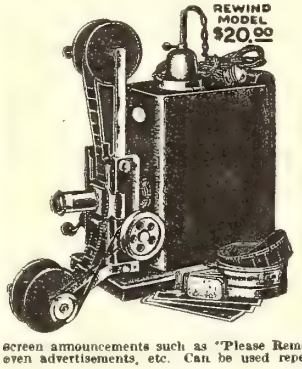
New Model Movie Machine
Your Choice of Gas or Electric Light

This is a beautiful, high-class Moving Picture Machine. Made of sheet iron with wood base. Finished in black or battleship grey with handsome red stripe trimmings. Solid and substantial construction. Size 12x7½x3½ in. Uses STANDARD FILM same as the big machines. TWO TYPES—Electric and Gas. The electric machine is equipped with plug and cord complete, ready to attach to any electric light socket. Gas machine has its own generator and makes its own light. The gas machine can be used anywhere and will be sent unless electric type machine is specially ordered. Sent securely packed in special shipping case with full instructions, film, supply of show tickets, etc., for $7.50, by express, or $8.00 if sent by prepaid parcel post.



Keystone Moviegraph
Moving Picture and Magic Lantern Combined

A regular beauty, all complete, ready for you to use the minute it arrives. Hang up a sheet, put on a reel, turn the crank, and you're off. That's all there is to it. Made of metal throughout, with heavy base casting. Finely adjusted mechanism, easily operated. Electric model only; simply screw in plug to your electric light socket and you are all ready for an exhibit. Equipped to show slides as well as Real Moving Pictures—just like the big machines. 12x9½x6 in. Comes with 3 EXTRA LONG STANDARD SIZE FILMS, 3 FINE LANTERN SLIDES, and admission tickets—all FREE. A machine you will be proud of. You can have endless fun and amusement, and MAKE MONEY with it. Sent by express, with full instructions and extra long cord and plug, securely packed, for $12.00; or by parcel post, to any address in the world, for 75c extra.



No. 2 Rewind Model
Largest and Most Powerful Model

This is the No. 2 Rewind Model, with equipment for unwinding and rewinding 100 to 200 feet of film. The size of the machine is 6¾ x 14 x 19 inches. It is constructed on a wooden base 6¾ x 11½ inches, which will not scratch the furniture. Electric model only, it operates from any electric lighting circuit. All you have to do is to screw in plug to any electric light socket. It has a regulator so that different sized lamps may be used—electric socket, plug and six feet electric lamp wire cord, and nickelled reflector. Also shows magic lantern slides. With this machine we furnish a can of 100 feet of film, three American-made Lantern Slides—subjects of which are Wilson, Pershing, Aeroplanes, Boy Scouts, Charlie Chaplin, Jiggs, Comics, etc., 100 Theatre Tickets, guarantee and full directions. PRICE $20.00, shipped by Express, or by prepaid parcel post to any address in the world for $1.00 extra.

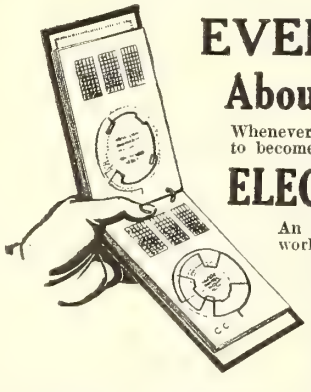
Extra Films

EXTRA FILMS. For all our Machines. Big variety of subjects, including leading and best known movie actors and actresses. Standard size. **Short Reels, Price** 15 cents each. **Extra Long** (5 feet), **Price** 3 for $1.00. **Special 100-feet reels** $2.50 each. **CHARLIE CHAPLIN FILMS.** 25c each; 5-foot lengths, 60c each. All postpaid.

LANTERN SLIDES for Keystone Moviegraph, American made, 6 for 75 cents.

"U-MAK-EM" SLIDES. A special slide for use with the $12.00 and $20.00 machine or any other machine with Lantern Slide equipment, for showing on the screen announcements such as "Please Remove Your Hat," "No Smoking," "Intermission," "Goodnight," sporting results and even advertisements, etc. Can be used repeatedly. **PRICE** 3 for 50 cents postpaid.

JOHNSON SMITH & CO., Dept. P.M.42 3224 N. HALSTED ST., CHICAGO



EVERYTHING You want to know About A. C. Motors and Repairing

Whenever any question arises regarding motors, or if you are anxious to become a specialist on electrical motor work, you need the

ELECTRICAL WORKERS FRIEND

An invaluable collection of diagrams and instructions for electrical workers, students, amateurs, etc.

This book contains 66 motor diagrams with complete instructions for rewinding and reconnecting A. C. Motors. Shows how to put each coil in the slots, giving all internal and external connections. For reconnecting they cover all practical changes showing which diagram to use for the change wanted. Bound in loose leaf form for handy reference. The only complete book of its kind on the market. So simple anyone can understand. It is helping thousands of other workers—it will help you too, as hundreds of testimonials prove.

SPECIAL PRICE, COMPLETE $4.00. Order today. If desired we will ship C.O.D. by Parcel Post.

YOU CAN EARN YOUR COPY FREE

We offer all owners of the Electrical Workers Friend a commission of 50c on every book they help us sell. All you have to do is show your book and recommend it. You can earn the full price of one of these books in a few days. Write immediately for full particulars—this offer is limited.

SMITH & SMITH PUB. CO. 1524 Lowrie St., N. S. Dept. B, Pittsburgh, Pa.

The Transparascope

By H. GERNSBACK

(*Continued from page* 1074)

issue that theoretically, given a sufficiently strong light, it will be possible for light to shine even thru the densest bodies. Of course, there is a limit to this, but it seems possible that if we could concentrate a strong enough light upon the back of a person it would be possible to see every organ inside of such a person. In this case it would be necessary to interpose a heat-filter between the source of light and the patient, otherwise serious burns might result.

To those who are skeptical that we will ever be able to make ourselves entirely or partially invisible, the reader is referred to an article appearing in another part of this magazine, entitled, "The X-Ray Fluid." It will be seen that Dr. Jules Stean has already accomplisht the very thing with animals, altho these at present necessarily are not alive any longer. But it is a step in the right direction, because Dr. Stean has actually made bodies transparent, and *he also is able to control the degree of transparency at will.*

If we had told you thirty years ago that it would be possible to actually see the bones in a live body we would have been laughed at derisively. The X-ray, however, has proven many things that were considered preposterous before. X-rays in contradistinction to light rays are streams of matter shot out at tremendous velocity, at extremely high frequency (rate of vibration. See table). Due to this, X-rays pass thru most solids as easily as light passes thru glass. The X-ray particles may be likened to tiny bullets, for they are just as real as bullets, and they move at speeds as high as 40,000 miles a second. X-rays do not experience the usual refraction, diffraction, interference or polarization as do light rays. X-rays pass in absolutely straight lines thru any medium that does not absorb them. This proves that they cannot be due to trains of waves as light rays, otherwise they could be made to interfere and to experience diffraction. X-rays are totally unlike light rays, and objects that are opaque to light rays are transparent to X-rays and *vice versa.* Thus, for instance, pine wood to X-rays is two and one-fourth times as transparent as water!

Of course, the human eye cannot see X-rays themselves. If it could all we would have to do would be to turn on the rays on a human body and we could look right thru it. But the human eye is not so constituted, and in order to get some of the X-ray effect we find it necessary to view the body thru a platinum-barium-cyanide screen. We interpose this screen between our eye and the body to be viewed, and then we only see a shadow-picture. It is as if we were looking thru a pane of glass at night; we can see nothing or very little. In order to see thru the pane the light must shine on or thru it. The limitation of the human eye, as far as X-rays are concerned, is similar. When X-rays fall upon the screen, the latter becomes luminous, due to fluorescence, and in proportion to the strength of the X-rays falling on them. We then see the bones of the hand as shadows, *but if we had "X-ray eyes" we would be able to see right thru them.*

The limitations of the human eye are not confined to X-rays alone. The human eye cannot see certain rays that may properly be termed light rays. For instance, the human eye cannot distinguish all colors of the spectrum. Rays below red,

the so-called infra-red, and above violet, the so-called ultra-violet rays, are invisible to us, altho some birds and animals can see them quite well.

How then will we solve the problem of making bodies transparent to our eyes? We must find some agency or some ray capable of piercing bodies similar to the X-ray or even better. Then by using another "carrier ray" at the same time we shall be able to look right thru the body we wish to view. Not only that; as our front-cover illustration and the illustration herewith show, we shall be able at will to control the rays in such a way that we will be able not only to make a body, whether it be a human being or a typewriter, invisible in its entirety, *but we will also be able to make it translucent to any degree desired,* as does Dr. Stean with his X-ray fluid today.

By referring to the table which we print herewith it will be seen that there are some regions which are as yet unknown. The new rays of which we speak probably lie between the 35th and 46th octave, or possibly between the 50th and 58th octave. They may also lie beyond the 61st octave. Perhaps a combination of ordinary X-rays used as a penetrator in connection with the as yet undiscovered rays can be used successfully to solve the problem. It is quite possible that there may be other rays in regions lying far beyond the 61st octave of which we are as yet totally ignorant.

What will be the practical use of the future machine which the writer has termed "Transparascope" (transparent—shining thru; scope—to see)? As our illustration shows, it will be of inestimable value to medicine. It will make it possible for us to see our internal organs in their true colors and in their true shape. For instance, it will be possible for us to watch the heart beat, and the physician instead of listening to the heart beat will be able to see just what is wrong with it. He will be able to examine the lungs, and he need no longer tap the chest to locate the disease. Physicians will be enabled *before* performing an operation to see for themselves just exactly what is wrong with an organ and no chance operation need be resorted to; no patient need be cut open to find out the real trouble. It should be noted that it will be possible to obtain any degree of transparency of the human body; thus the rays will be made to shine right thru the bones, making them entirely invisible, if it is desired. For instance, to view the heart right thru the ribs.

All this may seem far-fetched, but it is not only a prophesy but a prediction of the very near future.

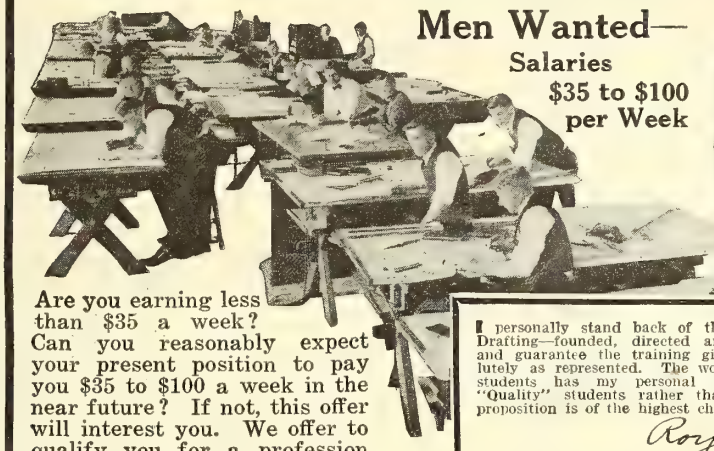
As far as the criminal aspect is concerned, we doubt very much that it will ever be possible for a human being to make himself invisible at will, because we think it will take some cumbersome apparatus to accomplish the invisibility, and it would be difficult to carry this about on the body. It does not seem likely that there will ever be discovered a substance, even of the radium variety, that would have the power to render humans invisible, altho this is not entirely impossible.

TELEPHONE COMMUNICATION BETWEEN LONDON AND GENEVA

Wireless telephone messages from England were plainly heard in Geneva recently when William Marconi gave a demonstration.

The newspaper correspondents attending the Assembly of the League of Nations were especially invited to the demonstration, and understood quite clearly messages spoken by Lord Burnham and Lord Riddell from Chelmsford, County Essex, England, 500 miles away.

Learn Mechanical Drawing



Men Wanted—
Salaries
$35 to $100
per Week



Are you earning less than $35 a week? Can you reasonably expect your present position to pay you $35 to $100 a week in the near future? If not, this offer will interest you. We offer to qualify you for a profession which, at the very start, pays higher salaries than the average man receives. We offer you the best personal service obtainable. We offer you personal instruction in mechanical drawing and teach you expert Draftsmanship in your spare time, at your home, by mail, in the same practical way that you would learn it in any big Drafting department. We offer to qualify you for one of the many high-salaried positions in the Drafting field, and to keep you in touch with openings for Draftsman in big machine shops, industrial plants, manufacturing concerns and United States Government Departments. We guarantee to start you on real Drafting work at once qualifying you as a thoroughly trained professional Draftsman, capable of succeeding from the very start. We offer to do all of this at a low cost for such service and in a comparatively short time.

I personally stand back of the Columbia School of Drafting—founded, directed and owned by myself—and guarantee the training given by it to be absolutely as represented. The work of each one of our students has my personal supervision. We seek "Quality" students rather than "quantity," as our proposition is of the highest character in every respect.

Roy C. Claflin
President

Become a Chief Draftsman

You cannot make a mistake by taking up mechanical drawing. The field is not crowded, nor can it be. No single profession today offers better opportunities. The great need for trained Draftsmen continues to increase. Each step forward in mechanical development creates a need for more trained Draftsmen. Promotion in this field is sure and certain. Men who start as Draftsmen are often advanced to Chief Draftsmen, Chief Engineer, Production Manager or other high-salaried positions. There is a constant demand for our graduates. We cannot supply them rapidly enough. Many of them are accepted even before they complete their training. This unusual demand for "Columbia Trained Men" is explained by the fact that our students enter upon actual drawing work the day they receive their first lesson. They spend no time with unnecessary preparation or useless theory.

One of the Finest and Best Equipped Institutions in America Teaches You Mechanical Drawing at Your Home

This is the mechanical age in world history. The day of big opportunities for technically trained men is here. Especially is this true in the case of Draftsmen, on whom the mechanical industries of America and the entire world depend. On no one profession does the continued development of machinery so nearly center. With the training which we can give you at your home, your services will always be in demand, at a premium, in this permanent, highly paid field.

Drawing Instruments Furnished

We supply our students with complete drawing equipment. A professional outfit is furnished, together with a highest grade set of Drafting instruments for your permanent use.

No Previous Training Necessary

As our students are put into actual practice at the beginning, they grasp the essentials of drawing quickly. The lessons supplied are thorough, clear and easily understood even by those who have had no previous technical training of any kind. No previous experience or special education is necessary.

Return the Coupon Today

It Brings to You a Valuable Book of Information FREE. Your future depends upon what you do now. We cannot begin to tell you here, in so few words, of the advantages afforded you by this unusually practical course in up-to-date mechanical drawing. If you are in earnest and desire to learn a big-paying profession, we urge you to act now by returning the following coupon. We will immediately send you our valuable book free, "Your Future in Drafting," which tells of our new method of teaching mechanical drawing and outlines our offer to you fully.

COLUMBIA SCHOOL of DRAFTING
Roy C. Claflin, *President*
Dept. 1302, 14th and T Streets
WASHINGTON, D. C.

FREE COUPON—RETURN TODAY

COLUMBIA SCHOOL of DRAFTING
Dept. 1302, 14th and T Sts., WASHINGTON, D. C.

Without obligation to me, please send me your illustrated book on Drafting, telling how I can secure your complete home study course (with which is furnished the professional set of drawing instruments and equipment), and your help in securing a position as Draftsman.

Name.....

Address.....

City.....State.....

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you.* Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6180-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ Pharmacy
☐ Electric Wiring	☐ SALESMANSHIP
☐ Electric Lighting	☐ ADVERTISING MAN
☐ Electric Car Running	☐ Window Trimmer
☐ Heavy Electric Traction	☐ Show Card and Sign Paint'g
☐ Electrical Draftsman	☐ RAILROAD POSITIONS
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ Business Correspondent
☐ Ship Draftsman	☐ BOOKKEEPER
☐ Machine Shop Practice	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Gas Engineer	☐ Traffic Management
☐ CIVIL ENGINEER	☐ Commercial Law
☐ Surveying and Mapping	☐ GOOD ENGLISH
☐ MINE FOREM'N OR ENG'R	☐ STATIONARY ENGINEER
☐ ARCHITECT	☐ CIVIL SERVICE
☐ Architectural Draftsman	☐ Railway Mail Clerk
☐ PLUMBING AND HEATING	☐ Textile Overseer or Supt.
☐ Sheet Metal Worker	☐ AGRICULTURE
☐ Navigator	☐ Poultry Raising ☐ Spanish
	☐ Automobiles ☐ Banking

Name_____

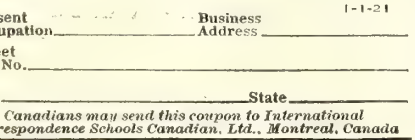
Present Occupation_____ Business Address_____ 1-1-21

Street and No._____

City_____ State_____

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada

FREE



$20

Violin, Hawaiian Guitar, Ukulele, Guitar, Mandolin, Cornet, Tenor Banjo or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.

SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 613 CHICAGO, ILL.

LEARN WATCH REPAIRING



You can learn by our modern and original system of instruction every part of the Watch Repairing Trade at home as good or better than at a shop. You can earn money while learning and secure a well paying position or start in business after completing our course of instruction. Good watch repairers are always in demand and earn from $30 to $65 per week. For particulars apply to the

MILWAUKEE SCHOOL OF WATCH REPAIRING, 166 Mason St., MILWAUKEE, WIS.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(*Continued from page* 1091)

an inclination of 60° with the lines of forces, but in such intermediate positions the central component is present tho fainter than for an inclination of 90° and the two outer components are *elliptically* polarized in opposite directions and one component cannot be completely extinguished for a given position of the Nicol. It is evident then that the polarity and the direction of the lines of force in any portion of the solar surface can be found by estimating the relative intensities of the lines of a Zeeman triplet.

Let us consider how these principles are applied in observations of the magnetic polarity and inclination of the lines of force in a sun-spot region. The slit of the spectroscope is moved across the spot and for each successive position a record is obtained of the relative intensities of the lines of a Zeeman triplet. The polarity will depend upon which component, the red or the violet, is transmitted for a given position of the Nicol. The intensity of the field is a function of the amount of separation of the lines. The more intense the field the greater the separation.

Magnetic intensities of solar fields are expressed in terms of gausses. A separation of the components corresponding to one thousand gausses can be easily detected for certain spectral lines and estimates of the field strength are made from observations of the widening of the line for lower values. One hundred gausses is the unit used in recording field intensity in sun-spots and the letters R and V to indicate the polarity. R30 would indicate that the polarity corresponded to that of the south magnetic pole and that the intensity was about thirty hundred gausses. The maximum magnetic intensity recorded in sun-spots is about forty-five hundred gausses.

By observing at what portion of the sun-spot the two outer components are transmitted with equal intensity it is possible to locate the neutral line in a sun-spot which connects points moving along the lines of force of the field.

The magnetic axis of sun-spots it has been found are directed radially outward from the center of the sun. That is, they lie in the direction of the solar radii.

A long continued and detailed study of the intense magnetic fields in sun-spots made at the Mt. Wilson Solar Observatory during the past twelve years or so has brought to light many interesting and valuable facts and in conjunction with careful examination of the forms of sun-spots revealed in photographs taken in the light of a single ray—spectroheliograms—has made it possible to formulate a theory of the nature of sun-spots and of a possible cause of their magnetic properties.

It appears certain now that sun-spots are solar storms analogous to whirling storms in the earth's atmosphere such as tornadoes and cyclones. It is well-known that such storms in the earth's atmosphere have a left-handed direction of whirl in the northern hemisphere and a right-handed whirl in the southern hemisphere due to an increase in linear velocity of the air from pole to equator arising from the earth's rotation.

Since the sun is also rotating on its axis it seemed reasonable to assume that solar storms—sun-spots—might also be cyclonic in nature and follow the same law of direction of whirl for the two solar hemispheres as for cyclones and

Voice Thrower 10c



Learn to throw your voice into a TRUNK, under the bed, out in the hall or anywhere. Lots of FUN fooling the Teacher, Janitor, Policeman, Parents, Neighbors, or Friends.

THE VENTRILO

is a little instrument that fits into the mouth out of sight. BOYS or GIRLS can use it in conjunction with the above for imitating birds and animals. Never fails. A 32-page book on Ventriloquism sent with the Ventrilo for 10 cents.

NEW FORD JOKE BOOK 1920

All the latest jokes on the Ford auto. Hundreds of them, and all good ones. Spring a new one on your neighbors.

Large book with cover by mail, 10c



ROGEN X-RAY



Price 12 cents

HERE, BOYS, is just what you want. With this instrument you can apparently see the bones in your fingers. Think of the fun you can have with it. Sample by mail, TWELVE CENTS.

SKULL RING



Here is a handsome, up-to-date Ring, representing a Skull and Cross-bones. Has stones in the eyes and looks something frightful. Women won't like it, but for men or boys it is a great novelty. **Sample, by mail, 20c.**

Gee! What a Wad!



This is STAGE MONEY

Looks like the GENUINE STUFF. Some Green backs and some Yellow backs. Create a BIG sensation among your friends. The girls will all be after you when they see the wad. BIG roll of 15 pieces by mail, 10 cents.

ENCHANTED BARREL



The Most Wonderful Pocket Trick Made

CHANGE A CENT INTO A DIME

Ask your friend to drop a dime in the barrel. When he takes it out, Behold! It is a CENT. You make 9 cents every time you fool them. Never fails. They cannot get on to it. Sample barrel, with directions, only.... **12c**

BIG VALUE for 10 Cts.



6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Baseball Book, giving rules for games; 1 Toy Maker Book; Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 5 Puzzles; 12 Games; 30 Verses for Autograph Albums. **All the above by mail for 10c.**

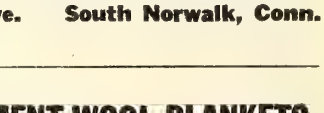
Any of the above Mailed with Catalog

ROYAL NOVELTY COMPANY
489 East Ave. South Norwalk, Conn.

GOVERNMENT WOOL BLANKETS

PRICE

$4.90



20,000 elegant wool army blankets purchased direct from U. S. Surplus Division. Blankets that are real wool and will keep you warm for several years to come. The raw material alone is worth more than the price we ask.

Slightly used in local camps, but practically as good as new. Inspected, renovated, laundered and sterilized by Government authorities. Our price $4.90.

Strictly new and just as received by the Government from the manufacturers. Our price $5.90. Regular value would probably be $16. Either of the above blankets are extra large size.

As a matter of good faith mail us a deposit of $1 for each blanket order, balance on delivery. We will ship blankets by express unless otherwise instructed.

KINGSLEY ARMY SHOE CO.
3852 Cottage Grove Ave., Dept. B-90 Chicago, Ill.

tornadoes in the two hemispheres of the earth. Observations in great numbers showed a vortical structure of the hydrogen flocculi (intensely luminous hydrogen gases) in sun-spot regions as if the superimposed hydrogen gases were being sucked inward and downward into a vortex centering in the sun-spot umbra.

An examination of the photographs suggested the theory that a sun-spot is a vortex wherein electrified particles produced by ionization of gases in the solar atmosphere are whirled at high velocities. Now it can be shown experimentally that such a whirling of electrified particles gives rise to a magnetic field and moreover sets up in overlying gases secondary vortices corresponding to the hydrogen whirls above sun-spots.

The Zeeman effect was accordingly searched for and detected in sun-spots and has since been found to exist in every sun-spot observed. Photographs taken in the light of the high-level hydrogen line show that hydrogen vortices centering in sun-spots cover vast areas of the solar surface. There is abundant evidence to show that the hydrogen gas is sucked inward and downward spirally and at lower levels moves spirally outward in the chromosphere above sun-spots, and that the sun-spots beneath consist of electric vortices whirling spirally upward along solar radii to the photosphere and spreading outward along its surface.

Magnetic observations of sun-spots have revealed, moreover, that there is a strong tendency to the bi-polar form. That is, in each group of sun-spots there usually exists two principal members of opposite polarity. About sixty per cent of all sun-spots form such bi-polar groups and in most instances the western member, or the one that precedes as the spot-group is carried across the disk by the solar rotations, is the most extensive in area and has the most intense magnetic field.

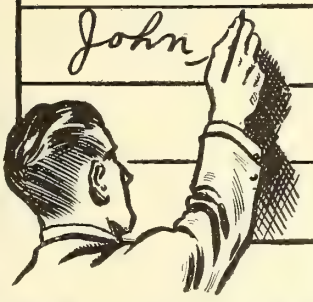
Even uni-polar spots show some of the characteristics of bi-polar groups—a magnetic disturbance in the photosphere of opposite polarity frequently preceding or following such spots.

Both the uni-polar and bi-polar sun-spot groups are often attended by minor spots of small area that may be either of the same or opposite polarity but the sharp division of polarity between the two principal members of a group is very marked and is evidently a characteristic feature of sun-spot activity.

In a few instances a sun-spot group is so complicated in form that it cannot be separated into two distinct members of opposite polarity. Such formations are very rare, however.

Observations made before the last sun-spot minimum showed that the polarity of the *preceding* member of a sun-spot group in the northern solar hemisphere was *negative* in almost every instance and that it was also opposite in polarity to the corresponding member of a group in the southern hemisphere. This appeared to be analogous to the law governing direction of whirl of cyclones in the earth's atmosphere except that the bi-polar character of each group introduced a new feature. Strange to say, however, after the date of the sun-spot minimum had past it was noted that the law was *reversed* and that the polarity of the preceding member in each hemisphere had changed. The cause for this remarkable reversal of polarity in each hemisphere at the sun-spot minimum is a puzzle and astronomers interested in solving the puzzle are awaiting with interest the approach of the next sun-spot minimum, which is due to appear shortly, to see whether a reversal will again take place with the sun-spot minimum. If so, there is evidently some connection between the sun-spot cycle and the polarity of a sun-spot group.

NAME	POSITION	SALARY
John	AUTOMOBILE ENGINEER	$125 A WEEK
	REPAIR MAN	$50 A WEEK
	CHAUFFEUR	$30 A WEEK



Put Your Name On This Pay-Roll

Price Reduced

Down goes the price on these famous Auto Books. We have induced our printers and binders to cut the price they charge us. We pass this saving on to our customers.

Mail Coupon Now For FREE Trial

Men like you are wanted for big-pay positions in the fascinating field of automobile engineering. We have made it easy for you to fit yourself for one of these positions. You don't have to go to school. You don't have to serve an apprenticeship. Fifteen automobile engineers and specialists have compiled a spare time reading course that will equip you to be an automobile expert without taking any time from your present work.

Partial List of Contents

Explosion Motors
Welding
Motor Construction and Repair
Carburetors and Settings
Valves, Cooling
Lubrication—Fly-Wheels
Clutch—Transmission
Final Drive
Steering Frame
Tires—Ignition
Vulcanizing
Starting and Lighting Systems
Wiring Diagrams
Shop Kinks
Commercial Garage
Design and Equipment
Electrics
Storage Batteries
Care and Repair
Motorcycles
Commercial Trucks
Glossary

AUTO BOOKS

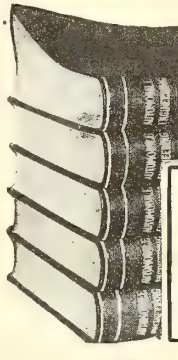
6 Volumes Shipped Free

Now ready for you—at a big reduction in price—an up-to-the-minute six-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Brimming over with advanced information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or the owner or prospective owner of a motor car ought to know. Written in simple language that anybody can understand. Tastefully bound in American Morocco, flexible covers, gold stamped, 2,650 pages and 2,100 illustrations, tables and explanatory diagrams. A library that cost thousands of dollars to compile but that comes to you free for 7 days' examination.

Only 10c a Day

Not a cent to pay in advance. First you see the books in your own home or shop.

Just mail coupon and express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books send only $2.80 in seven days and $3 a month until the special introductory price of $24.80 has been paid. (Regular price $45.00.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.) This great bargain offer must soon be withdrawn.



FREE!

With every set is included—FREE—a Consulting Membership which gives you the privilege of submitting your perplexing problems to a corps of experts for an entire year. This Consulting Membership regularly sells for $12.00.

Send No Money Now

Don't take our word for it. See the **books without cost.** There is so much profit in this offer for you, that we urge you to waste not a moment in sending for the books. **Put the coupon in the mails today. Send no money—only the coupon!**

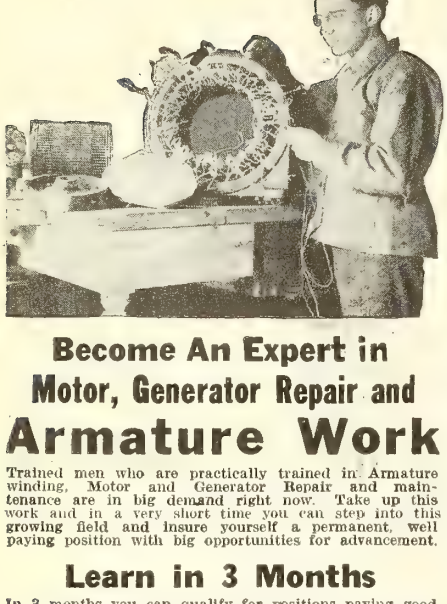
American Technical Society
Dept. A-252, Chicago, Ill.

American Technical Society,
Dept. A-252, Chicago, Ill.

Please send me the 6-volume set, Automobile Engineering for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within 7 days and the balance at $3 a month until the $24.80 has been paid. Then you send me a receipt showing that the $45.00 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after the 7 days' trial I will return them at your expense.

Name.....

Address..... Reference.....



Become An Expert in Motor, Generator Repair and Armature Work

Trained men who are practically trained in Armature winding, Motor and Generator Repair and maintenance are in big demand right now. Take up this work and in a very short time you can step into this growing field and insure yourself a permanent, well paying position with big opportunities for advancement.

Learn in 3 Months

In 3 months you can qualify for positions paying good salaries. Come to this well founded and completely equipped school where you will learn to actually wind every type of D. C. and A. C. armatures. Experts teach and direct you.

Write for Free Book

Mail the coupon today for full particulars of our 3 months' course in Armature work. Send the coupon and see how easy it is for you to become an expert in only 3 months.

SCHOOL OF ENGINEERING OF MILWAUKEE,
Dept. SI-1, 373 Broadway, Milwaukee, Wis.

Please send me full information about your three months' course in Armature work. No obligation on my part.

Name .....

Address .....

City..... State.....

Age..... Education.....

BE AN ARTIST



DRAWN BY 14-YEAR-OLD BOY

The above cartoon was drawn by Master Bob Brennan of the Washington School of Art. Bob writes that he is selling his work and that he is cartoonist on a small paper in Evansville, Ind. He is but one of our many students and graduates who are making money as cartoonists, illustrators and designers.

Learn By Mail at Home!

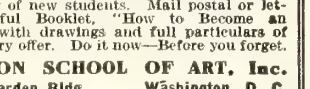
By our new method of teaching drawing by mail you can learn in your own home, in a short time. Get into this fascinating work yourself and earn $50 to $100 or more per week! The study is fascinating. Only a few minutes a day! Have your own studio or secure high-salaried position. Or work in spare time. Many students earn while they are learning.

FREE! BOOK AND ARTISTS' OUTFIT! WRITE TODAY

A complete outfit free to all students. Includes everything required to produce hundreds of dollars' worth of pictures. Write today. Special terms to a limited number of new students. Mail postal or letter for beautiful Booklet, "How to Become an Artist," filled with drawings and full particulars of our extraordinary offer. Do it now—Before you forget.

WASHINGTON SCHOOL OF ART, Inc.
Room 1580, Marden Bldg. Washington, D. C.

Model Electric Motor Boat



30 inches long. High power. Built like a real boat—$15.00

Send stamp for illustrated lists of working model boats, engines, etc.

BATHE MANUFACTURING COMPANY
Desk 2, 5214 Woodland Avenue, Philadelphia, Pa.

Turning from a consideration of the restricted magnetic fields of great intensity that exist in sun-spots to that of the general magnetic field of the sun we find the same method of observation is used, that of an estimate of the separation and relative intensity of the components of a Zeeman triplet. The time chosen for the observations is that of the sun-spot minimum when few sun-spots are present and consequently the strength of the general field is undisturbed by special magnetic fields of great intensity in sun-spot regions.

It is reasonable to expect from many considerations that a general magnetic field should be found for the sun. If we accept Schuster's theory that all rapidly rotating spheres are magnets simply as a result of their motion then we should certainly expect to find a general magnetic field in the solar atmospheres analogous somewhat to that existing in the earth's atmosphere tho of course the physical conditions of the two rotating bodies are far different.

As a matter of fact the existence of a general magnetic field for the sun has been detected and its vertical intensity at the poles has been found, from the lines observed, to be approximately of the order of fifty gausses or only about one hundredth of the maximum intensity of the magnetic field in sun-spots. It is therefore very difficult to detect and measure.

It has been found from a long series of observations that the inclination of the magnetic axis of the sun to its axis of rotation is six degrees approximately and that it makes a revolution about the axis of rotation of the sun in a period of about thirty-one and a half days. The polarity of the general field of the sun, it has been found, corresponds to that of the earth; that is, the north magnetic pole lies near the north pole of the axis of rotation.

Observations of the intensity of the sun's general magnetic field made at Mt. Wilson have revealed the fact that the magnetic intensity *decreases with elevation* in the solar atmosphere. Owing to the smallness of even the maximum displacements in Zeeman triplets arising from the general magnetic field of the sun it has been found that nearly all lines observed for this effect lie within a very narrow shell of the solar atmosphere scarcely 100 miles in thickness just above the photosphere, and that the intensity of the field falls off so rapidly with elevation that the displacements of the lines due to the field are too small to be measured at much higher altitudes. The value of the intensity of the general field given, about 50 gausses, is therefore the value for this shell of the solar atmosphere.

Tho the only *direct* evidence of the presence of a general magnetic field in the solar atmosphere and of the far more intense local fields in sun-spot regions is that obtainable from observations of the Zeeman effect, yet the conclusions formed from the results of these observations are what we would be led to expect from the form of the solar corona, which is apparently chiefly of electro-magnetic origin and follows approximately the lines of force of a uniformly magnetized sphere with the magnetic poles near the poles of rotation. Sun-spots produce periodic variations in the form of this corona during the period of the sun-spot cycle and, as we have seen, there is evidence that there is also a change in the polarity of sun-spot fields with the sun-spot cycle. It is believed that continuation of the magnetic observations of sun-spot regions thru several sun-spot cycles will reveal the law that governs these changes in the magnetic fields. The time that has elapsed since the first systematic observations of the Zeeman effect in the lines of the solar spectrum were begun is very short, cov-



A Valuable Book FREE BRINGS BIG PAY

Do you want to increase your income by home study in your spare time? Our new catalog of **home self-helps** will show you how. No matter what your line of work, you will find in our FREE CATALOG of self-help books many valuable suggestions as to how you can **easily** increase your income. Especially valuable to all interested in **Electricity, the Automobile, Machine Shop, Carpentry, Painting, Farm Mechanics and Machinery, Gas and Steam Engineering, Railroading or Modern Languages.**

Sent ABSOLUTELY FREE. A postal will bring it. Send for your copy **now.**

Frederick J. Drake & Co.
1009 Michigan Ave. Chicago

What a Dime Will bring You From the Nation's Capital

The little matter of **10 cts.** will bring you the Pathfinder **eight** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for all the Nation; an independent home paper that prints all the news of the world and tells the truth; now in its **28th** year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, strongly, briefly—here it is. Send 10c to show that you might like such a paper, and we will send the Pathfinder on probation **eight** weeks. The 10c does not repay us, but we are glad to invest in new friends. Address:

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, 267 Langdon Sta., Washington, D. C.



Oh Boys, Girls! Great Sport with CLAXOPHONE

Voice Thrower

Throw your voice under the **table, back of a door,** into a **trunk,** desk in **School,** any old place. **Big FUN** fooling **Peddlers, Policeman, Friends,** anybody. This **Claxophone** is a small device that lays on your tongue unseen, **always ready** for use by **anyone. Claxophone** with **full** instructions; also **Set of Secret Writing Tricks,** all sent for **10c** coin. (No stamps.)

CLAXO TRICK CO.,
Dept. K. New Haven, Conn.



DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my sworn statement of how I recovered my hearing.

A. O. LEONARD
Suite 369, 70 5th Avenue -- New York City



Big Band Catalog Sent FREE

Anything you need for the band —single instrument or complete equipment. Used by Army and Navy. Send for **big** catalog, liberally illustrated, fully descriptive. Mention what instrument interests you. Free trial. Easy payments. Sold by leading music dealers everywhere.

LYON & HEALY
63-98 Jackson Blvd., Chicago

CONVERT YOUR BICYCLE INTO A MOTOR CYCLE



by using a **STEFFEY ATTACHMENT**
Simple-Reliable-Economical

Fits any ordinary wheel, diamond, double-bar or truss frame. Easy to attach. Send stamp for circulars.

STEFFEY MFG. CO.
Dept. E, 5025 Brown Street, Philadelphia, Pa.

$2 Now!



"Hello There Bill!"

"Say, your voice is clear as a bell. Since I put this New Standard Earpiece on my phone, every word is distinct and powerful. Even a whisper is audible—and you know my hearing was never very good. If you want real 'telephone comfort' get a

"THERAPHONE"

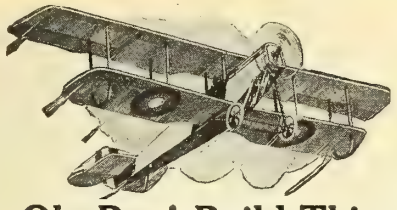
earpiece today. You can put it on in a minute and say 'goodbye' to delay and grouch. Prevents mistakes, conserves energy, saves time and money. It's only $2—Satisfaction Guaranteed."

THE EVOLUTION PHONE CO., Inc.
485E Greenwich Avenue, New York City

250 MAGIC TRICKS, 25c.

BE A MAN OF MYSTERY. Perform wonderful, startling and mysterious tricks. Mystify and entertain your friends. Give shows. Everything illustrated and explained so you can give a complete performance. To introduce our large catalogue of tricks and entertaining books, all for 25c.

UNITED SALES CO. Springfield, Ill.



Oh, Boy! Build This Model Aeroplane!

This wonderful 3-ft. Scale Model of the famous JN4D-2 Curtiss Training Plane can be built by any hardy boy. A perfect duplicate of the real one; it will fly in the air under its own power!

Complete parts to construct this IDEAL Model Aeroplane, including Plans and Building and Flying Instructions. Ask your dealer or Order Direct.....$8.00

Plans and Instructions *only* with Catalogue of Parts needed. Postpaid.....35c

Catalogue alone, listing many other types of Model Aeroplanes, Postpaid.....5c

IDEAL AIRPLANE & SUPPLY COMPANY

Making Model Aeroplanes Continously for 10 years

159-161 Wooster St., Cor. West Houston St., N. Y.

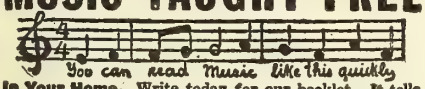
TRAFFIC

Men Needed Everywhere

Big salaries. "Bankers' " hours. Dignified position. Your own boss. Work easily learned in a few weeks at home. Course guaranteed. Satisfaction assured. Graduates coached free for two years after in position. You can't fail. Practical experience in actual traffic office offered graduates. Student R. W. Fish appointed General Traffic Manager after six months' study. His salary to start $3,000.00. Complete training inexpensive. Make up your mind **NOW** to get started. Easy terms. Write today and save $35.00. Act at once.

Interstate Traffic School, 262 Traffic Bldg., Ft. Wayne, Ind.

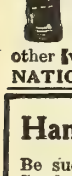
MUSIC TAUGHT FREE



You can read Music like this quickly

In Your Home. Write today for our booklet. It tells how to learn to play Piano, Organ, Violin, Mandolin, Guitar, Banjo, etc. Beginners or advanced pupils.

American School of Music, 57 Lakeside Bldg., Chicago



FREE This Powerful FLASHLIGHT

is given to you for selling only 40 packs "Quality Brand Garden Seeds" at 10c per packet. Order today. **Send No Money. We Trust You.** When sold return $4.00 collected and the **FLASHLIGHT** is yours. Cash commission if preferred. Many other valuable presents. Catalogue with order.

NATIONAL SEED CO., Dept. 126, Lancaster, Pa.

Handwriting Tells You Secrets

Be successful. Find out what holds you back. Send us an ink specimen of your handwriting and $1.00. Our expert Graphologists will tell you your faults, virtues, talents, etc. Your $1.00 back if you are not satisfied.

ROBERT R. ROSS, 110 West 40th St., N. Y.

MECHANIC'S POCKET SECRETARY 25c

Constructed of finest steel. Just push the button and out comes the article you require. Worth $1.00. Postpaid



10 in 1

Adjustable Pencil, pen, paper knife, ink eraser, pencil sharpener, nail file, and cleaner, mechanic's marking point, fine compass with screw attachment, foot rule.

25c Get One Today

Universal Co., Box A, Stamford, Conn.

Learn to Dance!



You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful Peak System of Mail Instruction.

New Diagram Method. Easily learned; no music needed; thousands taught successfully. Write for Special Terms. Send *today* for FREE information and surprisingly low offer.

WILLIAM CHANDLER PEAK, M. B.

Room 241, 4737 Broadway, Chicago, Ill.



SAVE 25% to 60%

on slightly used

GRAFLEX-KODAKS

Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. **All goods sold on 10 days' Free Trial.** Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.

CENTRAL CAMERA CO., Dept. 112 124 S. Wabash, Chicago

ering not much more than a single sun-spot cycle, so there is as yet insufficient data from which to derive a general law governing these magnetic phenomena tho there is the strongest indication that such a law does exist.

Even within the few short years that have elapsed since a regular program of observation of solar magnetic phenomena was first adopted at the Mt. Wilson Observatory, the results have been so decisive that the great value of such an undertaking is indisputable.

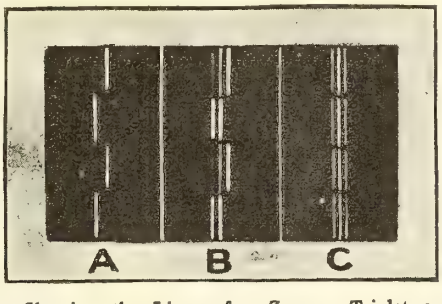
Solar magnetic phenomena are closely associated with and have a marked effect upon terrestrial magnetism. The appearance of unusually large and extensive spots upon the sun, which we now know possess magnetic fields of great intensity, set up magnetic disturbances in the earth's atmosphere such as magnetic storms and auroral displays. Streams of electrons or of Alpha rays—or both—for we are still in doubt as to the exact composition of these streams of ejected particles that are shot off from the sun in the vicinity of eruptive prominences and sun-spots, bombard the earth's atmosphere and set up magnetic disturbances here. The time of passage of such particles from sun to earth depends upon the nature of the particle and its velocity.

Certain lighter Alpha particles attain a velocity as high as seven-tenths of the velocity of light. Others have only one-hundredth of the velocity of the lighter particles or approximately a speed of thirteen hundred miles per second. Such particles would pass from the sun to the earth in about twenty hours.

Electrons travel more rapidly and in pecial instances attain a velocity approaching within two-hundredths of the velocity of light itself, which requires eight minutes to pass from the sun to the earth.

It is well-known that terrestrial magnetic storms follow the appearance of large sun-spots of extensive prominences *after an interval of a number of hours.*

Any discovery that is made concerning the laws that govern the appearance of sun-spots or prominences or other forms of exceptional solar activity may therefore have a distinct bearing upon problems of meteorology or terrestrial magnetism.



Showing the Lines of a Zeeman Triplet as Produced in the Laboratory With a Nicol Prism and Quarter-Wave Plate.

(a) For Inclination of Zero Degrees With Lines of Force. The Central Component Is Absent and the Two Outer Components Are Circularly Polarized in Opposite Directions, So Successive Strips, Which Correspond to a Rotation of the Nicol Thru an Angle of 90°, Show the Two Components Alternately Extinguished. To Determine the Polarity of the Field, It Is Necessary to Note Which Component Is Extinguished for Any Given Strip.

(b) For Inclination of Sixty Degrees With the Lines of Force. The Plane-Polarized Central Component Is Present, but the Elliptically Polarizd Outer or n-Components Cannot Be Completely Extinguished by the Nicol and Quarter-Wave Plate. The Polarity of the Field Is Indicated by the Relative Intensities of the Lines for a Given Position of the Strip.

(c) For Inclination of Ninety Degrees With Lines of Force. The Central or p-Component Is Present and Has Twice the Intensity of the Two Outer Components. All Three Lines Are Plane-Polarized, but the Plane of Polarization of the Central Component Is at Right Angles to the Plane of Polarization of the Outer Components.

FREE Use of This Fine Electrical Apparatus



Learn Electricity

in your own home with

Real Electrical Devices

HERE is a new way to learn the highly paid profession of electricity. You study with and work on laboratory unit boards right in your home in your spare time just as if you were here in this big, world-renowned school with its wonderful equipment. Thus you gain a complete, practical knowledge and experience in less time with less effort than with the older methods of instruction.

Electrical Apparatus For Home Experiments

Wonderful, cleverly constructed units of electrical apparatus are supplied to each student while learning These home laboratories are not toys, but life-size, expensive instruments and devices which the electrical expert meets with in everyday work. In this way you gain thorough, practical, electrical education at home. Thorough, yet simple, tests enable you to work out problems on your instrument boards. You receive the theory as well as the practice of electrical application, which in a short time will enable you to step into a highly paid electrical position.

Big Field—Big Pay

The opportunity for the well trained, electrical man is practically unlimited. Billions of dollars are invested in this great industry. Thousands of men are employed in it, but the demand today is for men who are trained specialists. These men command handsome salaries—$2,500 to $6,000 and up to $10,000 a year and more. You can easily get into this fascinating, highly paid field of work through our thorough method of instruction and the electrical apparatus that is sent to you for home study.

Write Now for Big Free Book

Send the coupon today for a copy of "The Short-cut to the Short-cut," giving full details on our laboratory unit method of home study and information regarding consultation privileges, our free employment bureau and other special services.

Mail the coupon, now, and begin immediately.

Extension Division

SCHOOL of ENGINEERING of Milwaukee

Dept. SI-1 373 Broadway, Milwaukee, Wis.

Extension Division,
School of Engineering of Milwaukee,
Dept. SI-1, 373 Broadway, Milwaukee, Wis.

Please send me a copy of "The Short-cut" giving details of your laboratory unit method of home study in Practical Electricity. This request obligates me in no way.

Name.....

Address.....

Town.....State.....

Age.....Education.....

GOVERNMENT SHOES
At 1/3 Their True Value



20,000 pair genuine Russet shoes, slightly worn, but neatly repaired with genuine Oak leather. Uppers guaranteed two years. Dyed everlasting black when requested without additional cost. Worth $12, wearing value. Our price $2.90.

$2.90 Pair



$3.90 Pair

25,000 pair Field Shoes, slightly worn but neatly repaired and repolished wherever necessary. Manufactured under Government specifications for strength and durability. Three thicknesses of sole leather, foot leather lined, waterproof, slightly worn, but a $15 value. Our price $3.90.



15,000 Trench shoes, slightly worn, but neatly repaired and repolished wherever necessary. Equal new in wearing value. Heaviest of high-grade leather, waterproof, triple sole, studded with hob nails, and heels with metal horseshoe; worth $18, our price $4.90.

As an evidence of good faith mail us a deposit of $1 for each pair of shoes ordered, stating style shoe desired. Balance on delivery.

KINGSLEY ARMY SHOE CO.,
3852 Cottage Grove Ave., Dept. S-90, Chicago, Ill.

Earn $2,500 to $5,000 a year

Be a Signal Engineer

Qualify at home in spare time for a big position as Signal Engineer. Get into this great new field of fascinating work where quick success, swift promotion and a high salary await you. Railroads everywhere need men who understand Signal Engineering and electrical safety devices.

Book FREE

Send quick for big illustrated Book on Signal Engineering and details of our great Free Outfit Offer and our wonderful system of training which includes a *Complete Course in Practical Electricity and Mechanical Drafting.* Send postal today. Don't delay! Get it now!

DEPART. OF SIGNALING, Dept. 1792
1924 Sunnyside Ave., Chicago, Ill.





Who wants to be a Good Boxer?

Do you want to outbox the best man in your crowd, no matter how big or strong he is?

You can do it all right. Marshall Stillman teaches you by mail, right in your own home. You learn how in five simple lessons. A few weeks' practice makes you lead, guard, hit, duck and feint like an expert professional. Also how to defend yourself against all sorts of violent attack.

Don't believe it? We take the risk. We send you the Course free on approval. If you like it you pay for it the 15th of next month—$5 in U. S., $6 in Canada, $7 in other countries. If you don't like it you return the Course in 10 days.

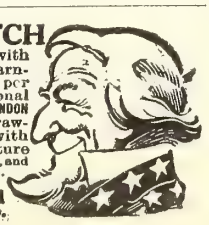
Write today. Give name and address clearly.

MARSHALL STILLMAN ASSOCIATION
Suite E202 461 Fourth Ave., New York

COPY THIS SKETCH

and let see what you can do with it. Many newspaper artists earning $30.00 to $200.00 or more per week were trained by my personal individual lessons by mail. LANDON PICTURE CHARTS make original drawing easy to learn. Send sketch with 6c in stamps for sample Picture Chart, long list of successful students, and evidence of what *YOU* can accomplish.

Please state your age.



The Landon School
112 Schofield Bldg. Cleveland, O.

PEAT BLOCKS FOR FUEL

So serious is the fuel situation in the Baltic States that the Government of Latvia is considering the issuing of wood and peat cards in much the same manner as the other Governments of Europe issued, during the war, bread, sugar and milk cards.

As a result of this threatened fuel shortage the Latvian Government has turned its attention to the harvesting of the vast peat deposits which are to be found about Riga, in the country around Kovno, and in other sections. Already the peat market in Riga is one of the interesting spots in the city, while the gathering and preparing of it is furnishing employment for scores of men and women.

Peat is merely decaying vegetable matter found about stagnant water. When harvested, it is cut into bricks and stacked to dry. The completed product as it appears in the market resembles in shape somewhat the blocks of comprest coal briquettes used on European railroads. To prevent profiteering, the Government will place a fixed price upon peat bricks.

In this attempt to educate the people in the use of peat, the various stations of the American Red Cross are setting an example by using it for cooking purposes. At the same time Red Cross officers are conducting experiments with a combination of peat and other materials in an endeavor to find a fuel which may be used in the manufacturing plants about Riga and thereby reduce the drain on the wood supply of the country.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc., required by the Act of Congress of August 24, 1912; of SCIENCE & INVENTION, published monthly, at New York, N. Y., for October 1, 1920.

State of New York, County of New York, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of the SCIENCE & INVENTION and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Experimenter Publishing Co., 233 Fulton St., New York City; Editor, Hugo Gernsback, 233 Fulton St., New York City; Managing Editor, Harry Winfield Secor, 233 Fulton St., New York City; Business Manager, R. W. DeMott, 233 Fulton St., New York City.

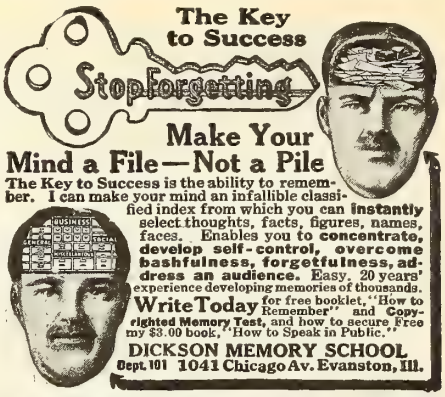
2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) Experimenter Publishing Co., 233 Fulton St., New York City; Hugo Gernsback, 233 Fulton St., New York City; Sidney Gernsback, 233 Fulton St., New York City; Harry Winfield Secor, 233 Fulton St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, give the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

H. GERNSBACK.

Sworn to and subscribed before me this 13th day of October, 1920.
Beatrice K. Owen, Notary Public, New York County, New York; New York County No. 57; New York Register No. 1129. (My commission expires March 30, 1921.) (Seal.)



Make Your Mind a File—Not a Pile

The Key to Success is the ability to remember. I can make your mind an infallible classified index from which you can instantly select thoughts, facts, figures, names, faces. Enables you to concentrate, develop self-control, overcome bashfulness, forgetfulness, address an audience. Easy, 20 years' experience developing memories of thousands.

Write Today for free booklet, "How to Remember" and Copyrighted Memory Test, and how to secure Free my $3.00 book, "How to Speak in Public."

DICKSON MEMORY SCHOOL
Dept. 101 1041 Chicago Av. Evanston, Ill.

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP **SAVE OVER HALF**

A few hours interesting work saves over half and gives you a machine to suit your ideas. We furnish motors, tone arms, case material, blue prints and full instructions Plays any record. Make fine profit building phonographs for your friends.

Write today for our Blue print offer. **FREE**

AGENTS wanted for Choraleon King Phonographs



Choraleon Phonograph Co.
221 3rd St., Elkhart, Ind.



$4 AND $5 WILL BUY
a month
A Standard, Guaranteed
TYPEWRITER
With Every Modern Writing Convenience

WRITE TODAY FOR ILLUSTRATED CIRCULAR
Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

TELEGRAPHY

(Both Morse and Wireless) and **RAILWAY ACCOUNTING** taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.

DODGE'S INSTITUTE **A Street, Valparaiso, Ind.**



GET ON THE STAGE

I Tell You How! Stage Work and Cabaret Entertaining successfully taught by mail. Your BIG opportunity. Travel, see the world as vaudeville actor or actress. My great Professional Course—only one of its kind—COVERS ALL BRANCHES. Develops Personality, Confidence, Skill and tells you just how to get on the Stage. Send 6c postage for illustrated booklet, "All About Vaudeville," State age and occupation. Write for this free Stage Book today!

FREDERIC LA DELLE Box 557-W LOS ANGELES, CALIF.

MEN

Intensely interesting booklet free.
Wonderful results.
H. Gyde Co., Washington, D. C.

BUILD A WHITE FIREFLY $2.00



CARRIES FULL GROWN MAN

World's lightest and simplest aeroplane. Designed by George D. White, America's foremost aeronautical engineer. Weight 150 pounds, length 15 ft. Needs 8-12 H.P. motorcycle engine. Lands and takes off at 24 miles per hour. Useful load 165 pounds. Can be built in a few weeks at home. Send $2 for complete working drawings, building instructions and price list of parts. SEND $2 NOW!

WHITE AIRCRAFT WKS.
Dept. 18, 425 Merchants Trust Bldg., Los Angeles, California.

READ LOCOMA



—an interesting, instructive MAGAZINE, on personal subjects, such as Love, Marriage, Divorce, Eugenics, Birth Control, Sex Hygiene, etc. For Men and Women only. 15 cents a copy, $1.50 a year, 8 months' special trial 50c.

100 E.E. & M. Bldg., Farmington, Mich.

STAMMER

If you stammer attend no stammering school till you get my large FREE book entitled "STAMMERING, Its Origin and the Advanced Natural Method of Cure." Ask for special tuition rate and a FREE copy of "The Natural Speech Magazine." Largest and best school for stammerers in the world. Write today. The North-Western School, 2331 Grand Ave. Milwaukee, Wis.

New York Subways a Century Hence

By H. WINFIELD SECOR

(*Continued from page 1071*)

much congestion, or focusing as we may call it, of the subway lines from Brooklyn and New York City proper in the lower business district of the city. But the subway engineers are slowly beginning to see a great light, and future tunnels under the East River to Brooklyn have already been planned—at least in blue-print form.

As Mr. Bolton asked, why is it that the builders of a city of this magnitude have so poor a vision that they can only conceive of a Greater New York composed of Brooklyn, Queens, Richmond and Manhattan? "Truly fallacious," this engineer intimated, "for what is to prevent the Greater New York City from extending and taking in a part of New Jersey, including Newark, Hoboken and Jersey City?" We do not mean to say that these highly developed territories need necessarily be taken into the legal jurisdiction of Greater New York, but they should be linked up just as closely by subways and other modes of transportation as are Brooklyn and Manhattan, for example.

Jerseymen had a good taste of the practically complete isolation of Jersey City and Hoboken due to strikes and tie-ups of the ferries and Hudson Tunnels, during the past few winters. When the two Hudson Tubes stop and the ferries discontinue service, transportation is at a standstill.

Even tho the Pennsylvania Railroad does have two tunnels under the Hudson to Manhattan, there should be several subways connecting New Jersey with New York, and there should also be one or more bridges such as suggested by the famous bridge builder, Gustave Lindenthal.

We see much better treatment of all such matters as this in foreign cities, where parts of great social centers are divided by rivers or other bodies of water.

The Greater New York of tomorrow, said Mr. Bolton, will be bounded by a great circle, probably 50 miles in diameter, which will include territory far out in Long Island, will extend far northward of Manhattan Island, and will include a large portion of New Jersey.

In 1970, or fifty years hence, Greater New York, judging by its recent growth, will have, instead of 6,000,000 people, a vast population of possibly 15,000,000 to 20,000,000 people. The problem to be solved is obvious and the solution with the present rapid growth of the city is that the subways must be extended and multiplied, but in a logical and farsighted manner.

As Mr. Bolton mentioned, in the days to come we will not have simply a few subway arteries of transportation running along just under the surface of the ground, but there will be high-speed subterranean expresses, 200 feet underground, which will hurl one from Brooklyn directly over into New Jersey, a distance of 12, 15, perhaps 20 miles, in as many minutes.

Thanks to the constant improvement of electrical apparatus, and systems of distributing the current, the subway trains of tomorrow, especially the expresses running along the high-speed routes, will make much faster schedule time than we can even imagine now. These high-speed express tubes will of course have stations at intervals of 5 or 10 miles undoubtedly, where the passengers will be raised and lowered to and from the street level by means of electric elevators.

And let us hope that the subway designers of tomorrow will relieve us of the terrific noise which is almost maddening on some of the present routes.

40 Years of Progress with Fine Tools

"—when old Dobbin was the motor."

Even in 1880, in the days when old Dobbin was the motor, machinists had learned to rely on Starrett Tools for long service and measurements of unvarying accuracy.

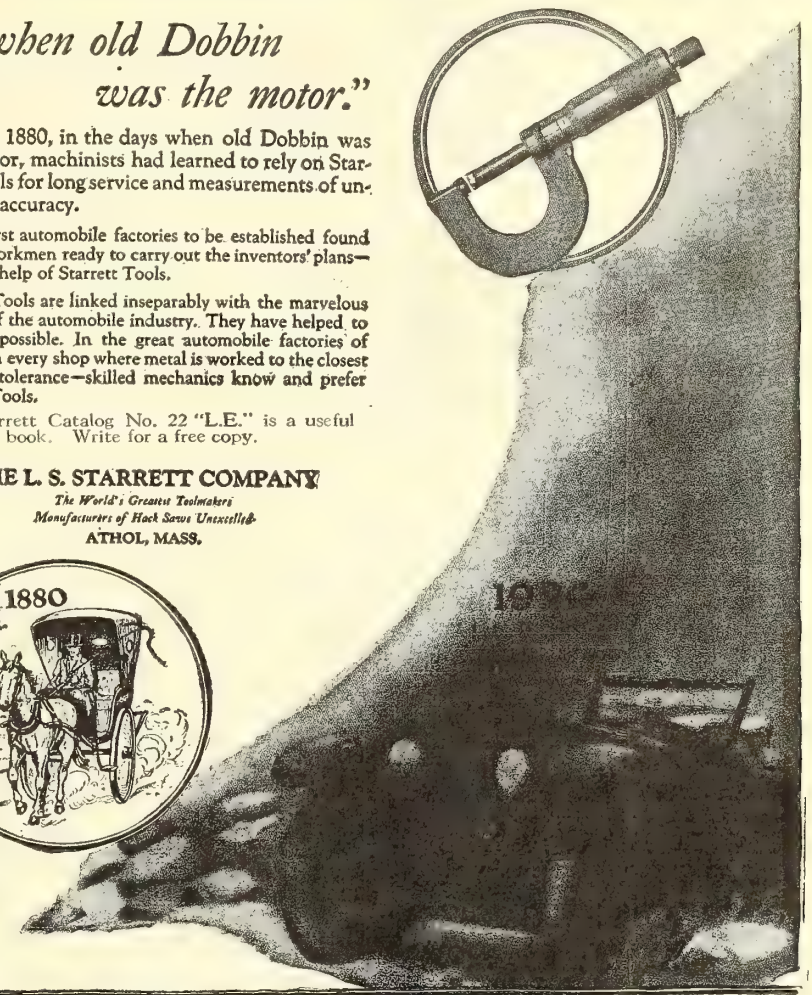
So the first automobile factories to be established found skilled workmen ready to carry out the inventors' plans—with the help of Starrett Tools.

Starrett Tools are linked inseparably with the marvelous growth of the automobile industry. They have helped to make it possible. In the great automobile factories of today—in every shop where metal is worked to the closest limits of tolerance—skilled mechanics know and prefer Starrett Tools.

The Starrett Catalog No. 22 "L.E." is a useful reference book. Write for a free copy.

THE L. S. STARRETT COMPANY
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.





Use Starrett Tools

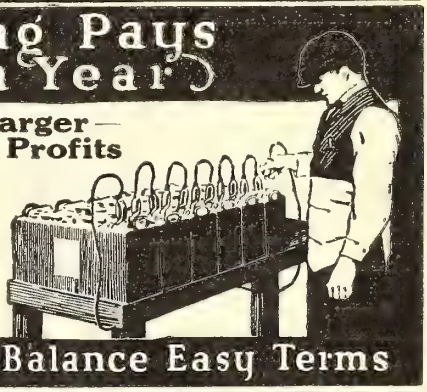
42-117

Battery Charging Pays $1500 to $3000 a Year

Buy an HB Battery Charger— Make Big, Easy Monthly Profits

You can get any HB Charger for just a little cash and have almost a year to pay balance on easy terms out of your battery charging profits. Start now! HB outfits made in sizes for charging 10, 16, 32 or 70 batteries. Choose size you need, then write quick for information. Free trial—money-back guarantee. Most reliable charger built, thousands in use, making big profits for owners. No experience needed to operate. Write us today.

HOBART BROTHERS COMPANY
Box 1721E Troy, Ohio

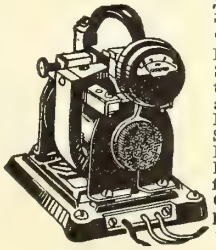


Small Cash Payment-Balance Easy Terms

AUTO OWNERS—BATTERY USERS—WIRELESS OPERATORS—EXPERIMENTERS

10c CHARGES YOUR BATTERY AT HOME WITH AN F-F BATTERY BOOSTER

IT PAYS BIG

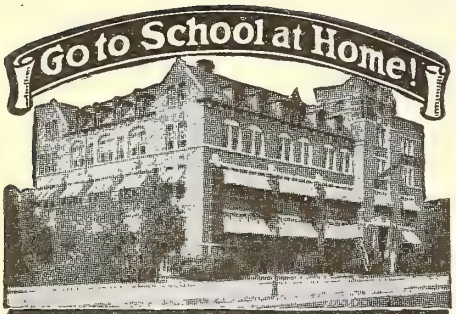


or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current

Bantam type 6-6 ampere for 6 volt battery, $15
Type 16-8 ampere for 6 volt battery.... 24
Type 166-12 ampere for 6 volt battery.. 32
Bantam type 12-5 ampere for 12 volt battery $15
Type 112-6 ampere for 12 volt battery.. 24
Type 1612-7 ampere for 12 volt battery. 32
Type 1626-12 amperes or 7 amperes in combination for both 6 volt and 12 volt batteries 48

F-F Battery Boosters are entirely automatic and operate unattended. Screw the plug in lamp socket in your garage, snap charging clips on battery terminals without disconnecting or removing battery from car, turn switch and lock garage door, knowing your battery will be charged in the morning. High charging rates are best for large batteries, or where time is limited. Shipping weight complete with **AMMETER** and **BATTERY CLIPS**, 11 to 15 lbs. Include postage and insurance with remittance for parcel post shipment. Keeping your Starting Storage Battery in charged condition makes it delightfully responsive and last longer, requiring fewer expensive battery renewals. Other F-F Battery Boosters for Farm Lighting Plants and Direct Current. **Battery Stations and Garages Use New F-F Rotary Rectifier for Group Charging. WRITE FOR BULLETIN NO. 12 NOW, IF NOT YET READY TO ORDER.**

THE FRANCE MANUFACTURING CO., Offices and Works, Cleveland, Ohio



HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competition is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

American School of Correspondence
Dept. H-226 Chicago, U. S. A.

American School of Correspondence,
Dept. H-226, Chicago, Ill.

I want job checked — tell me how to get it.

.....Architect $5,000 to $15,000	.....Lawyer $5,000 to $15,000
.....Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Photoplay Writer $2,000 to $10,000
.....Certified Public Accountant $7,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telephone Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....Telegraph Engineer $2,500 to $5,000
.....Electrical Engineer $4,000 to $10,000	.....High School Graduate In two years
.....General Education In one year	.....Fire Insurance Expert $3,000 to $10,000

Name.....

Address.....

The Hall Jet Relay for Recording Radio Signals

By PROF. RALPH D. DONER

(*Continued from page* 1099)

two of these posts and insulated from the other two, thus making half turns in parallel as conductors between the two metal posts. "T" is a telephone receiver from which the sound is led to the base of the jet by a resonator "S". Coil "C" is heated to a dull red heat by a current from the battery "B". When a signal comes in at "T" the sound strikes the base of the air jet; causes the break to occur nearer the orifice, and thus envelopes "C" in a cooling blast, reduces the resistance of the fine wires, increases the current thru C, B, and R, and closes the armature of the balanced relay "R". This controls the recording circuit B_2R_2 and produces an ink record on a moving paper tape.

The platinum wire must be very fine, 2 to 4 mil. in diameter, so that its rate of cooling may be rapid. The whole jet, telephone and nozzle should be enclosed in a sound-proof box to shield the jet from room noises, and the air supply must be quite steady and free from noises and hisses.

A less efficient means of translating the changes in the jet is to replace coil "C" by a vane "V", Fig. 7. The undisturbed jet passes thru a small hole in the center of the vane, but when the break occurs below the vane, either opens or closes a circuit as desired, and controls the recording circuit "R."

The writer, while assisting Dr. Hall, has experimented with the method first described, quite extensively, and some of the best results are: speed of 90 words per minute; continued service without readjustment for several hours; recorded signals of such low audibility that oral reception was difficult, have been recorded; tone selectivity (by use of resonator S) to within ⅛ octave, has enabled several messages to be recorded from one receiving set; and Nauen, Germany, etc., had been recorded in March and April, 1918, at Chicago with circuit in Fig. 6.

Fig. 8 shows a "bridge" circuit that has been used for the reduction of static. Two telephones are used, one attached to a resonator S, tuned to one tone of a two-tone arc, and the other to a resonator S_2, tuned to the other tone. In this way J and J_2 are acted on alternately but not simultaneously by the signals, and similarly C and C_2 change their resistances oppositely every time the tone changes. Thus the potential between A and D adds to that of B_3 for one tone, and subtracts for the other. Most crashes of static will affect both sides of the bridge about equally and in the same direction, hence producing little effect on the bridge. If C_1 and C_2 are long coils, it will take a loud crash of static indeed to cause both sides of the bridge to reach such a low point that a signal cannot influence one side more than the other.

The combinations possible with several such "jet relays" are almost unlimited. For instance, several receiving stations, miles apart, could be tuned to the same signal, Fig. 9, thus closing their relays simultaneously (in a series circuit) for the signal, but not all would close for static that was not perfectly general in character, and a clean record could be obtained at a central station R.

Recently the writer has made an investigation of the sensitive air jet and its

(*Continued on page* 1138)

Order Your Scientific and Technical Books *Now.*

They are difficult to obtain and prices are constantly increasing. We will quote present price on any book of this nature and the price will hold unless the publisher should increase his price in the interim.

Write for our 96-page catalogue—the most complete scientific and practical catalogue now issued. In addition, our 1920-1921 list will be sent you as soon as ready, and the prices in this list will hold good in possibly 80 per cent of cases; but you will be notified of any change before filling order.

There will be no obligation in requesting catalogue for we want you to know our Book Department. Write today. You'll find it valuable for suggesting books you need.

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Room 655, Woolworth Bldg., New York City

Agents: 90c an Hour



Introduce "Sodereze." A new wonder. A pure solder in paste form. Works like magic. Stops all leaks. For mending water buckets, cooking utensils, milk pails, water tanks, tin roofs—everything including granite ware, agate ware, tin, iron, copper, zinc, etc.

Quick Sales—Nice Profit

Everybody buys. Housewive, mechanics, electricians, jewelers, plumbers, tourists, motorcyclists, etc. No leak too bad to repair. Just apply a little "Sodereze," light a match and that's all. Put up in handy metal tubes. Carry quantity right with you. Write for sample and special proposition to agents.

AMERICAN PRODUCTS CO., 3016 American Bldg., Cincinnati, Ohio

LAW IN YOUR SPARE TIME AT HOME

Degree LL. B. Conferred

FOR BUSINESS FOR PROFESSION

Study law with only Institution which gives same Course by Correspondence through Lecture System as was given for years at resident classes of this College. Business today demands a knowledge of law for those who want success. Big opportunities in the legal profession. We coach you free to pass Bar Examination in any State. Special consultation privileges. Complete 24-volume library (12 books) specially prepared by leading professional and law trained business men. Organized 1910. Low enrollment fee, easy terms. Write for Free illustrated book.

HAMILTON COLLEGE of LAW, 402 Morton Bldg., Chicago

Make Your Own Violin

from exact reproductions of 12 old masters. Complete plans and specifications, one dollar, postpaid.

Violin Outfits from $15 Up

JOSEF DEULIN Violin Maker and Repairer "Everything for the Fiddle"
1414 Broadway :: DETROIT, MICH.

RADIO CLUB PINS

Special folder of designs and prices in addition to regular School pin catalog free on request. Be sure to see these new numbers which will put new life in your club.



METAL ARTS CO.
Dept. 12 Rochester, N. Y.

We have about 200 bound volumes of THE

Electrical Experimenter *now* Science and Invention

on hand. These volumes sold for $3.00, and in order to dispose of them we are selling each volume for $1.75 only.

Volume contains twelve numbers of the "Electrical Experimenter" magazine—May, 1918, to April, 1919, inclusive. There are 984 pages, 2,110 complete articles, 1,908 illustrations, 369 questions and answers. Sizes, 12" high; 9" wide; 2" thick. Bound heavily in green cloth.

$1.75 add postage for 8 lbs.

EXPERIMENTER PUBLISHING COMPANY, Inc.
Book Department
233 Fulton Street - New York, N. Y.



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addre t to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

How to Protect an Invention*

By JAY G. HOBSON

THE inventor who obtains the greatest remuneration from his improvement is possessed with sufficient knowledge of patent procedure, from the conception of his idea, to enable him to cover all points of possible attack upon his rights.

Hundreds of people have lost the fruit of their labors at the eleventh hour of success because some seemingly insignificant loophole in the beginning ultimately proved the undoing of their carefully laid plans for protection.

Every ounce of witnessed evidence is highly important as facts in proving priority of inventive conception. Even a small piece of scrap paper showing a drawing or specification of some added part, or change for practicability in the finished device, if properly dated, signed and witnessed by some trusted friend (not a relative) will often turn the tables in favor of the deserving party.

Photographs, models, designs, blueprints and all forms of descriptive matter concerning the invention in question are very valuable as proof of originality and ownership. So it behooves each person having ideas of worth to record steps of improvement as they are made in perfecting the article under consideration.

The first inventors of the adding machines and typewriters serve as shining examples of lack of attention to details of the progress made in perfecting their original ideas. Burroughs, the bank clerk, could have obtained basic patent protection on his embryo adder had he been farsighted enough to preserve each drawing and each model of his improvements. With basic patents he could have prevented numerous other concerns imitating the original conception and thereby secured greater monetary gain for himself.

On the other hand recall the case of Hoffman, who invented the modern steam pressing machine used in ninety-five per cent of all tailor shops today. Records of improvements from the beginning showing a very novel method of pressing clothes then in use, enabled the inventor and his associates to secure practically basic patents which at this writing exclude almost every attempt at infringement and competition. As a result the owners of this unique improvement are obtaining the rewards made possible by diligent attention to details of protection at the start.

There is as much difference between patents as between night and day. Because some unscrupulous patent attorney offers to get a patent, or no fee, is little assurance that the patent will be worth the paper it is printed on when it is allowed.

A patent without broad protective claims is really no patent at all. The claims embraced within the patent grant are the foundation of patent protection. If the claims are weak and too general you really have no protection.

I would rather have a patent with one broad claim than one with ten claims so thin that any person could get around them. Financiers, investors, manufacturers and stockholders are interested in any good improvement with broad, protective patent rights; but never in the kind that can be infringed upon by others.

Therefore, aspiring inventors should remember to preserve every important drawing for possible future proof in case it becomes necessary to fight some patent pirate who would claim priority and probably get away with it if the real inventor could not produce sufficient evidence to convince the judge, who in this case might be the United States Patent Office.

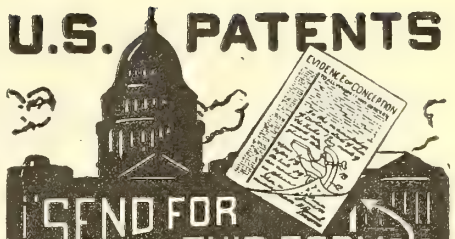
In the eye of the Patent Office, the word of the pirate is as good as that of the inventor unless one or the other can present the witnessed facts to prove who is the one entitled to Government protection.

While possession is conceded to be nine points of the law, yet the contestant may prove the possession to be stolen property if neither party can produce other evidence than oral testimony.

Save all evidence of development, employ an honest patent attorney and secure the patent before marketing the invention, which will result in the best protection against infringement and absolute loss.

(*Copyright* 1920)

*No queries are publisht this month owing to the article by Mr. Hobson.



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

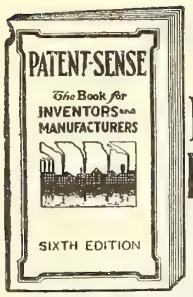
Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St. San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... *Address*.....



"The Book for Inventors and Manufacturers"

SIXTH EDITION

By return mail FREE. Write LACEY & LACEY Dept K. Washington, D.C.

PATENTS & TRADE-MARKS

SEND SKETCH AND DESCRIPTION for report on patentable nature, and instructions. Preliminary advice without charge. Full, prompt report in strict confidence. Reasonable terms, reliable service by Registered Patent Attorneys. WRITE TODAY.

CLARENCE A. O'BRIEN & CO.
PATENT LAWYERS
1023 WOODWARD BLG., WASHINGTON, D.C.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

PATENTS & TRADE-MARKS
FREE BOOKLET ON REQUEST
MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES
WARNER I. CUBBERLEY, PATENT ATTORNEY
22 NATIONAL UNION BUILDING
WASHINGTON D.C.

PATENTS

Write for free INVENTOR'S RECORD form for establishing the date of your Invention, and INVENTOR'S BULLETIN Confidential Service

WM. H. MULLIGAN, PATENT LAWYER
110 Woodward Bldg. Washington, D. C.

PATENTS

C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?

Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.
1926 Broadway, New York

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.

OFFICES
364 University St. Montreal, Canada
919 F St., N. W. Washington, D. C.

Free Book on PATENTS

HOW TO OBTAIN A PATENT

Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

Some Inventions to Invent

By SIENS N. ENVENSHN, Jr.

HAVING seen in 3 or 4 previous editions of this paper some suggestions by Uncle Jay Hobbyhorse on what ought to have been invented but hain't, I thot I would try to shove off some of my ingenious ideas on you, unsuspecting readers, for you to invent and get rich from.

Well, in the 1st place, the other day I chanct accidentally to want to go to the city to show off some of my patents, patent leathers, I mean, as I never wear 'em unless when I go there, and as usual I was obliged to set in the deepo till our train come; we have one each way, everyday, unless on Sunday, and I noticed what a burden it was for the agent to wake from his nap to sell the tickets (they was two of us going that day), and so I says why not sell tickets by slot machines, like chewing gum. Thar you are, then, invention No. 1.

The works would be as follos: Put a five cents piece in the slot to pay the cost of printing, this unlocks the works; then hit the typewriter keys on top of the machine and spell out where you are and where you want to go, such as for instants, *Crokers Corners to Brown Junction.* Then look at the table which shows the cost to go from anywhere to anywhere else, and then put the am't in a slot and you get a ticket. The only thing left for my readers to invent is to dope out a way of providing a way to see that the patron puts in enuff, which ought to be very simple.

When I had got this invented, along come the train and the two of us clumb aboard and was about to set down, but the seats was 2 dirty and we had 2 call a porter, and he was asleep; finally he come and I set down to think how to do away with the porters and decided that all they did was brush seats and people and open windows and collect tips, and that machinery could do all, except the last, witch I will accommodatingly do for the railroad.

A vacuum cleaner run by the car wheels with pipes running to the insides of the plush padding of the seats, would suck all the dust out of said padding and the occupant. Furthermore motors started and stopt by thermostats and *rain switches* could open and shut the windows, and all "you" haf to invent is a *smoke switch,* to start the motor when the smoke comes in.

To call the deepo's a electric phoney-graft, started by contacks made thru holes in a strip of paper run by a set of gears from the car's wheels, would do the work.

The holes is punched at distants so that for instants, when you have gone from Jonestown to Hooker's Crossing, or in other words, 10 miles,—the tape will have gone from one hole to another and the phoney-graft will holler—"Hooker's Crossing"!

Well, this is all the ideas I got that day, but it is enuff to make you rich, and when you get that way, don't forget your Uncle that put you where you are.—Contributed by Hilbert R. Moore.

What to Invent

By JAY G. HOBSON

(*Continued from page* 1102)

not always so with even their salt in the best of shakers made.

Therefore, in view of the very troublesome salt shaker used today, an improvement is much desired. One that I believe practical could be easily constructed to provide a simple means to force the salt thru the shaker top by a plunger arrangement operated by the thumb pressing rapidly upon the bottom of the shaker proper.

LEARN ENGINEERING

Electrical and Mechanical Engineers receive fabulous salaries. Thousands needed. We give you thorough personal training from 3 mos. to 2 yrs., under expert instructors. NOT A TRADE SCHOOL but a PRACTICAL-TECHNICAL COLLEGE teaching electricity, steam, gas, auto-tractor, armature winding, drafting. Extensive laboratory and shop equipment. DEGREES AWARDED. Day and night sessions; enroll any time. Write for free catalogue. Earn-while-you-learn plan.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.

Book on Law Free



Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.

Write Today—now while we are making a special reduced price offer.

American Correspondence School of Law
7442-3601 Michigan Ave., Chicago, Illinois

PATENTS Thirty-five years experience. Send model or sketch for opinion as to patentability. Free "Inventors Guide." Highest references and personal attention assure best results.

FRANKLIN H. HOUGH
520 Washington Loan & Trust Bldg.
Washington, D. C.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 74 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.

MUNN & CO., 618 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 625 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

Why continue to STAMMER?

Send for (free) illustrated 200-page book. It tells how Stammering and Stuttering can be quickly cured by the most Advanced Scientific Method in the world. THE LEWIS SCHOOL, 40 Adelaide, Detroit, Mich.

5 Master Keys

The world's most wonderful and only set of keys of its kind. They open and also test thousands of different locks. No home should be without them is the opinion of locksmiths, janitors, detectives, firemen, real estate men, travelers and many other users of our keys. They are highly endorsed as a precaution, convenience and household article. Send $1.00 for this set and novel key chain.
Master Key Co., 42 Manhattan Bldg., Milwaukee, Wis.

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write American School of Criminology, Dept. B, Detroit, Mich.

Be an Artist

Comics, Cartoons, Commercial, Newspaper and Magazine Illustrating, Pastel Crayon Portraits and Fashions. By Mail or Local Classes. Write for terms and List of successful students.

Associated Art Studios,
111 Flatiron Bldg. New York

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

BE A BANKER

Prepare by mail in spare time for this attractive profession, in which there are great opportunities. Send at once for free book, "How to Become a Banker"
EDGAR G. ALCORN, *President*
American School of Banking, 114 McLene Bldg., Columbus, O.

Learn to Write

I TEACH BY MAIL
WRITE FOR MY FREE BOOK "How to Become a Good Penman" and beautiful specimens Your name elegantly written on a card if you enclose stamp. Write for it today. F. W. TAMBLYN, 424 Meyer Bldg., Kansas City, Mo.

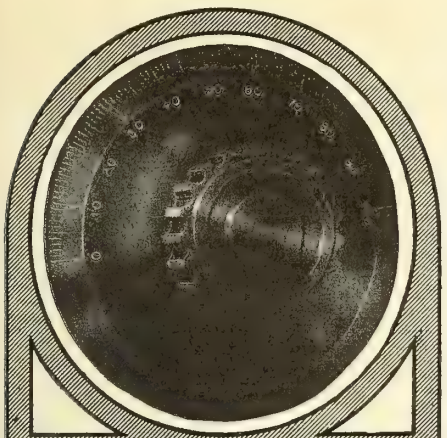
ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.



Printing Cheap

Cards, circulars, labels, book, paper. Press $12. Larger $35 Job press $150. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE, cards, etc. THE PRESS CO., D-47, Meriden, Conn.



CORWIN DIALS

There are two kinds of amateurs, those who get real pleasure and satisfaction out of their radio work, by using dependable equipment, and . . . . the rest.

There are two kinds of dials, Corwin Dials, and . . . . the rest.

The first class of radio men almost invariably choose Corwin Dials.

3″ Dial, 75c—with knob, $1.30
3⅞″ Dial, $1.00—with knob, $1.70

At all Radisco agencies, or sent postpaid anywhere

A. H. CORWIN & CO.
4 West Park St., Newark, N. J.

Become a
RADIO OPERATOR

Our Graduates
Now With
Independent Wireless Telegraph Co.
Ship Owners Radio Service
Radio Corporation of America
International Radio Telegraph Co.
U. S. Army Transport Service
American Hawaiian Line
and Many Others

Call or Write for Illustrated Booklet

Y. M. C. A. Radio School
152 E. 86th Street, New York, N. Y.
"Best Radio School in the East"

SEX KNOWLEDGE
By a Physician
SEX FACTS MADE PLAIN
What Every Young Man and Every Young Woman Should Know.
What Every Young Husband and Every Young Wife Should Know.
What Every Parent Should Know.
This Book Will Answer Questions You Would Like and Ought to Know, but Will Not Ask.
Price $1.00 Postpaid
Send for Free Catalog of Other Books.
UNITED SALES CO., Springfield, Ill.

A Radiogenes

By CHARLES S. WOLFE

(*Continued from page* 1070)

world until next morning, when the down train brought the morning papers and the operator.

Crafty Fred Ashton proposed to get the results of the fight by listening in with his unsuspected radio station to press accounts of the battle, and then hasten over to the store and put his money on a sure winner! The stage was all set for a "killing."

Then William's laughter became more difficult to control, for into his quick brain had flashed the rough outline of the counterplot.

The next day he hunted up two of his old and trusted pals. To them he entrusted the carrying out of certain details of his scheme, the substance of his instructions running something like this:

"Fellows, our compatriot, Mr. Fred Ashton, seeketh our scalps. I will not tell you how I know this fact, but be assured that I do. Unfortunately for Fred, he has reckoned without William Jones. I have been around the Horn, and across the Equator, and Frederick will have to get up earlier in the morning to slip one over on me. Fred proposes to do all his betting on the evening of the fight. Now how much money can we raise to cover his bets?"

Hasty inventory disclosed the fact that by pooling their capital, quite a goodly sum would be available.

"Fine!" cried William, when the statistics had been compiled. "Now I simply dare not be present to take Fred's offers, for he might possibly smell a rat. But you two take every cent he puts up. If you have to borrow cover him, no matter what your own private opinion of the fight may be."

One of the conspirators hesitated, demurring on the ground that a terrific sum might be involved, but William brushed his scruples aside.

"My only fear is that he may not have enough to satisfy us," he cried. "Take all he'll put up, and get it into the stakeholder's hands in cold cash."

And so it came to pass that on the night the fight was pulled off, Fred Ashton dropped into his chair before his instruments and donned the headset with shaking hands.

All unknown to Fred, in his carefully darkened room a hundred feet or so away, there sat also William Jones, who chuckled as he watched Fred's every move.

Ashton closed his aerial switch and lighted the filaments of his amplifier. As the set came to tune, a coarse, low-pitched station greeted his ears, batting away at a terrible clip. Beneath that fog-horn roar Fred could distinguish the faint, shrill, pipings of other stations, but profane experiments demonstrated that he could not tune out that bellowing monster.

As the minutes sped by and the coarse one showed no inclination to desist, Fred grew desperate. He tried to copy the speeding demon, but the rate was too much for him. He gave it over, and hung on on the off chance that the fellow might stop long enough for him to pick up something pertinent on the fight.

Finally, when it seemed to his tortured nerves that he simply must scream, comparative silence fell. The loud one had stopped. And there came to his ears the welcome, high-pitched piping of one of New York's press stations. His flying pencil followed the rhythmic Continental:



A Big Raise in Salary

Is Very Easy to Get, If You Go About It in the Right Way

You have often heard of others who doubled and trebled their salaries in a year's time. You wondered how they did it. Was it a pull? Don't you think it. When a man is hired he gets paid for exactly what he does, there's no sentiment in business. It's preparing for the future and knowing what to do at the right time that doubles and trebles salaries.

Remember When You Were a Kid

and tried to ride a bike for the very first time? You thought that you would never learn and then—all of a sudden you knew how, and said in surprise: "Why it's a cinch if you know how." It's that way with most things, and getting a job with big money is no exception to the rule, if you know how.

We Will Show You How

Without loss to you of a single working hour, we can show you a sure way to success and big pay. A large number of men in each of the positions listed are enjoying their salaries because of our help—we want to help you. Make check on the coupon against the job you want and we will help you get it. Write or print your name on the coupon and send it in today.

American School of Correspondence
Dept. G-226 Chicago, Ill., U. S. A.

American School of Correspondence,
Dept. G-226, Chicago, Ill.

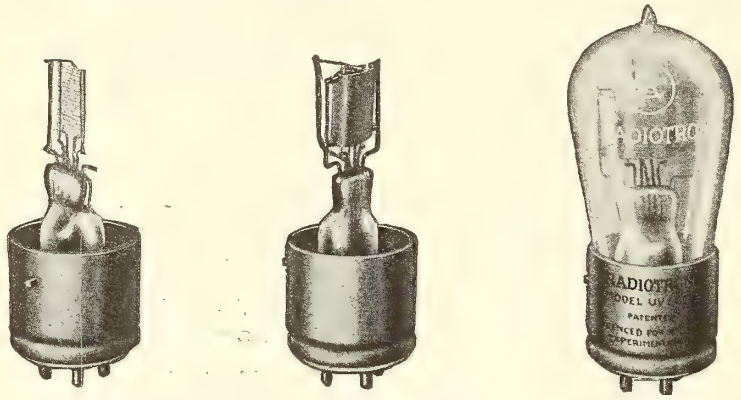
I want job checked — tell me how to get it.

.....Architect $5,000 to $15,000	.....Lawyer $5,000 to $15,000
.....Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Photoplay Writer $2,000 to $10,000
.....Certified Public Accountant $7,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telephone Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....Telegraph Engineer $2,500 to $5,000
.....Electrical Engineer $4,000 to $10,000	.....High School Graduate In two years
.....General Education In one year	.....Fire Insurance Expert $3,000 to $10,000

Name.....

Address.....

HAVE YOU SEEN THE NEW RADIOTRONS?



The first of this series is an ultra-sensitive detector, the second is a real signal amplifier—a combination destined to revolutionize amateur radio. Investigate and see for yourself.

Radiotron U.V. 200 is the most effective detector and tone frequency amplifier brought out to date. It operates from a single standard plate battery and has proved excellent for V. T. amateur circuits of all description.

List Price, $5.00

Radiotron U.V. 201 is an exceptional amplifier of the Pliotron type and proves advantageous for detection and for *radio* as well as tone frequency amplification. The filaments of both these tubes operate from a 6-volt storage battery.

List Price, $6.50

A complete line of vacuum tube ACCESSORIES is now in manufacture and will shortly be available.

Dealers and Jobbers: We have an especially attractive proposition for you. Write us at once.

Ready for instant mailing: two valuable bulletins containing explicit and detailed data as well as many practical circuit diagrams employing these two Radiotrons. Send for your copy today.

The Radio Corporation's tubes are covered by patents dated November 7th, 1905, January 15th, 1907, and February 18th, 1908, as well as by other patents issued and pending. Tubes licensed for amateur and experimental use only. Any other use will constitute an infringement.

Address all orders and inquiries to:
SALES DIVISION, COMMERCIAL DEPARTMENT

RADIO CORPORATION OF AMERICA
233 Broadway, New York City

JUNIORPHONE



A THERMO TELEPHONE
—WITH—
COMPLETE TALKING AND SIGNALLING SYSTEM

A PRACTICAL SCIENTIFIC TELEPHONE OPERATING ON A NEW PRINCIPLE.
EASILY ASSEMBLED FOR INSTANT USE
CAN NOT BE EQUALLED AS A DISTINCTIVE, INSTRUCTIVE AND INTERESTING NOVELTY.
APPEALS TO ALL UP-TO-THE-MINUTE YOUNGSTERS AS WELL AS TO THE GROWN UPS.



MANUFACTURED BY
AMERICAN THERMOPHONE COMPANY
114-116 BEDFORD ST. BOSTON, MASS.

"Twenty-first Round. Molinsky rushed from his corner and tore after the fast weakening O'Brien. He launched a terrible fusilade of lefts and rights. O'Brien clinched and hung on. Referee parted them. Molinsky dropped O'Brien with a—"

Fred shrieked a terrible imprecation, as, with a deafening roar, the old nuisance broke forth again. For five minutes Fred listened impotently to the ether-blasting bellowing, and just as he was going to quit in despair and go over to the store and risk his money on the strength of what he had heard, silence fell once more.

With a glad cry, he gripped his pencil. Joy! The press station was going!

"Twenty-second Round. O'Brien staggers from his corner as Molinsky rushes to meet him. Molinsky sends left to head. O'Brien counters feebly. Molinsky drops O'Brien for the count with a terrific right to the jaw, winning the championship."

With a gurgle of joy Ashton flung the head-set from him, seized his cap, put out his light, and rushed from the house.

Outside the store, he paused to gather his breath and his composure. Then, assuming a most casual attitude, he sauntered into the meeting.

All talk ceased as he crossed the threshold, for his avowed intention of placing his bets on the night of the fight was fresh in the minds of all. Enjoying the small sensation that his entrance had caused, he stood in the center of the floor, hands in his pockets, a sneer on his lips.

"Now then, you birds," he began, in his characteristically pleasant fashion, "I've been called a piker and a braggart around this place a good many times in the past few weeks. Let's see if we can pick out the pikers now. I have six hundred dollars here that says Molinsky wins the fight."

There was a startled gasp as Ashton fished a fat roll of greenbacks from his pocket. For an instant, stunned by the display of wealth, no one spoke. Then one of the conspirators came forward. It must be confest that he walked in a sort of trance. His highest previous wager had been five dollars, and on that occasion he had sat up all night awaiting the outcome. In a voice that he strove desperately to make cool, he croaked: "I'll take that bet, Ashton."

Somewhat startled, Ashton's cowardly soul faltered before this ready acceptance. But the knowledge he possessed reassured him. "You, Smith?" he nodded, carelessly dropping his money into the hands of the now important and excited stake-holder. "All right. Here's six hundred more. Any other sports in our midst?"

The crowd gaped and stared as Cole, the second of the conspiring trio, staggered forward to what he most certainly now regarded as the slaughter. He dropped his money soundlessly into the stake-holder's hands, as Ashton, his face betraying his surprise, followed suit.

Then Ashton played his trump card. Pausing to allow the moment to attain all its dramatic value, he said, slowly: "And now, pikers, I have one thousand more that says Molinsky wins. Any gentleman of the O'Brien persuasion present?"

There was a silence as the awed crowd huddled awaiting developments. Followed a ten minute delay while Smith and Cole, shaking but game, borrowed five hundred dollars. Then the bet was completed, and the crowd broke up in silence. It was an eventful night in the village.

The next morning the populace was out in force to greet the down train. And as it thundered to a stop, there was a rush for the open-doored baggage coach. The baggage master grinned as he hurled the bundle of morning papers out to the storekeeper. "Hooray for O'Brien!" he yelled, as he slammed the car door shut.

Fred Ashton started forward, amazement and incredulity mingling with dismay

Service-- the Keynote

There is no guesswork about what GREBE RADIO apparatus will do. In design, workmanship and material it is built for the most exacting Service.

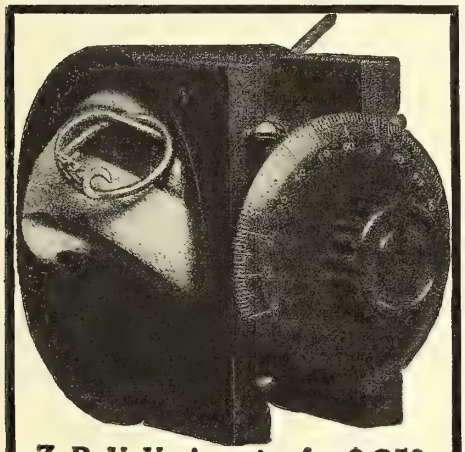
GREBE RADIO

apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service.

If your dealer doesn't carry our line, write us—mentioning his name—for catalogue.

A. H. Grebe & Co., Inc.
70 Van Wyck Blvd., Richmond Hill, N. Y.



Z. R. V. Variometer for $6.50
Short Wave Lengths

Complete catalogs of Radio Apparatus sent for 6 cents in stamps.

CLAPP-EASTHAM COMPANY
131 Main St. Cambridge, Mass.

A C. W. A
ACE Equipment ACE
E E

788 miles on nine-tenths of an ampere!

In test of our C.W. Transmitter, signals were copied at this distance. (Details on request.)

Complete transmitter mounted on grained formica panel 10x14x3/4, including motor generator, 4 A-P transmitting tubes, filter device, filament heating transformer, microphone, antenna current ammeter, plate current milliammeter and all necessary controls, etc., $395.00 f.o.b. Cincinnati. Complete transmitter, less motor-generator, $285.00.

Equipment so designed that either voice, buzzer modulated C.W. or straight C.W. transmission may be used by throwing single switch on panel. Construction of apparatus and material employed is of usual "ACE" quality.

"You may pay more, but you can't buy better."

THE PRECISION EQUIPMENT CO.
2437 Gilbert Ave.
Cincinnati Dept. E Ohio

PITTSCO

RADIO EQUIPMENT

Our catalog No. 22 illustrates everything in wireless. Send 10 cents in stamps for it.

F. D. PITTS CO.
Boston, Mass.
12 Park Square Dept. D

on his features. He raced for the crowd gathered about the opened papers. The head-lines confirmed his growing fears.

O'Brien Sends Molinsky Bye-Byes in the Fifteenth Round—A New Champion Crowned.

Then a second crowd gathered. Fred Ashton had fainted.

Later in the morning, Jones, the modern Ali Baba, sat with two of his confederates. Beyond doubt the other thirty-eight were there in the spirit. In the cool of his room he unfolded to his admiring audience the complete story of Fred Ashton's grievous downfall.

"You see, fellow citizens," he said, "when I saw Fred in his room with his set and realized that he was using his metal roof instead of a legitimate aerial, it dawned on me that here was the reason for his delayed betting. He intended to know the result before he put up his coin.

"I simply couldn't let him get away with it. I rummaged thru my old junk box and brought out two buzzers. The one I tinkered with until I got a high note that would pass very readily for any one of the commercial press stations. The other I adjusted to give a coarse, low tone, resembling an ordinary amateur, or old ship installation."

"Why two buzzers?" queried the interested Cole.

"Very necessary, my boy," responded William. "Vital, I might say. The high-noted outfit was designed to deliver to Frederick his hand picked news. The other was, to use an analogy, my "smoke screen." For while I was myself gathering some very badly needed information, I had to keep Frederick off the air. It wouldn't have done to have allowed him to listen to the chatter about the fight that must have been going on all evening. At the same time it would have spoiled it all to let him suspect that he was being prevented from hearing it intentionally. The coarse-pitched buzzer turned the trick nicely, disguised as an interfering station.

"So the other morning about two o'clock I hied me over into Ashton's yard and did things to the ground lead. Last night when he sat down to the set, I was waiting for him. I had the low-pitched outfit hooked up to my omnigraph and I just let it rave at somewhere around thirty-two per, which I felt confident he could never copy. Then when I knew myself how the scrap had gone, I switched off the omnigraph and gave him a round of the fight on the high-toned. I was watching him, and I saw that he had bit hard. Then, for art's sake, I gave him a little more of the omnigraph, and finished off with the 'Molinsky wins' stuff. Then he beat it to trim the gang."

"You had a set of your own rigged up and got the straight story first?" asked Smith.

"I did not!" retorted William, emphatically. "I realized the—er—frailties of the radio system, as instanced, for example, in what I was about to do to poor Frederick. So to make sure of things, the night that I embellished Ashton's ground lead I made an evening of it while I was at it. I shinnied up the pole in front of my house here. The commercial telegraph cable goes right by our door—past Fred's, too, for that matter, and if the boob had been half as smart as he thought he was he'd have done what I did—tapped that line and had a private wire in for the occasion. While I listened to the siren song of the sounder the omnigraph was demonstrating Continental as she should be shot to Freddy. All clear?"

The two conspirators nodded a wondering assent, and a silence fell—a busy silence. They were dividing Freddy's substance.

NEW KIND OF ELECTRICITY

Amazing New Vitality—Health Can Be Yours

Brings Wonderful Beauty and Health



At last! Electricity in its greatest form for the human system. Wonderful new Violet Ray treatments endorsed by physicians, beauty specialists, hospitals, osteopaths, and thousands of home users. Like a Godsend to sufferers. Like a beauty specialist for making poor complexions beautiful.

VI-REX Violet Rays

Better than gallons of liniment and drugs. Better than a ton of cosmetics. Violet Ray treatments now used at home by thousands. Remarkable records made in cases of ***neuritis, rheumatism, asthma, catarrh, deafness, insomnia, obesity, nervousness, lumbago, pains, as well as in cases of skin troubles, sallowness, pimples, blackheads, falling hair.***

10 Days' Trial Free



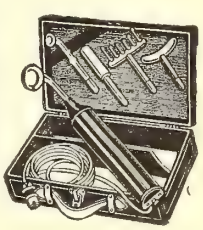
Try the Vi-Rex Violet Ray machine in your own home on our 10 day offer. Attach to any electric light socket or use Battery Outfit Complete. See how Violet Rays are absolutely painless and harmless. No shock. No vibration. Harmless even to infants. Soothing or stimulating as desired. Electricity in its most helpful, healing, soothing form. Creates energy, strength, vigor and beauty. Write for offer.

Send No Money

Do not send money now. Just write postal or mail coupon for wonderful free 52 Page Book explaining in detail. Read how Violet Rays massage every cell in the body. Read letters from users. See what physicians, sanatoriums, home users say.

WRITE NOW!

Why suffer? Why be satisfied with less than your full share of super health and beauty? See what wonderful Violet Rays will do for you. Mail coupon or write postal for free book and 10 days' Trial Offer. Do not miss this offer. Address NOW.



VI-REX ELECTRIC CO.
Dept. 41
326 W. Madison St., Chicago, Ill.

VI-REX ELECTRIC CO., Dept. 41
326 W. Madison St., Chicago, Ill.

Please send me your free book and particulars of your Trial Offer of the Vi-Rex Violet Ray Machine.

Name.....

Address.....

CUNNINGHAM



DETECTOR TUBE

TYPE C-300

WITH STANDARD FOUR PRONG BASE

TYPE C-300 invites comparison. Amateur requirements decided its design. Many years' research of vacuum tube properties have made Type C-300 the Ideal Amateur Receiving Tube. Detector sensitiveness at low plate voltages requires that gas motion be combined with the electron emission and by a **wonderful new process of manufacture** this gas action is so controlled that the plate voltage for maximum signal audibility is always within the limits 18-22½ volts. Only a single block cell is needed in the plate circuit—a big saving in battery investment. Type C-300 is completely silent in operation—a decided advantage in receiving weak signals.

Any three member vacuum tube is necessarily an amplifier, but the results obtained from Type C-300 as a tone frequency amplifier with only 22½-volt plate battery proved a surprise. Again Type C-300 invites comparison. Competitive tests show this tube to excel any tone frequency amplifier previously developed. For power amplification in operating loud-speaking telephones and in complex and multi-stage circuits use the special Plictron amplifier Type C-301 for freedom from distortion. Write for special Bulletin C-301.

Type C-300 is a free and persistent oscillator for regeneration. tive amplification and CW recep- from operating Type C-300 can- The pleasure and satisfaction dealer today—or write for his not be described. See your name and copy of Bulletin C-300.

TYPE C-300
$5.00

E. J. Cunningham

Trading as

AUDIOTRON MFG. COMPANY

35 Montgomery Street Dept. S. San Francisco

ELECTRIC LIGHT IN YOUR HOME $1.00





The latest electric light, no batteries to buy or electric bills to pay. Anyone can install and maintain this midget electric light. Safe, simple and inexpensive. No more smoke and smell, no wicks or oil, no chimneys to clean or break, just as safe in the barn, garage and clothes closet as in any open room, always ready for use, day or night. A touch on the switch and you instantly have a **bright electric light.** No matter where you live this light can be installed. It is not affected by heat or cold. Many homes have installed this electric light in their halls, closets, pantries, barns, sheds, cellars, garages, etc., with good results. It is an extremely useful light which no household should be without. The reason for this bright electric light is that the lighting bulb is fitted with a drawn Tungsten filament wire which is much more efficient and durable, besides giving a **300% increase in light** as compared with the ordinary carbon lamp. The power system furnished with this lighting outfit is somewhat similar to the electric power battery described. Each electric light outfit includes the following: Complete directions and plans, copper wire, insulated wire holders, knife switch, drop light fixture with socket, friction tape, battery protector, maroon shade, national mazda globe. Our dry battery compound, which assists in renewing and supplying the current and our current renewing system with which you can **renew the current at home without expense.** With every day use one recharge usually lasts two to three weeks. This electric lighting outfit is undoubtedly the most practical and durable electric light of low cost and long service ever devised. **Special price to introduce these electric lighting outfits $1.00, prepaid.** Outside the U. S. $1.25.

ADAMS BROS. Peoria and 13th Streets, CHICAGO

Grand Opera by Radio

By NELLY E. GARDNER

(*Continued from page* 1097)

tives of the press. And in the long halls of the Hotel McAlpin, had gathered a host of guests and employees to enjoy the rare musical treat. After the wireless concert, some of the enchanted listeners were invited into the apartment where they found Tetrazzini as gracious a hostess as she is a great musician. Much to the visitors' delight, the musicians began to play Titl's "Serenade," and Madame Luisa, as she likes to be called, began to hum softly. Gradually louder and fuller became her voice, until finally it rang out with all the triumphant glory of the opera. This extemporaneous concert seemed best of all to the men and women who sat there, listening in enchantment.

Madame Tetrazzini also heard a wireless telephone concert, that night. About 9 o'clock, the U. S. S. Texas, which was steaming 450 miles at sea, called New York and was connected with the apartment in the McAlpin. The Captain wanted to know if everything on shore was in readiness for the concert, saying that the men at sea were anxious that nothing should happen to spoil the evening that they were anticipating so eagerly. So Madame Tetrazzini talked to him, assured him that she was ready, and then to prove it, sang him a song all for himself.

In gratitude for this unexpected treat, the Captain replied, "Now I shall have one of my sailors sing for you."

Describing this incident, Tetrazzini put her hand to her heart, and said (partly in Italian, French and English), "Ah, I am so emotion tonight! I heard that lovely boy's voice sing to me, just as plain as if in this room. And such a voice it was! So sympathetic!"

As she spoke of her love for the soldiers and sailors her face lighted with the look that all kind-hearted and motherly women feel for the boys who risk their lives in the defense of their country. During the war, Madame Tetrazzini was renowned for her work among the Allied troops. In recognition of her extraordinary services, she wears the Victory bar of Italy; the first class medal of the Italian Red Cross; the Academic medal of Public Instruction in Paris; and an Italian decoration which is such a high honor that it has been bestowed upon only four Italian patriots—the Queen Mother, Margherita, Queen Helena, the Duchess of Aosta and Mme. Tetrazzini.

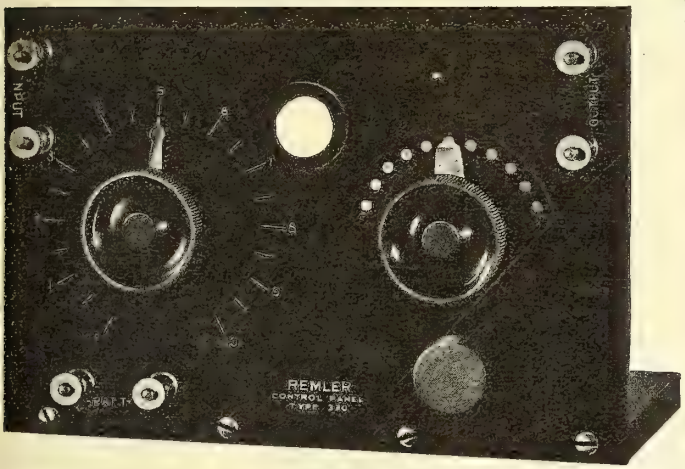
FARMERS WILL GET PRICES BY RADIO

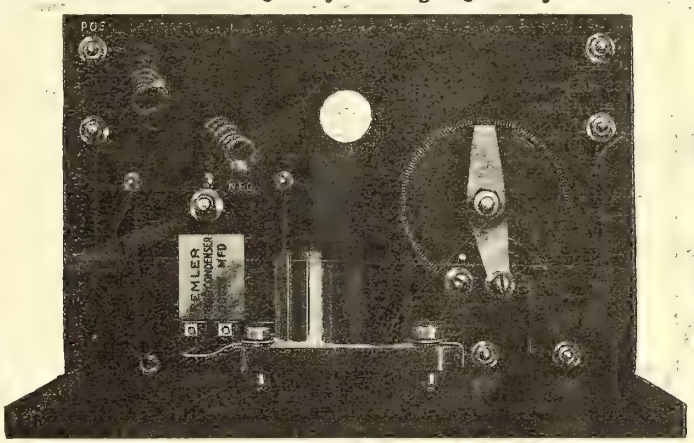
Market quotations are to be furnished daily by wireless to New Jersey farmers so as to keep growers supplied with up-to-the-minute information regarding the selling prices of their products, under an arrangement between the N. J. State Bureau of Markets and the Federal Bureau. Director Clark of the State Bureau invites boys' clubs to study wireless in order that their parents may avail themselves of the service.

"The quotations," he says, "and other valuable information of special interest to New Jersey farmers will be flashed from the Government wireless station at Washington at 5 o'clock each evening. Amateur stations to tune in for the market messages will require an instrument with sensitive detector and a 400 metre wave length. The message will be twice repeated and will be sent slowly enough for an amateur to jot it down if necessary, in dots and dashes for later interpretation."

Remler Type 330 Vacuum Tube Control Panel For the New Type C-300 Detector Tube

Maximum Value and Quality Through Quantity Production





THESE SPECIFICATIONS SPEAK FOR THEMSELVES

Genuine bakelite, highly polished, 5″ x 7¼″. White filled engraving. Special smooth running rheostat back mounted. All bakelite VT socket. The new Remler positive metal contact potentiometer for controlling plate voltage. Variable grid leak. Fixed grid condenser. Busbar wiring. Hardwood base. All metal parts polished nickel. . . . . **Price $8.00**

DEALERS: Send for our trade proposition on Remler Apparatus

REMLER RADIO MFG. CO. *"Apparatus that Radiates Quality"* **163 Sutter St., San Francisco, Calif.**

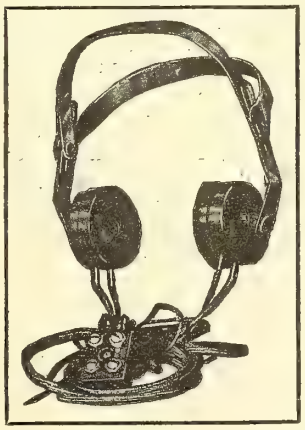
MURDOCK

No. 55

THE PRICES ARE UNUSUALLY LOW

2000 OHM DOUBLE SET

$4.50



THE QUALITY IS REMARKABLY HIGH

3000 OHM DOUBLE SET

$5.50

RIGHT IN PRICE AND IN PERFORMANCE

The substantial success earned by these receivers can be attributed to the instant recognition of their remarkable value by thousands of users. If, by chance, YOU are dubious regarding the possibility of securing really good 'phones at such prices, we suggest a trial, with the customary assurance of "satisfaction or money back." Ask your dealer for them.

BULLETIN No. 20 now ready for distribution. Send for your copy.

WM. J. MURDOCK CO. **55 Carter St., Chelsea, 50, Mass.**

509 Mission Street, San Francisco, Cal.

Why We Recommend Our Navy Type Headset For Exacting Use

OUR Navy Type Headset will produce audible signals from the least amount of current. Since the action is direct on the diaphragm, they work at the best mechanical ratio and there is no loss of current necessary to operate intervening mechanical movements. This diaphragm has a natural high pitch which enables the operator to read trans-Atlantic signals more readily through static interference.



"Navy Type" 50,000 Ohms A. C. Weight 9 oz., complete with head band and polarity indicating cord. Price $14.00.

The Navy Type is wound to an A. C. resistance of 50,000 ohms and is peculiarly adapted to vacuum tube reception. Then there is the exclusive Brandes feature of perfectly matched tone, which brings in the faintest signals in one clean, clear note.

BRANDES
Matched-Tone
HEADSETS

The sensitiveness and matched-tone features of Brandes headsets are permanent. The diaphragm is the only moving part, and as the headsets are of rugged construction for everyday use the adjustment is not easily disturbed. Brandes headsets require no tender care to keep them in perfect condition and no extra strong signal will make them inoperative.

You can pay more for a headset and you can buy a heavier one, but you cannot buy a better one than the Navy on the basis of sensitiveness, comfort or price. Send us $14 and we will send you a Navy Type Headset. Try it for 10 days. If you aren't satisfied, return the headset and we will refund your money without question.

C. BRANDES, Inc.
Room 814 32 Union Square
NEW YORK CITY

Also Makers of

Trans-Atlantic Headsets.....$12.00
Superior Headsets.....$8.00

Send 5c for Catalogue "E."

The Hall Jet Relay for Recording Radio Signals

(*Continued from page* 1130)

acoustical properties, employing an arrangement as shown in Figs 10 and 11. Air from a constant pressure tank entered at V_1, Fig. 10. Part of the air went thru valve V_3 and part thru a smoke producing chamber D, where punk was heated just sufficiently to cause partial combustion. The flow of air then passed thru V_5 and F direct to H, or thru V_4 and G a gas meter, by means of which the volume—and therefore the velocity—of the jet might be determined. A water manometer I measured the pressure.

Fig. 11 shows how the jet was ocularily examined. It is a well-known fact that the dust particles in a room are made visible by a strong beam of sunlight if the background is dark. The same principle is used here. A carbon arc illuminates the jet, and a screen shades the eye from the arc. A whistle W, or any suitable source of sound for the great range of pitches was used, either near the jet or sometimes at a distance and the sound conducted to the jet by a tube S.

First, curves were plotted for different jets, giving the relationship between pressures and velocity, so that in subsequent tests the velocity could be found from the pressure. Then a study was made of the jet, undisturbed by sound, to find the relation between the height of the jet and the velocity.

It would appear from some of the graphs, the lowest velocity, 44.5 feet per second, and a pitch of 3,000 gives the greatest response, but the fact is that this action is too slow to be very efficient and too unstable and sensitive. About the best working characteristics are: a diameter between .035 inch and .078 inch, velocity between 40 and 70 feet per second, and pitches any where from 500 up to 10,000 depending on the telephone receivers used, and the rest of the circuit.

For very high pitches a special receiver was constructed of low inductance and with a diafram about the size of a quarter of a dollar. This seemed to be less sensitive to static than lower pitch receivers. As high a frequency as 30,000 cycles has been tried with some success, with the idea in mind of building a system to work on a 10,000 meter wave without a detector, but this has never been thoroly tested.

The writer has put the sensitive jet to other uses, such as that of controlling an electrical toy by sounds with success.

It is possible to adjust the jet, the position of the platinum coil, and the pitch and construction of the resonator in such a way that the system will respond to but one tone, even tho other loud noises are present. On the other hand it may be adjusted so as to respond to the buzz of a fly!

"POPULAR ASTRONOMY" CORRECTION

In the "Popular Astronomy" article, page 892 of the December issue, the next to the last paragraph contained the word in the final line, possibility instead of impossibility. This paragraph should have read: "The theory that the moon was once an integral part of the earth has had many adherents and has been put forward by many of the world's greatest scientists, and from the foregoing facts and considerations it would seem that this is indeed a physical *impossibility*."

ABC Standardized Radio

Professional Radio Equipment at Amateur Prices!

IT TOOK three years to develop the *ABC* line of Standardized radio apparatus. Many of the instruments, and all of the small parts are now ready for the market. Automatic machines are turning them out quicker, better, and cheaper than ever before. Send a nickel for our advance booklet. It describes the small parts, the *ABC* sectional unit cabinets, the variable condensers, the new mica grid condenser, the Vibratone, Jr., etc. *Send for the booklet to-day.* You'll find it interesting.

Wireless Equipment Co., Inc.
188 Greenwich Street, New York



KNOBS

We have a large stock of knobs as illustrated. This knob is made of "Insulate" and is 1 inch in diameter with a 5/8-inch 3/16 threaded shank. Just the thing for rotary switches.

No. 4 Knob, each 15c; Per dozen $1.50
Shipping weight, each 2 ozs. per doz. 1 lb.

OTHER BARGAINS

Young & McCombs rotary spark gap, shipping weight 4 lbs. $16.00
Young & McCombs saw tooth rotor, shipping weight 1 lb. $4.60
De Forest variable condenser, shipping weight 2 lbs special price $5.75
Skinderviken transmitter button, shipping weight 4 oz. $1.00
Acme 1-2 K. W. semi-mounted transformer, shipping weight 30 lbs. $22.00

Send 15c for our big illustrated catalogue. This amount may be deducted on your first order for $1.50 or over. High printing costs make free distribution impossible.

ELECTRICAL SPECIALTY CO.
Dept. E. 48-50 S. Front St. Columbus, Ohio
Dept. E. 20 N. 9th. St. Philadelphia, Pa.



Thirty Day Special
AUDION CONTROL PANEL
Price $6.25 Prepaid

Polished Fomica panel size 4x6½ in. B battery control switch, Rheostat, tube socket, 6 binding post, and Grid Condensor, all metal parts polished nickel plated, use V. T. or Auditron bulb.

One Step Amplifier, Panel size 4x6½ in. Price $12.50 Prepaid.

Two step Amplifier, double filament controls. Panel size 6½x8 in. Price $22.50 Prepaid.

Send for complete literature; it's free

KEYSTONE RADIO COMPANY
MANUFACTURERS
Drawer 307 Greenville, Pa.

Arnold **Loose Couplers**
Combination Loose Coupler Parts and accessories.
Send 3c stamp for literature which is sure to interest you.

J. F. ARNOLD **2082 Lexington Av. N.Y. Established 1910**

Sex Books Clean, authoritative books on Sexology for those married or contemplating marriage. Catalogue free. **UNITED SALES CO., SPRINGFIELD, ILL.**

say

BAYER

Aspirin

Then It's Genuine

Unless you see the name "Bayer" on tablets, you are not getting genuine Aspirin prescribed by physicians for 21 years and proved safe by millions. Always say "Bayer."

Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid.

Deafness



Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums

"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable. Write *today* for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.

WILSON EAR DRUM CO., Incorporated
452 Inter-Southern Bldg. LOUISVILLE, KY.

Don't Wear a Truss



We Guarantee Your Comfort

with every Brooks' Appliance. New discovery. Wonderful. No obnoxious springs or pads. Automatic Air Cushions. **Binds and draws the broken parts together as you would a broken limb.** No salves. No plasters. No lies. Durable, cheap. Sent on trial to prove it. Full information and booklet free.

C. E. BROOKS
203D State St. Marshall, Mich.

PANDICULATE FOR HEALTH



BE WELL
YOUNG
STRONG

Booklet Free

Fifteen glorious minutes on Pandiculator better than two hours in gymnasium. Refreshes, rejuvenates; frees impinged, irritated nerves; corrects contracted muscles, spine ligaments; relieves congestion, improves circulation and body drainage. Doctors recommend it. No electricity, no discomfort; delightfully restful. Write now.

PANDICULATOR CO., 332 Advance Bldg., Cleveland, Ohio

"FIBRE-LITE" LIMBS



Easy Payments—Do Nature's Work. AGENTS WANTED who wear leg. Good Pay. FREE Fibre Sample.
Describe Stump to
WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.

The Divining Rod—Is It a Fake?

By PROF. T. O'CONOR SLOANE, Ph. D., L.L.D.

(*Continued from page* 1080)

is the tool of numberless fraudulent practitioners, the motion of the hand is so slight in its operation that there is room for a possibility of honesty on the part of a self-deceived practitioner or believer.

In all scientific work, the object is to remove experiments from extraneous effects. But here, to detect distant objects, the crudest imaginable appliance is used—one absolutely subject to human control and which it is practically impossible for anyone to abstract from such control, no matter how carefully or steadily he may attempt to hold it. It is absolutely unworthy of all scientific consideration. It is of purely psychical interest as a study in deception—both that of the observers, and in some cases of the operator himself.

There is any quantity of literature on the subject. In going back 500 years to Agricola's *"De Re Metallica,"* a book published in Latin in the 16th Century, we find several pages dedicated to the divining rod in which the author, whose German name was Georg Bauer, and who is known as Agricola, takes a very moderate view, being apparently afraid to say it is absurd and worthless, but advises people to use the regular methods of detecting ores, rather than attempt to exploit this instrument.

We reproduce the interesting wood cut from the old book showing the use of the rod in those days. One critic suggests that "there may be an element of sarcasm in the illustration," where some of the miners are extracting ore without waiting for the "dowser" to direct them.

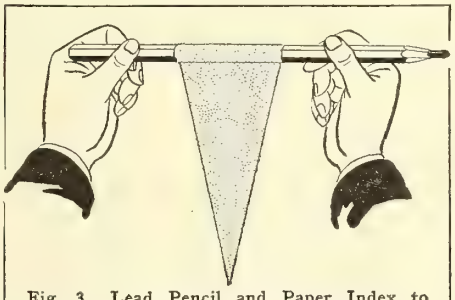


Fig. 3. Lead Pencil and Paper Index to Illustrate the Principle of the Divining Rod.

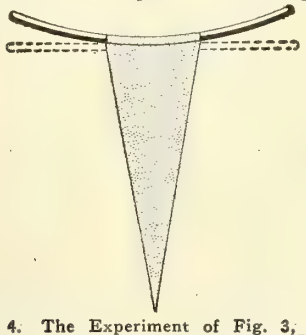


Fig. 4. The Experiment of Fig. 3, Using a Wire or Steel Knitting Needle, Instead of a Pencil.

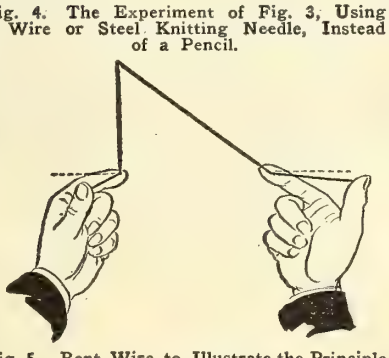


Fig. 5. Bent Wire to Illustrate the Principle of the Divining Rod.

"I believe that the care of the body is a sacred responsibility—the first we accept and the last we lay down."
—Lionel Strongfort

Physical Weakness Is A CRIME —Are You Guilty?

Have you prized your own body as your most precious possession? Have you kept it clean, externally and internally? Have you kept it free from taint? Have you a physique you can be proud of—a body you don't hesitate to reveal to your fellowmen in the shower or swimming pool or club dressing room?
You may be one of thousands of men who are leading wretched lives—tainted, diseased, wholly unfit for the strenuous tasks confronting you.

Slipping Back—To the Old Habits

Instead of being in the pink of condition as young and middle-aged men ought to be you may be one of those whose dissipations and excesses have weakened you so that you are degenerating, slipping back into your old, wicked habits again and have become a wretched human being, shunning society and being shunned—getting old long before your time—slinking through life, dejected, discouraged, diseased, hopeless.



Call a Halt Now

If you are one of these victims, let me caution you to call a halt to this slow suicide. Don't delude yourself with the transient relief drugs and dope give you. Day by day you will slip farther and farther into the chasm from which there will be less and less hope of rescue.

LET STRONGFORTISM Be a Big Brother to You

Through my scientific method I extend a helping hand to all who are in the frightful grip of disease, drugs and dope. Strongfortism reclaims human wreckage. If you feel down and out, it will brace you up, fill you with renewed life and energy, put pep into you and restore your confidence and manhood. It is not an ordinary physical culture course that I give you, but a unique system of individual assistance, which gives permanent health to anyone who follows my simple directions. I give you personal attention, pointing out to you the surest, speediest way of recovering. No one need know you are following my methods—all your friends will be astonished at the improvement that has come over you immediately after you begin following my instructions.

LIONEL STRONGFORT
Dr. Sargent, of Harvard, declared that "Strongfort is unquestionably the finest specimen of physical development ever seen."

Send for my Free Book—

"PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY" is a short cut to a fuller, freer, gladder and healthier life. Send a 10c piece for postage and read this wonderful book.

LIONEL STRONGFORT
Physical and Health Specialist
Dept. 231 Newark, N. J.

FREE CONSULTATION COUPON
Absolutely Confidential

Mr. Lionel Strongfort,
Dept. 231, Newark, N. J. Personal.
Please send me your book "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY," for postage of which I enclose a 10c piece.
Send me special information on subjects marked X below, without in any way obligating me.

..Colds	..Stomach Disorders	..Despondency
..Catarrh	..Constipation	..Skin Disorders
..Hay Fever	..Biliousness	..Impotency
..Asthma	..Torpid Liver	..Great Strength
..Obesity	..Indigestion	..Falling Hair
..Headache	..Nervousness	..Weak Eyes
..Thinness	..Poor Memory	..Pimples
..Rupture	..Rheumatism	..Blackheads
..Lumbago	..Gastritis	..Round Shoulder
..Neuritis	..Heart Weakness	..Lung Troubles
..Neuralgia	..Poor Circulation	..Female Disorders
..Flat Chest	..Increased Height	..Weak Back
..Deformity (Describe)	..Successful Marriage	..Muscular Development
..Insomnia	..Easy Childbirth	..Advanced Course
..Vital Depletion	..Drug Addicts	..Healthy Children
..Youthful Errors		..Manhood Restored
..Short Wind		
..Flat Feet		

Here mention other subjects not listed above:

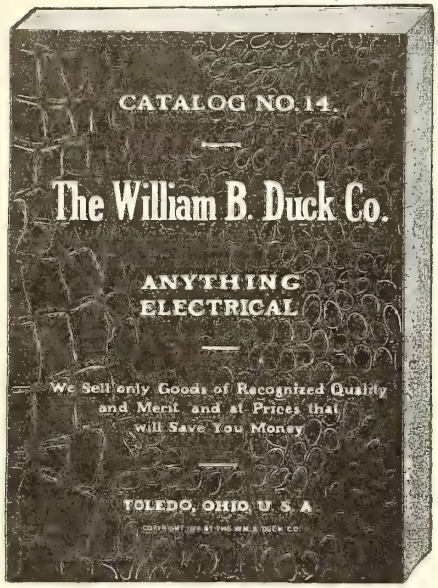
.....

Name .....
Age.....Occupation .....
Street .....
City.....State.....

"The Greatest Radio Catalog in the World"—*The Universal Verdict of Tens of Thousands of Radio Amateurs*

DUCK'S No. 14 BIG 200 PAGE WIRELESS CATALOG

A Veritable Treasure House of Everything Worth While and Dependable in Radio. The largest, most comprehensive, artistic and educational wireless catalog published. The Beacon Light to guide you right in the selection of your radio purchases, and at prices that will command your attention. Every instrument guaranteed with privilege of return if not satisfied.



Mail 12c in stamps or coin (*not sent otherwise*), which amount you are privileged to deduct on first dollar purchase. Revised price list to first edition of catalog, with prevailing prices, mailed on request

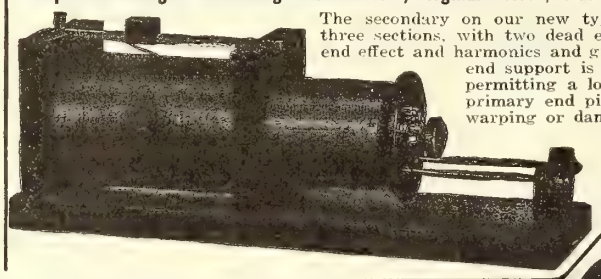
Announcing **Permanent Reductions on 3 of our most popular Radio Instruments**

The demand last month for our Navy Type, Arlington, and No. 7721 Receiving Transformers at the greatly reduced prices convinced us that with large quantity production, because of the exceedingly attractive prices on these instruments, we can continue to maintain these low prices. We therefore announce the following permanent reductions on these instruments.

Model 5BB Navy Type Receiving Transformer, Former Price $27.50. NEW PRICE $21.95
No. 1091 Improved Type Arlington Receiving Transformer, Regular Price $15.00. NEW PRICE $11.95
No. 7721 Receiving Transformer, Regular Price, $9.00. NEW PRICE $7.50

Send your order immediately for your choice of these popular instruments

Improved Arlington Receiving Transformers, Regular Price $15.00 New Price, Only $11.95

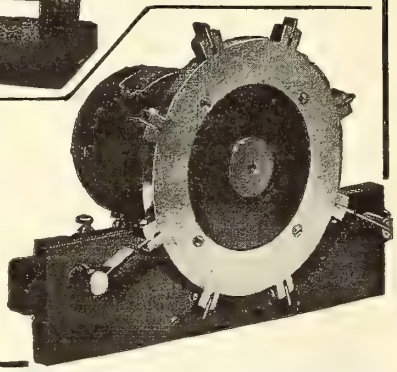


The secondary on our new type Arlington is divided into three sections, with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy, permitting a looser coupling. The base and primary end pieces have a spline to prevent warping or damage in transit. This feature is also on our Navy. It is a beautifully finished instrument.

Improved Type Sayville Rotary Gap

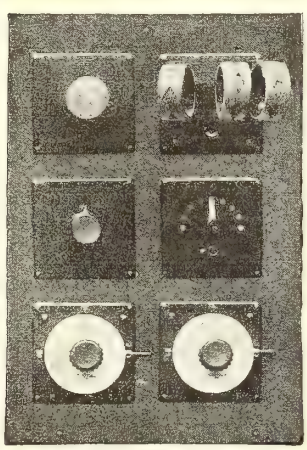
Embodies the latest and best features in Spark Gap Construction

Our New Type Sayville Rotary Gap is, we believe, far in advance of any rotary gap on the market within a range even of twice the price. It is the final development of many different types made in our experimental Radio Laboratory. It fulfills every requirement of the ideal rotary gap. It is neat and attractive in appearance; simple and durable in construction; possesses a wonderful motor; has a cast aluminum rotary wheel, beautifully polished; every part is in perfect alignment; there is no wobbling of the rotor; produces and maintains a clear and pure 500-cycle note; is instantaneous in action; permits of no dragging of the spark; has contacts of tempered flat copper of proper length and width, easily and quickly removable, and inexpensively renewable; the stationary contacts are adjustable to any length..... **$27.50**



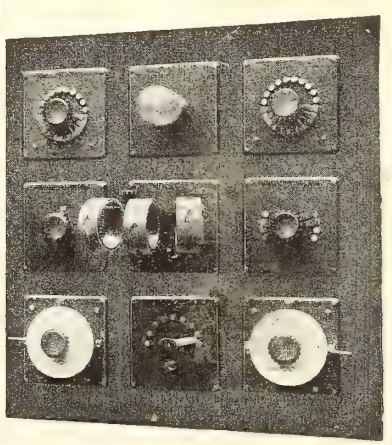
THE WILLIAM B. DUCK COMPANY, 230-232 Superior Street, TOLEDO, OHIO

Newest Ideas in De Forest Unit System Receiving Apparatus



Six Panel Unit Set

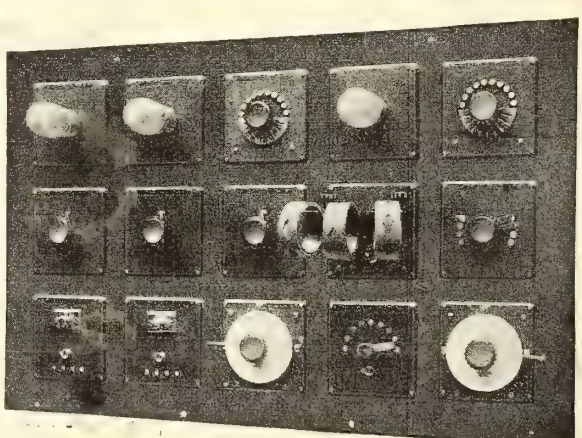
Comprising a combined Tuner and Detector to receive all local stations and practically any large station in the world. Everything necessary for the operation of the set, *including detector tube, "B" battery, head phones and a set of 11 coils*, can be had for $75.00 complete. (Purchaser to furnish panel board and "A" battery.) This set will give greater satisfaction than any outfit at anywhere near this price. Expansion possibilities unlimited



Nine Panel Unit Set

Comprising the same six panels shown above, and either three additional panels to give one step of amplification, or three panels to increase the efficiency of the original six. The former will add about $23.70 to the cost of the original six; the latter about $12.10.

ADVANTAGES of the Unit System include extreme economy due to the simplicity and interchangeability of the units; convenience in arranging circuits to the individual need; and greater operating efficiency due to the engineering design and quality of the instruments. The Unit Sets shown here are a few examples.



Fifteen Panel Unit Set

Comprising the original six panels, with either of the additional three panels included in the Nine Panel Set, and also two additional steps of amplification. Thus for a total of about $134.50, or $146.10, a full Fifteen Panel Set that will outdo any other receiving apparatus may be had.

DE FOREST RADIO TEL. AND TEL. CO.

Manufacturers and Inventors of High-Grade Radio Apparatus
1415 Sedgwick Avenue, New York, N. Y.
LEE DE FOREST, Inc., Western Distributors
351 Third Street, San Francisco

A Floating City

(*Continued from page* 1063)

motion, and this will be greatly reduced in its effects by the distance intervening between the bearings. If one ship is rising on the sea and the other descending, the 1,500 foot length of chord of the truss will make the inclination imparted to the platform very slight.

A great central crane is provided for handling goods, and of course special docks for giving access to the great structure will be provided.

Electricity is supposed to be applied in the most advanced way. A very powerful electric power station is to supply electric light for the *city* and to drive the motors of the four ships, as well as to take care of the steering. The ships, it is specified, are to have twin screws. Nothing is said about the effect of the wind on such a structure, but it is evident that it will be very great, and how far it may affect the operation is a matter of surmise.

New Draft Device Saves Fuel

By HAROLD A. MOORE

(*Continued from page* 1078)

tank, the action being perfectly comparable to that of the ordinary ball cock used on tanks in the houses.

The cock regulated by the float is stationed on a by-pass and the thru-line of pipe parallel to the by-pass, contains a supply cock which can be opened or shut by hand, so as to permit of hand regulation.

That is all that is to be said about the apparatus, which is simplicity in itself. It is claimed that by its accurate regulation, extraordinary results in the way of efficiency, are obtained; that evolution of obnoxious gases is prevented; and that metal laden vapors of great value are saved in the condensing chambers, presumably by the prevention of too strong a draft.

Recently, Mr. J. O. Anderson, the inventor of the new draft regulating device, has, according to reliable authority, successfully demonstrated the adaptability of his device for use in plants that generate steam for power purposes. On a cannery in Puyallup, Washington, he has erected one of his regulators and has produced results that are said to be radical improvements in combustion methods. The firm which allowed him to demonstrate was installing three new boilers and fireboxes to take care of increased demands made upon their power plant. One of these boilers had been installed under Mr. Anderson's direction, with combustion chambers and stack built according to his specifications, and upon its completion he prevailed upon them to allow him to proceed with his demonstrations from that point. He installed his draft regulator and fired up the boilers.

The first day he produced the full capacity of the boiler in steam with but 40 per cent of the fuel that the firm had expected to use. Experiments were made with crude oil, wood and coal as fuels, and with all the same satisfactory results were obtained. After five days, with minor adjustments, *he was able to effect a saving in fuel of over 80 per cent*, and was producing almost as much steam as the three boilers would have generated under ordinary circumstances.

Cost Accounting

New Post-Graduate Course NOW READY

A really remarkable development in extension accounting instruction—the creation of master accountants and industrial engineers. Absolutely new in both material and method.

Comprises 30 loose-leaf lessons supplemented by numerous charts and graphs. Every student under the personal instruction of nationally known specialists.

This course is open to any accountant whose broad experience and advanced standing qualify him to take up the work without preliminary instruction as well as to any graduate of our 90-lesson course in advanced accounting.

Cost Accounting Booklet Sent Free

In order to give you a thorough comprehension of our new method of instruction, we want to send you, free of charge, an instructive booklet on Cost Accounting, containing an organization chart and an interesting explanation of the "Organization in Balance." Address

International Accountants Society, Inc.

"The Professional School of Accounting"

2626 South Michigan Avenue, Chicago, Illinois

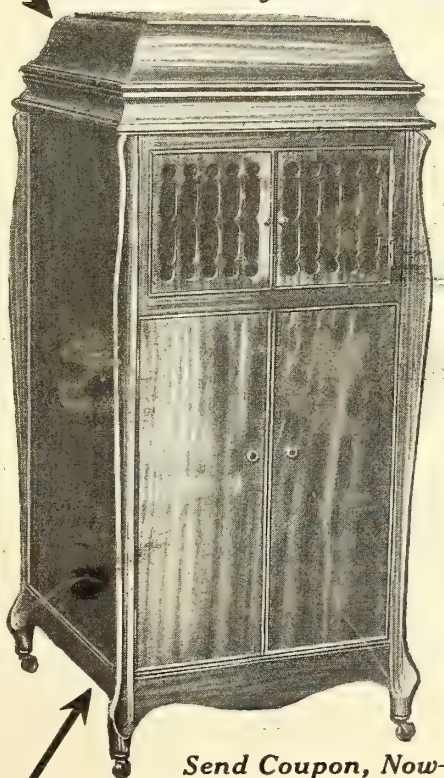
International Accountants Society, Inc., Dept. 221, 2626 S. Michigan Ave., Chicago, Ill.

Gentlemen: I am interested in your advanced accounting courses. Please send me complete information on subjects checked.

☐COST ACCOUNTING AND SYSTEMATIZING ☐Credits and Credit Administration
☐C. P. A. Coaching ☐General Accounting; Preparatory for Post-Graduate Course ☐Internal (Executive) Auditing
☐Income Tax ☐External (Public) Auditing ☐Applied Business Statistics

Name.....Street Address.....
City .....State.....Age?.....Position? .....
Education?.....Any practical experience?.....
Ever studied accounting?.....Where and how much?.....

YOU Can *Easily* BUILD This PHONOGRAPH



TREMENDOUS SAVING IN COST

You don't need to be a cabinet maker. We have made it an easy and pleasant job with

Our Simplified Plans We furnish blue prints, diagrams, motor, ready-built horn, cabinet pieces and all metal parts complete. You do the assembling; **6 models to choose from.** A few hours work, and you will have as fine a type of phonograph as any produced, and at a price away below what you would pay in a store.

KEEP THE SAVINGS IN YOUR POCKET

Machines play all records, have a wonderful tonal quality, excelled by none. No need now for any family to be without a phonograph because of the cost. THE MAKAFONE solves the problem. BUILD IT YOURSELF AT LESS THAN ONE-FOURTH REGULAR COST, but equal to the high-priced cabinet machines. Free Records with each outfit. SEND TODAY FOR FREE CATALOG and full particulars of our wonderful offer. *Many a manufacturer got his start in this way. Why not you? Build machines and sell to your friends.*

Agents Attention You can make and sell *these* machines from our plans at a profit of $50 to $75 each. Others are selling two and three a week. Here is your opportunity to make big money and become independent. Pleasant and profitable work.

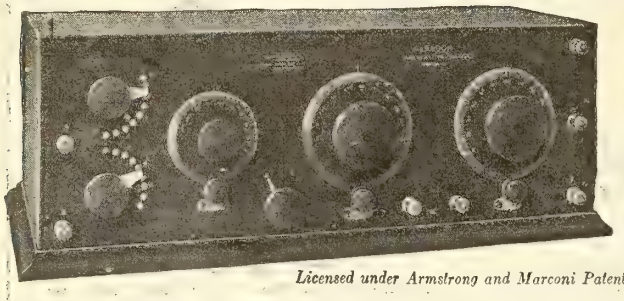
Send Coupon, Now—Today

MODERN PHONOGRAPH SUPPLY CO.
510 Springer Bldg., 313 So. Clinton Street, Chicago.

Modern Phonograph Supply Co.
510 Springer Bldg.
313 So. Clinton St., Chicago, Ill.

Gentlemen: Please send me full particulars of your Makafone proposition, without obligation to me.

Name.....
Address.....State.....



Be sure it's a *Real* Paragon — Look for the phrase, Type R. A. TEN, engraved in the bakelite panel.

Licensed under Armstrong and Marconi Patents

If it *isn't* an R. A. TEN—it *isn't* a PARAGON

Features of the genuine

Paragon R. A. TEN

(Reg. U. S. Pat. Office)

Amplifying Short Wave Receiver

Wave length, 160 to 1,000 meters.
Amplification 100 times.
No dead end losses whatever.
Vernier attachments on controls.
Guaranteed for *two* years.
Price Eighty-Five Dollars.

THIS Advertisement is published more for your protection than for ours. Only recently, several letters have come in from radio men, who bought imitation Paragons, and were tremendously disappointed.

YOU can tell the genuine by looking for the full name on the panel. The complete name is copyrighted, and the use of "Paragon" on any other instrument is therefore *illegal*, as well as unfair and deceptive.

Be sure to get a Paragon—a real Paragon—and prove for yourself that "The weaker the signal, the stronger the amplification."

Our word of honor to you is our guarantee—Let us prove it

CONTINENTAL RADIO AND ELECTRIC CORP.

J. DI BLASI, Sec. Dept A11. | *Sole Distributors of the Paragon RA-TEN* 6 Warren Street | J. STANTLEY, Treas. New York

BY MAIL, *or at our store,* you can be sure of accurate, helpful service. People who thoroughly understand amateur radio will help you select your equipment from a stock which includes every good make. Prices clearly reflect the savings of low rent and expense.

Have you seen the new FADA Audion Control Panel, with the automatic filiament control? We have a complete assortment of these splendid cabinets. Price $17.50.

SPECIAL CLEARANCE: Small lot of D. C. Volt meters. 500 to 600 volts. Brand new, splendid quality, we ran across the lot at a bargain. Price $14. *Fully guaranteed.* Send your order promptly.

New 84-page catalogue just out.
Send 10c. for your copy.

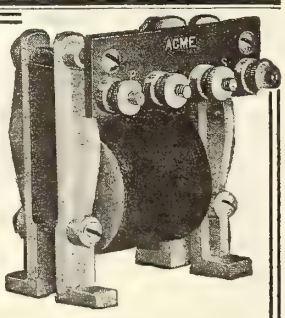
American Electro Technical Appliance Co.

235 Fulton St. Dept. E. S. New York.

ACME AMPLIFYING TRANSFORMER
$5.00

The Heart of Any Amplifier. Can't Be Beat.

Carried in Stock by Leading Dealers. Write for Bulletins.



Acme Apparatus Company 28 WINDSOR STREET CAMBRIDGE 39, MASS.

SUCCESS OPPORTUNITY **UTTMARK'S NAUTICAL ACADEMY RADIO SCHOOL**

Offers a thorough course in all branches of wireless telegraphy. Radio Operators earn at the start $125.00 per month, and first-class board, etc., free.
Our school prepares you for your license in three to four months. Positions guaranteed to first-grade licensed operators.

Day and Evening Classes

8 State Street, New York, N. Y.

Phone, Bowling Green 8079

The X-Ray Fluid

By JULES H. STEAN, Ph. D.

(Continued from page 1076)

membranes, thru the action of x-ray fluid. Also the auricle of the ear is, due to its tissue structure, transparent, but visible in detail.

Another cut, half body part of fœtus, shows the ribs partly developed and partly composed of cartilage. It also shows the tissue, the thickness of which may be seen above the spinal column.

The second cut, arm and hand of a fœtus, is characteristic of the power of the fluid. Here we have the developed bones, as well as the undeveloped ones. The picture shows the ossification of the bones remarkably well. The ulna and radius not developed to the full degree are plainly visible.

The photographs of the specimen have lost very much in detail and appearance, as the specimens were preserved in ordinary glass vessels which caused a distortion of light in photographing, but the pictures may give a good idea as to the value of the fluid in the study of anatomy.

The reproduction demonstrates that *the transparent specimen shows all parts of the inside body,* which parts may differ in the index of refraction materially from the tissues.

In order to produce specimens which show inside parts, as bones, or the more plastic arteries, the bones may be stained *or the blood vessels filled with colored substance.* For instance, instructive preparations may be obtained by injecting into the blood vessels colored fluid for the demonstrating of the vascular system and the specimen may then be immersed and preserved in the x-ray fluid.

The study of the structure of the vegetable texture shows some remarkable and interesting details when penetrated by the x-ray fluid. *Wood one-half inch in thickness acquires such a transparency that print can be read thru the board.* But the wood has not lost the detail of its structure at all, and is preserved unharmed.

Leaves and flowers are very easily prepared and give a unique picture entirely clear to look thru, except that the veins stand out very prominently.

Taking into consideration the work accomplished with the x-ray fluid, it can be said that it will be a valuable help for the student and layman for the study of anatomy, as well as for the botanist.

Rare specimens can be preserved in the natural state indefinitely, eliminating wax preparations to a large extent.

Here a student may handle the glass vessel containing the prepared specimen, may observe the interesting features of the object without being handicapt in his imagination, as he would be in the case of a wax preparation. Every part of the specimen is visible in the glass vessel and tissue and underlying parts may be seen clearly in their original form. No parts need to be touched or dissected and knowledge may be obtained in a more sanitary form and more thoroly than by the old method.

BUYING RECORDS BY TELEPHONE

Numbers of people have already written the manager of this new department telling him how much pleasure it has given them to hear new records over the telephone so that they might order them without further trouble. Needless to say, the sales in this department have greatly increased since the plan is in use.

Is Electrocution Humane?

By JOSEPH H. KRAUS

(*Continued from page* 1081)

will be stimulated as near to the muscle as possible, and secondly, when the nerve is stimulated as far away from the muscle as possible.

The distance between the two bare wire electrodes is now carefully measured. A record is then made with a tuning fork giving exactly 250 vibrations per second and which has mounted on one prong a fine wire. It will be seen therefore, that between each two adjacent points of the tuning fork record one-250th of a second has elapsed and from the graph we also see that there is a certain latent period between experiment one and experiment two, the muscle having contracted more rapidly in experiment one than in number two.

The difference in time is then carefully measured, and when compared with the difference in lengths of the nerve, a definite ratio will have been established. The rate of impulses can then be computed and the following speeds observed. In the sciatic nerve of a frog the speed of nerve impulse transmission has been calculated as 27 meters per second. In man this speed has been found to be from 110 to 140 meters per second. Just compare this speed with that of light or compare this with the speed of electricity—three hundred million meters per second.

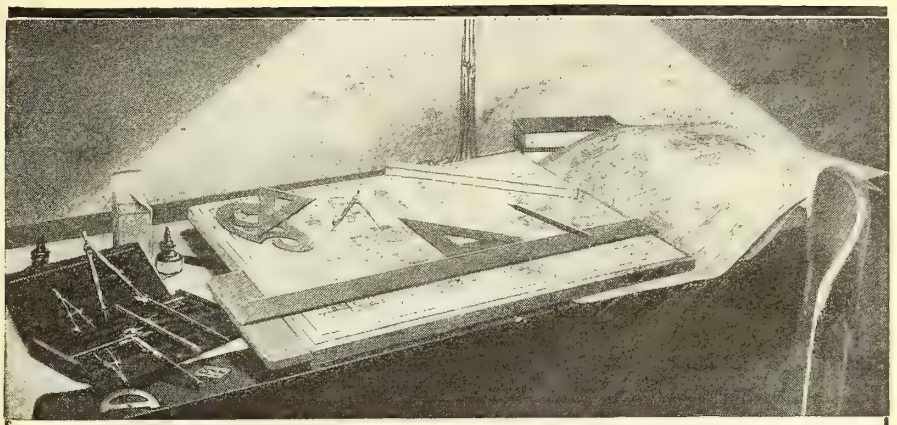
It is obviously impossible for a nerve to transmit a sense of pain to the brain at the terrific speed at which electricity travels, contracting as it does, every muscle in the body including the involuntary muscles of the heart and causing this contraction to be maintained, at the same time rendering the individual unconscious.

Dr. Spitzka has definitely stated that were he to die in any way whatsoever, he would prefer the electric chair, except for the stigma attached to such an execution. "Were capital punishment," he says, "properly handled in this and other states in the Union, there would not be half as many murders as are occurring daily."

A murderer now, however, has many chances to get away without paying the penalty. At first he can plead insanity, sometimes a very ridiculous plea, wherein the fact that he swallowed a pin when an infant, has even been brought up as evidence. If adjudged insane, he goes to an asylum where there is a reasonable chance of getting out. If he is indicted for murder in the first degree and found guilty, he may receive one of two sentences, either life imprisonment or be sentenced to die.

With life imprisonment he may fight for and obtain a pardon. Again, he may have the death sentence appealed to a higher court. After the appeal is granted he has another chance; if again adjudged guilty and the order of the lower court is comfirmed he may appeal to a still higher court. At all times he may apply to the Governor for a commutation of sentence.

Obviously, therefore, it would seem that in order to make capital punishment what it should be, it is necessary that it be carried out drastically. This does not mean to infer that the editors are in favor of capital punishment in any form, but the rapidly increasing number of murders tend to show that something is radically wrong somewhere.



Draftsman's Complete Outfit FREE

Everything used by expert draftsmen given you absolutely free. Outfit includes "professional" complete set of fine drawing instruments in velvet lined case, drawing board, T square, two triangles, protractor, universal curve, triangular standard scale, water-proof ink, pens, pencils and all accessories.

Easy to Learn at Home

from Largest School of Its Kind in the World

The Coyne Home Study course guarantees to train you. The Coyne Trade and Engineering Schools is the largest institution of its kind in the world. Students come from all over the **world** to get Coyne training because of the Coyne schools' long established, tremendous reputation. Coyne originated the "Learn by Doing" method now endorsed by educators everywhere. Write for the Coyne free book. Some Coyne students took **good positions 3 months before their course was finished.**

Send for FREE Book

Mail this coupon for our interesting book, "Drafting the Foundation of Industry," sent you free. It shows you how to become a draftsman in the quickest and easiest way. It's absolutely free, no obligation. Send the coupon now.

COYNE
HOME STUDY DEPT.
TRADE & ENGINEERING SCHOOLS
Largest Institution of Its Kind In the World
39-51 East Illinois St., Dept. 1252, Chicago Ill.

Draftsmen Make $225.00 to $500.00 a month

There is a tremendous demand for trained draftsmen. Draftsmen get good pay from the very start and can work up $500 a month *and more.* You can travel and work in any business in any part of the country you please. Coyne training makes everything easy. Coyne student L. T. Dubendorf writes: "Immediately after completing Coyne course I went to work for Armour & Co. Work was easy for me. Five months later I accepted a position in New York at a large increase in salary."

Coyne Trade and Engineering Schools,
Dept. 1252 39-51 E. Illinois St., Chicago, Ill.

Dear Sirs: Please send me, absolutely free, without obligation, your book, "Drafting the Foundation of Industry," also full information about the Coyne Home Study Course in Drafting.

Name.....

Address.....

.....*State*.....



Free Trial

YOU may have any instrument with complete musical outfit, for a week's free trial at home. No obligation. Return it at our expense after trial if you wish. Outfit includes velvet lined case, self instructor, music and all accessories at factory cost. A tremendous saving.

Convenient Monthly Payments

A few cents a day will pay for instrument and outfit if you decide to keep it. Wurlitzer instruments are known all over the world for artistic quality.

Send Coupon for Beautiful New Catalog

Every instrument known illustrated with price, easy terms and free trial blank. Catalog absolutely free. No obligation. Send this coupon now.

The Rudolph Wurlitzer Co., Dept. 1252
117 E. 4th St., Cincinnati, O.—329 S. Wabash Ave., Chicago
120 W. 42nd St., New York, N. Y.

Send me your new catalog illustrated in color with full details of Wurlitzer Complete Outfits and free trial and easy payment offer.

Name _____

Address _____

(State instrument you are especially interested in.)

Trade Mark Registered
WURLITZER
200 YEARS OF MUSICAL INSTRUMENT MAKING
Copyright 1920 Rudolph Wurlitzer Co.

JUST WHAT YOU WANT ON SEA FARM OR RANCH
OVER 2½ FEET LONG
ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.

Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. **Guaranteed by the maker.** Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness. Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.

EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.

WARNER'S INFALLIBLE AUTOMATIC PISTOL

$25.00



Best value in Automatics in America. Shoots Colt 32 Cal. Automatic Cartridges. Has TWO MAGAZINES — 15 quick successive shots. The Pistol takes eight cartridges at one loading, one in the chamber and seven in the magazine. The extra magazine is loaded with seven more and kept ready for instant reloading. Each empty shell is automatically ejected immediately after firing. Fixed stationary barrel, ensuring great accuracy. Trigger action is exceptionally light and quick, and must be pulled back for each shot. Never misses fire or jams. Has Safety Lock for disconnecting the pistol when not in use. Length over all—Total length, 6¼ in., barrel 3¼ in. Material, workmanship and finish of the highest possible grade throughout. A wonderful combination of ACCURACY and RELIABILITY. Superb shooting qualities; as easy to aim as pointing the finger; works as smooth as an engine; will shoot through four inches of pine wood. Fine for target shooting. Weighs only 23 ounces. Sold under positive guarantee to shoot equal to any pistol on the market or money refunded. Price, only $25.00 postpaid. Cartridges (express only), $4.50 per 100.

15 Quick Shots

32 Cal.

AUTOMATIC REVOLVER

HIGH QUALITY - RIFLED BARREL - GOOD VALUE

With Shell-Ejecting Device

PRICE **$13.00**

.22 Cal. .32 Cal. .38 Cal.



One of the most powerful and effective weapons made. The .22 can be fired rapidly and in succession, as fast as you can count. The ideal weapon for Express Men, Bank Agents, Pay Roll Clerks, Automobilists, and all others where quick action is absolutely essential. Accidental discharge impossible. Another feature is the Automatic Shell Ejector, that throws the empty shells out when the barrel is tipped down. The Revolver is exceptionally well made of the very finest of materials and scientifically tested for accuracy. Fitted with fancy rubber handle. .22, .32, or .38 calibre. PRICE $13.00, postpaid anywhere. Cartridges - for above Revolvers - by express only. .22 cal., 60c per 100; .32 cal., $2.50 per 100; .38 cal., $2.50 per 100.

"The Baby" Double Action Hammerless Revolver

A HANDSOME AND MOST EFFECTIVE WEAPON

$6.50

Measures but 4¼ inches long

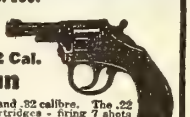


Takes regular .22 calibre cartridges

The new Baby Double Action Hammerless Revolver has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of Efficiency and Practicability. It is small in size, yet is just as effective and accurate as the most expensive weapon you can buy. Every lady should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard .22-calibre (short) cartridge obtainable anywhere, or you may obtain the cartridges from us (cartridges can be shipped only by express). The revolver fires six shots in one loading. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. The Price of the Baby Revolver is only $6.50, sent by mail postpaid to any address.

"Young America" REVOLVER .22 & .32 Cal.

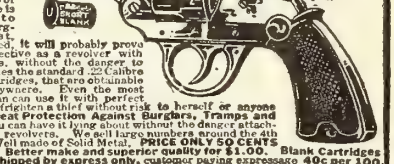
A Good Pocket Gun



A double-action revolver made in two sizes—.22 and .32 calibre. The .22 calibre revolver takes the .22 calibre rim fire cartridges - firing 7 shots at one loading. The .32 calibre gun takes S. & W. center fire cartridges and accommodates 5 shots in the cylinder at one loading. The "Young America" weighs approximately 9 ounces, and is one of the lightest weight revolvers of its type on the market. It is an excellent house arm or pocket weapon, and the most popular Fourth of July revolver. Octagon Barrel accurately rifled, made of best steel, very highly nickel plated and polished. The handle fancy hardened rubber. PRICE $10.00 postpaid anywhere. Cartridges - by express only - .22 cal., 80c per 100; .32 cal., $2.50 per 100. *Write for free Catalog*

BLANK CARTRIDGE PISTOL

PRICES 50c. $1.00



This well made and effective Pistol is modelled on the pattern of the latest type of Revolver, the appearance of which alone is enough to scare a burglar, whilst, when loaded, it will probably prove just as effective as a revolver with real bullets, without the danger to life. It takes the standard .22 Calibre Blank Cartridges, that are obtainable almost everywhere. Even the most timid woman can use it with perfect safety and frighten a thief without risk to herself or anyone else. A Great Protection Against Burglars, Tramps and Dogs. You can have it lying about without the danger attached to other revolvers. We sell large numbers around the 4th of July. Well made of Solid Metal. PRICE ONLY 50 CENTS Postpaid. Better make and superior quality for $1.00. Blank Cartridges .22 cal., shipped by express only, customer paying expressage 40c per 100.

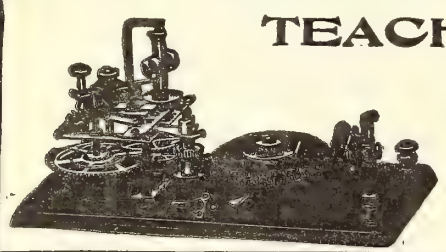
JOHNSON SMITH & CO. Dept., PM 42 **3224 N. Halsted St., Chicago**

"THERE'S MONEY IN IT"

AT HOME LEARN TELEGRAPHY AT HOME

MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter, THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.

26 L Cortlandt St. New York



Send for a Copy of Our Manual of Wireless Telegraphy

We now have ready for distribution our Manual of Wireless Telegraphy. It contains 200 pages, fully illustrating and describing the many instruments used in Radio. 45 pages cover general instructions, diagrams, station calls, tables, codes and other information identified with the art.

The book is printed on high finished paper with a two-color cover and measures 9x5¾ inches.

Due to the scarcity of paper, the high cost of publication, and in order that the Manual may get into the hands of those most interested in Wireless, we ask 25 cents for it, give a coupon receipt for the amount, which coupon can be applied on a future purchase.

Get Your Copy Before the Edition Is Exhausted

MANHATTAN ELECTRICAL SUPPLY CO. INC.

17 Park Place New York | 114 S. Wells St. Chicago | 1106 Pine St. St. Louis | 604 Mission St. San Francisco



You can Ukulele!

You can easily play quaint, dreamy Hawaiian music or latest songs on the Ukulele. Prof. Harry J. Clarke's latest method enables you now to play the Ukulele in a few weeks. We give you a genuine Ukulele absolutely FREE with complete course of lessons. Write at once for FREE narrative of Hawaiian music and offer. No obligations! Send Now!

Hawaiian Institute of Music, 1400 Broadway, Dept. 5008, New York

MASTER CONTINENTAL CODE DODGE SHORT CUT ONE HOUR METHOD INSURES SUCCESS

Thousands have. Everybody can. Testimonials free. Investigate and win. Costs 50 cents. Saves 50 dollars.

C. K. DODGE

Box 300 Mamaroneck, N. Y.

The Sun's Unknown Rays

By ROGERS D. RUSK, M. A.

(*Continued from page* 1086)

low pressure are due in part to air rising from portions of the earth which have become unequally heated. Why storms are commoner certain years than others and why they seem to vary with the activity of the Sun are puzzling problems. Huntington has found that in addition to the direct action of the Sun's heat, there may be another and swifter agency at work which we have not yet detected. In his work he made a careful study by days of the years from 1904 to 1918, in which he compares the spottedness of the Sun with the barometric pressure on the earth and with changes in the weather. He also compares other solar disturbances and the amount of heat radiated at any time with the barometric pressure.

In studying the sunspots he divided the Sun's disk into three equal divisions, as shown in Fig. 3, with the result that he found the two marginal areas to be more effective in producing weather changes on the earth than the central area. This is a somewhat surprising conclusion as disturbances at the edge of the Sun are projected away from the earth, while those nearer the center of the Sun's disk are projected more directly toward the earth. This may be the result of some electric or magnetic disturbances, or it may be due to some unknown agency. If it is the former, the storminess can be explained by the fact that the earth, air and clouds are charged bodies, and that a disturbance of these charges would lead to increased motion of the atmosphere and clouds, and hence increased variability in the weather. Huntington himself says: "In view of all these facts we seem to be led to the conclusion not only that variations in solar activity are among the prime causes of disturbances in the earth's atmosphere, but that these variations are of two kinds. One is clearly thermal. The other kind may be electrical or of some type not yet understood."

"Home Electrics"

By G. L. HOADLEY, M. E.

(*Continued from page* 1089)

as in Fig. 4, the lower right-hand one usually reading in tenths of a kilowatt-hour, Read such dials as usual, and add two ciphers to obtain the reading in watt-hours. The latest practise is to leave off all markings above the dials, as shown in Fig. 5.

Sometimes a dial hand by wearing of its aperture or of the spindle becomes misplaced, is behind its proper place as it turns. This is the case in Fig. 6, with the hand of the second dial from the right. It is evident that as the right-hand index has past 0, the next hand should have past the 8.

The above sources of error cover those met with in practise.

The highest value obtainable from any standard four-dial register is 9,999. Heavy consumers of electricity may use more than that amount of energy per month and a register constant or multiplier is required to extend the range of the meter. In such cases, the makers' stamps on the face of the meter register, "Multiply by 10" as in Fig. 5. They will hardly ever be met with in household use.

To determine the amount of energy consumed over a month, for instance, subtract the reading of the meter at the beginning of the month from the reading at the end of the month. This will give the net consumption. Figs. 7 and 8 illustrate typical registers and will assist in learning to make correct readings.

Swiftest Things on Earth

(*Continued from page* 1064)

Airplanes the Fastest Carriers

Altho the United States sent one of the fastest and highest powered airplanes ever designed, to compete in the recent James Gordon Bennett Trophy aerial meet, the American entrees broke down and never finished the race owing to engine and other troubles, and Sadi Lecointe, the French aviator won the International Airplane Race by covering the course of 300 kilometers (equivalent to 186.45 miles) in one hour, 6 minutes, 17 1/5 seconds. This is equivalent to a rate of 2.81 miles per minute, or 168.6 miles per hour. This is a little faster than the high speed limit attained by Tommy Milton in his automobile, but Lecointe's speed is the average for an ultra long run, and not the greatest airplane speed attained.

The highest official speed attained by an airplane, is that reached by de Romanet, the French aviator, who attained 193 miles an hour on November 4. It has been reported several times that airplanes both in this country and abroad have reached a speed as high as 230 to 235 miles an hour.

The velocity of sound is 10.88 feet per second, at zero degrees Centigrade, at a pressure of 1 atmosphere. A cyclone rushes at the rate of 585 yards a second and about the fastest material thing on earth is the projectile from a gun, the velocity of which is, as shown in the accompanying illustration, 975 yards per second or at an equivalent velocity of 2,000 miles per hour. The next succeeding fastest thing we know of is the velocity of the earth itself, as it speeds around its orbit about the sun at the rate of 65,533 miles per hour. Finally, we come to the highest speed thing we know of, which is credited with having the ultimate speed attainable in the universe by any object or agency,—that of Light and Electricity, which travel at the marvelous speed of 186,000 miles per second. This is also the speed of the Hertzian waves used in radio-telegraphy and telephony, so that a high powered radio wave sent out from the station at a point on the earth's surface, will theoretically pass around the earth seven times in one second.

MICROPHONE DETECTOR OF FIRE DAMP

The microphone is applied to the detection of fire damp in mines. This is its principle: If sound waves from two pipes of equal pitch impinge on microphones connected in series with a telephone, a clear note is heard, but if one of the pipes emits a slightly different note, beats will be heard in the telephone.

Here is the application: One pipe is placed in the mine, the other above the ground and they are blown simultaneously. If the air in the mine is charged with fire damp, it will produce a different note from that produced by clear air, owing to the difference of density, and in consequence, a series of beats in the telephone gives warning of the presence of fire damp.

The same apparatus is very sensitive to the presence of coal gas.

1921 ATLAS WITH MAPS of NEW EUROPE FREE

To the readers of "Science & Invention" who take advantage of this offer now made in connection with

Webster's New International

THE ONLY GRAND PRIZE

(Highest Award) given to dictionaries at the **Panama-Pacific International Exposition** was granted to **Webster's New International** and the **Merriam Series** for superiority of educational merit.

WORDS OF RECENT INTEREST

Anzac, ace, barrage, Bertha, blighty, Boche Bolsheviki, camouflage, Lewis gun, Liberty bond, Sammy, soviet, tank, war bride. These are but a few of the thousands of late words —all clearly defined in this great work.



"To have this work in the home is like sending the whole family to college."

"The Supreme Authority" **The Merriam Webster**

A Complete Reference Library in Dictionary Form—with nearly 3,000 pages and type matter equivalent to a **15-Volume Encyclopedia**, all in a **single volume**, in Rich, Full Red Leather, or Library Buckram Bindings, can now be secured on the following remarkably easy terms:

THE ENTIRE WORK (WITH COMPLETE 1921 ATLAS)

DELIVERED for $1.00

and easy monthly payments thereafter (in the U. S. and Canada)

ON SUPERIOR INDIA PAPER

Reduced About One-Half In Thickness and Weight

INDIA-PAPER EDITION

Printed on **thin, opaque, strong,** superior India paper. This edition is only about **one-half** the thickness and weight of the regular edition. Size 12⅜ in. x 9¾ in. x 2¾ in. **Weight 8⅜ lbs.**

REGULAR PAPER EDITION

Printed on strong book paper of the highest quality. Size 12⅜ in. x 9¾ in. x 5½ in. Weight 15¼ lbs. **Both editions are printed from the same plates and indexed.**

Over 400,000 Vocabulary Terms, and in addition **12,000 Biographical Names, nearly 30,000 Geographical Subjects,** besides thousands of other references. Nearly **3,000 pages. Over 6,000 illustrations.**

The only dictionary with the New Divided Page, characterized as "A Stroke of Genius."

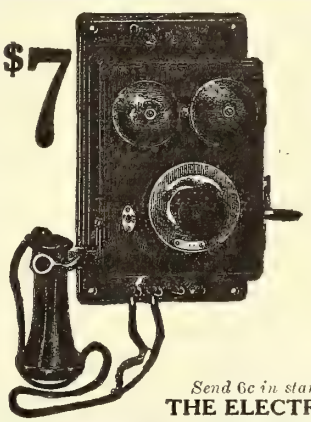
The ATLAS is the 1921 "New Reference Atlas of the World," containing 148 pages, with 96 pages of maps beautifully printed in colors with areas and populations of all countries, including changes brought about by the Great War, Parcel-Post Guide, etc., all handsomely bound in red cloth, size 9⅝ x 12½.

To those who mail this coupon at once

G. & C. MERRIAM CO.
Home Office Dept. S Springfield, Mass.
(Publishers of Genuine Webster Dictionaries for over 75 years)

Please send me free of all obligation or expense a copy of "Dictionary Wrinkles" containing an amusing "Test in Pronunciation" (with key) entitled "The Americanization of Carver"; also "125 Interesting Questions" with reference to their answers and striking "Face-simile Color-Plate" of the new bindings. Please include specimen pages of India and Regular paper with terms of your "Science & Invention" free Atlas offer on Webster's New International Dictionary.

Name .....
Address .....



$7

For Homes, Offices, Factories, Farms

Complete Wall Set Magneto Telephone

Western Electric Type

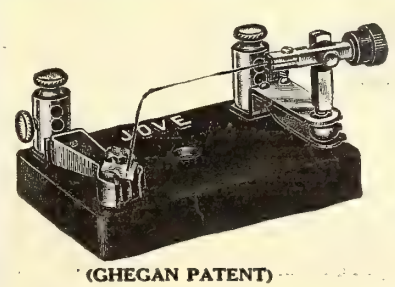
This is a complete commercial telephone station. They were bought from telephone exchanges who put in Central battery types. Slightly used but guaranteed to be in A1 working order.

Will work perfectly at all distances up to 20 miles.

Long Distance Telephone Set—
One station **$7.00**
Shipping weight, 15 lbs.
Two stations **$13.00**
Shipping weight, 25 lbs.

Send 6c in stamps for our big 160 page Wireless and Electrical Catalog No. 22.

THE ELECTRO IMPORTING CO., 231 Fulton Street, New York



(GHEGAN PATENT)

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

Send stamp for new edition 42E Catalog.

J. H. BUNNELL & CO., 32 Park Place, New York

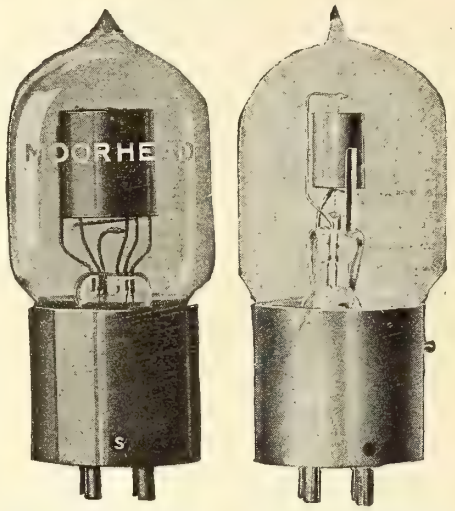
—always remember

The A-P Electron Relay and the A-P VT Amplifier-Oscillator constitute the one proven vacuum tube combination on the market to-day. Perfected in May, 1920, this combination has ***made good in actual use.*** AND A-P tubes are the only tubes equipped with the SHAW ***bakelite*** base—the base that prevents surface leakage, the base that prevents the tube from absorbing atmospheric moisture, the base adopted by the U. S. Navy Department—an exclusive patented feature of A-P tubes.

When you want an ***efficient*** amplifier in which none of the amplifier qualities are sacrificed to make it also a detector, use the ***A-P VT Amplifier-Oscillator.*** When you want an ***efficient*** detector in which none of the detector qualities are sacrificed to make it also an amplifier, use the ***A-P Electron Relay.***

The A-P Electron Relay is the most sensitive spark detector known to the radio art. It is a soft tube. It contains the right ***quantity*** of gas and, equally important, the right ***kind*** of gas. The electrodes are correctly designed. On the market since May, 1920, it has ***made good in actual use.***

For sure results, for better results use A-P tubes and only A-P tubes. Licensed by the Radio Corporation of America under DeForest Audion and Fleming patents, for amateur and experimental use in radio communication. Equipped with the SHAW bakelite (four-prong) base.



The A-P Electron Relay, equipped with the SHAW standard four-prong base. Price $6 and worth it. Order from your dealer.

The A-P VT Amplifier-Oscillator, equipped with the SHAW standard four-prong base. Price $7 and worth it. At dealers.

A combination of two or more A-P VT tubes as amplifiers with an A-P Electron Relay as the initial detector or oscillator is the ideal receiving combination for long distance amateur or long wave reception. ***Only with such a combination can full efficiency be attained.***

The Atlantic Radio Supplies Co.
8 Kirk Place, Newark, N. J.

The Pacific Radio Supplies Co.
638 Mission St., San Francisco, Cal.

Distributors for Moorhead Laboratories, Inc., Manufacturers of

The A-P VACUUM TUBE Combination

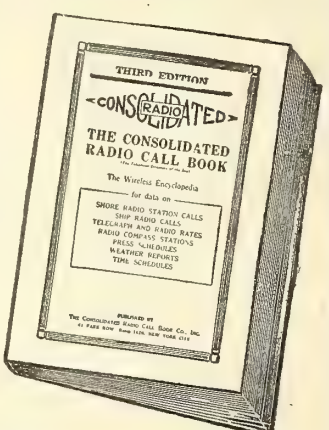
THE THIRD EDITION OF THE
CONSOLIDATED RADIO CALL BOOK

Very Greatly Enlarged—Ready January 25th

192 pages. 32 pages more than 2nd edition, better paper, stiff covers, etc.

Some of the special information contained in the new book: Radio rate sheet (charges to and from vessels, etc.); Cable rates; Table for finding cable charges to various points; Weather reports and hydrographic reports of the world; Time signal section of the world; American radio compass stations; French radio compass stations; British radio compass stations; Canadian radio compass stations; General information section; International abbreviations; High power radio stations of the world; Press schedules of spark stations.

The Consolidated Radio Call Book is the only book in print officially listing all the Radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.



Every New Amateur Call Is Listed

SPECIAL—Wireless Map of the World in Colors Given Free With Each Copy

Price $1.50 Prepaid

Either Direct from us or for sale by the following responsible Dealers:

American Electro Tech. Appliance Co.,	New York City
American Hardware Stores,	Bridgeport, Conn.
Atlantic Radio Co.,	Boston, Mass.
Bamberger & Co., L.,	Newark, N. J.
Benwood Specialty Co.,	St. Louis, Mo.
Brodie Electric Co.,	Los Angeles, Cal.
Bunnell & Co., J. H.,	New York City
California Electric Co.,	San Francisco, Cal.
Catton, Neill & Co.,	Honolulu, T. H.
Chicago Radio Apparatus Co.,	Chicago, Ill.
Continental Radio & Electric Corp.,	New York City
Cutting & Washington Radio Corp.,	New York City
Detroit Radio Laboratories,	Detroit, Mich.
Dewey Sporting Goods Co.,	Milwaukee, Wis.
Doubleday-Hill Electric Co.,	Pittsburgh, Pa.
Electro Importing Co.,	New York City
Findley Electric Co.,	Minneapolis, Minn.
Fuller Co., Seth W.,	Boston, Mass.
Gurd & Co., Wm.,	London, Canada
Holt Electric Utilities Co.,	Jacksonville, Fla.
Hovey, A. T.,	Boston, Mass.
Jenkins, Lester I.,	New Bedford, Mass.
Katzenbach & Co., F. S.,	Trenton, N. J.
Kendall Co., W. D.,	Worcester, Mass.
Killoch Co., David,	New York City
Kluge, Arno A.,	Los Angeles, Cal.
Krause & Co., A. F.,	Detroit, Mich.
Manhattan Electric Supply Co.,	New York, Chicago
McCarthy Bros. & Ford,	Buffalo, N. Y.
McClurg & Co., A. C.,	Chicago, Ill.
Meter Electrical Construction Co.,	Oshkosh, Wis.
Meyberg Co., Leo J.,	San Francisco, Cal.
Mohawk Electrical Supply Co.,	Syracuse, N. Y.
New Era Shop,	Milwaukee, Wis.
Newman-Stern Co.,	Cleveland, Ohio
Nola Radio Co.,	New Orleans, La.
Noll & Co., E. P.,	Philadelphia, Pa.
Northwest Radio Service Co.,	Seattle, Wash.
N. S. W. Bookstall Co.,	Sydney, Australia
Pacent Electric Co.,	New York City
Paramount Radio Supply Co.,	Atlantic City, N. J.
Parks, Henry Francis,	Butte, Mont.
Pearlman's Book Shop,	Washington, D. C.
Penn Radio Apparatus Co.,	Reading, Pa.
Pennsylvania Marconi Wireless School,	Philadelphia, Pa.
Piedmont Electric Co.,	Asheville, N. C.
Pioneer Electric Co.,	St. Paul, Minn.
Pitts Co., F. D.,	Boston, Mass.
Post Office News Co.,	Chicago, Ill.
Precision Equipment Co.,	Cincinnati, Ohio
Radio Distributing Co.,	Newark, N. J.
Radio Electric Co.,	Pittsburgh, Pa.
Radio Equipment Co.,	Boston, Mass.
Radioelectric Shop,	Cleveland, Ohio
Ray-Di-Co.,	Chicago, Ill.
Reuter Electric Co.,	Cincinnati, Ohio
Riverside Laboratory,	Milwaukee, Wis.
Rose Radio Supply,	New Orleans, La.
Saunders Co., Geo. S.,	Boston, Mass.
Schmidt & Co., Rudolph,	Rochester, N. Y.
Shaffers',	Norfolk, Va.
Shotton Radio Mfg. Co.,	Scranton, Pa.
Smith Novotoy Electric, Inc.,	Charlotte, N. C.
Southern Electrical Supply Co.,	San Diego, Cal.
United Radio Telegraphers' Assoc.,	Baltimore, Md.
Western Radio Electric Co.,	Los Angeles, Cal.
Whitall Electric Co.,	Westerly, R. I.
White & Boyer Co.,	Washington, D. C.
Williamson Electric Co., H. E.,	Seattle, Wash.
Wilmington Electrical Specialty Co.,	Wilmington, Del.
Wireless Mfg. Co.,	Canton, Ohio
Wireless Press,	New York City
Wireless Shop,	Los Angeles, Cal.
Young & McCombs,	Rock Island, Ill.
Young Men's Christian Assoc.,	Los Angeles, Cal.
Zamoiski Co., Jos. M.,	Baltimore, Md.

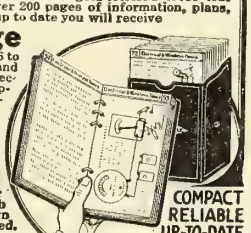
Consolidated Radio Call Book Co., Inc., 41 Park Row, New York City

FOR ONLY $1.50

You will receive the regular **$3.00 Electrical and Wireless News**, published in loose leaf pocket form. Much of the information described has never before been published in books. As, for instance, how to obtain electric current from trees, wireless without aerials, a pocket size wireless set that really works, and a hundred other wise tips for the non-technical experimenter and advanced mechanic. **The Electrical and Wireless News** consists of a handsome gold-lettered loose leaf pocket binder, desk file and over 200 pages of information, plans, etc., and to keep it absolutely up to date you will receive

Free of Charge

every month for four months, 16 to 24 renewal pages of the latest and best ideas on how to make electrical, chemical and wireless apparatuses, supplies, etc., at little cost. You insert the new pages in the pocket binder and file the old pages in the desk file for further reference. All the above decribed sent securely packed, postpaid, for $1.50. Note: The 16 to 24 monthly renewal pages after the 4 months will be $3 per year thereafter or only $2 if remittance is sent with above order. Canada and foreign 25% higher. Stamps not accepted.



COMPACT RELIABLE UP-TO-DATE

IRVING A. ABRAMS, Pub.
1305 Peoria St. Chicago, Ill.

BLUE PRINT READING



Electricians, Carpenters, Bricklayers, Mechanics, Shipyard, Sheet Metal, Structural and Concrete Workers, Boiler Makers, Plumbers, Pipefitters and others can earn big money if they can read Blue Prints. Get into the big-pay class. By our simple method we train you in a short time. Write for Catalogue 15-B, **stating trade.** Do it today.

BE A DRAFTSMAN
Earn $35-$150 a Week

Employers everywhere are looking for draftsmen. They are offering big salaries and good positions are always open. By our practical method we train you quickly in your spare time. Drawing outfit, books, etc., furnished FREE. We help you to obtain position when qualified. Write for Catalogue 15-G. DO NOT DELAY.

COLUMBIA COR. SCHOOL
Dept. 1, Drexel Bldg., Phila.

Personal Radio Service

There is considerable saving and satisfaction in doing business with a concern where the members of the firm personally see that your orders are filled promptly and accurately. If you are looking for such a concern for your radio needs, send your next order to.

KELLY & PHILLIPS
312 Flatbush Ave. Brooklyn, New York.
Send 10c. for complete catalogue.

LEARN WIRELESS

At the **OLDEST, LARGEST** and **BEST EQUIPPED** school of its kind in New England. Thousands of satisfied graduates all over the world. Splendid opportunities in the Merchant Marine. Day and Evening classes. Start any Monday. Illustrated Prospectus for the asking.

EASTERN RADIO INSTITUTE
899E Boylston St. Boston, Mass.



NEW 1920 REDHEAD PHONES

$12.50

We announce the new model of the famous Red Head Radio Receivers, greatly improved, 3200 ohms. $12.50 the pair.

THE NEWMAN-STERN CO.
Dept. E. E. Cleveland, Ohio
Distributors for DeForest, Murdock, Signal, Bunnell and other famous lines.

Model Locomotives

FREDERICK DEY
Sole Agent for W. H. Jubb
Grand Ave., Englewood, N. J.
Send Stamp for Particulars

TYPEWRITERS DELIVERED FREE

by Parcel Post. Underwoods, Remingtons, L.C. Smiths, Royals and Monarchs, rented and sold on payments of only $4 per month. Home Study Course in Typewriting *Free*. For full information, address

GALBREATH TYPEWRITER CO., ROGERS, OHIO

HOME STUDY - SPECIAL RATES

Normal, Grammar School, High School, Civil Service, Engineering, Agricultural, English, Bookkeeping, Shorthand, Typewriting, Journalism, Bible, Salesmanship, and Law Courses thoroughly taught by mail. For Special Rates, apply

CARNEGIE COLLEGE, ROGERS, OHIO

DO YOU WANT ?
Prosperity! Power! Happiness!

Positive Wonderful Results by Our System. "Success" Lesson and Personality Sketch for 10c and birth date.

THOMSON-HEYWOOD CO.
Dept. 350 Chronicle Bldg. San Francisco

Talking on a Thread

(*Continued from page* 1077)

The thread must be made very uniform in diameter, and should also possess an extremely smooth surface, as otherwise there would be heard, of course, noises and other disturbances in the machine when it came to reproducing the voice.

The inventor points out another very interesting fact with regard to this "talking thread" phonograph, namely, that the chisel edged stylus or recording member does not cut into the thread or moving portions thereof, but records the speech or musical vibrations simply by its varying pressure on the thread as it travels along below it, which produce in the surface of the thread, certain irregularities corresponding to the vibrations of the recording member.

The Editors of this publication have had the pleasure of hearing this "talking thread" phonograph in operation, and it is really one of the most wonderful devices of its kind that one can possibly imagine, especially when it is realized that it is possible to "talk" on several hundred feet of the thread and after this is all reeled up, the reel can be removed from the machine and mailed to any point on the globe, placed in a similar machine by the recipient and have its message transcribed whenever and wherever desired.

It is the inventor's idea to commercialize this machine for use in business offices as a *dictaphone*, and one supreme idea fathered by the inventor lies in the fact that, instead of wasting time in dictating a letter on a phonograph of the present type, which is then to be transcribed by a typewriter, the business man of tomorrow may be able to talk into the machine, to remove the length of thread containing the letter or statement, and mail it directly to the party for whom it is intended, no matter whether he is 100 miles or 1,000 miles distant. Undoubtedly such a scheme as this will be considered a commonplace in a shorter time than we are perhaps inclined to believe possible.

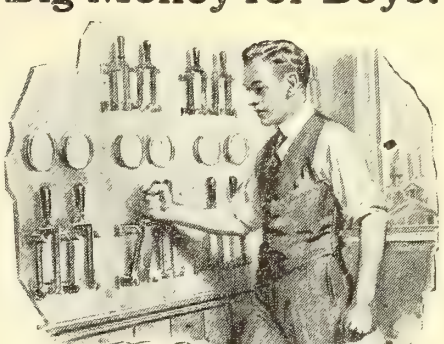
The machine is very finely built and reflects the wonderful model-building ingenuity of the Swiss. Among some of the interesting features of the machine are these: it can be either manually operated or else can be driven by a spring or electric motor; when a reel is wound to a certain depth with the thread, a bell automatically rings, informing the operator of the fact that a fresh empty spool is required; a clever needle and dial on the front of the machine indicate how much thread has been "talked on" so that if the operator wishes to repeat a section or the whole of a sentence or paragraph, he can simply throw over the reverse lever on the top of the machine which winds the thread on the stock spool, and then by throwing the reverse lever to the take-up position—proceed to run the thread under the reproducing edge of the stylus and listen to the repetition of his own voice, the same as is now possible with the standard *dictaphone* used for business correspondence.

WOMAN FINDS NEW STAR

Another new star has been discovered at the Harvard Astronomical Observatory. The Nova is in the constellation Sagittarius, and was at its maximum brightness on Aug. 11 and 12, 1914, being then of the eighth magnitude, and since then has declined in brilliancy.

Miss Woods of the observatory staff detected the star, the position of which is given as right ascension 17 hours 59 minutes 44 seconds, declination minus 31 degrees 44.9 minutes (190). The discovery is the fortieth of its kind in the history of astronomy and the twenty-second in the records of the Harvard Observatory.

Big Money for Boys!



Learn ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into good positions and get experience that will give them a real start toward success in life. Good salaries are offered with rapid promotion.

For 29 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6179-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ Pharmacy
☐ Electric Wiring	☐ SALESMANSHIP
☐ Electric Lighting	☐ ADVERTISING MAN
☐ Electric Car Running	☐ Window Trimmer
☐ Heavy Electric Traction	☐ Show Card and Sign Paint'g
☐ Electrical Draftsman	☐ RAILROAD POSITIONS
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ Business Correspondent
☐ Ship Draftsman	☐ BOOKKEEPER
☐ Machine Shop Practice	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Gas Engineer	☐ Traffic Management
☐ CIVIL ENGINEER	☐ Commercial Law
☐ Surveying and Mapping	☐ GOOD ENGLISH
☐ MINE FOREM'N OR ENG'R	☐ STATIONARY ENGINEER
☐ ARCHITECT	☐ CIVIL SERVICE
☐ Architectural Draftsman	☐ Railway Mail Clerk
☐ PLUMBING AND HEATING	☐ Textile Overseer or Supt.
☐ Sheet Metal Worker	☐ AGRICULTURE
☐ Navigator	☐ Poultry Raising ☐ Spanish
	☐ Automobiles ☐ Banking

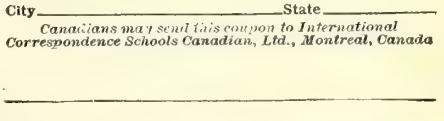
Name_____ 1-1-21

Present Occupation_____ Business Address_____

Street and No._____

City_____ State_____

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada



WANTED—Railway Mail Clerks

$135 to $190 Month

Hundreds Needed at Once

MEN—BOYS Over 17

Franklin Institute
Dept. G184, Rochester, N. Y.

Kindly send me, by return mail, free information, telling how I can quickly get into the U. S. Government service as Railway Mail Clerk ($1600 to $2300 a year) or as City Mail Carrier or Postoffice Clerk ($1400 to $1800 a year.)

COUPON

Name.....

Address.....

If not interested, hand to a friend.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the aobve rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted. Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the April issue must reach us not later than February 22.

The Circulation of Science and Invention is over 140,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York City, N. Y.

Aviation

New Airplane Free. Our Airplane School opens new class Feb. 21, 1921; offers course of study requiring common school education, takes six months, costs $500.00. Course includes aeronautical designing, building, complete course in flying, flyer's license and without further cost a new 3-passenger airplane which has passed U. S. Gov't. inspection and cost over $9000.00 to build. Investigate this proposition immediately. Limit under this offer 100 airplanes. Educational Dept., Poll-Eells Corporation, Airplanes and Motors, 157 Pearl St., Buffalo, N. Y.

Boys make a model aeroplane that will fly. Easily made at small cost. Write for circular. Aero Shop, 6581½ Hurlbut Ave., Detroit, Mich.

Aviation. Motor 30/40 HP 2-cyl. Oppose air cooled weight 128 lbs. ideal motor for light aeroplanes, motor sleds, wind wagons, hydroplanes, etc. Price only $325, complete with propeller ready to run. Aircraft Service, 338 Coney Island Ave., Brooklyn, N. Y.

Auto Accessories

Tire Agents. Exclusive representatives to use and sell the new Mellinger Extra-Ply Tires. (No seconds.) Guarantee Bond 8,000 miles. Wholesale prices. Sample sections furnished. Mellinger Tire Co., 980 Oak, Kansas City, Mo.

Auto Motors Supplies. Buick, Michigan, Stoddard-Dayton, E.M.F., Cadillac, Overland, Continental and Buda Motors. All types $50 each and up. Special High Tension magnetos 2 and 4 cylinder $9.50 each. Electric and Gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for catalog. Address Motor Sales Dept. 12, West End, Pittsburgh, Penna.

How to make automobile storage battery plates. $1.00 postpaid. H. Deckelman, 7118 Nashville Ave., St. Louis, Mo.

Fords start easy in cold weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene, using our 1920 carburetors. Increased power; styles for all motors; can attach them yourself. Big profits to agents; money back guarantee; 30 days trial; Air Friction Carburetor Co., 1511 Madison St., Dayton, Ohio.

Insyde Tyres inner armor for automobile tires. Positively prevents punctures and blowouts. Guaranteed double tire mileage. Any tire. Enormous demand. Low priced. Write for particulars. County agents wanted. American Accessories Co., B 784, Cincinnati, Ohio.

Don't lose your auto. Auto Theft Alarm, patent pending; gives continuous alarm if your auto is driven or towed away. Independent of ignition or car mechanism. Make one yourself easily from odds and ends. Licensed drawing and instructions $1.00. Adelson, 3238 (D) Douglas Boulevard, Chicago, Ill.

Blueprints. Automobile Armatures. See ad under "Electrical." Charles Chittenden.

Motorcycles—Bicycles

Don't Buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 1602, Galesburg, Kans.

Motors, Engines and Dynamos

Special Garage Motors. New, manufactured by General Electric Co. ¼ HP $22.75; 1 HP $88.50; 2 HP $126.50; 3 HP $146.50; 5 HP $188.50. All sizes both single and Polyphase Motors for immediate delivery. Special charging generators all voltages. Write for catalogue. Motor Sales Dept. 12, West End, Pittsburgh, Penna.

Short Stories, Manuscripts Wanted

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Short Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 165 Hannibal, Missouri.

Business Opportunities

$35 Profit Nightly. Small capital starts you. No experience needed. Our machines are used and endorsed by Government Institutions. Catalogue free. Atlas Moving Picture Co., 459 Morton Bldg., Chicago.

Honeymoon. "Instructions for the Honeymoon." New book, written by physician. Clean, free from vulgarity, yet so plain all may understand. 25c United Sales Co., Springfield, Ill.

Oklahoma Farms. Write for free agricultural booklet. Board of Commerce, Shawnee, Okla.

"What Every Girl Should Know." By Mrs. Margaret Sanger, the birth control advocate. 50c. United Sales Co., Springfield, Ill.

If you want to sell or exchange your farm, unimproved land, city property or patent, write me. John J. Black, 194th St., Chippewa Falls, Wis.

"Ten Tragedies of Ten Girls." Startling book, 50c. White slavery exposed. United Sales Co., Springfield, Ill.

Breed Canaries. Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

Rare, Instructive and Entertaining Books. Catalogue 10c. United Sales Co., Springfield, Ill.

Repair Leaky Cisterns. Practical cement workers complete, guaranteed instructions $1.00. L. H. Jacks, Ashland, Ore.

Book of Nature. By Dr. Faulkner; plain facts about sex matters for those married; about to marry, 25c. United Sales Co., Springfield, Ill.

Mechanics, Hobbiests, Manufacturers—build my idea Continuous Automatic Gravity Phonographs. For particulars write A. Lunn, Box 455, Postal Station F., Toronto, Canada.

Tattooing is a good paying proposition, start in business for yourself. Complete tattoo outfit for amateurs $10.00. Send 10c for up-to-date price list. Harry V. Lawson, Box 31, Norfolk, Va.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89th St., New York.

"Money-Talks." The Business magazine published for progressive people. Send for sample copy P. O. Box 236-B, Newark, New Jersey.

I made $30 a Week evenings with a small Mail Order Business Home. Free Booklet tells how. 2c postage. Alex Scott, Cohoes, N. Y.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $2,000 necessary. Will allow expenses to Baltimore as explained. Address, Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

Be an Inventor. Become famous, rich and independent. Particulars free. Jay G. Hobson, Martinsville, Indiana.

Enter a New Business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by any one at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

Be Independent. We teach by mail how to manufacture unexcelled toilet goods. Particulars free. School of Cosmetics, Box C, Omaha, Neb.

Big Money Selling Artificial Pearls. Particulars free. Bolitho, 211 Rue St. Honore, Paris, France.

We will start you in the cleaning and dyeing business, little capital needed, big profits. Write for booklet. The Ben-Vonde System, Dept. H. Charlotte, N. C.

$5,000 Yearly income paid thousands of people who invested in Texas oil lands. They made the start. $2.00 may start you making $200 monthly, possibly more. You get warranty deed to land with interest in well and participating interest in entire sub-division. Results count. Bank reference, established facts free. Write today. Sourlake Texas Oil Co., 602 Demenil, St. Louis, Mo.

Help Wanted

Silvering Mirrors. French Plate taught. Easy to learn. Immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Missouri.

Universal Shorthand Course (Pitman) makes stenographic experts in 36 lessons. Efficiency guaranteed or money back. Helps users of other systems increase pay. Easy terms. Write for Booklet 12. Universal Shorthand Course, 6609 Kimbark Avenue, Chicago, Ill.

Stop Daily Grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 48, Marion, Indiana.

Firemen, Brakemen, Baggagemen, $140-200, Colored Porters by Railroads everywhere. Experience unnecessary. 897 Ry. Bureau East St. Louis, Ill.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Men Wanted for detective work. Experience unnecessary. Write J. Ganor, former U. S. Gov't Detective, 135 St. Louis.

Hundreds Men—Women—Girls, over 17, wanted immediately by U. S. Government. Permanent, for life, positions. $1,400 to $2,300 year. No strikes. No layoffs. Easy, pleasant inside or outside work. Quick raise. Vacation with pay. Common education sufficient. Write immediately for free list positions now open. Franklin Institute, Dept. G25, Rochester, N. Y.

Be a Mirror Expert. $3 to $10 a day; spare time home at first, no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Men Wanted at $35 to $100 a week to make mechanical drawings. Work is easy, pleasant and leads to higher positions in Industrial Field at excellent salaries. We furnish set of instruments, train you at home, in spare time, by practical method and help you qualify for position. Write today for particulars Roy C. Claflin, President, Dept. 1322, 14th and T. Sts., Washington, D. C.

Detectives earn big money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

Be a Detective. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. Write American School of Criminology, Dept. B, Detroit, Mich.

Become Automobile Experts. Start business for yourself. Earn $200 month. Sample lessons free. Franklin Institute, Dept. G 806, Rochester, N. Y.

Men—learn wireless at home quickly and easily. Attractive positions now open for men qualified as radio operators, electricians, mechanics, inspectors and draftsmen. Beginner operators now averaging $200 per month; no previous experience or wireless education necessary to enter. Opportunity to travel and see the world or locate in land wireless work. Oldest and largest radio school in America; established in 1914. We train you through our home study course, or at our local schools to qualify for official license, and help you secure position on land or sea. Wireless outfit furnished for home practice. Free catalogue on request. National Radio Institute, Dept. 505, 14th and U Streets, N. W., Washington, D. C.

Salesmen Wanted

Salesmen. Earn $3,500 to $10,000 a year. City or Traveling. Experience unnecessary. Quickly qualify through our amazing system. Free employment service to members. Send for Salesmanship book, list of lines and full particulars. Nat. Salesmen's Training Ass'n, Dept. 158B, Chicago, Ill.

Wanted. Responsible live wire. $80 weekly. No selling or investment. Steady work. Write J. C. Hahn, Cullom, Illinois.

Correspondence Courses

Dollars Saved. All kinds of used correspondence courses sold. (Courses bought.) Lee Mountain, Pisgah, Ala.

Volume VIII.
Whole No. 95

Science and Invention

H. GERNSBACK,- EDITOR
H. WINFIELD SECOR,- ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D.,- ASSOCIATE EDITOR

MARCH
1921
No. 11

MAR 11 1921
PATENT OFFICE

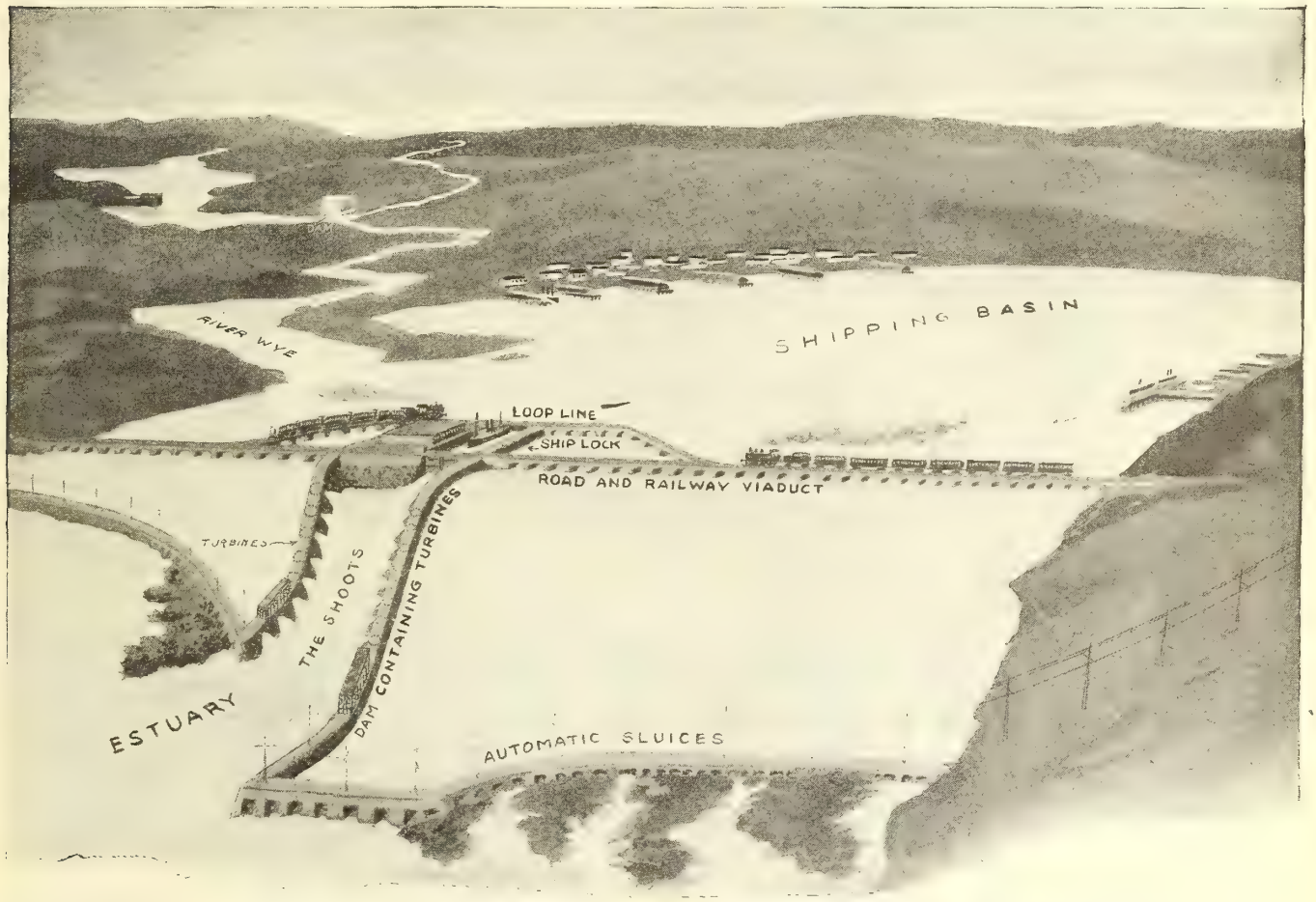
Utilization of Tidal Power in England and France

WE present to our readers, two schemes for utilizing tidal power, the one following the lines of a plan, originating in France, for a power station on the British Channel; the other a proposed installation of a very large size at the mouth of the Severn River, England. The estuary of this river is celebrated for the great rise and fall of tide, which brings about the formation of a bore.

The idea of the French installation is by a system of conduits to admit water to an impounding reservoir as the tide rises. The water entering the reservoir passes thru pipes, and referring to the cut, with valves in the central line open and those in the side lines closed, the water flows in thru the central line actuating turbines in the power house. The course of the water as it passes thru the power station, it will be observed, is from the sea towards the reservoir, so that the turbines rotate in a sense determined by the direction of this flow. When the dam is full and the tide begins to fall, power is again developed by closing the gates in the central line and opening those in the side lines. The effect will be that the reservoir will empty itself and the flow of water thru the power station will be in the same direction, within the station, as it was before. Thus the turbines will always turn in the same sense, whether the tide is entering the reservoir, or whether the reservoir is delivering its contents to the channel.

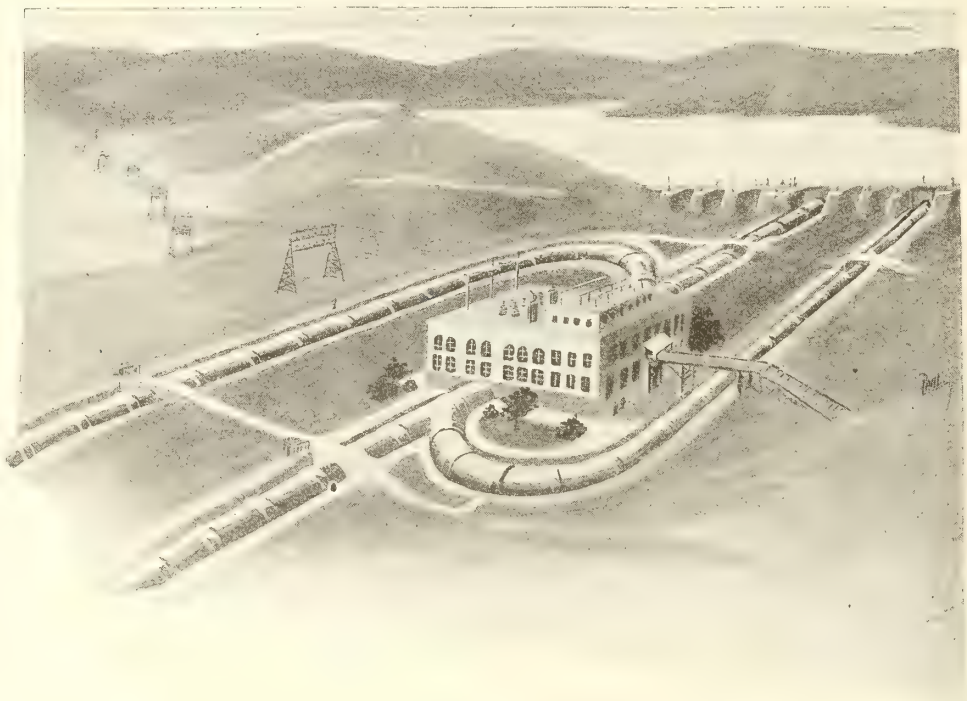
The idea of the scheme is simply to give the turbines the same direction of rotation, whether the reservoir is filling or emptying itself. The above is perhaps little more than a suggestion but it at least carries out the idea of a uniform direction of rotation of the turbines in the power station.

We now come to the proposed Severn River installation. Taking advantage of any natural shoals the channel is to be dammed with provision of a shiplock plant. The dam whose line is determined by the natural contour of the river bot-



In England There Is Very Great Rise and Fall of the Tide. In the Severn Estuary a Thirty-Foot Rise and Fall Is to Be Utilized As Shown Above. A Half Million Horse-Power Is to Be Developed.

tom, provides, as will be seen from the cut, a wide channel leading to the lock. In the walls forming this channel there are to be installed turbines of a million maximum horse-power. The power which the turbines can develop will vary over a very large range. To the left of the cut is seen the River Wye, beloved by Cook's tourists, and far back in the interior there has been found an ideal site for the establishment of an immense lake or reservoir. This site it is proposed to dam and to connect it with the Wye by a tunnel; when the conditions are such that the turbines are exerting a million horsepower, half of it will be taken off and expended for filling the lake.



On the French Coast It Is Proposed to Install a Turbine Plant, Whose Rotors Shall Turn in the Same Direction for Rising and Falling Tide. We Illustrate a Suggestion for Doing This.

Under other conditions of the tide, when normal conditions would give the turbines very little power, the waters of the lake are to be drawn upon so as to bring the power up to the normal 500,000 horsepower.

Above the dam a railroad bridge and viaduct crosses the estuary. At the locks it is doubled so that one set of tracks passes on the ocean side of the locks and the other on the river side. The object of this arrangement is to give the trains continuous passage. In locking ships thru the gates it will be seen that one track or the other will always be closed. If but a single track crost the locking station it would have to be opened every time a ship went thru, thus introducing the trouble of intermittent passage for trains.

The method of energy storage, involving the use of the artificial lake, contemplates special turbines to be stationed in the vicinity of the lake so that, as the water is allowed to flow into the Wye, these turbines will give the power, which under the conditions of slack water the turbines in the Severn waters cannot supply. It is a most ingenious arrangement and would seem to contain a good suggestion for other similar locations. Offhand, a number of such power stations could be suggested, for on the coast of England, there are several localities which would seem open to this class of treatment.

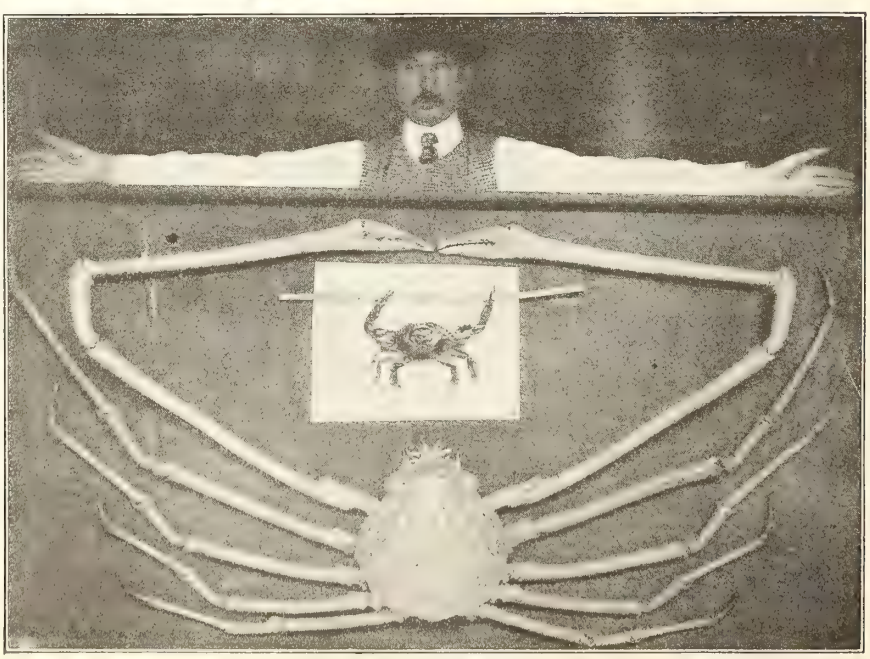
In the case of the "Severn Barrage," as the installation is called, an enormous amount of energy will have to be stored in the lake. The tunnel for its supply is to be driven thru over a mile of solid rock, and is to have a diameter of 40 feet, so as to be the largest thing of its kind in the world.

For such installations as these, if they are to be established on this side of the ocean, one's thoughts go at once to the northeast where in the state of Maine and in the provinces on the Bay of Fundy there are many ideal sites. Our readers will remember the famous waterfall in the Harbor of St. John, New Brunswick. This waterfall falls in opposite directions as the tide changes. Here one of the installations we have described as being designed for the British Channel, might indeed be put into successful operation. For many years, coal has been brought down from the provinces. Perhaps a time will come when power from the ocean will be distributed from the head of the Bay of Fundy where the enormous tidal rise and fall would seem to make possible the construction of an ideal power plant.

An Eighteen-Foot Crab!

HOW would you like to be in swimming at your favorite beach and suddenly find yourself in combat with a gigantic crab like the one shown in the accompanying illustration? This is not a reconstructed crab of prehistoric times, doped out in plaster and wood by a bespectacled theorist or student, but it represents what is said to be the largest crab in the world, and which was found in the sea-waters off Japan.

This enormous creature of the deep has tremendously large arms with pincers, which arms extend eighteen feet. The size of this huge specimen compared with that of an ordinary sized American crab is clearly show in the illustration.



This big crab, in order to escape being killed, when attacked by other large marine inhabitants, proceeds by the aid of his pincers to plaster and cover his whole body with various growths and seaweeds, et cetera, until he resembles a bit of the sea bottom itself, thus evading his pursuers.

The relative size of the giant crab is also demonstrated vividly by its comparison with the man shown standing with arms extended.

Atlantic City in Miniature

THOSE who like true-to-nature miniatures will surely admire this clever and interesting scene now being exhibited at the Pennsylvania Railroad Station in New York City by the Atlantic City Publicity Bureau.

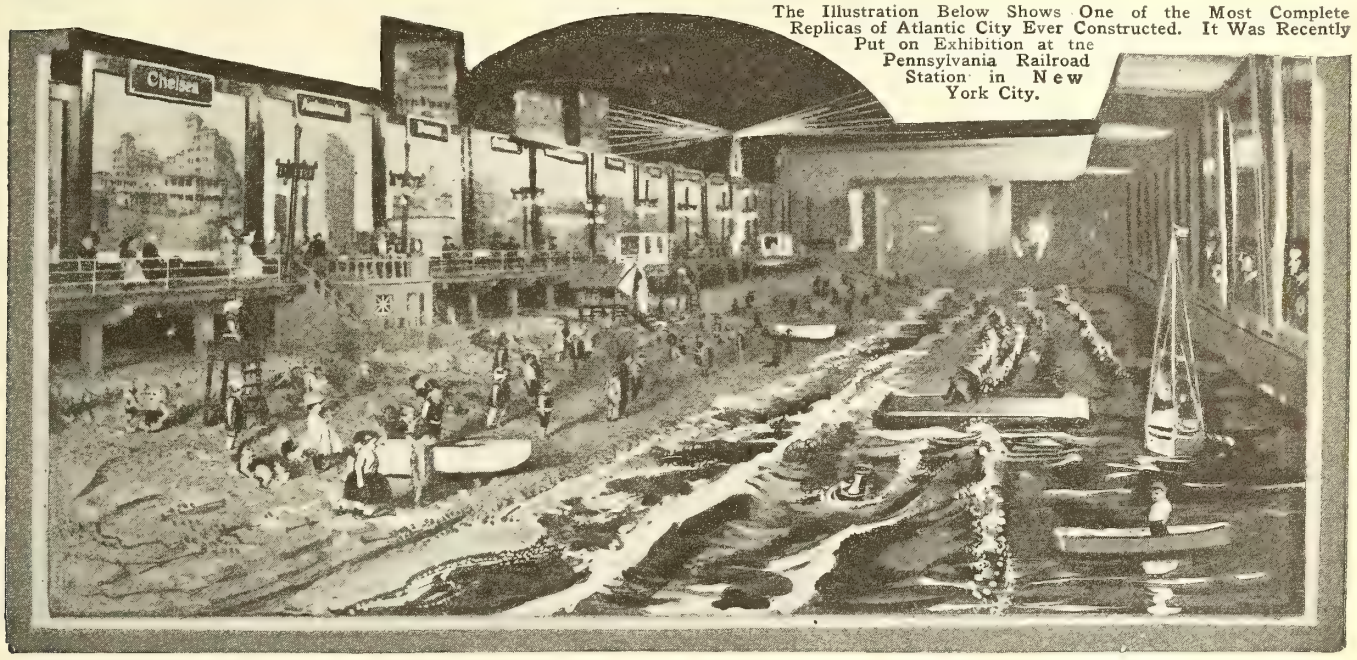
The display itself is forty feet long and thirteen feet wide and was donated by three Atlantic City Fire Department members. The breakers and boardwalk are faithfully reproduced in exact detail with photographs of the famous Atlantic City hotels making up the background. On the boardwalk four continuous streams of pleasure seekers move along in opposite directions. Here we find miniature dolls, drest in the height of fashion, watching the crowds at the beach, some strolling along and some in wheeling chairs propelled by an attendant. Even their tiny legs move as they travel to their ultimate destination in back of the scenes.

Here they dip under, on an endless belt only to come up on the opposite side and continue their seemingly tireless movements. At the beach are miniature dolls in all kinds of positions; some buried in the sand and some frolicking around. Others again are enjoying the cool inviting waters and dipping under the surface each time the breakers carry them under.

The flood lights are suddenly extinguished and the night scene of Atlantic City boardwalk is rendered in detail, the only illumination coming from the miniature boardwalk lamps and a lighthouse in the background. The waves continue to roll and the bathers remain in the water.

A word as to its construction. Four long endless bands of tape are moving constantly, two in one direction and two in the other. To these bands are attached the miniature dolls 4 or 5 inches high so that their feet and legs depend freely. Into the bottom of each foot a small nail is driven which collides with a series of nails driven laterally into two strips of wood lining each side of the slot enclosing endless tape bands.

The forward motion of the doll causes a movement of each foot exactly similar to a walking movement in a human being. The breakers in the water are made by painted strips of canvas, glued to three rollers which constantly revolve in a tank of water. To these breakers are attached the bathing dolls. The display is valued at $6,000.

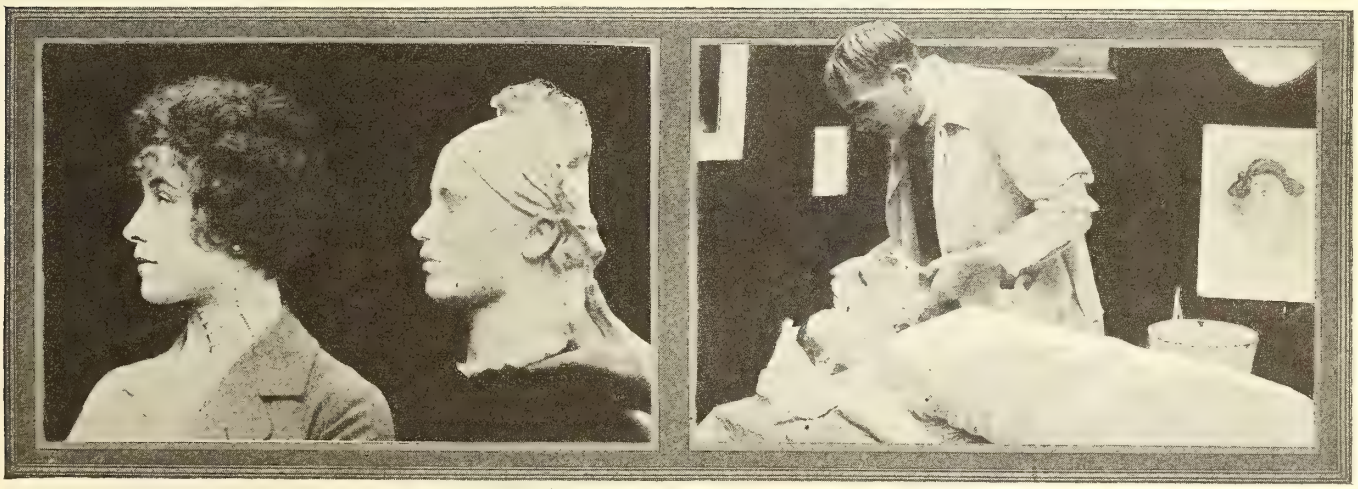


The Illustration Below Shows One of the Most Complete Replicas of Atlantic City Ever Constructed. It Was Recently Put on Exhibition at tne Pennsylvania Railroad Station in New York City.

Taking a Mask of the Human Face

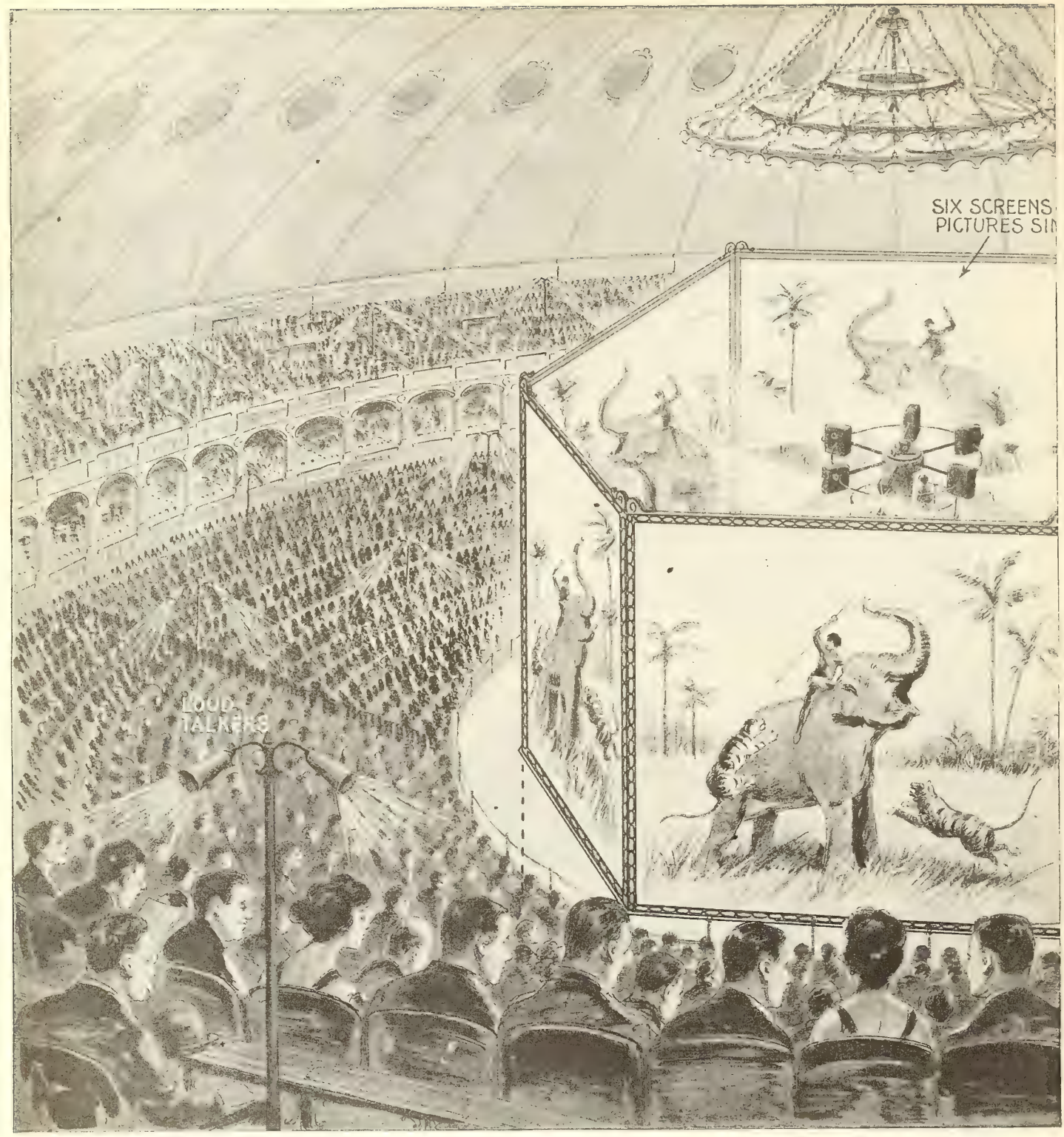
We illustrate the making of a face mask from a living model. It is anything but a pleasant operation. It is done with plaster-of-Paris put on soft, which in a few minutes sets to a stony hardness.

Oil is used as required to prevent its adherence. It may have to be removed in parts. This is provided for by having a wire bent so as to lie close to the surface along the lines where it is desired to cut the plaster, and by withdrawing the wire, the material is cut so that the mask can be removed in pieces. This gives an intaglio of the features. The pieces are put together, then either treated with oil or wax to prevent adhesion, and as many plaster casts as desired are taken therefrom.



A Plaster-of-Paris Likeness of One of the Most Beautiful Women in France. The Molded Form Was Poured Into a Plaster Mask Taken as Shown at the Right.

Expert Shown Removing One-Half of Plaster-of-Paris Face Mask After It Has "Set" and Hardened. A Wire Placed Over the Face Facilitates Splitting the Mask.



The Above Illustrates a New Idea in Motion-Picture Theater Building Whereby It Becomes Possible for 50,000 People or More to View Motion Pictures. The Idea, in Short, Is to Use a Hexagonal Screen, Which Consists Really of Six Distinct Screens on Which Six Pictures Are Thrown Simultaneously, as Well as Synchronously. The Entire Audience, Therefore, Views the Picture at the Same Time. The Screen Is Arranged So

The Movie Theater of the Future
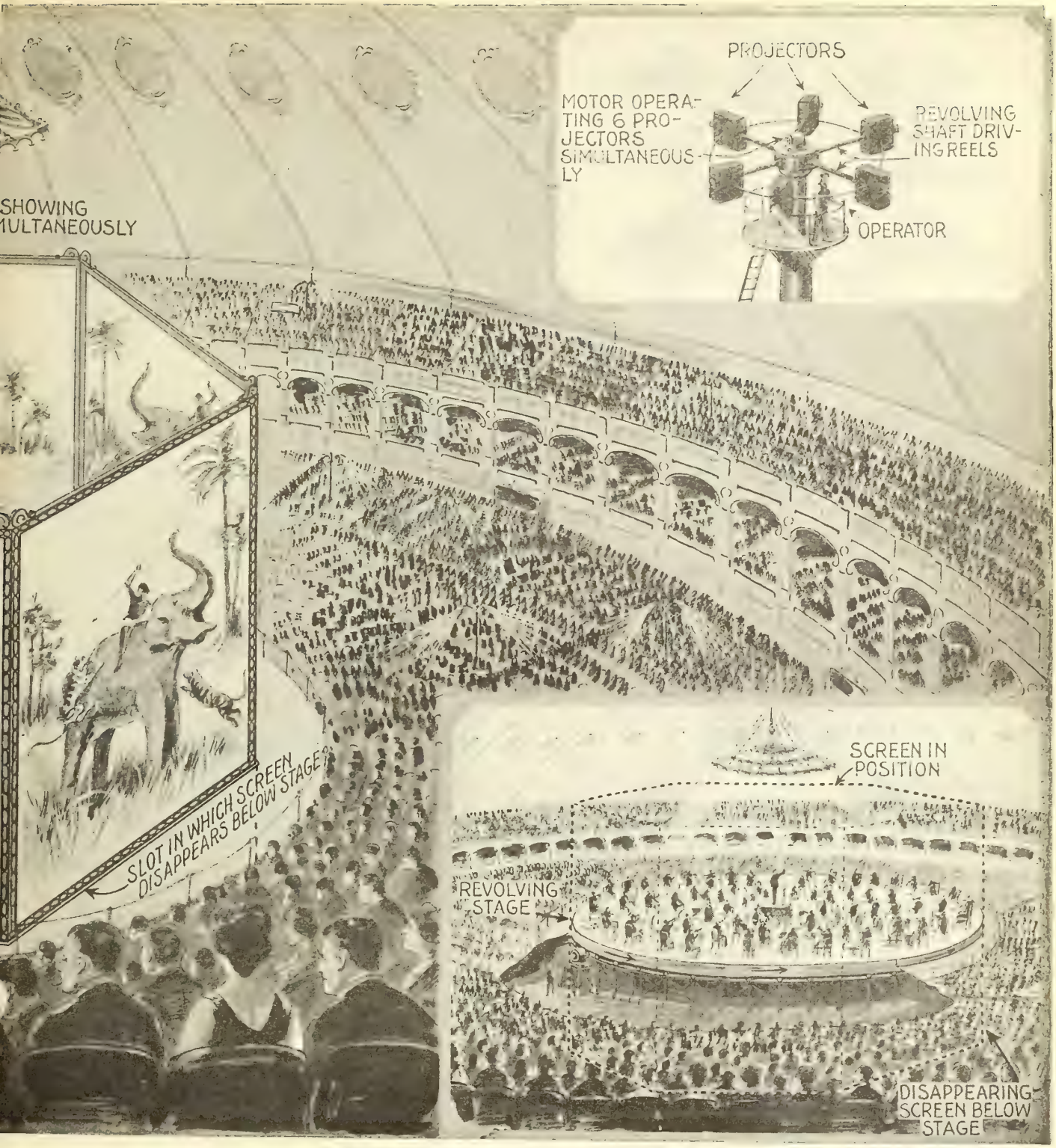
By H. GERNSBACK

OUR moving picture theaters have increased by leaps and bounds during the past decade as is realized by everyone. In our large cities it is always difficult to seat all the patrons who desire to gain admission, and when a big feature is advertised, it is usually impossible to secure admission, even tho these houses seat anywhere from two thousand to five thousand people at one time.

Take, for instance, the largest picture theater in New York City, the Capitol, which is also the largest theater in the world. This theater has 5,300 seats and quite frequently it is impossible to gain admission; it has been remarked often that this house would be sold out if it were five or six times as large.

What, then, will the future bring? If at the present time we have houses seating more than five thousand people which cannot accommodate the moving picture-loving public, what will happen five or ten years hence when the population has largely increased and when the taste for movies has increased as well?

Built along the lines of the present motion picture houses, that is, on the rectanguar plan, it seems almost impossible to make the houses much larger than the present Capitol Theater. A person sitting in the last row is some 212 feet



© 1921 Science & Invention

That It Sinks Below the Floor, Unmasking a Revolving Stage Upon Which the Orchestra Is Seated. The Novelty of the Revolving Stage Will Be Appreciated by All Theater-Goers. New Effects Are Provided by Such a Feature, as Is Made Apparent from Our Article. Loud-Talking Telephones Thruout the Auditorium Make It Possible for Everyone to Hear, Even Tho Seated in the Last Row.

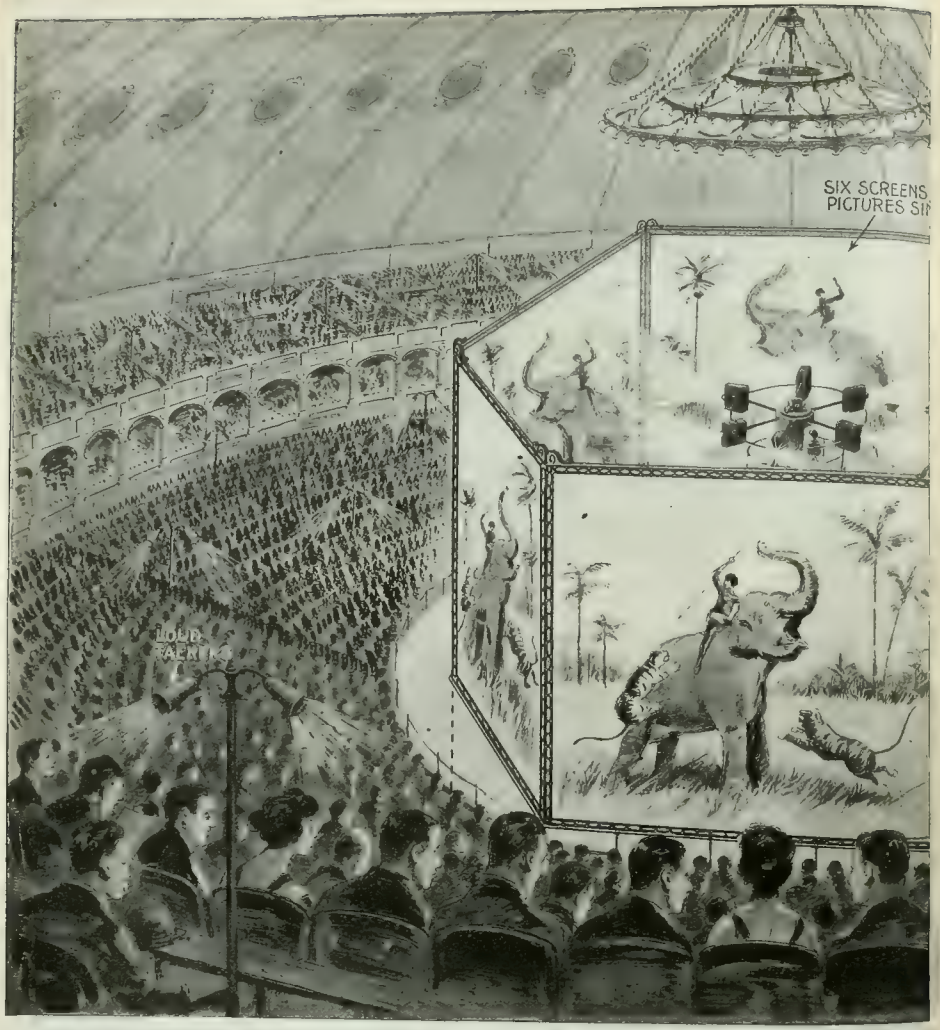
away from the screen, which is about the limit, unless he should wish to use opera glasses, which seems impractical. What then is the solution?

The writer suggests to go back to the old Roman amphitheater construction for moving theater houses, and our illustration shows how it can be accomplisht. A house as pictured here should *seat from forty to fifty thousand people* without much trouble, and it seems reasonable that such a theater would be readily filled and could be run profitably, at least in our larger cities.

Of course, such a scheme precludes the use of a single screen, and for this reason the hexagonal screen arrangement as shown must be used. This screen, which by the way disappears below the floor of the theater (similar to the curtain now used at the New York Hippodrome), is placed in the center of the house. Motion picture projectors, of which there are six, are located in the central axis of the six screens as shown. One operator attends to the six projectors, *all of which run simultaneously and are strictly synchronous as well.* In other words, the identical films are shown simultaneously on the six screens, and the action must be synchronous for the following reasons. Suppose one of the screens should flash a certain comical action ahead of the other five screens. Naturally, the audience sitting in front of this particular screen would start laughing loudly, before the people sitting in front of the other screens had reached that particularly mirthful topic. The other five "audiences" would therefore be annoyed, which can be readily understood. It should be noted that there are really six separate "audiences" to a house of this kind, one "audience" for each screen facing it.

For this reason, it would be of the utmost importance to run the films synchronously, which can be accomplisht with very little trouble by means of a single motor and six revolving shafts which drive the six reels, as seen in our illustration in the upper right-hand corner. If a film of any of the projectors should break, the operator stops all of them until

(*Continued on page* 1218)



The Above Illustrates a New Idea in Motion-Picture Theater Building Whereby It Becomes Possible for 50,000 People or More to View Motion Pictures. The Idea, in Short, Is to Use a Hexagonal Screen, Which Consists Really of Six Distinct Screens on Which Six Pictures Are Thrown Simultaneously, as Well as Synchronously. The Entire Audience, Therefore, Views the Picture at the Same Time. The Screen Is Arranged So

The Movie Theater of the Future
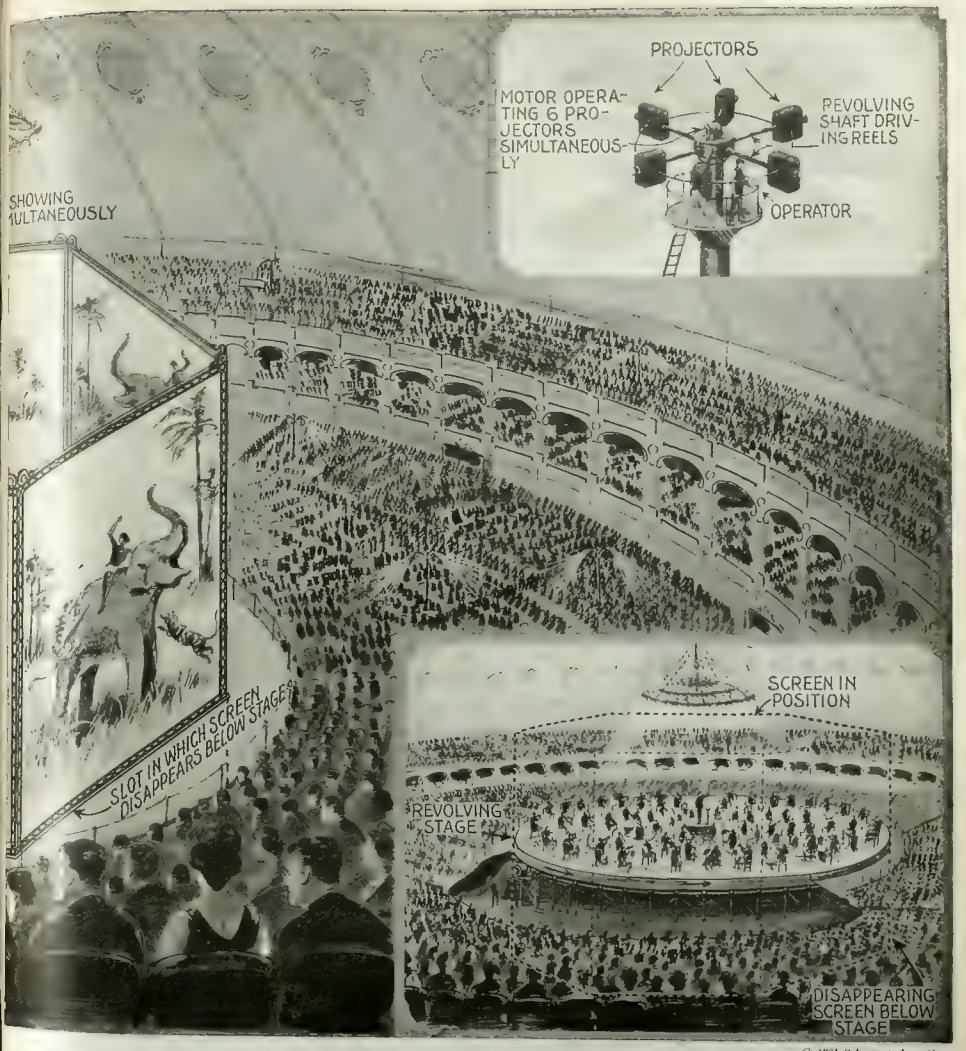
By H. GERNSBACK

OUR moving picture theaters have increased by leaps and bounds during the past decade as is realized by everyone. In our large cities it is always difficult to seat all the patrons who desire to gain admission, and when a big feature is advertised, it is usually impossible to secure admission, even tho these houses seat anywhere from two thousand to five thousand people at one time.

Take, for instance, the largest picture theater in New York City, the Capitol, which is also the largest theater in the world. This theater has 5,300 seats and quite frequently it is impossible to gain admission; it has been remarked often that this house would be sold out if it were five or six times as large.

What, then, will the future bring? If at the present time we have houses seating more than five thousand people which cannot accommodate the moving picture-loving public, what will happen five or ten years hence when the population has largely increased and when the taste for movies has increased as well?

Built along the lines of the present motion picture houses, that is, on the rectanguar plan, it seems almost impossible to make the houses much larger than the present Capitol Theater. A person sitting in the last row is some 212 feet



© 1921 Science & Invention

That It Sinks Below the Floor, Unmasking a Revolving Stage Upon Which the Orchestra Is Seated. The Novelty of the Revolving Stage Will Be Appreciated by All Theater-Goers. New Effects Are Provided by Such a Feature, as Is Made Apparent from Our Article. Loud-Talking Telephones Thruout the Auditorium Make It Possible for Everyone to Hear, Even Tho Seated in the Last Row.

away from the screen, which is about the limit, unless he should wish to use opera glasses, which seems impractical. What then is the solution?

The writer suggests to go back to the old Roman amphitheater construction for moving theater houses, and our illustration shows how it can be accomplisht. A house as pictured here should *seat from forty to fifty thousand people* without much trouble, and it seems reasonable that such a theater would be readily filled and could be run profitably, at least in our larger cities.

Of course, such a scheme precludes the use of a single screen, and for this reason the hexagonal screen arrangement as shown must be used. This screen, which by the way disappears below the floor of the theater (similar to the curtain now used at the New York Hippodrome), is placed in the center of the house. Motion picture projectors, of which there are six, are located in the central axis of the six screens as shown. One operator attends to the six projectors, *all of which run simultaneously and are strictly synchronous as well.* In other words, the identical films are shown simultaneously on the six screens, and the action must be synchronous for the following reasons. Suppose one of the screens should flash a certain comical action ahead of the other five screens. Naturally, the audience sitting in front of this particular screen would start laughing loudly, before the people sitting in front of the other screens had reached that particularly mirthful topic. The other five "audiences" would therefore be annoyed, which can be readily understood. It should be noted that there are really six separate "audiences" to a house of this kind, one "audience" for each screen facing it.

For this reason, it would be of the utmost importance to run the films synchronously, which can be accomplisht with very little trouble by means of a single motor and six revolving shafts which drive the six reels, as seen in our illustration in the upper right-hand corner. If a film of any of the projectors should break, the operator stops all of them until

(*Continued on page* 1218)

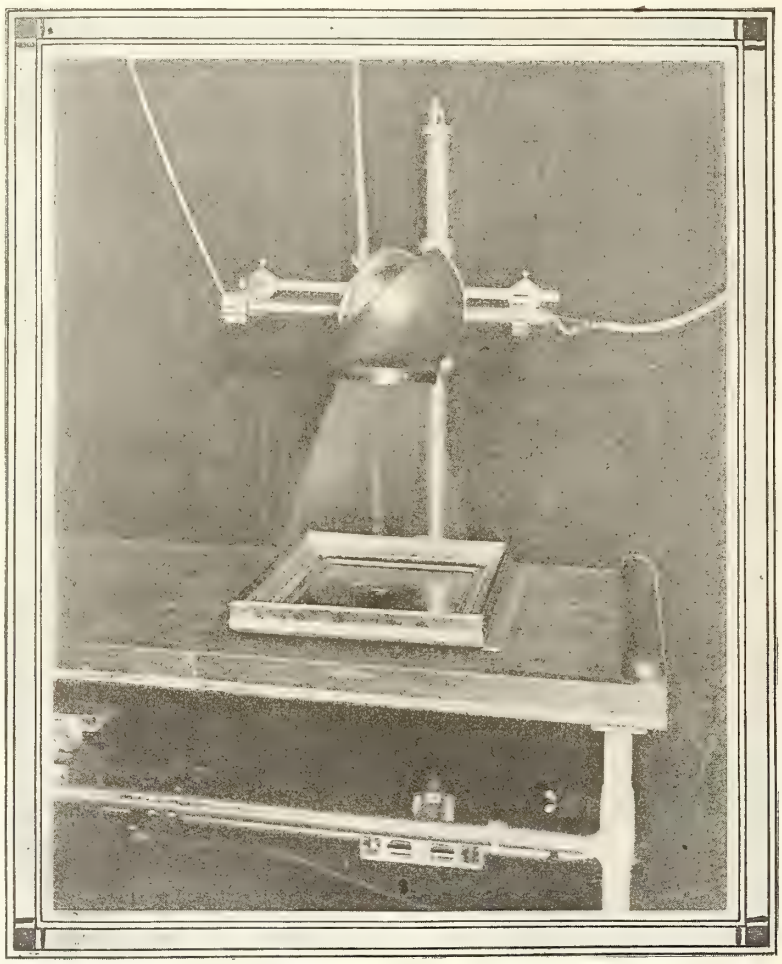
X-Rays Expose Counterfeited "Old Masters"

By JACQUES BOYER

THE rôle of X-rays in the last few years has been almost exclusively medical, but now it seems destined to be extended and to cover a more varied field day by day. The services which it has rendered to metallurgy in revealing imperfections in such metallic parts as may be of particular importance is recognized now; and finally it is invading the domain of the fine arts, so that the world of fine art and painting is destined to utilize its remarkable power.

The first investigations of this nature were carried on in Germany in 1914, and are described by Faber in the *Zeitshrift für Museumkunde*. They have been followed out in Holland by Dr. Heilbron of Amsterdam, who has attained very curious results.

Recently a French specialist, Dr. André Cheron, has attained still more exact results in this field, and we give herewith the technique of his methods which has made possible the radiographic verification of the authenticity of paintings by the "old masters."



X-Ray Apparatus Used Successfully in Exposing Spurious "Old Masters." The Genuine Old Grounds Were Done in Pigments Which Were Comparatively Transparent to the X-Rays.

It is known that the degree of transparency of a body to X-rays depends upon the number and weight of the colors present. Now in a picture there are three things to consider: the support (canvas or wooden panel), the ground with which this support is covered, and finally the colors which are used in the picture itself. The support is always very transparent to X-rays, cloth much more so than wood.

As regards the ground, it seems to follow from the records which we possess on the manufacture of colors and on the preparation of canvas and panels, that the old artists spread over their supports a mixture of calcium carbonate and glue, comparatively transparent to X-rays. Today, on the contrary, a coating of white lead is almost exclusively used, which is much more opaque and which, working into the interior of the threads of the cloth, makes a contrast with the transparency of these threads which cannot escape notice.

As regards the colors used by the artist for depicting his subject, they also vary greatly in density and consequently in transparency to X-rays. Some colors such as white are and always have been almost exclusively made of heavy compounds of lead or of zinc; such colors are practically opaque to the X-ray.

Others, like bitumen and the generality of blacks, are extremely light and let the rays pass thru very readily. Finally, between these two extremes we find very different density or weight, from light carmine to heavy chrome yellow with cobalt blue, ultramarine, sienna, Veronese green, English vermillion and orange, taking the intermediate positions.

But a certain number of colors which were formerly made on a base of mineral salts (the majority of reds, for example) are today sometimes made of vegetable substances far more transparent, like madder. It is the same with aniline colors.

It is clear now that to obtain a good radiographic image of a painting two things are essential: (1) the transparency of the support and of the ground; (2) the relative opacity of the colors or at least of certain of the colors whose contrasts form the image.

These conditions are accurately realized in the ancient paintings; on the contrary, modern paintings on an almost opaque ground, covered with colors, often very transparent to X-rays, give less perfect images by the X-rays and are often almost invisible.

Here is our first result. Radiography can give us a clue to the age of a picture and consequently sometimes can determine its authenticity.

Another result that radiography will show is the injuries which a painting may have experienced in the course of the centuries, in spite of the most skillful restorations. Since it is a question of ancient painting, the ground and the color used in the restoration will be of different manufacture and probably of different atomic weight, and will disclose on the photographic plate by absolute spots, perfectly defined in area, the injuries often entirely unsuspected by the casual observer.

And now perhaps the most interesting of these researches is the revealment of surprises by radiography. To see a picture by transmitted X-rays is to know in great part its history. The artist himself may have modified his work in the course of its execution. All the additions, all of the overlays which have been used on it, are thus revealed; not to mention the unexpected discoveries of paintings entirely hidden under modern work, the latter done by some unscrupulous artist.

The first two proofs obtained by M. Cheron, *The Madonna of Stellas* and *The Flower Piece*, show very well the contrast between the radiograph of an ancient picture and that of a modern one.

The first has colors that are quite strong and the figures can be recognized clearly. But besides there appear at the base of the picture entirely unsuspected restorations of considerable extent. In the second picture, on the contrary, no image is visible except that of the three white flowers, which are the only things done in a color sufficiently opaque to give a silhouette thru the ground of white lead which undoubtedly coated the canvas.

Another painting, the picture of the *Royal Infant at Prayers* of the French School of the fifteenth century, now in the Louvre, was also recently radiographed by Dr. Cheron. The authorities of the Museum consider from certain records that the original base of the picture had suffered considerable deteriorations and that these were hidden, by a uniform black coating; this radiograph confirms their hypothesis.

Finally, another radiograph obtained by the same process shows a little Flemish scene; it had formerly been attributed to van Ostade. The radiograph is still more curious. It shows no trace of the figures, except the head of one of them which can be made out in the center of the painting, but on the contrary, two peacocks, two ducks and two chickens appear upon the plate. There were undoubtedly two paintings superimposed on the same wooden panel; the first, that of the birds, is apparently an antique, since no opaque ground impairs the clearness of the silhouette. The second picture, the counterfeit van Ostade, is probably modern, since the colors, except the whites, are almost uniformly transparent to the X-rays.

Top: Modern Painting of Flowers at Left; at Right Appears X-ray Photo — the Only Opaque Spots Are Those from the Three White Flowers Done in White Lead, a Metallic Pigment.

Center: Left —What Appears to Be a "Perfect" Old Master Is Revealed by the X-ray as Being in Reality a Restored Painting. The Lower Photos Show Modern Scene Painted Over Older Painting.

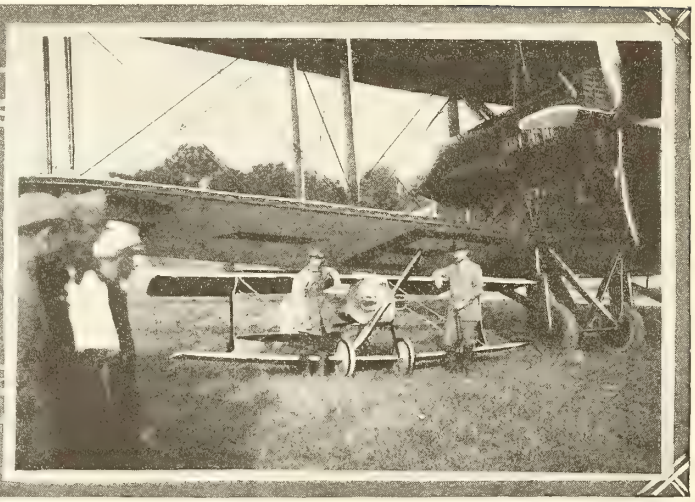


World's Smallest 'Plane

By the Paris Correspondent of "SCIENCE AND INVENTION"



The Accompanying Photographs Show What Is Probably One of th Most Successful and Smallest Airplanes in the World. It Was Designed and Constructed by Mr. de Pischof of France. This "Baby" 'Plane Measures 17 Feet Wide by 11 Feet Long and Stands But 4 Feet, 2 Inches High. Its Speed Is 60 Miles Per Hour When Driven by Its 16 Horse-Power, Opposed Two-Cylinder Engine.



MANY people have been waiting for the small airplane of low horsepower, which will be cheap to run. An engineer, Mr. de Pischof, has built for them an *avionette*. This constructor is a practical aviator and has studied aerodynamics and built successful airplanes ever since the early days of aviation. The first de Pischof machine was built in 1907 in connection with Mr. Koecklin and an *autoplane* was constructed in 1911.

In size they are among the smallest airplanes in the world—in construction, the simplest ever designed. This sport machine flew, during the tests, most successfully. Its construction is entirely metallic and this small airplane is fitted with a 16 horse-power Clerget-Blin horizontal opposed two-cylinder engine built specially as an airplane engine.

The span is 17 feet and the total length is 11 feet, while the height is 4 ft. 2 in.

It is a remarkable fact that this *avionette* can be completely dismantled in a few minutes by the aid of but one small spanner wrench and a pair of pliers. When the wings are folded the width of the plane is reduced to 3 feet. It follows that any small shed will shelter this machine, as, when folded it is no more cumbersome than a light motor car.

The wheels of the undercarriage are mounted on the longerons of the lower wing.

The total wing area is 80¾ sq. ft. When empty, the *avionette* weighs 225 lbs.; its maximum speed is 60 miles an hour and its *ceiling* or highest altitude is placed at 6,520 feet.

Four Rooms in One

"U-TURN-IT" makes four rooms out of one! Those who live in the congested cities such as New York, where the rents are climbing rapidly "towards the fourth dimension," will find of special interest this latest invention which comprises four living rooms in a small revolving cabinet, the whole affair being about the size of the ordinary pantry.

One Mr. P. L. Cimini is responsible for this invention, which has met with a great deal of favor on the part of the public who have seen the device while on exhibition on Broadway, New York City, recently.

The revolving four-in-one apartment comprises a substantially built revolving cylinder which can be fitted into a corner or into the side of a single room, if that is all the space available, and which will permit the owner to transform this single room at will into a library, a wardrobe, a bedroom or a kitchen, all of which are excellently designed as attested by the accompanying photographs of the invention.

There are four compartments to the cylinder, one containing a bed and bedroom accessories; another a bookcase and library equipment; another a wardrobe, and the last—the most important of the lot, in many ways—a perfect kitchenette, which includes a stove and even a sink.

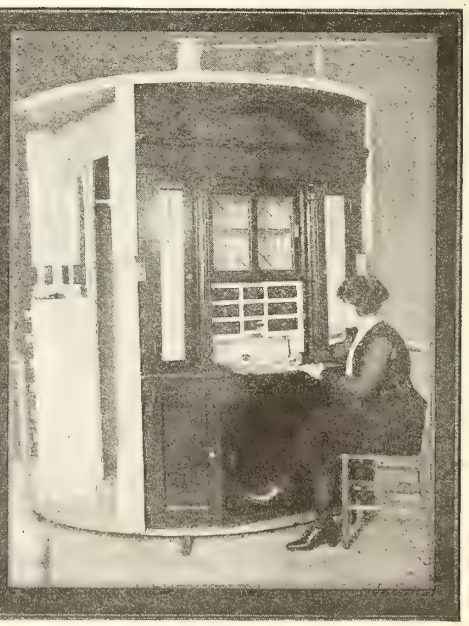
A simple turn revolves the cylinder and changes the room—*pronto*. This circular combination apartment is well ventilated and may also ventilate the room in which it is placed. The kitchenette is cleverly designed so as to meet practically every requirement of Mrs. Newlywed, and there is a place for everything, provided everything is kept in its place! There are cute little compartments, or drawers, for the flour, the sugar, the spices, etc.



The Complete Kitchenette.



Wardrobe and Folding Bed at Side.



The Library, Including Desk and Bookcase.

The Anatomy of Crystals

FREQUENTLY in solutions of solids, such as those of salt, sugar, alum, borax and of innumerable chemical compounds, symmetrically and characteristically shaped solids appear on evaporation, and by taking special precaution, very beautiful examples can be obtained. Then, if we depart from easily managed solutions such as made in the laboratory, and go into the field of Nature, we find there other crystals, in many cases formed by processes quite unknown to us, and hardly susceptible of surmise; among such are crystals of carbon—as the diamond, of common alumina or clay—such as the ruby, or lead sulfid—*i. e.*, galena or galenite, and so on thru a myriad of minerals.

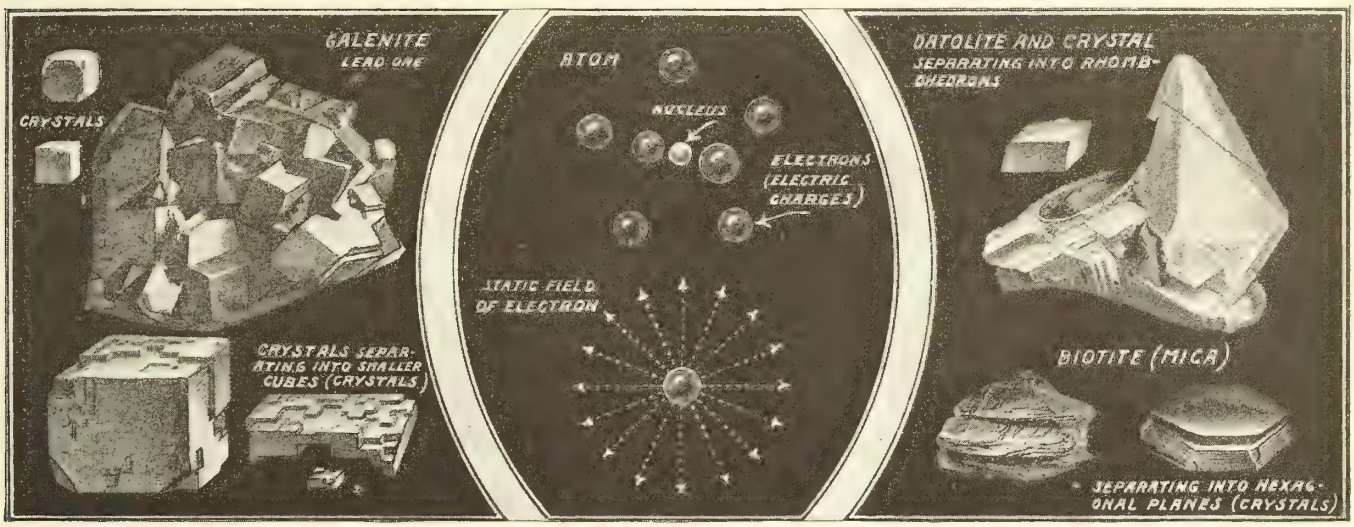
as the first or isometric system. Then come four other systems whose axes are not all of identical length, but each of which has its three axes. In the second system they intersect at one point at right angles and only two of them are of identical length. In the third system, the axes are of different lengths, but still intersect at right angles. In the fourth and fifth systems, at the point of intersection, the axes which are of varying lengths, intersect at oblique or obtuse angles. So far there have always been three axes to a crystal.

Finally, in the sixth system, there are four axes, three of them lying in a transverse plane to the length of the crystal and intersecting at angles of 60 degrees, while the fourth axis passes thru

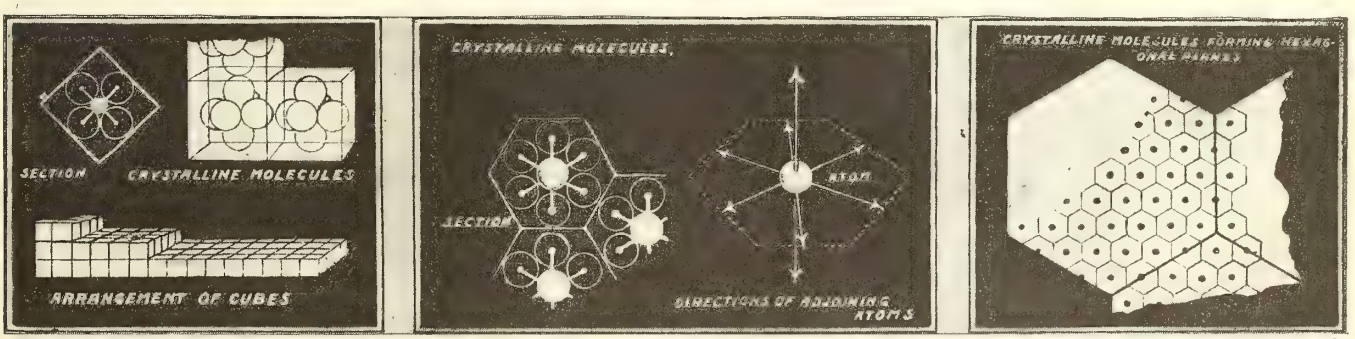
eral readily splitting away in faces parallel to those of its proper cubic crystal. By keeping it up, we can get a collection of almost microscopic cubes.

Again, we show mica, cleaving into sheets, transverse to the longitudinal axis of its crystals. In this mineral, we have only one prominent direction of cleavage. It would be very hard to find in mica, any other cleavage plane than that transverse to its longitudinal axis or in crystalogical terms—parallel to its base. Thus, Nature may give us a hexagonal prism of mica, and by utilizing its extraordinary cleaving, it may be made into sheets of almost microscopic thinness.

One of the illustrations shows a rhombohedron; the axes of this crystal are inclined one to the other. This is the



The Story of Crystals. Galenite, Datolite and Biotite Mica, As Typical Mineral Crystals, Formed in the Mysterious Laboratory of Nature. Suggested Symmetrical Crystal Building and Forms of Molecules. Those Interested in the Various Systems of Crystal Formation May Refer to the Article Appearing on Another Page, By Prof. F. L. Darrow, Which Contains a Diagram Showing All of the Systems. Contrary to Popular Opinion, Perhaps, the Method or Exact Way in Which Crystals Form Is Not Even Yet Thoroly Understood by Chemists, and Examination Under the Most Powerful Microscope Fails to Disclose the Exact Process By Which Dame Nature Proceeds to Build Up Crystallic Structures Which Outdo Anything That Man Has Accomplished.



Illustrations by William M. Butterfield.

In many cases a large crystal by mechanical means may be reduced to small ones, by a process of division, approximating to pulverization. The famous Abbé Haüy, the French mineralogist, early in the last century, placed crystallography upon a scientific basis. He found that crystals could be divided into six systems. Of these systems, five were definable by the relations of three axes in each crystal.

We have spoken of galenite crystals. These crystals are primarily cubes, and the axes of a cube are taken as being three in number, at right angles to each other, intersecting at a point in the center and terminating in the centers of the six faces of the cube, and therefore of equal length.

All crystals which can be referred to three such axes, belong to what is known

the intersection and is perpendicular to the plane which they determine. Such is a very brief resumé of the six system classification of crystals.

Every crystal that exists can be referred absolutely to one or the other of these systems, altho cases may occur when by some force crystals have been twisted or distorted, but the distortion is so easily recognized as such, that these instances do not invalidate the wonderfully simple laws effected by these products of Nature.

In many cases, crystals have what are known as cleavage planes. This means that they can be divided along the area of such planes so as produce a new crystalline face. We illustrate the result of this operation herewith. In a crystal of the first system, like galenite, it will be seen how cleavage occurs, the hard min-

crystalline form of datolite. Innumerable other examples of crystals could be given. The planetary disposition of nuclei and electrons in the atom which is generally accepted by theorists is sometimes taken as giving a base for the theory of crystals. In referring to the cut, a nucleus is shown with its electrons around it, and it is certainly suggestive of the possibility of geometrically shaped space being filled with the atoms building up symmetrical molecules and in the other views, the idea is carried out still further.

It is fair to say that in different scientific lines, few subjects are at once so fascinating and so wonderful in their exact mathematical relations and also simplicity as crystallography.

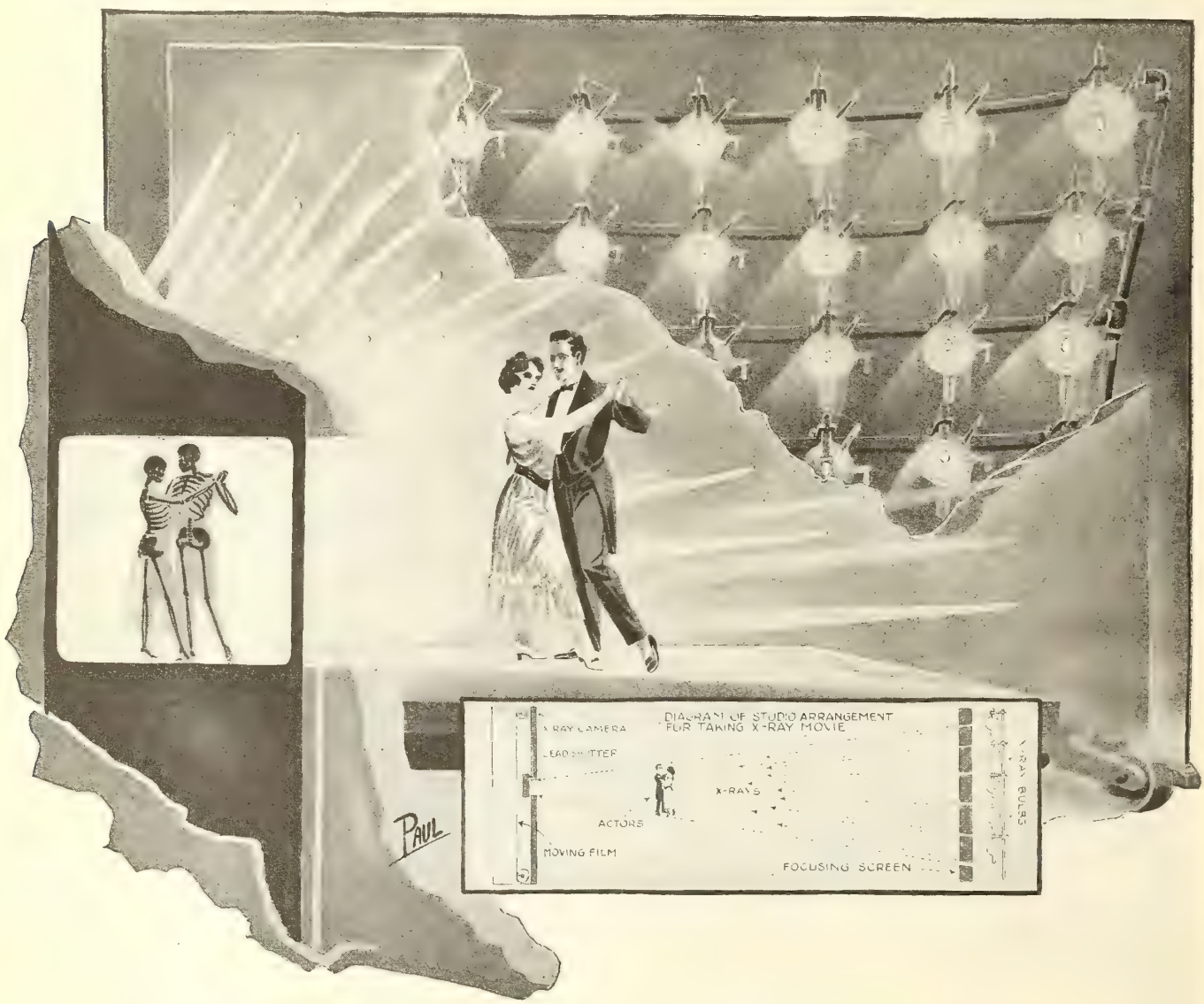
X-Ray Movies--Why Not?

By PROF. HAROLD F. RICHARDS, PH. D.

THE ability of X-rays to penetrate bodies thru which light cannot pass is being utilized in a variety of ways, but certainly no one will affirm that a limit to their applications has been reached. Surgeons in every large hospital in the country are constantly taking X-ray photographs of fractured bones and of bullets and other foreign bodies lodged in the flesh. Few modern dentists extract infected teeth or hidden defects that might result in the collapse of a structure.

X-Ray Movie Dramas

There remains at least one field, however, to which it seems possible to apply the X-ray, and that is to the amusement of the public. Formerly it seemed weird enough merely to view a photograph of the bones of the body, but that is not unusual nowadays, and to many people director the bones can be shown either sharp and unclothed or enveloped with a filmy shadow representing their fleshly contour. The settings will be seen only in part, for tapestries, curtains, bed clothing, thin furniture of wood and all other light objects will not register at all, and the actors will appear as animated skeletons flitting thru a mystic world of sombre shade in which chairs and interior partitions and tobacco pipes are



Professor Richards Here Shows Us How It Is Readily Possible to Produce "X-Ray Movie" Dramas and Comedies, Utilizing a Bank of Powerful Coolidge X-Ray Tubes As Shown. He Concentrates the X-Rays from the Bank of Tubes by Directing Each Bundle of Rays Thru a Hole in a Lead Screen, Lead Being Opaque to These Rays. Imagine an X-Ray Movie of a "Love Scene!"

impacted molars without first examining the interior of the gums with the X-ray. Fluoroscopic examination of the stomach and lungs is a commonplace; the beating of the heart and the peristalsis of the stomach can be made visible to the naked eye; the whole course of a meal thru the alimentary tract can be followed if certain devices are employed. Research hospitals in the East are now earnestly engaged in accurate determination of the exact utility of the X-ray in the treatment of cancer. Great steel and iron manufactories regularly use the X-ray to reveal the location of faults deep within the metal and are thus able to guard against

there is nothing particularly novel in actually watching the heart beat or the stomach rock a meal into physical energy. But if X-ray "stills" can be made without trouble, why can we not have X-ray movies? *I purpose in the following paragraphs to suggest a possible means by which X-ray movies can be produced and to point out as well the difficulties that must be surmounted.*

The imagination of the reader will have no difficulty in picturing at once the wonderfully bizarre effects that could be obtained with the utilization of X-rays in the movie industry. The actors will all be skeletons, and at the will of the

vaguely defined as faint shadows, while steel joists, water conduits and kitchen pans will stand out sharp and clear. The audience will see the revolver in the villain's hip pocket whether the hero does or not, and will tell at a glance whether the door is really locked. When the hero returns from war and blandly announces to his lady that he still bears a machine-gun bullet in his thigh, the audience will know whether he is telling the truth.

A Love Scene in X-Ray Drama

The "movie fan" will enjoy going into his favorite film house and seeing two

(*Continued on page* 1224)

How We Feel

By JOSEPH H. KRAUS

DID you ever stop to consider how numerous and varied are the senses which you perceive directly thru the skin? Those several qualities of sensation relating to the sense of touch and including that of discrimination, the sense of temperature and the sense of pain? A careful investigation of the skin surface bears out the idea that these three great classes of cutaneous (skin) sensations have special mechanisms or classes of mechanisms for each individual sense.

In considering these senses, it is best to take them up and deal with each separately. Thru the agency of the skin and the touch-corpuscles, we are able to perceive various qualities such as shape, texture and hardness of the objects in contact with the skin.

Of course, the sense of hardness also has associated with it a muscular sense, in that we are able to tell the hardness of the object by pressure. But, the real sense of touch can be easily found and so can the location of the touch spots by a very simple experiment which anyone can perform.

Relation of Touch to Pressure

If a hair is mounted on a wooden handle with a small piece of sealing wax and the skin prest with this hair until the hair bends, then a certain known pressure is being applied to the skin. The skin is then gone over carefully with this hair and wherever a touch sense is indicated we feel the hair touching the skin, a tiny cross or dot is placed on a chart.

The pressure applied by the hair is then determined by pressing down upon a balance which will register the number of grams-pressure a hair of that thickness can give, because the hair will bend at a certain point and the point of bending will give us the weight the hair is capable of applying.

It appears to matter very little whether the surface of the skin is pushed downward or pulled upward by an instrument. A sense of pressure in either case is announced to the brain. We find that on the tongue and nose, a pressure of only 2 grams per square millimeter will announce to the brain that a certain region is being touched.

On the back of the forearm, it requires a pressure of 33 grams per square millimeter and on the back of a finger, only 5 grams. Nearly all pressure sensation localizes itself near a hair root, and in

(*Continued on page* 1248)



SENSE OF FEELING

In Our Center Diagram, We Show Several of the Sense Impressions Which Are Conveyed to the Brain. The Girl by Placing Her Foot Into Water, Experiences the Sense of Coolness from the Water, and Also a Slight Sense of Pressure When Thrusting Her Foot Into It. She Can Tell She Is Sitting on a Rock by the Sense of Touch and Altho a Certain Sense of Pressure Is Due to the Clothes Which She Is Wearing, She No Longer Experiences This Pressure, Because She Has Become Accustomed to the Clothes, So We Say. On the Left, We Show the Distribution of Touch Corpuscles in the Section of Human Skin and on the Right, the Termination of Nerves in One of These Touch Corpuscles. Notice How Well Distributed the Nerve Endings Are.



Fig. 1—Heat Spots on a Small Portion of the Palm of the Hand Are Shown by the Blackened Areas. Those Areas Black-lined Are Less Sensitive and Those Dotted, Very Slightly Sensitive to Heat. The Unshaded Sections of the Small Portion of the Palm Are Non-Sensitive to Heat.



Fig. 2—Cold Spots—The Blackened Areas Are More Sensitive Than the Lined Portions and the Latter More Sensitive Than the Dotted Ones. The Unshaded Parts Are Not Sensitive to Cold Sensations. The Reader Can Easily Map Out the Areas as Shown Above on the Hands of His Friends.



Fig. 3—A Hair Mounted on a Wooden Handle with a Piece of Sealing Wax for Determining the Minimum Amount of Pressure Necessarily Applied Before a Sensation Is Evoked. Different Thicknesses of Hair Should Be Mounted on Individual Handles and Each One Specifically Marked.

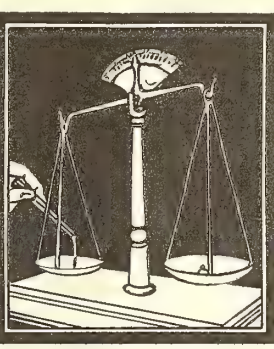


Fig. 4—Method of Determining the Amount of Pressure Produced by the Hair, by Pressing It Down into One Pan of a Delicate Balance. The Hair Bends and the Point of Bending Will Give Us the Degree of Pressure Applied by the Hair. Various Thicknesses Give Us Different Pressures.



Fig. 5—A Draftsman's Compass Fitted with Two Cork Tips Enables Us to Determine the Distance Between the Points Necessary to Produce the Sensation of Discrimination. If This Distance Be Very Small, a Sensation of Two Points Is Not Obtained.

Mushrooms That Explode

IT is safe to say that mushrooms to-day occupy an important place in the menu of many families. In Europe and Asia mushrooms have been cultivated for commercial use for many centuries. In America we find that the mushroom industry is growing by leaps and bounds.

Many varieties of this edible fungus are known to almost every one. Probably one variety known as Lycoperdons or *Explosive Mushrooms* is known to few observers.



A Sectional View of the Lycoperdon or Exploding Mushroom, with an Interior Formation Similar to a Shrapnel Shell.

This Remarkable Photograph Was Taken at the Instant When a Lycoperdon Mushroom Exploded.

Two Full-Grown Lycoperdons with Powdery Surfaces. When Young These Mushrooms Are Edible.

This interesting specimen abounds in Europe over a great area. They are easily recognized if one takes pains to look for them; when they are young they are very edible for table use, their form is spherical, when young the interior contains a whitish mass somewhat spongy; when it grows to maturity this becomes a pulverized powder and the stem slowly disappears, a puff ball resulting.

The curious thing about Lycoperdons is that when this transformation takes place the summit of the sphere breaks open with slightly audible noise when strong sun-rays strike it, a veritable explosion takes place, a cloud of powder is thrown into the air like a volcano giving it the name of *Pacific Crater*.

Why We Grow Bald

By DAVID J. CALICCHIO, M. D.

MY hair is falling out! My hair is getting thin! I am getting bald!" These sentences are repeated every day by millions of people. Your hair can be prevented from falling out. And it is easy to do so, as soon as you will learn, thru the following lines, the cause that makes the hair fall out. The cause itself is plain and easily understood.

Every hair consists of two parts. One part is imbedded in a small pit of the skin, which part is called the root of the hair. The other extending above the skin is known as the shaft of the hair.

The root of the hair is an outgrowth of flesh (hair papilla) underneath the skin. This root is abundantly supplied with small tubes (capillaries) carrying blood to the terminal parts of the body. This blood bathes and feeds the hair.

The blood is as useful to the hair as water is to flowers. Now, when the blood is hindered from reaching the root of the hair, the hair is deprived of its nourishment; it then dies and falls out.

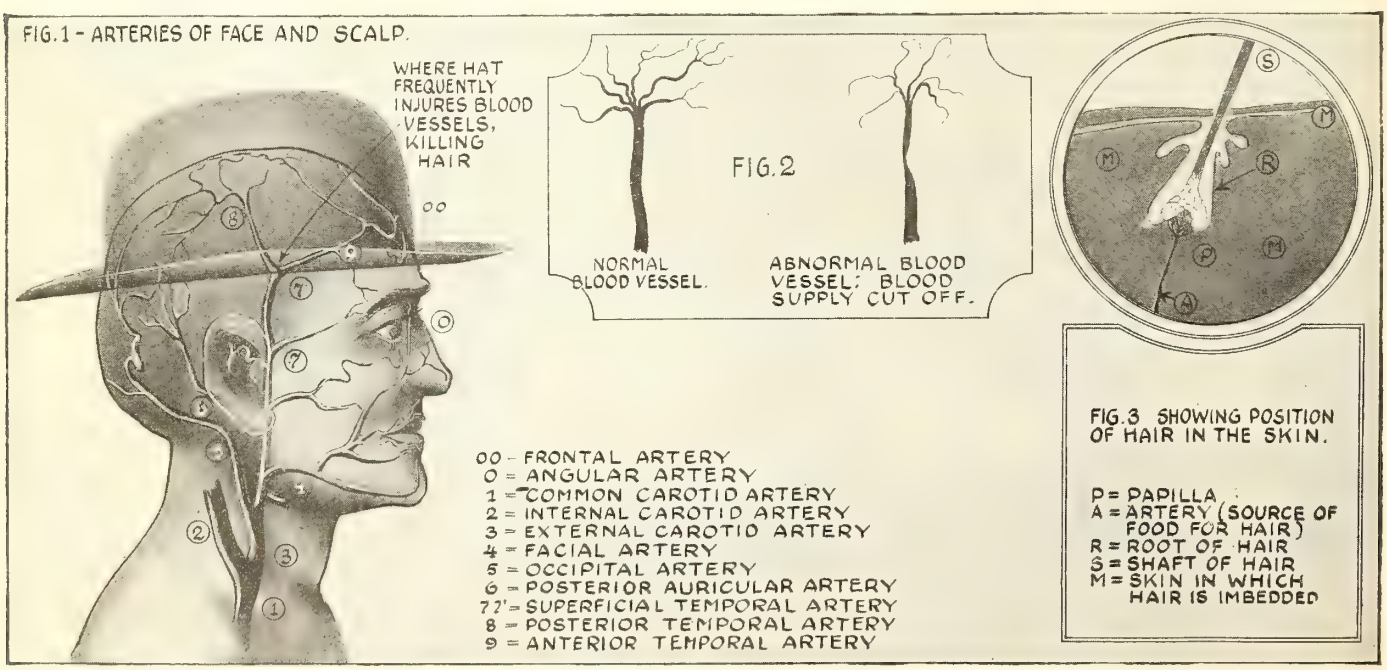
Every part of the body is supplied with tubes (arteries) carrying blood, which arteries divide towards their extremities. The arteries carry food all over the body.

The scalp has four main arteries, two on each side of the head. One artery ascends on the left, the other on the right side.

One artery passes upward from the neck over the lower jaw (mandible) in front of the ear, while the other artery goes upward behind the ear.

As these arteries branch toward the top of the head (sinciput), they divide into smaller and smaller branches like that of a tree, and cover the entire head.

(*Continued on page* 1244)



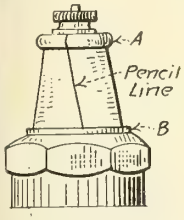
Why Human Hair Has a Tendency to Fall Out at the Top of the Head and Not at the Sides Is Explained in Plain English in the Accompanying Article and Illustraton by Dr. Calicchio. It Is an Oft Repeated Fact That the Constant Wearing of a Hat Will Be Liable to Cause Partial Baldness or Loss of Hair, and This Is Not Merely a Mistaken Idea Handed Down from Generation to Generation, but Is Founded Upon Strict Physiological Facts, Which Are Apparent When We Once Stop to Consider How a Hat May Injure the Blood Vessels Circulating Thru the Scalp Covering the Head. These Vessels Supply the Hair Roots with Nourishment. Injure These Blood Vessels, and Your Hair Is in Jeopardy.

MOTOR HINTS

HOW TO PREVENT THEFT OF CAR

First Prize $25.00.

Here is an extremely simple way to "lock" a motor, for preventing theft and it also is a good joke to play on someone that "knows-it-all" about the car.



The entire apparatus required is a fairly soft lead pencil. Simply mark each spark-plug on the porcelain from A to B, as per illustration—thereby short-circuiting the plug.

When the motor is to be started, twist the thumb and forefinger around the porcelain, rubbing out the mark, and the plug will work as well as ever.

Don't attempt to mark a plug when the motor is running, unless you "enjoy" high tension shocks.

Contributed by R. J. CURTIS.

AUTOMATIC AIR VALVE

Second Prize $15.00.

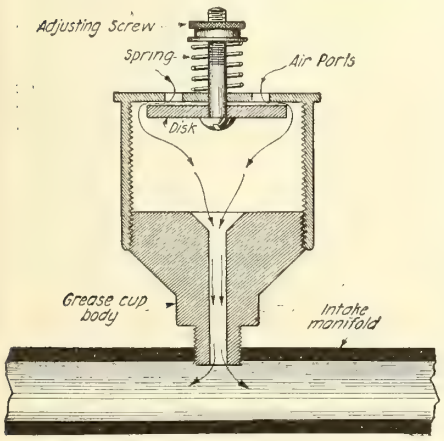
At high speeds the automobile engine works most efficiently on a lean mixture due chiefly to the fact that the duration of the explosion stroke is so small the burning of the mixture must be extremely rapid or most of the power will be lost. This condition is rarely achieved with a carburetor alone so some other device is necessary to admit additional air to give a lean mixture.

A simple and effective air valve can be made from a grease cup and a few odds and ends. A circle of ¼ inch holes is drilled in the cap of the cup, a center hole being provided to pass the stem of the movable member. The latter is a disk of iron or brass with a long 8/32 bolt thru the center. A large washer and thumb screw serves to regulate the pressure of a light coil spring.

This completes the valve. It is to be mounted in the intake manifold at any convenient place. The engine is started and the tension on the spring adjusted so the valve opens when an engine speed equivalent to about 30 miles per hour is attained.

This valve results in a saving in gasoline, reduction of carbon and gives the engine a snappy action instead of the sluggishness noted when an over-rich mixture is used at high speed. It will not affect the operation of the engine when working under heavy loads at open throttle.

Contributed by THOMAS W. BENSON.



A Simple Home-Made Air Valve of the Automatic Type for Insertion in the Intake Manifold.

$50.00 IN PRIZES

Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

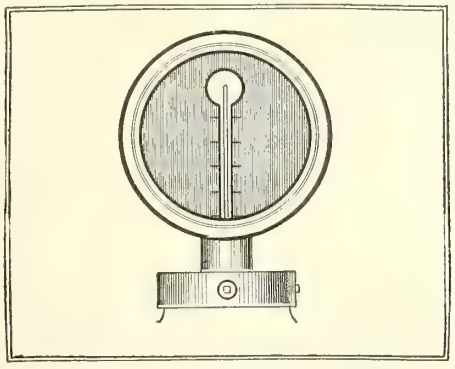
FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

FOOLING MOTO-METER THIEVES

Third Prize $10.00.

Here is a real kink to those who have had Moto-Meters stolen from their cars. Strange to say, these expensive devices are only screwed on and without protection. There have been many missing in my section lately, which led the writer to look about for a means of securing them, and yet make it handy to remove when water is needed. First the cap part was screwed on tightly to the radiator top, then with a small drill bit and brace a small hole made thru the cap and threads of both parts. Next, a small screw tap was secured and a hole tapt out to take a ½" machine screw. Next, the head of said screw was filed into a little square knob and a hollow key driven over this knob to form a square hole in same, after which this key would serve to unscrew the screw, which held the cap from being turned off by a thief. Any odd screw head will answer because the right tool for taking out this screw isn't in everyone's hand; again a thief taking off one of these devices is not likely to take any extra time getting it off, as they usually take things only that are loose.



Effective Screw Lock for the Moto-Meter.

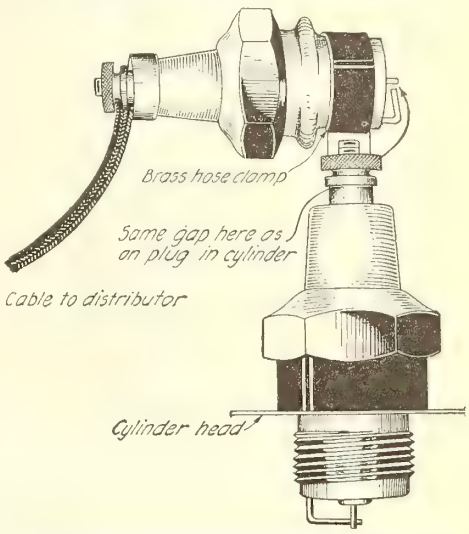
I have had no trouble as yet with this simple protection, while other cars lose meters.

The same trick can be arranged more handy still by having inside the cap a secret spring button, known only to yourself which may be pusht in with a match end, and cap removed when desired.

Contributed by R. C. LEIBE.

INTENSIFYING GAP FROM OLD SPARK PLUG

The high speed gasoline motors of the present day manufacture, very often develop a weak cylinder, due to poor compression or piston rings leaking oil. By intensifying the spark of that cylinder, this undesirable weakness is very readily overcome.



Intensifying Spark Gap Made from a Discarded Plug Fitted on Top of the Usual Plug.

My suggestion is to intensify the spark of that cylinder by means of a gap in the circuit. There are many devices of this type on the market today, sold at fancy prices; but an old spark plug and a brass base clamp are the only things needed for such an arrangement. These may be found in almost any garage or shop.

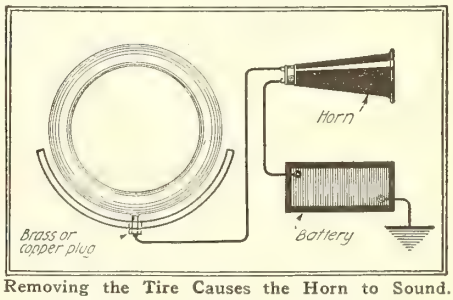
The diagram is self explanatory and I know of numerous instances where this device has worked wonders.

Contributed by JOSEPH A. MAYO.

ELECTRIC FIRE ALARM

A doctor friend of mine was having trouble with his tires, which were continually being stolen, thus losing about eight or nine of them a year. He asked me if I could suggest any way to prevent this trouble, and I made a device to be placed on his car, with which he has already detected several attempts to steal his tires, but the thieves never got very far. The drawing shows how I fixt 'em!

First I run a wire from the battery to the horn; then his auto electric system being grounded, I run another from the tire holder to the horn with an insulated brass plug which is held down by the tires; as soon as a tire is removed, the brass plug rises and makes contact with the frame, causing the horn to blow till another tire is put on. A switch may be connected so as to shut off the alarm when you have no extra tires.



Removing the Tire Causes the Horn to Sound.

Contributed by S. R. SHILLINGFORD.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory

Measuring the Giants of the Universe

ANOTHER milestone on the road of astronomical progress was reached recently when the diameter of a star was measured by means of the Michelson interferometer, a device destined to rank with the spectroscope and the photo-electric cell in value to the astronomer. As is well known, even the nearest of the stars are so distant that they show no perceptible disks in the most powerful telescopes. The least angle that the great telescopes will resolve is *one-tenth* of a second of arc—the angle subtended by a ten-cent piece viewed at a distance of fifteen miles—and the angular diameters of the giant stars do not exceed two or three *hundredths* of a second of arc, while the average diameter of the nearer stars is scarcely a tenth of this amount, or two or three thousandths of a second.

In *all* telescopes the stars appear simply as points of light. The disc-like appearance of the star images that is to be observed in photographs of the heavens is due simply to the *accumulation of light* upon the photographic plate during the interval of exposure. If we look thru the telescope at these same stars this disc-like appearance vanishes and they appear simply as luminous points.

It can be shown that to resolve an angle of one-hundredth of a second of arc by means of the telescope a lens about forty feet in diameter would be required. Manifestly, then, it is futile to hope to measure the angular diameters of the stars by increasing the size of the lens, since lenses of this size could never be made.

Fortunately, however, the apparently insurmountable difficulties of the problem can be overcome by making use of the familiar interference fringes found about the focal image of an object by the lens of the telescope. After the light from the object to be observed passes thru the lens the paths of all the rays converging toward the focus are not equal in length. The waves of certain pencils of light interfere with the waves of other pencils so that alternate rings of light and dark are formed about the focal image, if the source is a point, or alternate bands of light and dark, if the light is past thru a slit before striking the lens. If the interference is such that the *crests* of light waves come together a band of maximum light is produced and if the *crest of one wave* and the *trough of another* coincide the result is a ring or band of darkness. The most light falls at the center of the image where pencils equal in length meet and the interference fringes formed by interfering pencils of light are arranged symmetrically with respect to the central image.

Now it has been found that there exists a relationship between the size and shape of the luminous object and the clearness of the interference fringes, and this relationship can be made use of to measure minute angles that can be measured in no other way.

To produce the fringes under the most favorable conditions the light from a star whose diameter is to be measured is first passed thru two parallel slits placed at a definite distance apart in front of the lens of the telescope. Two slits produce fringes that are much finer, sharper and clearer than when only one slit is used. By increasing the distance between the slits the interference fringes can be made to disappear. If the distance is still further increased they will reappear again, then disappear and so on, each successive reappearance being fainter than the preceding one. The first disappearance is the one usually used for measurement. If the distance between the slits is measured at disappearance of the fringes the angle subtended by the object can be found from a simple relationship existing between this angle, the wave-length of light (which can be taken as one fifty-thousandth of an inch) and the distance between the slits.

The interferometer method, as it is called, can be used to measure the diameters of the satellites of Jupiter or of Saturn and of the asteroids and the distance between close double stars as well as the diameter of the stars. An achievement only second in importance to that of measuring the diameter of a star was the measurement of the angular distance between the two components of the close double star Capella, made not long ago by the Michelson interferometer. This angle is of the order of one-tenth of a second and therefore, just at the limit of resolution of the most powerful telescopes.

A valuable feature of the interferometer method of measuring small angles is the fact that its use is not necessarily restricted to the great telescopes.

Some years ago Prof. Michelson obtained by means of an interferometer attached to an eleven-inch telescope at the Lick Observatory measurements of the diameters of the satellites of Jupiter, which average one second in diameter, using slits four inches apart. The results were of the same degree of accuracy as those obtained by long series of direct measurements with the most powerful telescopes. Results as accurate as were obtained with the eleven-inch telescope he considered could have been obtained with a six-inch telescope, since slits placed only four inches apart could be used with a six-inch lens.

The distance between the slits is always in inverse proportion to the diameter of



© 1921—Science & Invention.

We Have Been Educated to the Fact That the Earth Is a Rather Small Body. Few People, However, Realize How Exceedingly Small It Is, When for Instance, We Compare It With Our Own Sun. The Above Shows This Graphically. If the Sun Was a Hollow Sphere, You Could Place the Earth in the Center and the Moon Could Still Revolve in the Same Orbit That It Occupies Now. We Would Then Have Almost 200,000 Miles Left Over for Good Measure. In Other Words, the Earth With the Moon and the Latter's Entire Orbit Does Not Even Fill Out the Sun. Still, All in All, Our Sun Is Only a Pigmy As Compared to Betelgeuse.

the object to be measured, so the smaller the angle to be measured the further apart the slits must be placed, and the distance between the slits is limited only by the size of the object glass of the telescope.

The possibility of the perfection of the interferometer to the point where it would permit of the measurement of angles as small as the angular diameters of the brighter stars when attached to the greatest telescopes in existence was foreseen by Michelson some years ago, and the year 1920 marked the accomplishment of this feat of measurement at the Mt. Wilson Observatory. The giant red variable star Betelgeuse, in the constellation of Orion, has the distinction of being the first star to have its diameter determined by this method.

The angular diameter of Betelgeuse is now known to be approximately three-hundredeths of a second of arc. When the distance of the star from the earth, or its parallax, is also known it is possible to convert this angular diameter into miles and compare the star directly with our own sun. Now the distance of Betelgeuse from the earth is somewhat uncertain, but it is estimated that it cannot be less than one hundred and fifty light years, and it may be twice as great, or three hundred light years. Using the lower limit of its distance from the earth, the diameter of the star comes out as something like three hundred million miles.



© 1921 Science & Invention

Compare This Picture With the One on the Preceding Page. If the Star Betelgeuse Was a Hollow Sphere, It Could Encompass Comfortably the Sun, the Planet Mercury, Venus, the Earth, As Well As Mars, and There Would Be Still Room to Spare Aplenty for All the Planets to Revolve in, Keeping in Their Present Orbits.

If it is three hundred light years distant from us, its diameter in miles corresponding to the angle measured would be *six* hundred million miles.

We are inclined to think of our own sun as a body of considerable dimensions, at least as compared to the earth and our most familiar standards of measurement. We know that if our planet Earth attended by the moon were placed at the center of the sun, the moon in its orbit would lie about two hundred thousand miles below the solar surface while the earth would be an inconspicuous point at the center of the sun. Now, imagine Betelgeuse to take the place of the sun at the center of the solar system. It would extend nearly *ten million miles beyond the orbit of Mars* and beneath its surface would lie all of the terrestrial planets, Mercury, Venus, Earth and Mars!

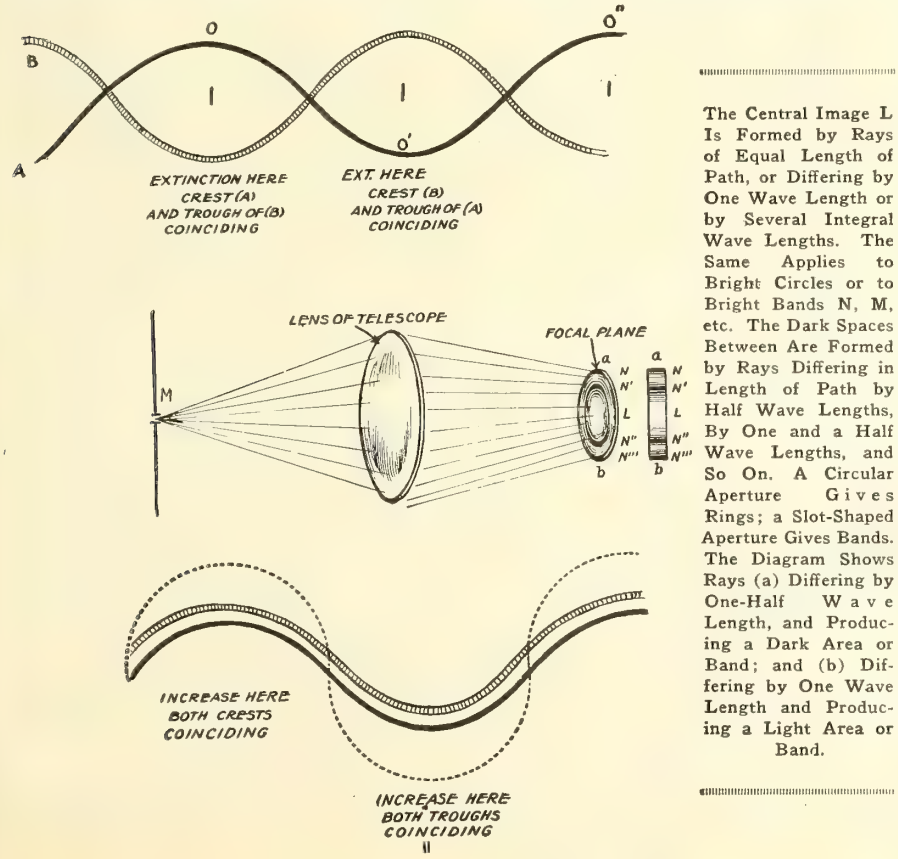
We know that light with its unimaginable velocity of one hundred and eighty-six thousand miles per second would dart seven times around the earth's circumference in *one second,* but it would take nearly *fifty-four hundred seconds,* or about *an hour and a half,* to make the circuit of the mighty globe of this red giant.

It is known that, tho the red giant stars are the bulkiest of all the stars, they also have the least density of all the stars, that is, the quantity of matter in these stars or their mass, in other words, is very small compared to their volume and their gravitational attraction for bodies at their surface is correspondingly weak. The density of some of the red giant stars has been estimated to be as low as *one millionth* of the density of the sun, or about that of the upper strata of the earth's atmosphere. (The density of the sun is one and four-tenths times the density of water.)

Betelgeuse is also an irregularly variable star, as are so many of these red giants of the universe. The cause of its peculiar variability of brightness is still in doubt. It is estimated that the surface temperatures of the red giant stars are comparatively low, probably even less than that of the electric furnace or about 3,000° C., and low enough to permit the formation of certain chemical compounds, a fact which may have some bearing upon its variability of light. It may consist of incandescent, dust-like, particles widely diffused about a central nucleus of greater density. The temperature of our own sun is estimated at something like 6,000° C., while the intensely hot hydrogen stars have temperatures averaging about 10,000° C.

The star Betelgeuse, then, which has become famous as the first star to have its diameter measured by a new scientific device, is a massive red giant, low in temperature and tremendously great in

(*Continued on page* 1216)



The Central Image L Is Formed by Rays of Equal Length of Path, or Differing by One Wave Length or by Several Integral Wave Lengths. The Same Applies to Bright Circles or to Bright Bands N, M, etc. The Dark Spaces Between Are Formed by Rays Differing in Length of Path by Half Wave Lengths, By One and a Half Wave Lengths, and So On. A Circular Aperture Gives Rings; a Slot-Shaped Aperture Gives Bands. The Diagram Shows Rays (a) Differing by One-Half Wave Length, and Producing a Dark Area or Band; and (b) Differing by One Wave Length and Producing a Light Area or Band.

© 1921 Science & Invention

Early Steam Engines from Hero of Alexandria to James Watt

By PROF. T. O'CONOR SLOANE, Ph. D., LL. D.

THE fact that when water is heated, steam is produced, thereby producing pressure, has been known for many centuries. The first steam engine is credited to an early mathematician and philosopher, Hero of Alexandria, the date of whose invention is assigned to over a century before the Christian era. We illustrate two constructions of his engine which operated by the action of escaping steam. In the simplest construction, a vessel with tangential outlets is carried by pivots establishing an axis at right angles to the outlets. On heating it, the escaping steam by its reaction effect, causes the vessel to whirl around with great rapidity. In another more advanced construction, one of the bearings becomes a hollow trunnion, admitting steam from a separate boiler, which steam escapes from the outlets, so that no heat is applied directly to the revolving portion.

Little was done beyond this inadequate engine for seventeen centuries. We have already chronicled Leonardo da Vinci's experiment with a cylinder and piston actuated by steam, but this never developed into an engine. A steam fountain was produced by an inventor, de Caus of Heidelberg, in 1615 and Giovanni Branca of Rome in 1629, produced an engine in which an escaping jet of steam blew a sort of paddle wheel around. Then we come to the famous passage in the Marquis of Worcester's book where he tells of his engine, or "water raising" apparatus, and we are informed by the Duke of Tuscany in 1656 that this really did work and was operating in Vaux Hall, London, in 1656. Its construction is not known, but is a matter of probable surmise. The water was lifted 40 feet. Then Thomas Savery in 1698 produced an apparatus for raising water which was probably built on the lines of the Marquis of Worcester's machine, and operated by the alternate production and condensation of steam, and having no moving parts.

The operation of the Marquis of Worcester's engine is problematical, the illustration showing one surmise. By manipulation of the valves the receivers are alternately filled with steam, which is in turn condensed by inflowing water.

About 1711, Thomas Newcomen, a blacksmith of England, a Devonshire man, appeared on the scene. He constructed operative reciprocating engines, with cylinders and pistons, for pumping water from mines. These were beam engines, the pump rod, weighted if necessary, depending from one end of the walking beam and the piston rod depending from the other. The ends of the walking beam were arcs of circles, over which chains passed so as to secure parallel motion for pump rod and piston rod. In its operation, steam was admitted from a boiler placed directly below the cylinder, the steam entering the cylinder below the piston. The combined effect of the weighted pump rod and of the steam, raised the piston to the top of the cylinder. The steam was then condensed. In one construction, a jacketed cylinder was used and water was admitted into the space outside the cylinder and within the jacket to condense the steam. In another construction a jet of water was injected directly into the cylinder below the piston. In either case the condensation by the water was effected after the piston had reached the top of the stroke and the steam had been turned off; this created a reasonably good vacuum below the piston, which descended under the effect of atmospheric pressure. It will be observed that the valves in the Newcomen engine were three in number. The operations were repeated over and over again, and originally the valves were operated by hand. The steam valve had to be opened and shut and the same had to be done with the water inlet valve and the water outlet valve, each at its own proper time. This interesting historic engine ran at from 10 to 16 strokes to the minute. Newcomen made his boilers of copper with lead domes.

A Few April Articles

Shooting Grain, Hardware, Milk and Other Commodities at 200 Miles an Hour Across Country in Electrically Propelled, Air-Driven Trains,—all Automatically operated without motormen or trainmen. The Remarkable Invention of Lester P. Barlow who invented the only successful type of bombs used in the World War, which exploded just before striking the ground—and also the inventor of many other startling and practical war and peace inventions.

Electricity Direct from Coal—Its Possibilities—With numerous illustrations showing apparatus so far developed. By Prof. T. O'Conor Sloane, Ph.D., LL.D.

The Oddities of Physics—Is a Level Line Straight? When is a Plumb Bob Not Plumb?—and many other interesting everyday paradoxes in applied physics, illustrated and described. By H. Winfield Secor.

Monster Animals of Long Ago. With wonderful illustrations. By Dr. E. Bade.

Latest Scientific Developments from the U. S. Bureau of Standards.

Astronomical Photography for the Amateur. Illustrated with photos taken by the author. By H. F. Curtis.

New Science Story, "The Love Machine." By Charles S. Wolfe.

The Sixth Sense. By Joseph H. Kraus.

The Transmission of Power by Waves thru Liquids in Pipes.

The Comparative Losses in the Steam Locomotive Versus the Electric Locomotive.

Radium in Cancer Treatment—With photos and diagrams showing how Radium is applied externally and internally.

In the earlier engines a boy was assigned the job of opening and closing these valves; he was called the "cock boy." The story is told that one of these youths, Humphrey Potter by name, had the ingenuity to tie the valve handles to the moving parts of the engine so as to make it work automatically, which constituted a most important advance. As many as 16 strokes a minute were attained in some of Newcomen's engines.

James Watt's Discoveries

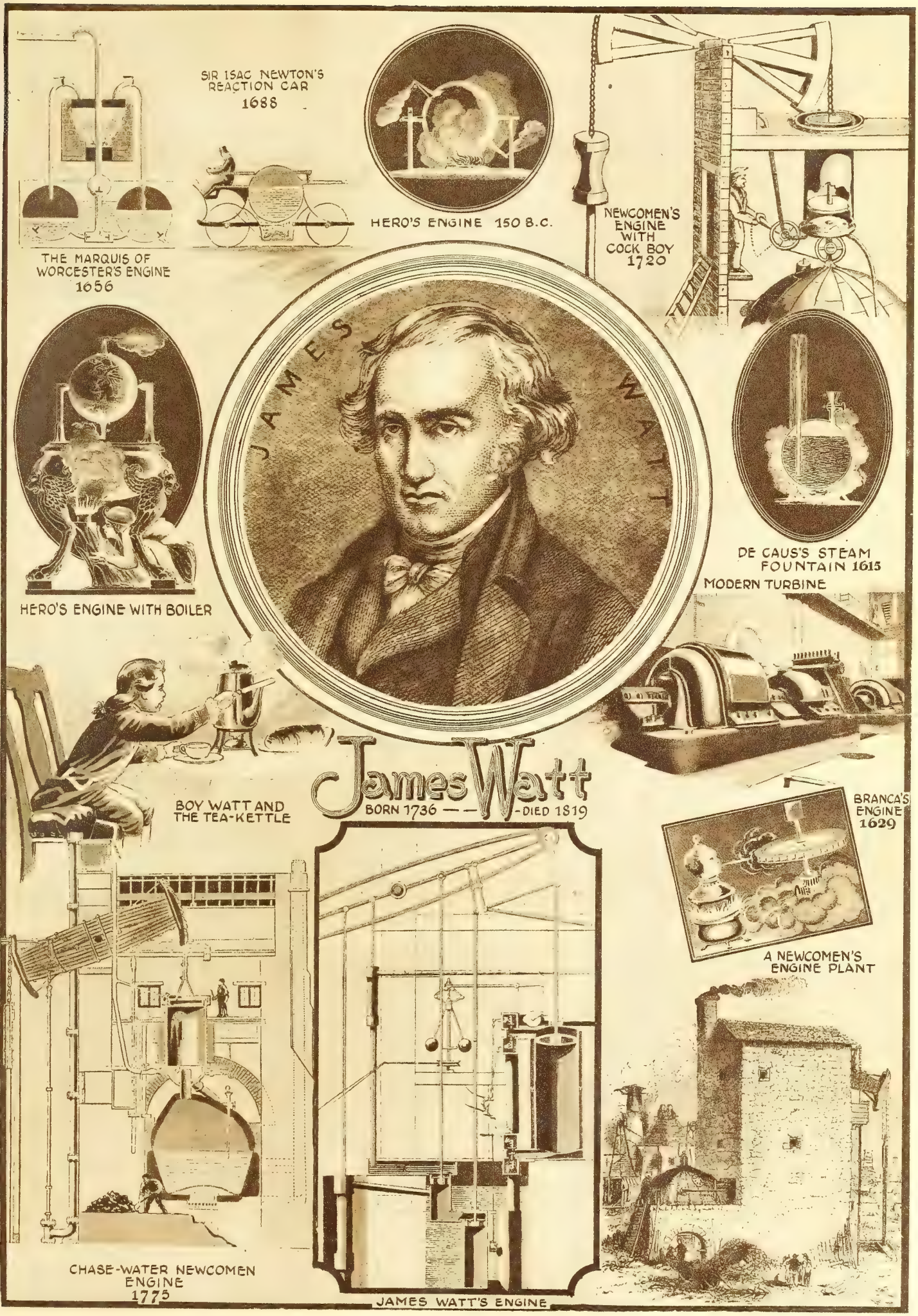
James Watt, born in 1736, and dying in 1819, a Scotchman by birth, was establisht in London as an instrument maker. He received a model of the Newcomen engine from the University of Glasgow to put in order. This was a very small model, but it served to direct his thoughts to the force of steam and he evolved the idea of condensing the steam in a separate vessel, from the cylinder. The effect of this was to maintain the heat of the cylinder, which in the Newcomen operation was cooled by the condensing water with great waste of fuel. This was Watt's great invention which converted the uneconomical Newcomen engine into a machine which at least had within itself the elements for developing economical operation. He also made his engines double-acting. He had endless trouble with the details and the capitalizing of the business of constructing engines. His patent, which is quite a full one, is dated 1769. It is questionable if he would ever had succeeded if it had not been for his association with a capitalist and manufacturer named Boulton. The imperfect Newcomen engine was working in various places, and it was obvious to Boulton that it could be supplanted by the Watt engine. So the firm of Boulton and Watt was formed, and the modern reciprocating double acting condensing steam engine was produced. The first Boulton and Watt date is 1775. Watt invented several methods of converting the circular motion of the walking-beam into a true straight line motion. These devices are termed, rather loosely, parallel motions. One of them is employed in the Watt engine illustrated in our cut. He also invented the ball or centrifugal governor, formerly called the circular pendulum. But the condensing of the steam in a separate vessel, involving the discovery of a new law of thermo-dynamics, is his great achievement.

An interesting retrograde step was the later development of the non-condensing engine, in which Watt's great invention is abandoned. Practically all locomotives are of the non-condensing type. The non-condensing engine is made possible by the use of steam at high pressure.

Such is a resumé of the history of the reciprocating engine. After Watt's time its development was a question of detail.

Of course the story is told of his observing in his boyhood days the force exerted by the steam escaping from the spout of the family kettle. But the repairing of the little model Newcomen engine seems to have been the turning point in his career.

But here a most curious feature in the cycle of invention is to be noted. The first steam engines were reaction engines, Sir Isaac Newton even going so far as to make a little reaction motor car. Then came the engines without moving parts, operating by the alternate pressure and condensation of steam, and then came the reciprocating engine of Newcomen and then of Watt. From the date of Watt to the present, endless efforts have been made to produce the rotary engine, void of reciprocation and operating by direct pressure on a piston following a circular path, and now the most recent type of engine departs from reciprocation and turns its moving member directly by the action of steam, largely on the lines of the old Hero's engine. We allude to the steam turbine. In this construction Newcomen and Watt have been past over and the invention of Hero of Alexandria, 20 centuries old, is in a measure returned to by the modern engineer.


THE MARQUIS OF WORCESTER'S ENGINE 1656
SIR ISAC NEWTON'S REACTION CAR 1688
HERO'S ENGINE 150 B.C.
NEWCOMEN'S ENGINE WITH COCK BOY 1720
JAMES WATT
HERO'S ENGINE WITH BOILER
DE CAUS'S STEAM FOUNTAIN 1615
MODERN TURBINE
James Watt
BORN 1736 — -DIED 1819
BOY WATT AND THE TEA-KETTLE
BRANCA'S ENGINE 1629
A NEWCOMEN'S ENGINE PLANT
CHASE-WATER NEWCOMEN ENGINE 1775
JAMES WATT'S ENGINE

SCIENCE



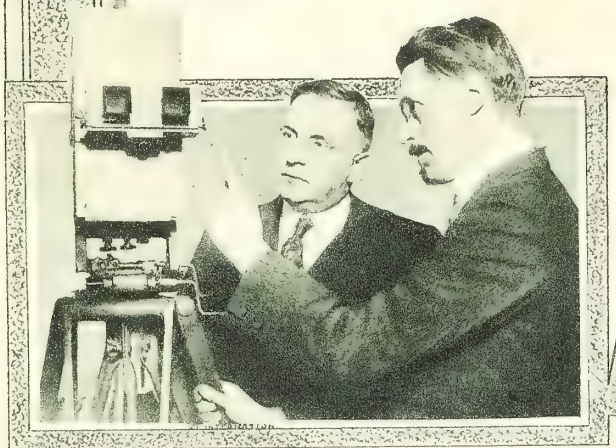
Police Stick and Revolver Combined, Form an Excellent Rifle for Long-Distance Emergency Shooting. The Club Is Specially Made, and Accurately Bored and Rifled.

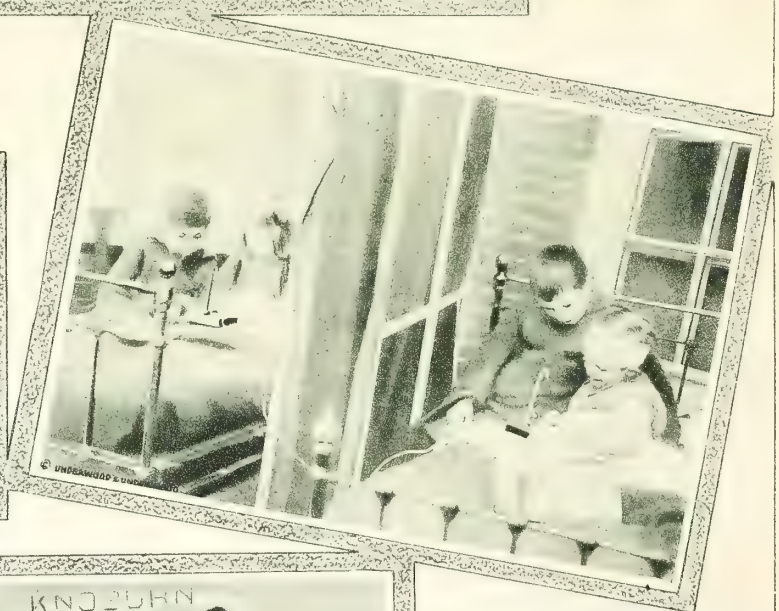


Photo Above Shows New Auto Sign Which Operates in the Same Position As the Usual Hand Signal. It Signals to the Front As Well As to the Rear. It Is Illuminated at Night and the Device Can Be Used As a Parking Lamp, Showing Red to the Rear. It Requires Only a Two Candlepower Lamp.

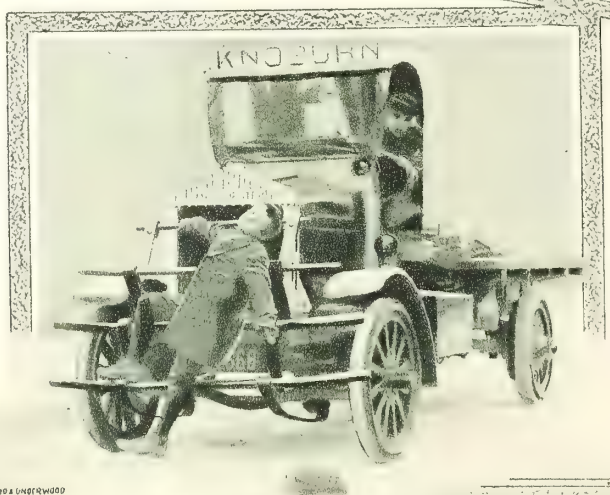


Photo at Right Shows Latest Type of Aluminum Airplane Built in Germany. The Machine Is Made Entirely of Metal and Has a Wing Spread of About 115 Feet. It Is Propelled by Four 250 H. P. Engines Built Right Into the Wing. Its Capacity Is 18 Passengers.





The Photo Above Shows the Inventor (at Right) and His New Binocular Vision "Movie" Camera Which Is Said to Solve One of the Most Absorbing and Difficult Problems in Motion Picture Work—That of Providing a Picture Having True Depth and Perspective. The Inventor Is P. John Berggren of Swedish Extraction, But Now of Chicago. This Machine Would Seem Then to Give the Effect We Have Long Sought—Real Stereoscopic Motion Pictures in Which the Images Stand Out in Relief.

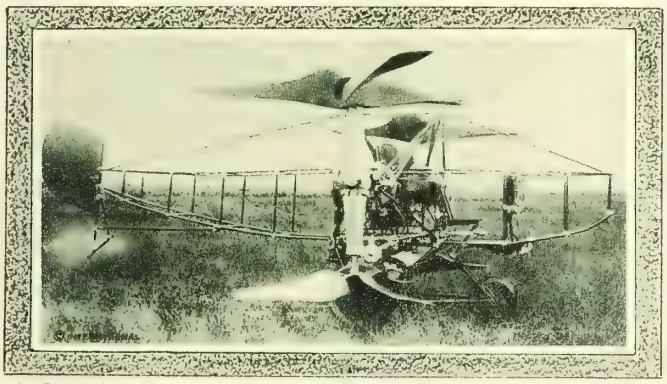


One of the Latest English Toys Is the Electric Signaling Set Here Shown in Use by Children in a Hospital Ward, Much to Their Delight. The Outfit Comprises a Battery, Signaling Lamps, Etc., Together with a Code Table by Means of Which Messages Can Be Communicated Between Two or More Stations.

A Remarkable New Auto Truck Life and Property Saver. This Automobile Safety Attachment Has Been Designed to Act As a Fender for Picking Up Persons Struck and Also for Preventing a Vehicle from Turning Over Should a Wheel Come Off. The Present Photograph at the Left Shows How a Person Is Saved When Struck by a Truck Fitted with This Device.

© UNDERWOOD & UNDERWOOD

IN PICTURES



A Remarkable Flying Machine Recently Completed by a Chicago Inventor Which Operates Upon the Helicopter Principle. In Other Words, the Machine Lifts Itself from the Ground by Means of Two Sets of Horizontal Blades Which Revolve in Opposite Directions. This Machine Can Rise Vertically and Hover in the Air, Contrary to the Usual Airplane.

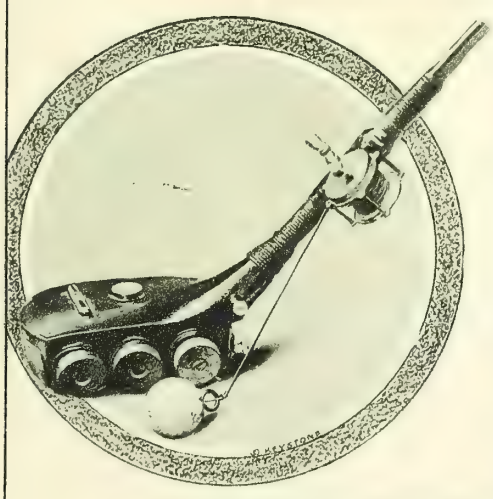
Drop Your Three Cents in the Slot and Out Comes Your Daily Paper. The Only Prerequisite Is That with This Latest Newspaper Vending Machine You Must Have the Proper Change Ready. The Newspapers Are Placed in the Machine the Same As in Chewing-gum Slot Machines with Which Everyone Is Familiar. Three Cents Is Inserted—a Handle Is Pulled—and Out Comes the Paper.





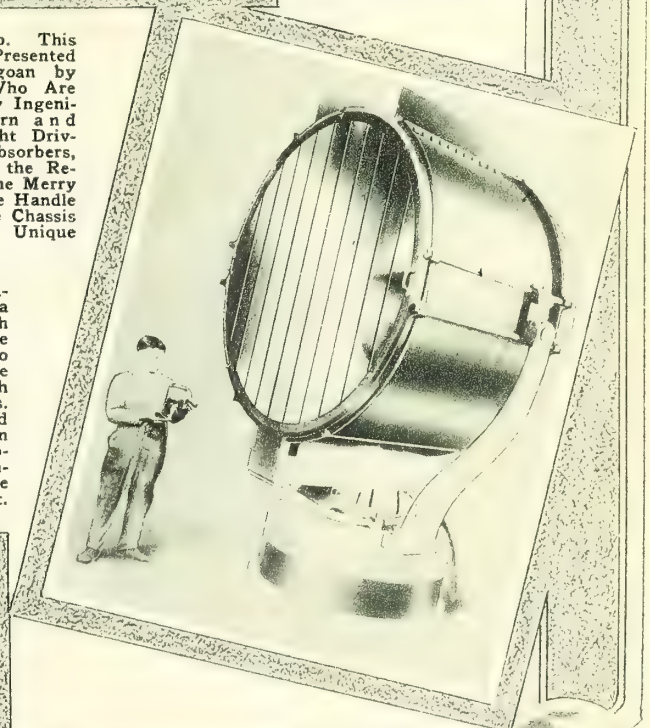
Latest Photograph of the Famous Inventor of the Telephone, Dr. Alexander Graham Bell, Receiving the Freedom of the City, at Edinburgh, Scotland, His Native City, in the Presence of a Distinguished Company. He Is Holding the Handsome Casket Containing the Burgess Scroll. On the Right Is Lord Provost Chosser.

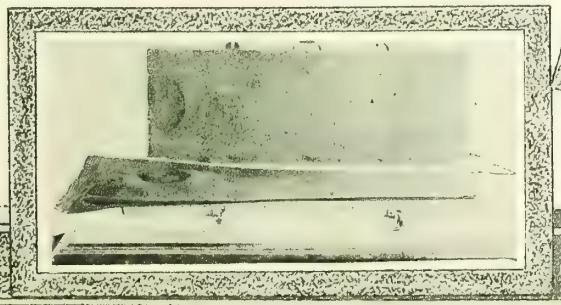
Photo Below Shows the Largest Electric Searchlight in the World and Also Coincidently the Smallest Electric Searchlight, Being Held by the Man Shown at the Left of the Photo. Giant Searchlights Such As the Large One Often Require 50 to 70 Kilowatts to Give Their Full Light Intensity, While the Small One Will Operate on a Few Hundred Watts.



A Marvelous Golf Club. This Club Was Made and Presented to a Prominent Chicagoan by Five of His Friends Who Are Responsible for Its Many Ingenious Features. The Horn and Electric Light for "Night Driving," the Three Shock Absorbers, the Level, the Compass, the Retrievable Ball and Also the Merry Music Box Wound by the Handle Shown at the Rear of the Chassis Are Very Novel in This Unique Club.

Now Comes a French Invention in the Form of a Simple Pants Press, with Electric Heating. The Press Opens Up So As to Permit the Trousers to Be Carefully Laid Out with Recesses for the Pockets. The Press Is Then Closed and Electric Current from the Nearest Socket Applied. After Fifteen Minutes the Trousers Are Ready to Be Taken Out. ©Keystone.





The Devil's Understudy

By CHARLES S. WOLFE

OUR readers will be very much interested in this story which contains considerable food for thought. In our March, 1920, issue we described a patented apparatus by whose means electrical currents are carried by ultra-violet rays, which latter act as conductors. This makes Mr. Wolfe's story very plausible, and we hope our readers will enjoy Mr. Wolfe's latest efforts.—Editor.

MOST every town's got one, I guess. Crazy scientist, I mean. One of these absent-minded, high-browed old birds that comes wandering trance-like down the street with their hands behind their backs and their minds off some place in "The Sweet Bye and Bye." People turn and grin when one of them passes and says to one another, "There goes that crazy scientist."

I don't. Grin after 'em, I mean. I turns and gives them birds the most careful double O. I notes any little peculiarities, now—their gait, height and so forth. And if I ain't got too much else to do just then, I tags along after them, casual-like, and see where they hang out. Then if I want 'em again I know where to start and look. 'Cause you never can tell about those babies.

Nine out of ten of them is just mild nuts; the kind that gets in the bathtub and forgets to turn the water off. But the tenth lad! Oh, boy!

The saw-bones that examined Gleason told me that insanity is merely a question of degree. Which, I take it, is just saying that some is bad and some is worse. Gleason, now, was in a class by himself. Hands down, he wins the non-skid soap dish. Twenty years I've been roaming the streets in plain clothes, and I've only run into one Gleason. If ever I meet another I'm thru roamin'.



"* * * All Three of Us Has Had Considerable Experience in These Matters, and It Only Takes a Minute for Us to See That He's Been Gathered to His Fathers, Sure Enough. But the Funny Part of It Is, That We Can't See No Trace of What Took Him Off. No Bruises, Wounds or Anything. And You Simply Can't Croak a Guy Without Doing Something to Him."

Remember the Gleason case, do you? I'll never forget the way it started off. I was in the office with the old man, makin' a report, when Bill Lawrence comes bustin' in without even knocking. His eyes were bulging right out of their sockets and you could see something had upset him awful.

The Old Man gets ready to freeze Bill for his sudden entrance, but Bill never gives him the chance. "For Gawd's sake, Chief," he cries, "it's terrible! Horrible! I——"

"Heavens, Lawrence," yells the Chief, mad as a wet hen. "Are you growing hysterical? What's terrible?"

"Murder!" gasps Bill, wildly.

"Well, what of it?" roars the Old Man. "Haven't you ever seen murder before? What's the matter? Losin' your nerve?"

"Yes, but these murders——" Lawrence protests, feebly.

"These murders?" echoes the Chief. "There was two of them, then?"

"Ten of 'em, Chief," Lawrence half sobs.

"Ten of them?" bellows the Chief. "That ain't murder, you boob, that's civil war. What are you talking about?"

"It's true, Chief," says Lawrence, solemnly, getting some kind of a grip on himself. "Ten men killed right out on the open street and nobody knows who done it or how it was done. Big fellows, they are, too; bankers and the like."

The Chief was getting right down to business. "Bomb outrage, was it?" he growls at Lawrence.

"No, sir," replies Bill. "No violence, sir."

"No violence?" the Old Man bleats. "What's eatin' you, Bill Lawrence? How can you have murder without violence? A gink is shot, stabbed, strangled, poisoned or beaten. If you don't think them's violent just ask the victim. How was this job pulled off?"

"I don't know," says Bill, soberly. "I looked the bodies over. No marks on them. Not one. They're just dead, that's all. They topple right over in the street, right in a crowd. They don't even holler. When you pick 'em up they're deader 'n Rameses."

"Humph!" growls the Chief. "Something wrong, somewhere. I——"

(*Continued on page* 1233)

How is Your Mental Balance?

Psychological Examinations Being Made at Columbia University, New York City, to Test the Mentality and Efficiency of Men and Women. The Illustration at the Right Shows the "Color" Perimeter Which is Used to Measure the Field of Vision and the Color Zones of the Retina of the Human Eye. By Means of the Graduated Dials These Factors May Be Measured to a Fraction of a Degree.





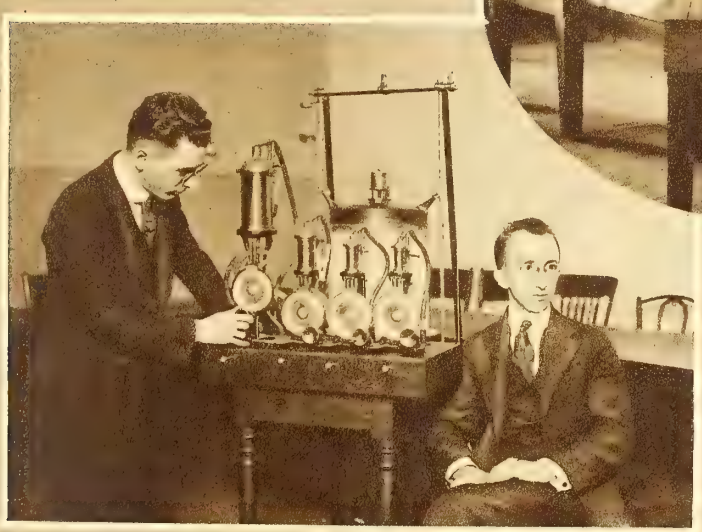
Another View of the Psychological Testing Laboratory at Columbia University. Here the Subject is Placed on a Pivoted Table Fitted with a Scale and Balance Weight and the Various Mental Sensations Produced in the Subject's Mind Are Noted Thru Many Changes. This Practical Test Is Carried Out for Determining the Various Labyrinthine Sensations.

Illustration at Right Shows a Subject Blindfolded and Placed on a Revolving Chair, the Same as Used so Successfully in Testing the Balance in Selecting Aviators During the War. This is Known as the "Orientation" Test. The Subject is Revolved and Tries to Tell at What Point He Stops Each Time. A Graduated Dial is Placed Under the Revolving Stool with a Pointer Attached to the Stool as Shown.



At Right: Metronome and Electro-Mechanical Apparatus Used in Columbia University Psychological Laboratory for Measuring the Degree of Fatigue, by Means of the Masso-Ergograph. By Means of This Instrument the Man's Muscular and Nervous Endurance Is Accurately Measured in Minutes and Fractions of a Minute.





Picture at Left Shows Subject Seated and Endeavoring to Determine by the Sense of Hearing the Change in Tones as Created by the Expert at the Extreme Left, Who Is Seen Manipulating the Apparatus for Generating Different Musical Tones. This Apparatus Is What Is Known as the "Stern's Tone Variator." The Various Tones of the Musical Scale Are Created by a Blast of Comprest Air Shot Thru Openings in a Revolving Disc Having a Definite Number of Holes in Its Perifery and Constituting a Siren.

© KEYSTONE

Dr. Pringle Discusses Mind

By JOHN H. DEQUER

"MIND and life are so closely related that we cannot really consider one apart from the other," said Doctor Pringle as he touched the tendrils of a sensitive plant with a small brass rod. "They are different aspects of that peculiar, etheric transformation we call vitality."

As we were seated in his country laboratory watching the marine life in his large salt water aquarium, my attention was drawn to the antics of a fish which moved back and forth with almost clock-like regularity, while the rest of the living things seemed to move at random as if actuated only by choice.

Noticing my preoccupation and anticipating the question in my mind, Doctor Pringle remarked, "Every movement of living things is the result of some force at work upon their nervous or protoplasmic structure. If we knew what these forces were and could accurately measure and calculate their rates and intensities, then we could predict every movement of fin, and every flop of tail in these creatures as well as all the brain processes of man, for we can rest assured that there are no causeless and therefore no reasonless processes in nature.

"These little animals wiggle and swim as they must; under the forces at play upon their tissues, they cannot wiggle or swim otherwise. All acts, whether of an amoeba or a Tesla are the result of an interplay of the subatomic forces as yet not understood upon the cell structures of living things. To determine what these forces are, and if possible to control them to our advantage is one of the great problems of science."

"But how would you proceed to discover these forces?" I asked with no little curiosity.

"I am on their trail now," he answered. "This pool which you see thru the glass in the laboratory wall is my first milestone. In it I study the lowest forms of life under natural conditions, for it is in the lowest forms that we find the least complexity and therefore they are the logical structures with which to begin. Life is life. It is the same in the amoeba as in the elephant. In fact an elephant is but an amoeba infinitely multiplied. A man is but an amoeba infinitely complexed. To understand the uni-cell is the first step in our study of the multi-cells, as we may call the higher animals.

"The pool itself is quite an idea," he went on with just a little note of pride in his voice. "It is formed from a natural hollow in the top of this granite cliff. I have built the cottage so that thru this heavy plate glass window in the basement wall I can see what goes on in the water from the surface down for ten feet. The pool has a sloping beach on the west side. On this slope I have fastened several glass devices for arresting these forms of life, which habitually frequent certain depths. I have discovered that these creatures act differently under different conditions of water pressure, electric, magnetic and radiant energy.

"In the ravine, a little to the north of the pool, is a creek which tumbles from the highlands into the sea over a series of rocky ledges, and here I have installed a water turbine which supplies electric energy, not only for the needs of the ranch, but by means of a mechanical device anchored in a little inlet from the sea, I regulate a centrifugal pump so as to keep time with the tide; thus I produce actual tidal conditions in my pool.

"I need this kind of an arrangement if I am ever to understand how in the primordial ages the uni-cell became worm, the worm fish, the fish reptile, the reptile mammal, and then came man. All life came up out of the sea. And sometimes life goes back to her, as it did in the case of the whale and the seal.

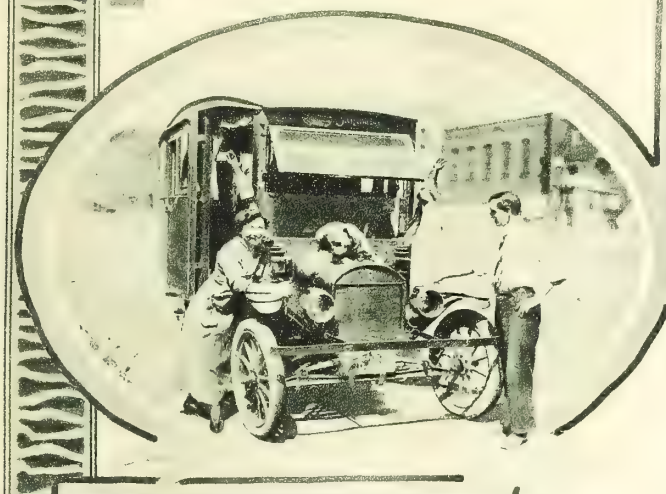
"You see, during the primitive ages of this world's history the continents first heaved up from the warm bosom of the

(*Continued on page* 1251)



"I Need This Kind of An Arrangement If I Am Ever to Understand How in the Primordial Ages the Uni-Cell Became Worm, the Worm Fish, the Fish Reptile, the Reptile Mammal, Developing Into Man. All Life Came up Out of the Sea. And Sometimes Life Goes Back to Her, as It Did in the Case of the Whale and the Seal."

"At Home" in an Auto



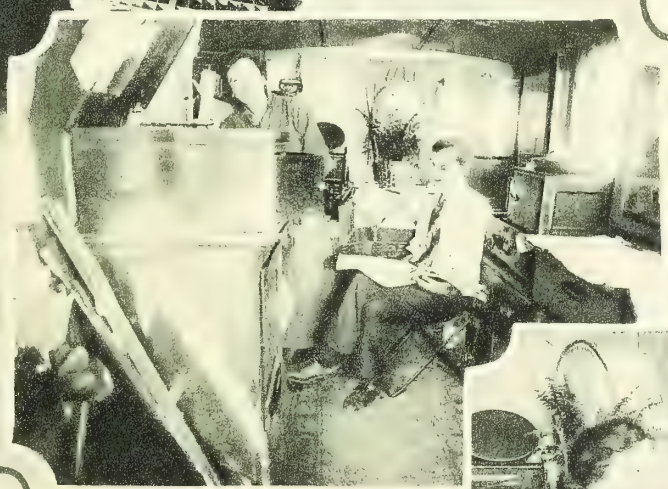


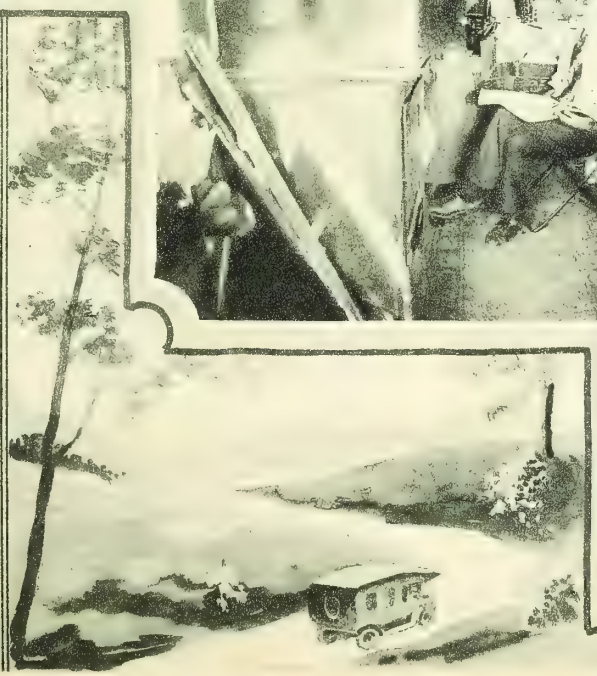
"HOME was never like this!" Mr. and Mrs. Robins who have built a complete little traveling home of their own, are shown in the accompanying photograph. They even have a name for their home on wheels—"The Adventurer," —and besides they eliminate the worry of the empty coal bin, not to mention the gas man, the water meter bill and several dozen other petty annoyances of everyday life. They have no landlord to take the cheer out of the end of each month.

This automobile home is built on a regular truck chassis and includes a bedroom, living room, dining room and printing shop. It is thus an easy matter for the lady of the house to watch the cooking and prepare the potatoes at the same time that the phonograph reels off the latest jazz tune. Other advantages are to be found by the dozen. Suppose one fine October morning you awoke and found the air quite chilly—instead of taking out the wool underwear from the moth balls in the trunk and ordering about 10 to 15 tons of coal at $20.00 per ton—you walk around the corner, to the nearest map shop and buy a few road maps covering the complete route to the sunny southland—where the orange blossoms bloom and the oriole sings sweetly all day long.

Mr. Robins combines business with pleasure and finds no difficulty in getting orders in the various towns and cities for printing, which helps to pay the gasoline and tire bill. Mr. and Mrs. Robins and their pet bull dog have visited nearly every state in the Union.







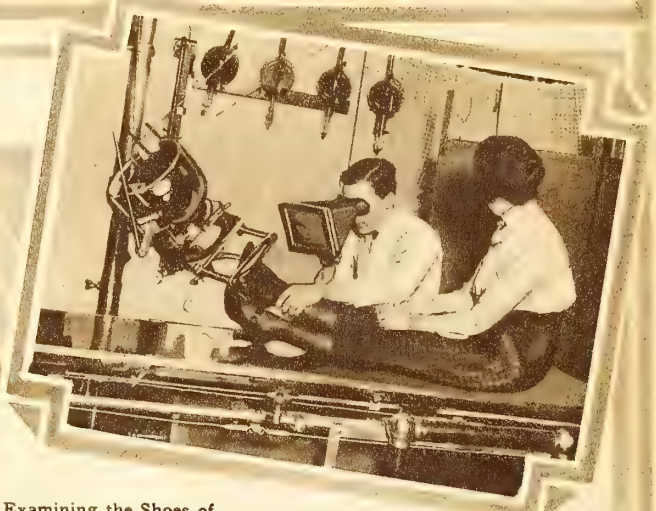


© KEYSTONE

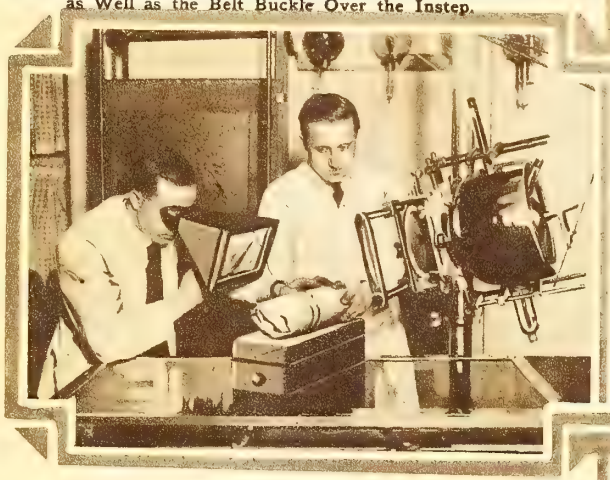
ODD USES FOR X-RAYS



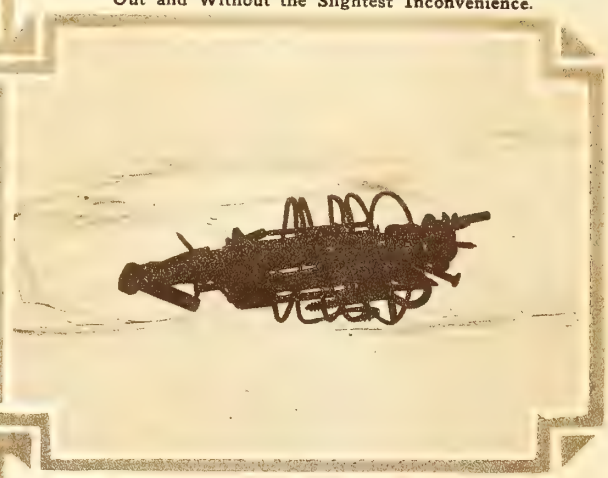
It is a Great Surprise, But Here is What the Innocent Looking Little Lady Had Concealed in Her Shoe,—Two Undeclared Diamond Rings, Possibly Worth Several Thousand Dollars. Note the Wonderful Detail in This Skiagraph of the Foot and Shoe, the Steel Arch and Shoe Nails Showing Clearly as Well as the Belt Buckle Over the Instep.



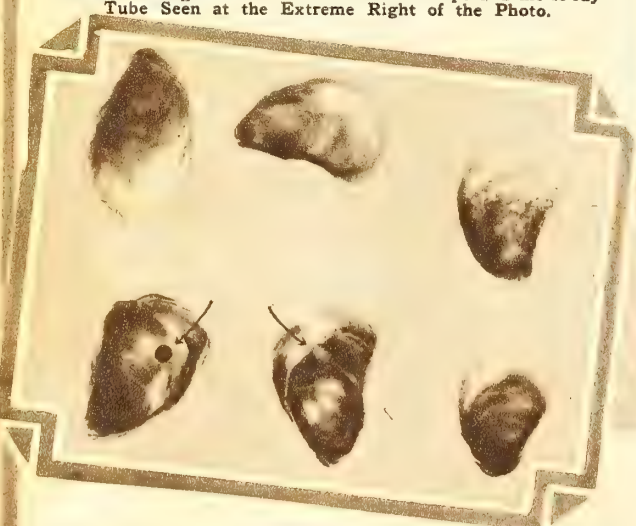
Examining the Shoes of a Fair Immigrant to Ascertain Whether or Not She Happens to Have Any Jewelry or Other Undeclared Valuables Secreted in a Hole in the Heel, or in a False Sole, Perhaps. The Operation is Quickly Carried Out and Without the Slightest Inconvenience.



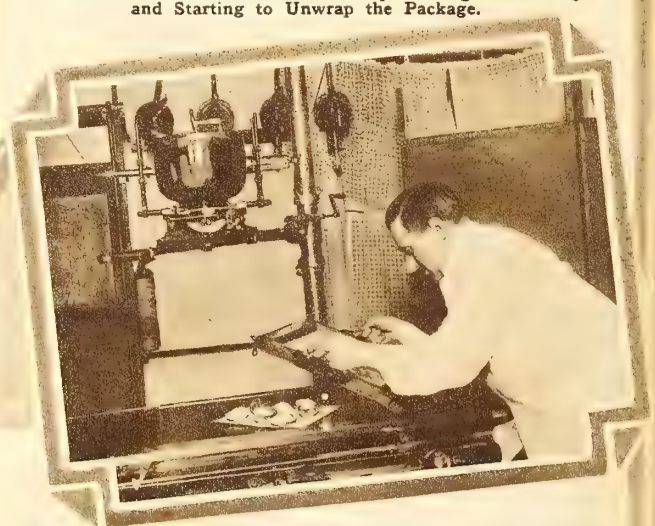
In the Custom House and Police Inspection Depots, the X-ray Makes It a Sinecure to at Once Ascertain Just What is in Any Suspicious Looking Package Such as the One Which is Being Held Between the Fluoroscope and the X-ray Tube Seen at the Extreme Right of the Photo.



The Suspicion Confirmed!—a Bomb! Imagine What Havoc This Fiendish Invention Might Have Wrought, if it had Reached Its Destination, and the Recipient Had Opened It in the Manner Intended—That is by Cutting the String and Starting to Unwrap the Package.

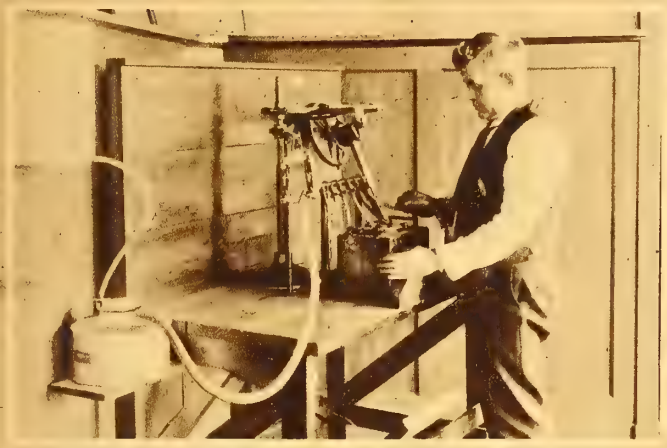


And Here We See What the X-ray Discloses When an Oyster Contains a Pearl or an Embryo Pearl, That is, One in the Early Stages of Growth. The Black Spot Indicated by the Arrow Represents a Fully Grown Pearl and the Light Spot a Partially Grown Pearl. Oysters Containing a Partially Grown Pearl Are Cultivated and Watched Until the Pearl Grows to Maturity.



Giving the Pearl-Bearing Oyster the Third Degree Under the X-ray. Previously Many Thousands of Oysters Were Opened Annually by Fishermen and Others in a Ruthless Attempt to See If They Contained Any Pearls. Now, Thanks to the X-ray This Examination Has Become an Exact Science and the Oyster is Not Harmed in the Least.

Science Kinks

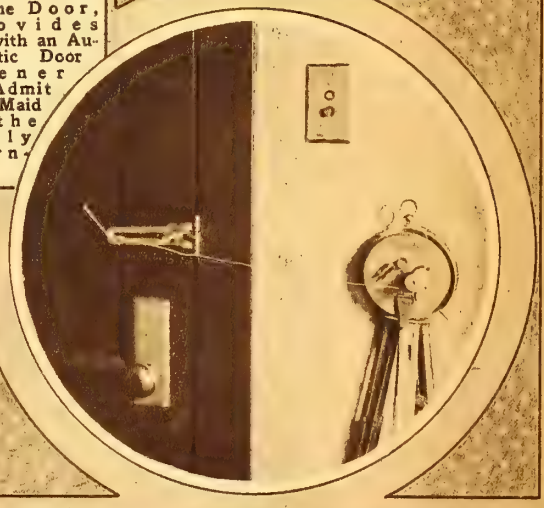


Here Is a Storage Battery Steam Table and Work Bench Which Does the Work on One Table Which Formerly Required Two, Three or Four. It Drills the Posts of the Battery, Steams It Thru the Steamer at the Side, and a Lifting Vise Also Lifts Out the Elements to Be Repaired.—Photo From American Bureau of Engineering.



If You Are a Bachelor, Why Not Press Your Ties the Electrical Way? Moisten Them Slightly and Simply Rub Them or Pull Them Over an Electric Light Bulb.

An Alarm Clock Rigged Up with a Spool, Some Cord and a Hasp or Bolt on the Door, Provides Us with an Automatic Door Opener to Admit the Maid in the Early Morning.

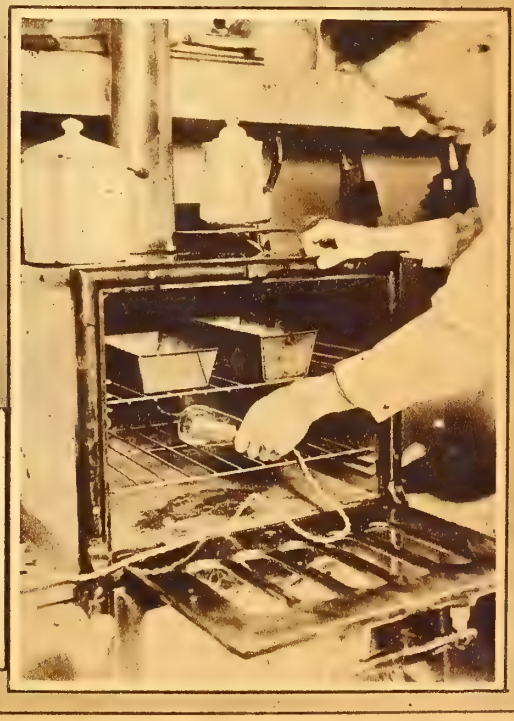


If You Want to Copy a Drawing, Try This Scheme of the "Reflecting Drawing Board." Place the Drawing Next to a Sheet of Glass Mounted in a Frame, and on the Opposite Side of the Glass Place a Plain Sheet of Paper. Looking Thru the Glass You Will See the Image Clearly on the Plain Paper — Then Proceed to Trace the Lines Over the Reflected Image.





Photo at Left Shows the Latest Wrinkle in a Liquid Soap Container Which Is Arranged to Hang from a Chain in the Shower Bathroom. The Nickeled Dispenser Contains Liquid Soap Which Is Expelled Whenever the Container Is Shaken. This Is a Decided Improvement Over the Old "Catch-As-Catch-Can" Battle with the Elusive Cake of Ivory.



Another Useful Science Wrinkle Applicable to Home Needs. This Consists in Placing an Electric Light Bulb in the Oven Which Provides Just the Right Amount of Heat for Bread Raising. A 60-Watt Bulb Will Usually Provide the Proper Amount of Heat, But This Will Depend Somewhat Upon the Size of the Oven.

"Fathoms Deep" A Subsea Movie Thriller











The Most Spectacular Picture Which Will Soon Be Brought to the Attention of the Motion Picture Audiences Is the One Produced by J. E. Williamson, Who, with the Aid of the Apparatus Invented by His Father, Capt. C. Williamson, Has Been Able to Show Exploits Not Only on Land and in the Air, but Actually Fifty Feet Under the Water.





The Story Is of a Riff-raff Crew Running Amuck in and About the Tropics With a Stolen Submarine. The Band Having Turned Pirates Are Waylaying and Looting All Passing Craft and Hiding Their Spoils. A Love Story Is Intermingled With the Plot and a Series of Conflicts on the Surface of the Sea as Well as Along Its Bottom Between Two Rival Treasure Expeditions, Both Equipt With Diving Suits and Helmets, Is One of the Many Startling Novelties in Dramatic Surprises Presented in This Pretentious Work. Eleven Months Have Been Spent in Taking the Picture, Ralph Ince Himself Directing and Playing One of the Leading Rôles in Association With Film Favorites.—Photos Courtesy J. E. Williamson.

If New York City Were the Snowiest Place

By CHARLES NEVERS HOLMES





The Accompanying Illustration Shows Vividly What a Giant Snowball All the Snow Falling During One Winter in New York City Would Make, As Compared to the Brooklyn Bridge. This Snowball Was Computed for a Typical Deep Snow Fall of 6½ Feet for the Entire Winter.

A Typical New York Seasonal Snowfall Rolled Into a Giant Ball Nearly One Mile in Diameter Is Shown at the Left, Compared to a Still Greater Snowfall of 73½ Feet, the Record Fall Which Occurred at Tamarack, Calif. This Gigantic Snowfall, If It Fell in New York City and If Rolled Into a Single Large Ball, Would Have a Diameter As High As Ten "Eiffel Towers," or More Than 10,000 Feet.

THE average annual snowfall in the State of New York amounts to about 7 feet, and there is a record of a snowstorm in New England, which lasted from the 19th to the 24th day of February, 1717, when the snow fell to a depth of 5 to 6 feet. Almost every part of the United States, including Florida, has had some sort of a snowstorm during the past century, and our "Weather Bureau" announces that the heaviest snowfall in this country takes place on the Pacific Coast. That is, the heaviest snowfalls occur in the Cascade mountains of Washington and Oregon and in the Sierra Nevada mountains of California. In this region, during the winter season, the snow accumulates upon level ground to *a depth of 25 to 30 feet*, being twice as deep as that in the canyons and gulches. Indeed, in the higher parts of the Sierra Nevada mountains an average *snowfall of 65 feet* is not unusual. And, at Tamarack, California, about a mile and one-half above sea-level, there was a record of *a snowfall of 73½ feet which fell during* the winter of 1906-1907.

Now, a snowfall of 73½ feet, or 882 inches, is certainly considerable snow and, in all probability, Tamarack, California, is the most snowy place in the United States. And such a snowfall, when melted, would amount to a good deal of water, an average of over 7 feet of water, inasmuch as, under ordinary conditions, 10 inches of snow yield 1 inch of water. Therefore, the amount of "frozen vapor" falling in Tamarack, as thus recorded, would be equal in depth if it were melted to water, to about the unmelted average annual snowfall in the State of New York. And such a vast snowfall descending upon a square mile of surface would approximate 2 billion cubic feet. Accordingly, were 73½ feet of snow to fall during the winter of 1920-1921 upon the City of New York, provided none of it melted or was removed, that city would be buried beneath 645 billion cubic feet of snow. Then, were all this snow to melt suddenly, New York City would be inundated by 65 billion cubic feet of water. If all of that 73½ feet of snow which covered the whole city were to drift up wholly upon Central Park, that park would be "snowbound" to a height of about 3 1/3 miles. Such a huge seasonal snowfall of 73½ feet should be compared with an unusually deep seasonal snowfall in New York City of about 6½ feet. This latter snowfall would cover New York City with approximately only 57 billion cubic feet of snow.

Alcohol from Petroleum

ANNOUNCEMENT of the discovery of a new alcohol closely akin to wood and grain alcohol in its adaptability to commercial purposes was made by the Standard Oil Company at the same time that Carleton Ellis, who developed the process, announced in Newark to the New Jersey Chemical Society, of which he is President, that it had at last become possible to make the new alcohol, or *petrohol*, as it is called, from the by-products of petroleum refining.

On behalf of the Standard Oil Company, which has the rights thruout the world to manufacture the new product, Frank D. Howard, in charge of the Corporation's Development Department, made the announcement that petrohol was being made for commercial purposes at the Company's Bay Way Refinery at Elizabeth, N. J., Mr. Howard explained that while a small quantity of petrohol, if taken internally, might not produce the deadly effects of wood alcohol, it nevertheless was inherently a poison, and could not be used as a beverage.

At the Bay Way Refinery it is being manufactured at the rate of about 250 gallons a day, according to Mr. Howard, who explained that it was intended for use chiefly in the arts, as a solvent of gums, rosins, shellac, etc., and may be used as a substitute for wood and grain alcohols, because it is somewhat cheaper than the latter. He suggested that petrohol also might be destined to play a great part in the development of the dye industry of America, for it is possible to manufacture it in practically unlimited quantity.



Fig. 1 — Top Photo Shows Giant Cameras and Arc Lights Used in Photographing the Pictures to Be Printed in "Rotogravure."

Fig. 2—Intensifying the Lines and Shadows on the Photographic Negatives.

Fig. 3 — Printing the "Form" Containing the Films Mounted on Glass; the Image Is Being Transferred by Powerful Electric Arc Lights to Carbon Printing Paper. This Printing Is Done in a Vacuum Frame Which Causes the Paper to Be Held Very Tightly Against the Films.



Fig. 4—Copper-Plating Steel Cylinders in the Electro-Plating Room, the Dynamo Supplying the Current for the Process Appearing at the Left. The Copper Is Deposited on the Cylinders Electrolytically.

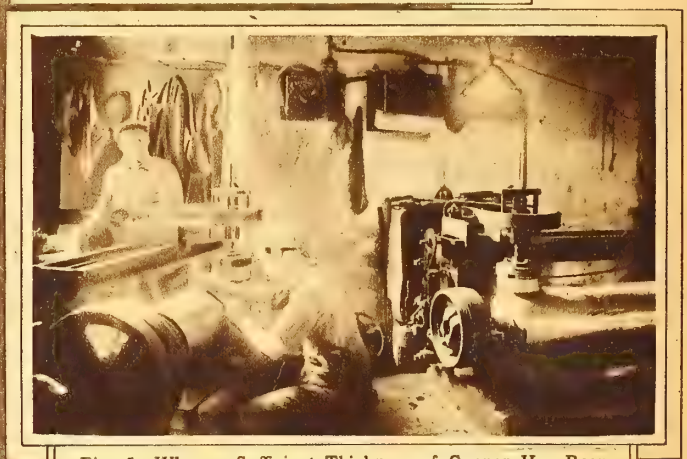


Fig. 5—When a Sufficient Thickness of Copper Has Been Deposited on the Steel Rolls They Are Accurately Turned, Ground and Finally Polished. They Must Have a True and Even Diameter Along Their Entire Length.



Fig. 6—The Pictures from the "Form" Have Been Transferred to the Copper Cylinder by Wetting the Carbon Tissue Containing the Images and Wrapping It Around the Cylinder. The Images Are Now Ready for "Etching" with Acid, As Shown Above.



Fig. 7—Here We See the Final Stage, "Rotogravure" Pictures Being Printed from Roll Paper Passing Rapidly Over the Copper Cylinders Containing the Images; This Press Cuts and Folds the Finished Sheets.

How Rotogravure Pictures Are Made

By OSWALD R. SCHULTZ*

SINCE almost all the Sunday newspapers and many magazines thruout the country have either supplements or inserts printed by the *rotogravure* process, the description of how this is done will be of interest to the readers of this journal. It is the latest and most valuable application of photography to the printing press, so far as artistic results are concerned, and by it a web of paper can be printed from a copper cylinder at high speed.

The following article will give, we hope, a description of the process in a popular and simple manner.

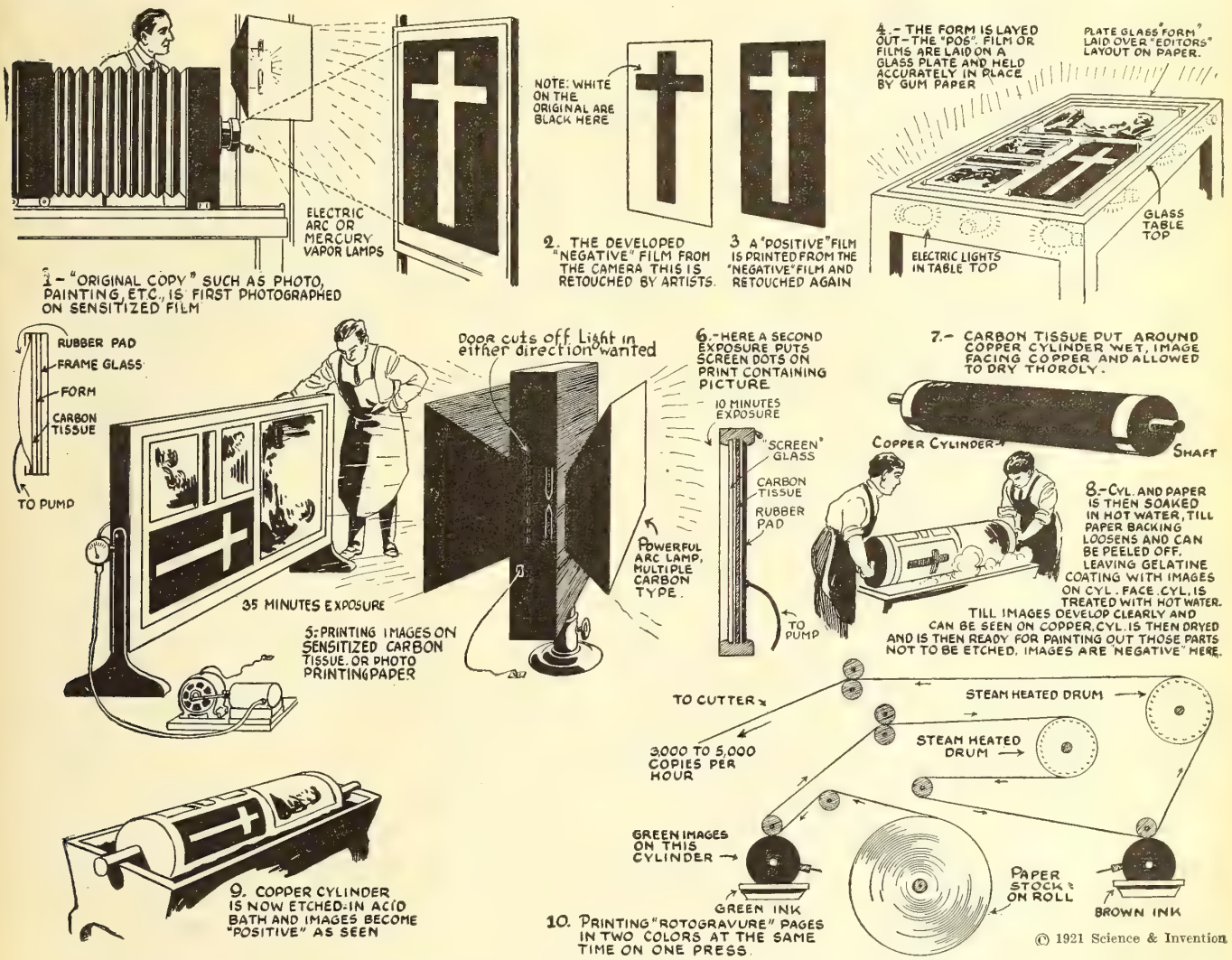
One of the interesting developments of this rotogravure studio is a giant camera, probably one of the largest in the world. On seeing this camera you would not recognize it as such, unless its mysteries were explained to you. This camera, unlike the usual type with which we are all familiar, has no bellows at all. Instead, these are substituted by a large room which has been finished with a dead black paint and a huge plate and film holder slides along on a bed or table so as to be readily focused. In the front wall of the room a hole has been cut about one foot square and in

"Making Up the Form"

By pasting the retouched positives on a large piece of plate glass, we enter the second stage of the process, which is called "making up the form." A large piece of plate glass is placed on top of a ruled layout and each positive placed in its marked place on this glass.

The form is then ready to be taken into the carbon printing room, where it is placed in a *vacuum printing frame.*

In the meantime carbon tissue paper, which comes in rolls 3 by 12 feet and which consists of a strong paper evenly



Illustrating the Successive Stages Followed in Reproducing Photos and Text Matter by Famous "Rotogravure" Process.

Photographing the Original Subject

The first stage of the process is the making of the photographic film negative from the original drawing or photograph. (Fig. 1). This negative is made as crisp and clear as possible as upon its success depends the quality of the *positive* made from it, and the success of the subsequent operations. Great care is taken in retouching the negative as well as the positive. (Fig. 2). This consists not only in adding shades to the negative by working over the varnished or ground film with soft lead pencils but in removing shades by scraping with a sharp knife on the positive.

*Of the Neo-Gravure Printing Co., who print the Rotogravure Section of this journal.

this the lens is fitted. This panel may be quickly released and different lenses inserted to suit the work in hand. Outside the room and directly in front of the lens there is a second bed or rack on which the copy carrier slides, this carrier comprising a large vertical frame or panel on which the art work (photograph, painting, etc.) can be secured. This giant camera is of course, only used for larger layouts and art work of unusual size. The focal capacity of this camera is eight feet, and the largest plate or film which can be accommodated, is sixty inches by thirty-five inches. For photographing the usual size of photos and other illustrations, the standard photo-engravers' type of copying camera is employed.

coated with gelatin containing a brown pigment is sensitized in bichromate of potash squeegeed on a ferrotype plate and dried for not over two hours.

Printing the Pictures on "Carbon Tissue"

When ready to be used the carbon tissue is cut into proper size and placed on top of the form in the vacuum printing frame. The vacuum printing frame is in a small way the same kind of frame that is used by amateur photographers to print their Kodak pictures, only in an enlarged form. The small sized frame gives the necessary contact by a steel spring while the large sized frames have a more elaborate mech-

(*Continued on page* 1220)

The Velocity of Light

By PROF. JAMES S. STEVENS

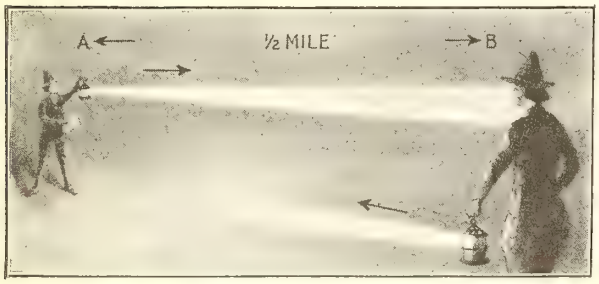


Fig. 1. Early Measurement of Velocity of Light. The Time Required to Flash a Light From A to B and Return or One Mile, Was Found to Be 1/186,000 Second.

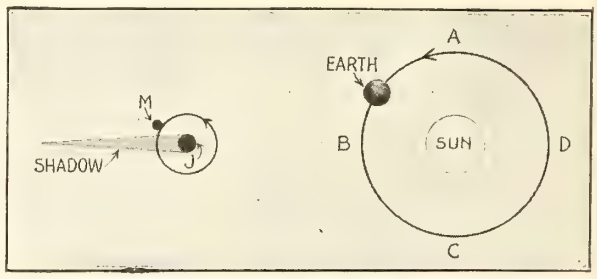


Fig. 2. Measuring Velocity of Light by the Eclipse of Jupiter's Moon.

BEFORE the time of Galileo those who paid any attention to the subject at all were probably of the opinion that the instant light left the sun it reached the eye of an observer upon the earth. Galileo will be taken as a type of the experimental physicist so long as the science endures. Not content with accepting this dictum of the ancients he undertook to measure the *velocity of light.*

He suggested that if two observers were stationed at a certain distance apart and each provided with a dark lantern, then if one observer should flash his lantern and the second observer should give a similar signal when the light was received, the interval between the two signals would be the time of the round trip made by the light. See Fig. 1. If we assume that these observers were one-half mile apart the time occupied for the light to pass from the first observer to the second and back again is known to be about 1/186,000 second. Inasmuch as their best recording instruments were unable to measure time intervals accurately to the tenth of a second it is obvious that this experiment must have been a failure. The credit of the suggestion, however, belongs to Galileo.

About the year 1685 Roemer, a Danish astronomer, noticed that the time of an eclipse of one of Jupiter's moons was nearly one thousand seconds behind the schedule when the earth was on the opposite side of the sun from Jupiter. Dividing the double distance from the earth to the sun by one thousand gives us approximately a correct value for the velocity of light. See Fig. 2. Roemer's problem was a very difficult one and we have given only the barest outline. Very accurate results for the velocity of light were obtained by two Frenchmen—Fizeau and Foucault, about 1850. Fizeau used a revolving toothed wheel and Foucault a revolving mirror, which was later modified and improved by two Americans, Michelson and Newcomb, who made the standard determination of this constant.

The value of the velocity of light is an extremely important magnitude in physics. There are three reasons for this:

1. It is used as the celestial yard stick.
2. It has an important bearing upon the nature of light.
3. Recent developments have given it an increased importance in connection with the modern theory of relativity.

When an astronomer wishes to measure distances in the heavens he finds the numbers of such extraordinary magnitude that our ordinary units are not comparable with them. It is, of course, necessary that the unit of measurement should be comparable with the thing measured. We would not, for example, think of measuring the length of a room with a scale one centimeter long; nor would we attempt to measure the thickness of a coin with a scale graduated in inches only. When we express the distance from the earth of one of our nearest sidereal neighbors, *Alpha Centauri*, a star in the southern heavens, we have to use the number 2.6 (nearly) with 13 ciphers attached, if our unit is the mile. Astronomers, therefore, are accustomed to express these enormous distances in what is known as the light-year. One light-year represents the distance which light travels in one year and is found by taking the product 186,300x 60x60x24x365. This product is about $59x 10^{11}$ and shows that light reaches us from the star in question in 4.4 light-years. Some notion of the vast distances of the fixt stars may be obtained by considering that the light from some of them would not yet have reached us if it had begun to travel towards us on the traditional date of creation, 4004 B. C.

Probably one of the most bitter controversies which has ever been waged by scientists took place over the merits of the two rival theories of the nature of light. Sir Isaac Newton championed the older corpuscular theory and his influence was so great that it held the field against all comers for several generations. The bearing of the determination of the relative velocities of light in rare and dense media (see Fig. 3) upon the merit of these theories may be shown as follows: If light is regarded as made up of material corpuscles it follows that when these are passing thru a medium which is optically denser than air its velocity will be greater than in air. It is well known that if a body were to pass thru space with a certain constant velocity and then come near enough to the earth to be under the influence of gravity it would receive a certain acceleration so that it would strike the ground with its velocity considerably increased. In some such fashion as this, altho it must be confest the analogy is not a perfect one, light would travel faster in a denser than in a rarer medium if it were material in its make-up. On the other hand, if light is wave motion it would pass more slowly thru the denser medium just as water waves are retarded in their progress when they strike a sandy beach. If, therefore, it could be determined which situation exists the question regarding the nature of light would be settled. This problem was undertaken by Foucault who showed conclusively that the velocity in the denser medium was less than that in the rarer medium and by Michelson who made the experiment a quantitative one and showed that these velocities were in proportion to their refractive indices. In passing it may be noted that in the case of carbon bisulfid a result of 1.758 was obtained which is about seven per cent higher than the known value of its refractive index. About the time that Michelson was working on his experiment Lord Rayleigh showed mathematically that there was considerable difference in the velocity of a wave if we compared the velocity of the individual wave with the velocity of the waves as a group. By use of mathematical processes he reached the conclusion that in the case of such liquids as carbon bisulfid the ratio of the velocities would be as 100 to 93. When this correction was applied it checked very closely with the result of Michelson's

(*Continued on page* 1243)

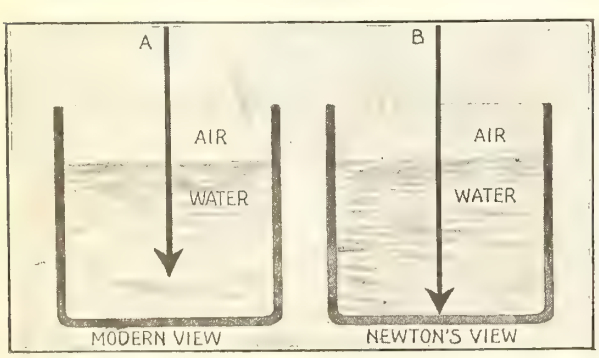


Fig. 3. Illustrating the Two Views of the Velocity of Light. By the Modern Theory, Light Travels About 75 Per Cent as Far in Water as It Does in Air, in the Same Length of Time. Newton Held the Reverse of This Theory.

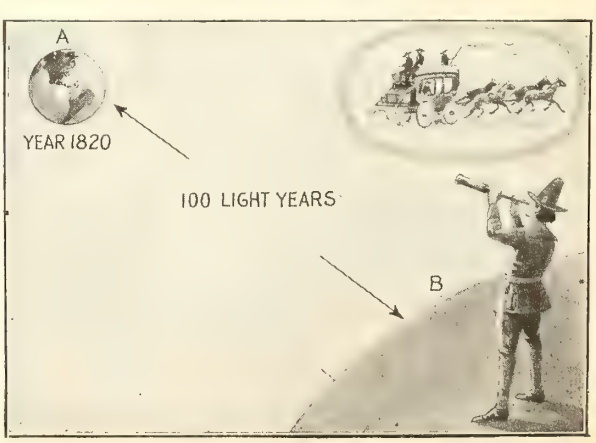


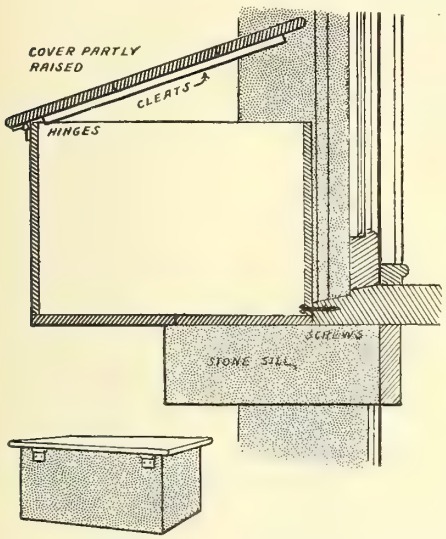
Fig. 4. An Observer on the Planet "B" Would Witness Events Which Happened 100 Years Ago If He Looked Thru a Powerful Telescope and Saw the Earth at the Present Day. This Assumes That the Observer at "B" Was Distant 100 Light-Years from the Earth.

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

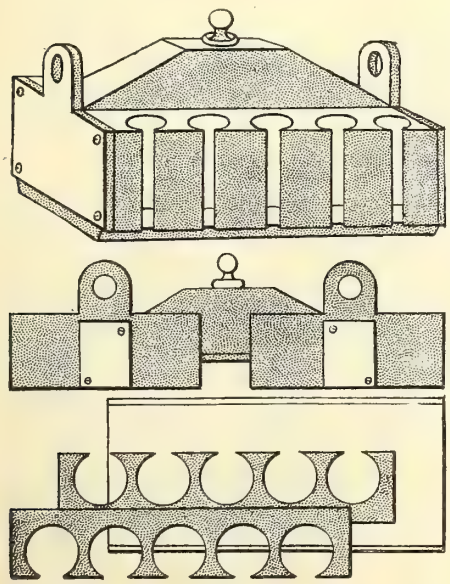
Window Refrigerator

WE show in our illustration, a simple packing case or box of any convenient size converted into a window refrigerator by adding an overhanging hinged top (made from a larger packing case) and covering the whole with oilcloth, zinc



Mr. Butterfield Shows the Home Mechanic, in the Illustration Above, How to Construct a Particularly Efficient Window Refrigerator. This Window Refrigerator Will Prove Efficacious in Both Winter and Summer, and Is Suitable for Holding Milk Bottles, Meats and Other Foods.

or sheet tin, the latter to be painted so as to prevent rusting. The shape shown, with its top and other parts, has proven after years of experience with various kinds of window refrigerators to be the most practical, as it sheds rain, snow and dust sufficiently well, besides being easily operated. This is essentially a winter refrigerator, to be used without ice, but can be made with a lining (ice-box fashion with sawdust filling) to occupy a similar position, providing a dripping drain pipe is not objectionable. When ice is used, however, the refrigerator should be placed in a window not reached by the sun.



This Card and Chip Case Will Prove Most Useful and Also a Welcome Addition to the Library or Card Room, If It Is Constructed of Hard Wood Such As Mahogany, Walnut or Oak.

By nailing cleats on the sides and cutting shelving pieces provision may be made for shelves as desired. It would be well to use some thin felt at the joints, as it is quite essential to have it water-tight. It may be advisable to have a ventilating pipe, an inch in inside diameter, inserted through the bottom.

It is of interest to note in this connection, that a quantity of work has been done on the subject of making furniture and household appliances out of packing boxes. For one thing they start the constructor with some square angles—bad squaring being a failing of the amateur.

Card and Chip Case

The card and chip case usually sold has the disadvantage of providing small storage space for cards, although keeping the chips in a most desirable position. The home-made device shown in the illustration provides both a chip holder and a central box for holding several packs of cards. It is also possible to store a cribbage board or narrow score-cards for bridge with the cards. The size of this case depends upon the desired storage space for cards and the size of the chips used, the plan of construction remaining the same in all cases. In boring the holes for the chip-holders allow at least ⅛ inch over the diameter of the chips so as to give an easy fit, bore the holes from both sides of the wood, thus letting the bit break thru the center of the block and in a block wide enough to include all of each hole. The slots for removing the chips are made after the holes are bored by sawing the wood so as to cut part way into the holes.

Care must be taken in boring the holes to keep them in line, as if they make angles with each other in the middle of the block, the job will be spoiled. The holes should be properly done in a drill press.

There is a peculiar fascination in working out wooden articles from the solid; it calls for good tools well sharpened as well as for good workmanship. The result, too, gives a solid product that will last forever. It would even be possible for a good workman to make the side-handles out of the same block with the rest of it.

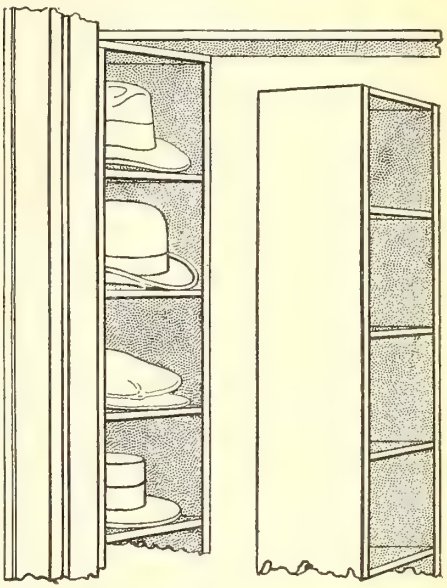
Mahogany or teak are excellent woods for the purpose. Black walnut is also good but may prove a little hard to work.

Hat Rack for Closet

Every man or woman with more than one hat finds it most difficult to keep these articles of wearing apparel in good condition, by the ordinary process of hanging them on a hook in the clothes closet. No other article seems to fall as easily or so inevitably get out of shape, but with the plan shown in the plate, this undesirable hat trouble is removed. A few pieces of lumber nailed or screwed together in the form of a series of boxes, open at the front and one on top of the other, occupying one or both of the commonly unused ends of a closet do the trick. This is the usual storage plan for protecting hats in the professionally equipt "cloak room"; here it is applied to your home closet; we know that our party hat is well taken care of in the cloak room, why not have all of our hats taken good care of in the home closet?

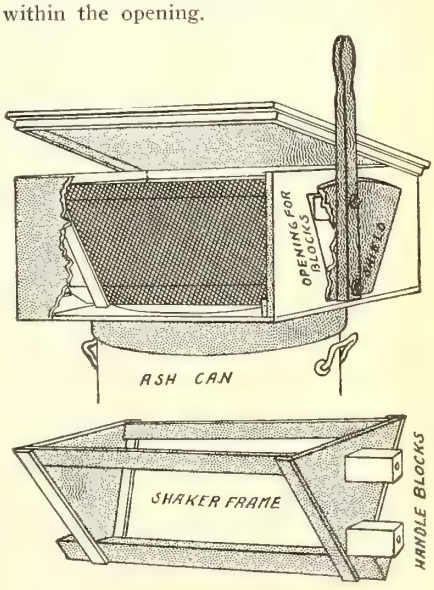
Ash Sifter

An ash sifter that can be depended upon to sift the finest cinders without distributing dust all over the premises is shown in the cut. It consists of a box with a hinged top; in the box two holes are cut, one in the bottom for the ashes to fall thru and one in the end for the shaking blocks to pass thru. The latter



Did You Ever Notice How Many Hats Have Been Ruined by Throwing Them One on Top of the Other in a Dark Corner of a Clothes Closet? Here Is a Way to Keep Each Hat in First Class Condition and Prevent Its Being Drawn Out of Shape.

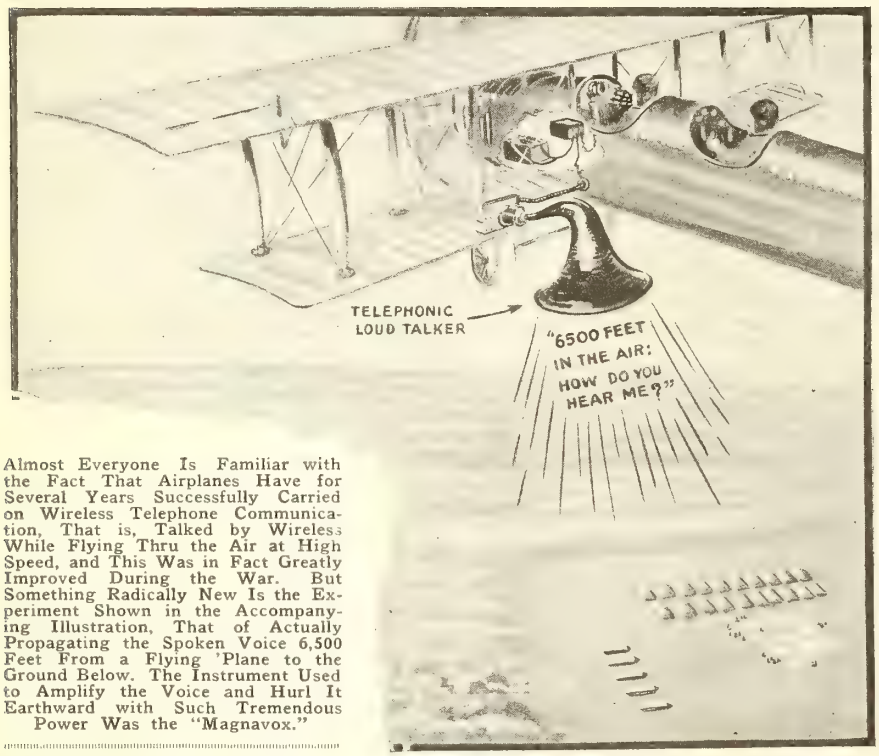
opening is V shaped and acts also as "stops" when the blocks are oscillated along with the shaker frame by its attached handle. To prevent dust coming thru this opening a moving shield is bolted to and between the blocks and handle on the outside of the box. The shaker frame with its attached wire netting oscillates on a "V" shaped base resting on two cleats with "V" notches, one at either end of the box as shown. The free ends of the boards round the bottom opening can be secured with metal oilcloth binder nailed to their ends within the opening.



A Home-Made Ash Sifter Illustrated Above, Is Simplicity Itself and, Contrary to Many Devices of This Type, Will Not Cover the User with Dust, Providing It Is Properly Made.

Hurling Voice from 'Plane Aloft

By H. E. METCALF



Almost Everyone Is Familiar with the Fact That Airplanes Have for Several Years Successfully Carried on Wireless Telephone Communication, That is, Talked by Wireless While Flying Thru the Air at High Speed, and This Was in Fact Greatly Improved During the War. But Something Radically New Is the Experiment Shown in the Accompanying Illustration, That of Actually Propagating the Spoken Voice 6,500 Feet From a Flying 'Plane to the Ground Below. The Instrument Used to Amplify the Voice and Hurl It Earthward with Such Tremendous Power Was the "Magnavox."

RECENTLY a Magnavox loud-talking telephone set was installed in an Army airplane, at Mather Field, California. The telemegafone, as it is called, was attached to the intermediate strut of the left wing and wired in position so that the mouth of the horn pointed downward and slightly backward. Two 8-volt batteries were used for the source of energy, and a standard 4-button Magnavox hand transmitter was used in the cockpit of the airplane.

A strong cross-wind of about 25 miles an hour was blowing on the field and the sky was overcast. While the motor was being warmed up, the voice could be plainly heard on the ground thru the roar of the motor, even when the motor was speeding up to 1400 R.P.M. The plane took off, and tests were made at altitudes varying from 500 to 6,500 feet at 500 foot intervals. During each test the pilot would cut his motor down to about 800 revolutions and messages were transmitted from the plane to the observers on the ground, with perfect distinctness.

It was noticed that at altitudes between 1,000 and 4,000 feet the voice was at its maximum strength, indicating better transmission from the higher altitudes. The last test took place between 5,000 and 6,500 feet and altho the voice was plainly heard, various noise conditions about the field were such that the message could not be distinctly understood. At all lower altitudes every word of the messages which were being sent down, was very clear.

It is to be noted that in these tests, no amplifier of any kind was used, and tests on the ground have indicated that the ratio of voice transmission thru the air between the standard V-2 outfits, such as was used in the plane, and the AC-3 amplifier outfit, is such that the amplifier will give distinct communication over a distance three times as great as the outfit without the amplifier. At altitudes of 500, 800 and 1,000 feet, the voice could be heard with a half throttled motor, with the plane making its own headway and not in a gliding position, half-throttle being sufficient to maintain forward speed without loss of altitude.

It is believed that this is the first time that communication has been had from a plane 6,500 feet in the air by means of the actual voice, of either the pilot or the observer. Extensive experiments are now under way for their permanent installation.

The Photo-Ratiograph Analyzes Vibration

IN the Bureau of Engraving and Printing, Washington, D. C., one of the principal objects to be seen, is the famous "surface lathe" or engraving machine. This machine, by imparting various motions to a cutting point, can produce the most marvelous scroll work designs on a metal plate, used as the base for engraving currency, bonds, postage stamps and the like.

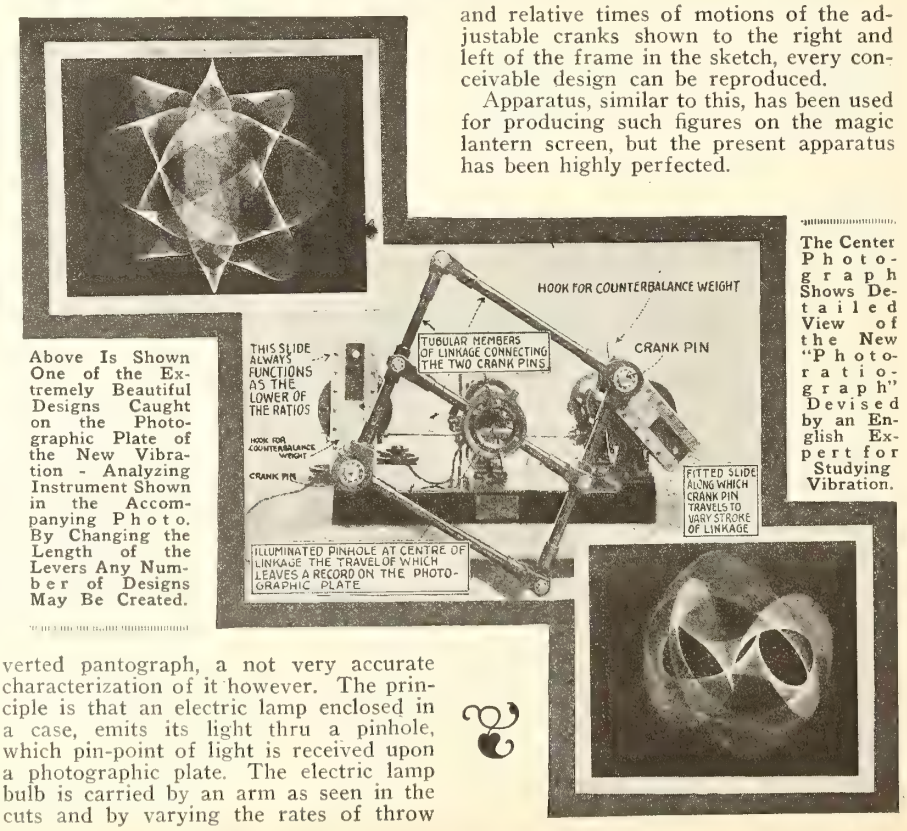
If we imagine a point or a tool moving in one direction, back and forth, it will of course, make a straight line. If simultaneously with this motion, another motion at right angles to the other, exactly the same in extent and timing, is imparted to it, it will form a circle.

If the plate on which the circle is normally formed, is caused to traverse the top of the machine, without moving the point from its regular path, a series of approximate circles will be formed, making what would be a very excellent border.

By imparting various motions to the engraving tool or stylus, there is absolutely no limit to the number of designs and the complications of the same which may be produced. There are probably no more than two or three men in the United States who can operate the famous engraving machine alluded to in the Bureau of Engraving plant, so as to get from it its full capability.

An English experimenter, Mr. A. C. Banfield, has developed an instrument for producing these designs by photography. The instrument is called the "photo-ratiograph." It has been described as an inverted pantograph, a not very accurate characterization of it however. The principle is that an electric lamp enclosed in a case, emits its light thru a pinhole, which pin-point of light is received upon a photographic plate. The electric lamp bulb is carried by an arm as seen in the cuts and by varying the rates of throw and relative times of motions of the adjustable cranks shown to the right and left of the frame in the sketch, every conceivable design can be reproduced.

Apparatus, similar to this, has been used for producing such figures on the magic lantern screen, but the present apparatus has been highly perfected.



Above Is Shown One of the Extremely Beautiful Designs Caught on the Photographic Plate of the New Vibration - Analyzing Instrument Shown in the Accompanying Photo. By Changing the Length of the Levers Any Number of Designs May Be Created.

The Center Photograph Shows Detailed View of the New "Photo-ratiograph" Devised by an English Expert for Studying Vibration.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

CRYSTALLIZATION

THE processes of crystallization are to be ranked among the most important agencies known to the science of chemistry. The term crystallization is used to designate the production of crystals, often by the slow separation of a substance in solution from the liquid in which it is dissolved, the substance thereby assuming a definite and symmetrical form. This process can be brought about by a physical change in the condition of the solvent, either a change of its temperature or a diminuation of its volume. Just why substances should thus separate in some regular geometric shape is one of the unsolvable mysteries of our earth. This phenomenon, however, contributes much to the beauties of nature. Water vapor in condensing at temperatures below freezing takes the form of delicate crystals of marvelous beauty and exquisite design. Here there is no question of solution. In those immense, subterranean laboratories of Mother Earth, the vast resources of mineral wealth have been slowly crystallized during countless ages of past geologic time. Diamond is only carbon crystallized into rare and beautiful form by tremendous heat and pressure developed within the crust of the earth. Costly gems, so highly prized as objects of ornamentation, are the products of natural and little understood processes of crystallization. In accordance with the eternal and infallible laws of the universe the molecules of all crystalline substances are constantly being marshalled into six simple plans or systems. The six systems with their various axes are shown in Figure 1. Two examples of each system are shown. They are designated as follows:

1—Isometric or regular system (a). Three equal axes, all at right angles.

2—Tetragonal system (b). Two equal axes and one of different length, all at right angles to each other.

3—Orthorombic system (c). Three unequal axes, all at right angles to each other.

4—Monoclinic system (d). Two axes at right angles, and a third at right angles to one of these, but inclined to the other.

5—Triclinic system (e). Three axes all inclined to each other.

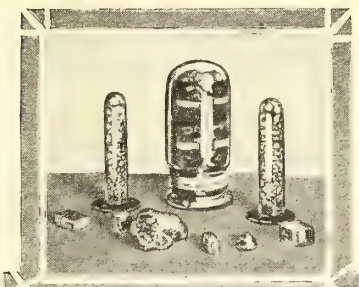
6—Hexagonal system (f). Three equal axes in the same plane, intersecting at angles of 60 degrees, and a fourth axis at right angles to all of these.

Every crystalline substance will be found to have its faces and axes corresponding to one of these six systems.

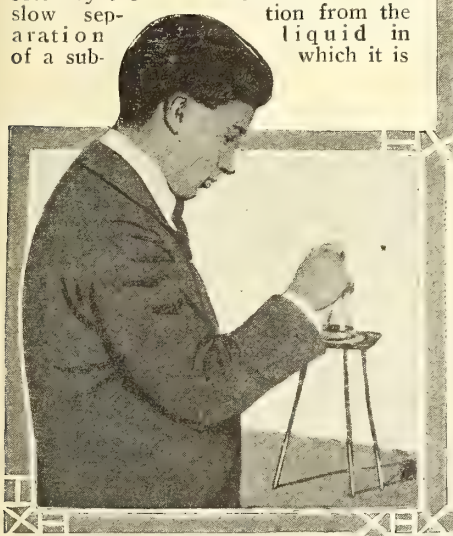
But aside from the beauty of crystals in themselves the process of crystallization is one of immense importance in the purification of chemical compounds. By crystallization and recrystallization many times repeated Madame Curie succeeded in separating from several tons of the mineral pitchblende, a few hundredths of a gram of a substance of intense radioactive powers and thereby discovered the new element, radium.

When a substance crystallizes from a

(*Continued on page* 1237)

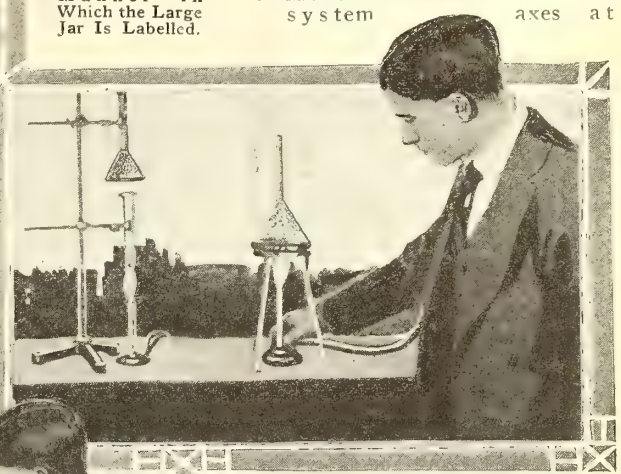


Several Forms of Crystals, Calcite, Alum, Quartz, etc., Are Shown Scattered Upon the Table, While Crystals of Potash Salts May Be Seen in the Specimen Jars. Note Particularly the Manner in Which the Large Jar Is Labelled.

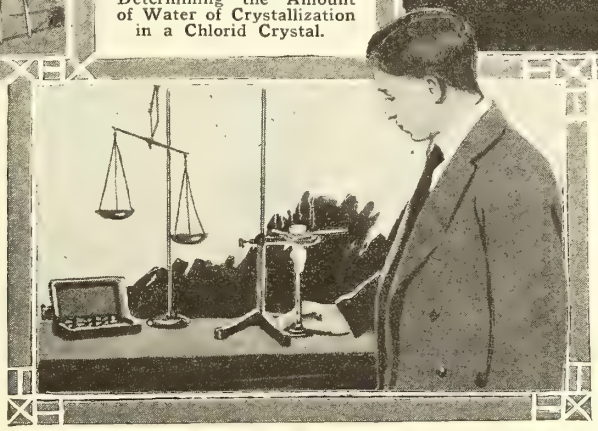


To Right: Obtaining Pure Iodine from Impure Iodine Compounds by Heating. Iodine Passes Upward as a Gas and Crystallizes Immediately Upon the Cool Surface of Inverted Funnel.

To Left: Dropping a Tiny Crystal of Alum in a Super-Saturated Solution of the Same Chemical. The Liquid in the Flask Becomes Solid Immediately.



Determining the Amount of Water of Crystallization in a Chlorid Crystal.



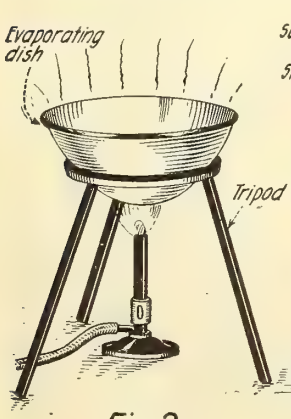


Fig. 2

Preparing Crystals of Alum with Evaporating Dish Supported Over Bunsen Burner.

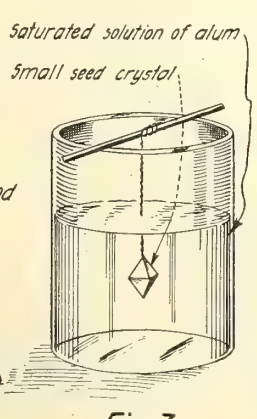


Fig. 3

Growing a Crystal of Alum in a Saturated Solution of Alum.

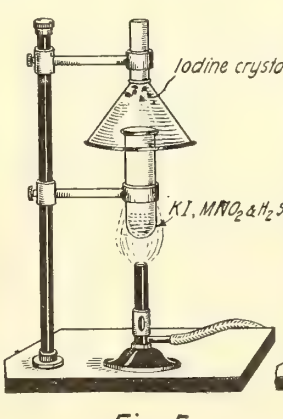


Fig. 5

Preparation of Iodine Crystals—A Simple and Interesting Experiment.

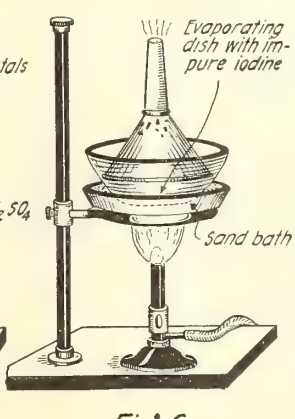


Fig. 6

Preparation of Pure Crystals of Iodine from an Impure Sample.

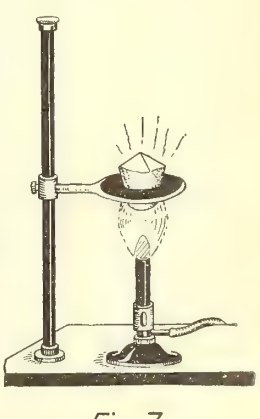
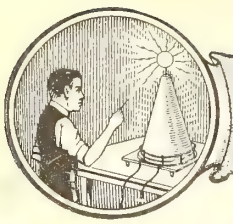
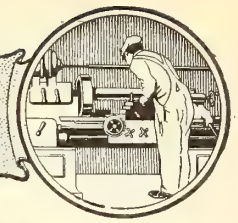


Fig. 7

Determining the Percentage of Water of Crystallization.



THE CONSTRUCTOR



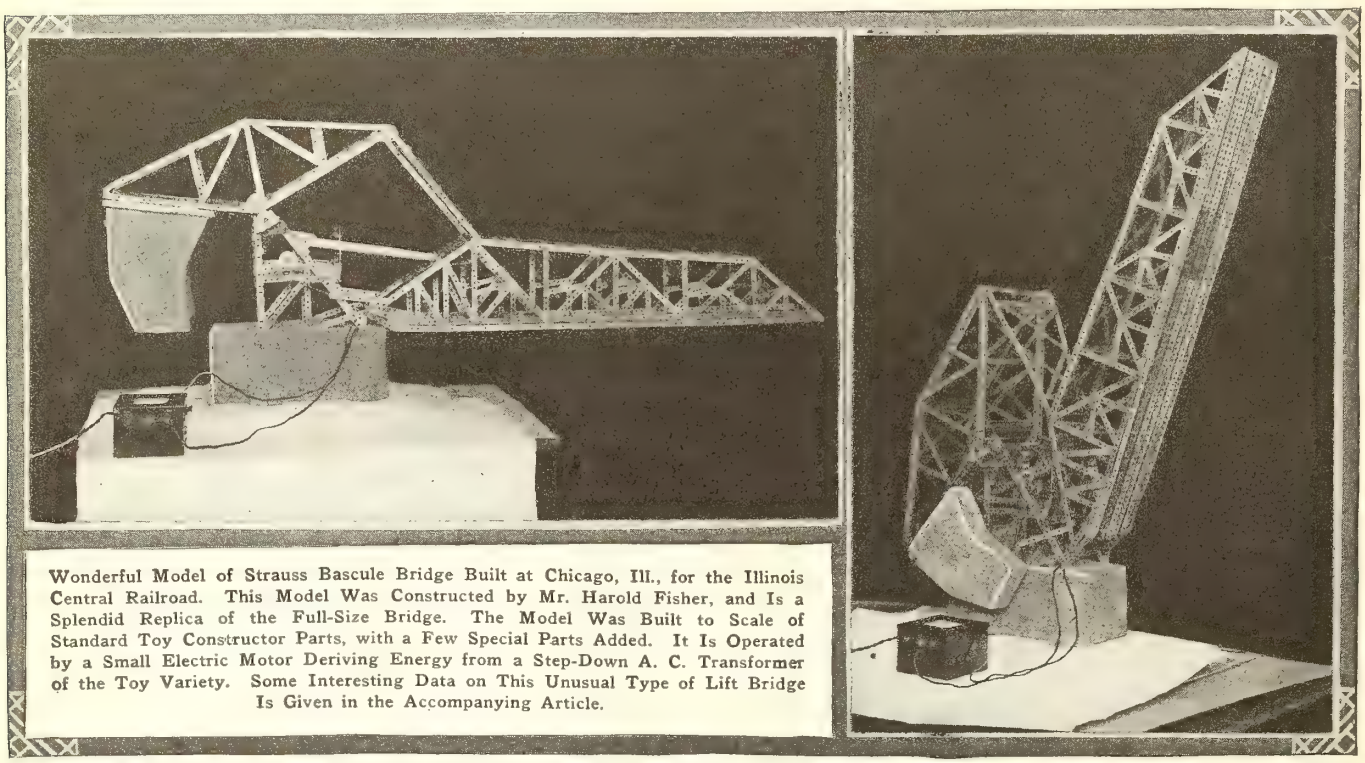
Model of The World's Longest Jack-knife Bridge

THE model bridge shown in the accompanying photos is one of the finest the editors have ever seen. The model was constructed by Mr. Harold Fisher of Chicago, Ill. The bridge is raised and lowered by a small electric motor and the members used in building the model are all standard parts, such as supplied in toy engineering outfits for boys. These miniature steel beams, bolts and washers are daily proving more valuable to engineering students, designing engineers and architects, for building working models such as this, which often expose defects in design where blueprints do not.

This bridge across the Chicago River at 16th St. is a double track, single leaf, Strauss Bascule, built for the Illinois Central Railroad. C. H. Norwood of Chicago installed the electrical equipment and air devices.

The moving leaf has a length of 260 feet, center to center of bearing points. To counter-balance this enormous mass of steel, a counter-weight of over 2,000,000 pounds was required, and was built upon a rocker-arm, which, in turn, was supported by a triangular tower. The substructure was built 11 feet into bedrock which was 30 feet below water level. The power for operating the bridge was derived from two 150 horse power alternating current motors, 440 volts, three phase, 60 cycle circuit. For emergency use, a 62 horse power gas engine was installed.

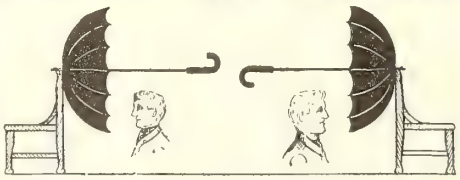
In the open position, the bridge has an opening angle of 83 degrees. To gradually check the movement as it approaches the highest point, air bumpers have been used in addition to the regulation air brakes. In closing, air buffers also take up the shock. Air is supplied to the regular and emergency brakes under 125 pounds pressure by a 25 cubic feet, directly connected, motor driven compressor with automatic governor and unloader. The storage capacity consists of a 65 cubic foot steel tank. Lock motors and main lifting motors are controlled thru limit switches at the ends of their respective travel. The circuit for the lifting motors is broken when the bridge is within 15 degrees of closing, but it is then completed with a push-switch which short-circuits the limit switch and the bridge closes, hits the limit buffers, rebounds, closes again and is then locked. The master control completes the circuit for 5 accelerating and reversing contactors of each main-lifting motor. These are of the magnetic type. The signal, locking, braking and lifting motors are all interlocked, thus minimizing any possible accidents to the zero point.



Wonderful Model of Strauss Bascule Bridge Built at Chicago, Ill., for the Illinois Central Railroad. This Model Was Constructed by Mr. Harold Fisher, and Is a Splendid Replica of the Full-Size Bridge. The Model Was Built to Scale of Standard Toy Constructor Parts, with a Few Special Parts Added. It Is Operated by a Small Electric Motor Deriving Energy from a Step-Down A. C. Transformer of the Toy Variety. Some Interesting Data on This Unusual Type of Lift Bridge Is Given in the Accompanying Article.

Umbrellas Serve As Sound Reflectors

A VERY singular experiment which it is interesting to carry out in the open is possible with two umbrellas and a couple of chairs. The umbrellas are opened up and the covers *well soaked with water*. Then the extreme ends are tied on to the backs of two chairs in the manner shown in the illustration. The umbrellas are placed fifteen or twenty feet apart, the insides facing each other. It is essential that the two umbrella-sticks should be in alignment, and to make sure of this stretch a piece of white thread between the two. Then let a person stand at each chair and adjust things until the line of thread is perfectly straight.



Using Two Umbrellas As Sound Reflectors in Acoustic Experiments.

Two experimenters should take up a position with the head inside each umbrella. Keep the mouth or ear within an inch or so of the sliding attachment. Words spoken in quite a low whisper are heard distinctly at the other umbrella, even tho this may be twenty feet away. Curiously enough, the sound does not seem to come from its real direction, but appears to issue from the umbrella to which one is nearest. More strange still a third person kneeling down between the two umbrellas midway hears not a word that is said. The covers of the umbrellas should be kept well dampened or the sound will not be thrown back in the manner indicated.

Contributed by S. LEONARD BASTIN.

Transparent Case for Reference Notes

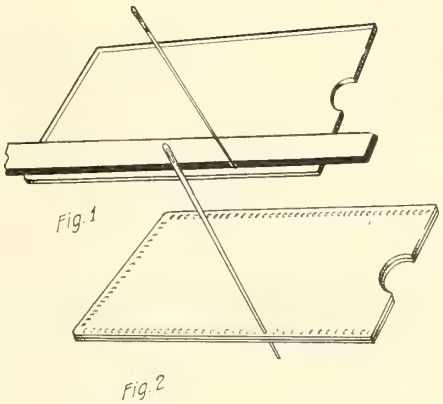
At times I have found the ordinary note or memo book impractical, while the device I shall describe has proved highly practical, convenient and simple to construct. It is in effect an improvement upon the practise of carrying notes, tables, formulas for frequent quick reference on small slips of paper or cards which ordinarily soon become worn and difficult to read.

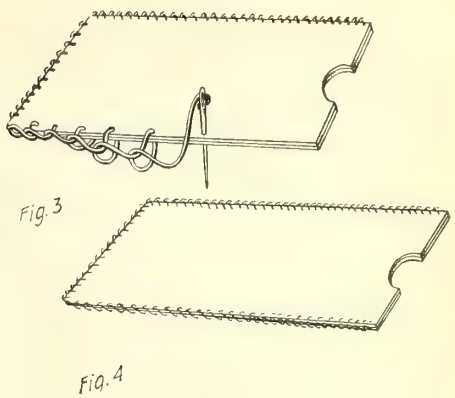
Essentially the device consists of a small transparent celluloid envelope and a small supply of cards with which it may be filled as needed. This celluloid envelope protects the card, keeps the writing or printing fresh and legible, permits notes to be read from both sides of the card and makes the whole stiff and durable.

The regular 2"x3½" standard card is perhaps the most convenient size and may be secured in quantities of 100 or more from printers, stationers or paper houses at very small cost.

If a card of the suggested size is used, then the envelope is made of two sheets of thin transparent celluloid cut to 2 3/16" x 3⅝", and a semicircular thumb space is cut out of one edge. The celluloid may be purchased cheaply at art or drafting materials stores.

On one of these celluloid sheets, with a needle or other pointed instrument, a guide line is lightly scratched about 1/16" from the three edges as shown in Fig. 1. Place this sheet over the other and all along the scratched guide lines, with needle or other pointed instrument, pierce both sheets at once at intervals of about 3/32". (See Fig. 2.) Now follow with double-threaded needle, lacing both sheets together (Fig. 3), completing the envelope ready to use as per Fig. 4.





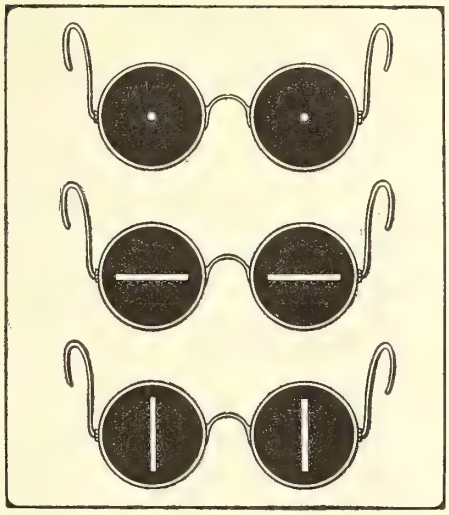
The Diagram Above Shows a Handy Transparent Case with Reference Notes, Which Can Be Easily Constructed by "Boy Scouts" and Others Who Have Use For Such a Case, But Who Do Not Desire to Pay the Price Asked For Them. The Case Consists of a Small Transparent Celluloid Envelope Together with a Supply of Cards with Which Each Case May Be Filled as Needed.

Contributed by C. NYE.

Curious Cardboard Spectacles

Some very singular experiments can be carried out with cardboard spectacles cut with different kinds of openings. The discs for the eye pieces are cut out of cardboard and these might be about two inches in diameter. The nose-rest or bridge is made from copper wire bent round in the right shape. The end of this bridge can be twisted into holes made in the sides of the discs. The bows are also made of wire one end of which is fixt to a hole in the side of the discs, and the other is bent round so that it will rest over the ears.

The discs are treated in the following manner. In one of the pairs of spectacles a hole is made with a pin right in the center of each disc. In another a horizontal slit is cut across as can be seen in the diagram, while in the third the slits are put in vertical fashion. The slits which should be narrow, can be cut out with a sharp chisel or a pocket knife.



The effect of wearing these spectacles is very curious. With the pinhole pair the range in vision is somewhat restricted but, so far as distant objects are concerned, there is extreme clearness. It is possible to read print easily at three or four times the normal distance. In the case of the spectacles with the horizontal slit the field is much the same as usual, but only horizontal lines are to be seen clearly. Vertical lines cannot be discerned, or seem to be very confused in outline. Thus, the trunk of a tree is very difficult to locate, but any of the boughs that are more or less horizontal stand up with great clearness. When the spectacles with the vertical openings are put on a reverse effect is secured. Here it is only the vertical lines in houses, fences and trees that can be seen plainly. Thin lines disappear altogether. Thus a clothesline cannot be detected at all although the supporting posts are astonishingly clear.

Contributed by S. LEONARD BASTIN.

A Wire Guider for Winding Coils

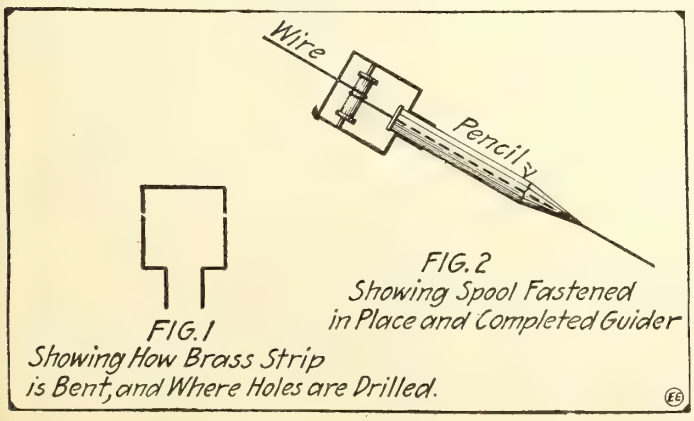
A metal pencil known as a clutch pencil is first secured. This may be obtained at any stationery store for a few cents. First drill a hole in the end of the pencil opposite the end in which the lead fits. Next cut a piece of thin brass about five inches long and one-half inch wide, and then bend it in the shape as shown in Fig 1. Drill two holes in this strip at the point shown by the arrows and make a small axle which will fit in these holes. Slip a small spool—which serves to guide the wire—over this axle and solder the axle to the strip.

After this is done, solder the ends of the brass strip to each side of the pencil. The wire to be wound is past around the spool once and is then led thru the entire length of the pencil and out the other end.

When a coil is to be wound, hold the pencil against the form and then turn the form which feeds the wire thru the point of the pencil.

With this arrangement the wire will go on very easily and if a little care is taken no trouble will be experienced from overlapping of wires as is the common trouble when winding coils with the fingers. Also no more sore fingers.

Contributed by HORACE C. LEEDS.



This Novel Wire Guider to Be Used in Winding Coils of Various Kinds, Is Readily Constructed From a Metallic Magazine Pencil of the Usual Type, One of Which Can Be Purchased at Any Stationery Store at About Ten Cents. The Wire to Be Wound on the Coil Is Given One Turn Around a Spool Pivoted on a Shaft at the End of the Pencil; It Then Passes Thru the Pencil and Onto the Coil. Besides Facilitating Accurate Winding of Coils in the Lathe at High Speed, this Scheme Entirely Eliminates Cutting of the Fingers.

Ozone--Its Liquid State

By JOSEPH H. KRAUS

ALTHO the liquefication of gases has been commercially employed for a number of years, the production of liquid ozone on a large scale has not met with any great success. The reason for this is that ozone as a liquid is a rather dangerous explosive, and the process for manufacturing the same is fraught with danger of explosions.

Ozone oxidizes substances much more rapidly than the gas from which it is obtained (oxygen), and it promotes spontaneous combustion of many substances which are permanent in oxygen itself. In those substances combustible in oxygen, when ozone is substituted for the other gas it offers a much greater and more vivid effect.

The interest in ozone is quite natural, because of its industrial use and the difficulty in obtaining it in a pure state. Before we can further delve into its production in liquid form, let us see how ozone can be employed and just what ozone is.

Ozone is an allotropic form of oxygen. Just what allotropism is, is rather difficult of explanation in a short article of this nature; however, suffice it to say that this word refers to two or more forms of the same element differing in properties. Thus, the diamond is pure carbon and yet has different properties from the forms of carbon which we are more familiar with. Therefore, we consider that carbon has several allotropic forms.

In nature, ozone probably does not appear in as great a quantity as three-tenths of a liter in a million liters of air. We know that this gas will easily yield oxygen in the atomic state and that it has extraordinary oxidizing properties. It will, for instance, immediately turn ferrous compounds into ferric compounds, and in order to show the extraordinary strength of ozone, we quote a few more striking examples. All organic matter in surface waters is readily oxidized by ozone, and ferric compounds therein contained leave a ferric hydroxide in suspension. Silver is readily oxidized at ordinary temperatures and nascent iodine is liberated from potassium iodide. Lead sulfid is oxidized into lead sulfate, and even mercury succumbs to the terrific power of this gas.

In this way, ozone presents us with a source of nascent oxygen and if it could be secured easily in liquid form, it would enable us to obtain the much desired nascent oxygen. In air there is always a repeated action between ozone and oxygen; the ozone changing to the latter gas and vice versa, even when under the influence of a high frequency machine. It is thus seen, that we can never get a high concentration of ozone in air as the former gas loses its unstable form and becomes oxygen again.

Therefore, liquid ozone is the only salvation. The effect of ozone upon rubber is to eat it thru in a few seconds, altho cork will withstand its action fairly well, unless the concentration of the ozone is extremely powerful. When speaking of the gas chemically, the concentration is not exprest in percentage but in grams per cubic meter.

For bleaching waxes, oils, and textiles, ozone is without a peer, and as a bactericide it is meeting with great success. Its use, as the latter, has been described from time to time in this journal. Both drinking water and bathing water have been purified successfully by but a slight quantity of the gas compared to volume of water.

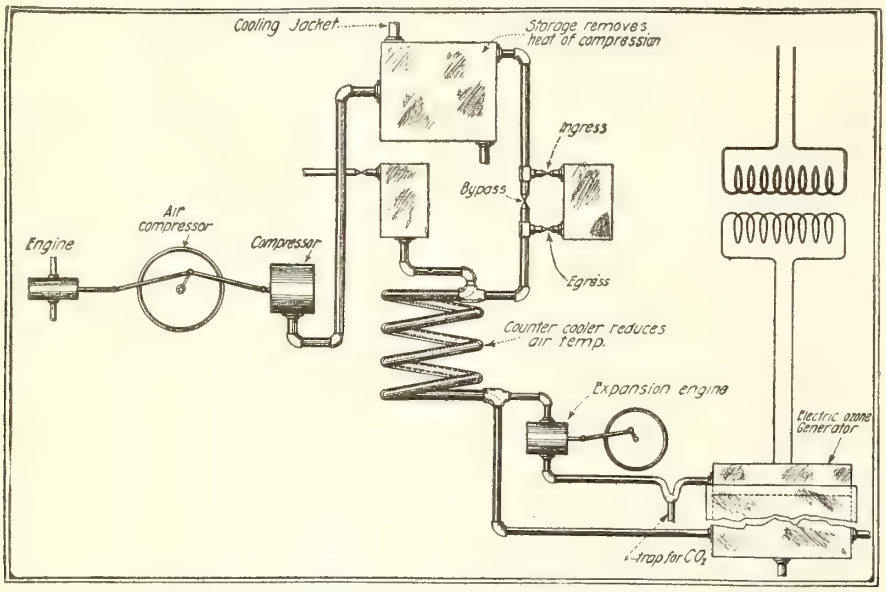
It is interesting to note that certain bacteria such as the *bacillus subtilis*, and the *bacillus ramosus* are not affected by ozone. Fortunately for us, these germs are harmless. Another interesting subject, arises when we consider the odor of ozone. A question has often arisen as to whether we really smell this gas or whether the sensation we perceive is due to oxidation of organic substances in or around the olfactory nerves. Many observers have questioned the point and altho it has been almost definitely proven that the sensation is directly due to an oxidation process, there is still room for doubt.

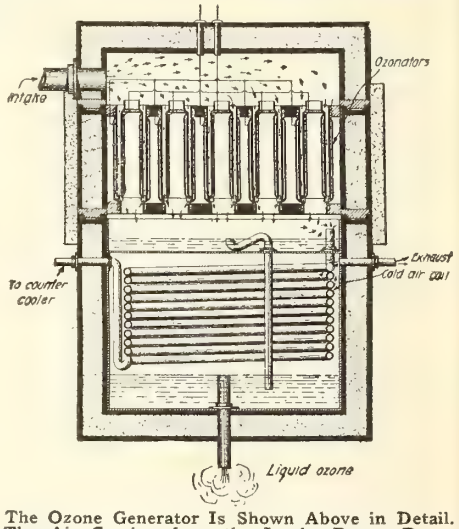
The following fact tends to prove the opposite side of the theory. Ozone when taken in slight concentration does not oxidize the nerves; if it did oxidize them its odor should be entirely obliterated for one who is working in an atmosphere of the gas for a short time. Such, however, is not the case, and a person can work in an ozonized atmosphere all day and smell the gas continually. Its effect upon the sensitive membrane, lining the nose is, if anything, to create a super-sensitive membranous condition. Not alone does the action of the gas completely rid a room of odors but it destroys every living dangerous bacillus in the room.

Its effect upon vile odors is not a masking action, but a thoroly oxidizing effect, and odorous substances are burnt into non-odorous forms.

So much for the importance of ozone as a gas but when the liquefied gas is considered, we have a different story.

Some time ago, a very interesting patent upon that subject, was issued to Horace Dumars, who has experimented and produced liquid ozone on a large scale, at the time when Trippler and Linde, two authoraties on liquid gas production, first appeared in the field.





The Ozone Generator Is Shown Above in Detail. The Air Coming from the Intake Passes Down Between Two Concentric Double-Walled Glass Tubes, the Coatings of Which are Connected to the High Voltage Generator. The Molecules of Oxygen are Changed to Ozone by the Action of the Current, and Immediately the Gas Liquifies.

The Method of Making "Liquid Ozone" Directly, Is Clearly Shown in the Above Diagrams, and All the By-Products Formed During the Liquefication of Such Ozone Are Used Again in Other Parts of the Apparatus to Facilitate Its Production. Air is First Comprest by a Motor-Driven Compressor, and Then Past into a Storage Tank. From Thence It Travels to An Expansion Engine Which Has a Different Purpose, Described in Detail in the Accompanying Article. The Cold Air is Then Acted Upon by High Voltage Ozonators and "Liquid Ozone" is Immediately Produced.

This invention provides for the production of ozone is a pure state without the danger generally incurred in such installations. Its basic principle is rather easy of comprehension. Air in the apparatus is reduced to a temperature lower than that at which ozone liquefies, and yet at the same time higher than the liquefication point of either nitrogen or oxygen.

This temperature for ozone is minus 106° Centigrade; that of oxygen minus 179° Centigrade, and nitrogen minus 196° Centigrade. The diagram shown discloses the apparatus complete. The air is first taken thru a compressor where it is forced into a storage tank. Here the comprest air is allowed to cool by reason of its contact (thru the walls of the tank) with the atmosphere and the cooling jacket surrounding it.

The air then passes thru a dryer generally filled with liquid carbon dioxide where its water is removed. Here, its ingress and egress are regulated by valves, both ingress and egress openings being connected by a by-pass in case the same is to be placed in service.

(*Continued on page* 1258)

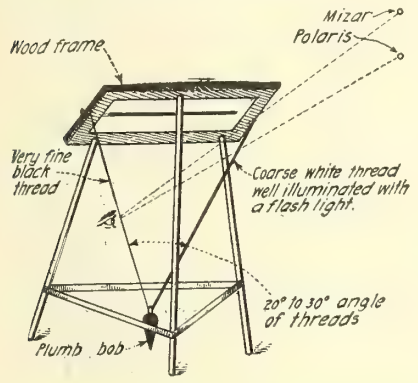
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

SIMPLE TRANSIT INSTRUMENT

A simple and very useful instrument for the amateur in astronomy, can be made according to the accompanying sketch, utilizing the optical phenomenon of the "entoptic" vision (inside the eye).



Here Is a Very Interesting Transit for Lovers of the Skies. A Frame, Stand, Plumb Bob and Pieces of Black and White Threads Complete It.

To find the meridian at night, some moments before any one of the two stars, Zeta of the Ursa major (Mizar) or Delta of Cassiopeia pass over the meridian thru Polaris, follow them with the plumb line plane; so that one of these and the Polaris will be on the same vertical plane and after this instant for about seven to eight minutes more; at this moment the plumb line plane is exactly in the meridian plane of the place.

The eye must be placed behind the fine black thread at a distance from it, of two to ten inches (nearer than the distinct vision of the observer's eye) so that the black thread will appear when looking at the star or other object as a series of very fine vertical lines of diffraction (this is the "entoptic" vision of the thread). The star is seen to approach to the "entoptic" image of the thread which the observer maintains in the center of vertical axis of the coarse white thread, soon the star touches one side of the multiple image of the black thread, passes over it and comes out of the other side without ceasing to be visible at any moment of its passage over the image of the thread. When it passes over the center of this image, is when the plane is in its right place.

Leaving the instrument in the meridian, passage of the stars, moon, sun, etc., can be watched, and solar apparent time at 12 can be taken when the shadows of the two threads combine in one as received on a screen placed in a convenient position; local mean time or standard time is then taken by adding or subtracting the correction of the day and latitude of the place.

To avoid vibration of the plumb bob it can be submerged in a pail of water. At night the coarse white thread must be very well illuminated. A flashlight is ideal.

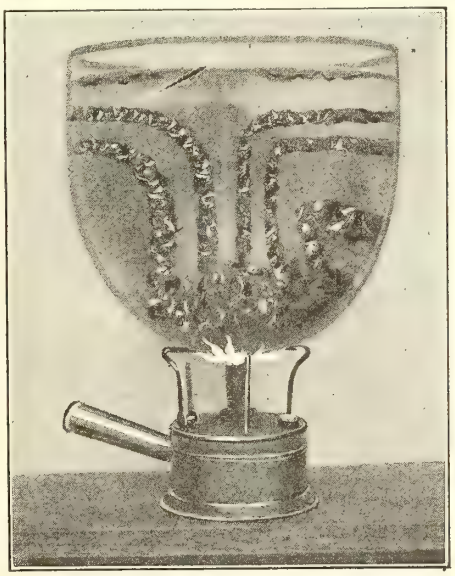
Contributed by RAFAEL GABALDÓN.

SECOND PRIZE, $3.00

A CHARMING EXPERIMENT

In science the term convection currents is employed to describe the movements which take place when water, or any other liquid, is being heated. When a vessel of water is placed over a fire the layers at the bottom first of all become warm and, owing to their lightness, these rise steadily to the top. The cold water which is heavier streams downwards to take the place of the liquid that has come up. It is easy, by following a simple experiment, to watch the course taken by the convection currents. Secure a glass vessel with a rounded bottom containing water and place this over a small spirit flame. Then throw in a few fragments of any solid coloring matter such as aniline, cochineal or litmus. These pieces sink to the bottom where they tint the streams of water that are rising upwards owing to the warmth. The convection currents which are then plainly seen assume the most graceful curves and the whole effect is extremely beautiful.

Contributed by S. LEONARD BASTIN.



Solid Coloring Matter in Water Will Give This Novel Effect When the Water Is Heated.

ACID PROOFING

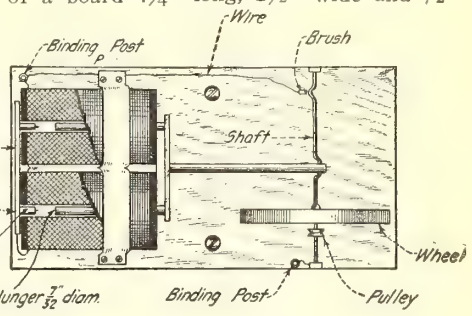
In order to prevent cement or wood laboratory tables from being attacked by acids apply to the tables three or more coats of finely powdered asbestos mixed with a slightly alkaline solution of water-glass (sodium silicate). This will give a surface, which on drying is not attached by even the strongest mineral acids.

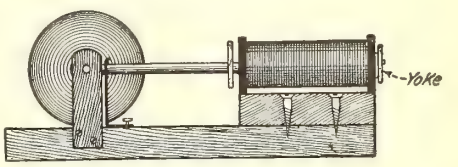
Contributed by J. H. K.

THIRD PRIZE, $2.00

HOW TO MAKE AN ELECTRIC ENGINE

The base of this battery engine consists of a board 4¼" long, 2½" wide and ½" thick. Another board 1½" long and 2½" wide and ½" thick is secured to the larger one by screws. The wheel is made of lead, copper, or brass and is 2" in diameter. Two coreless magnets having a ¼" hole in them are placed on the platform and secured by a strip of brass or tin.





This Small Battery Motor Can Readily Be Made by the Experimenter. It Will Operate on a Couple of Dry Cells for a Long Time.

The iron plungers are made from a soft iron rod 7/32" in diameter and ¾" long. The right hand magnet is connected to the brush and the left hand magnet is connected to binding post "P." The shaft is made of heavy brass or steel wire bent into the shape shown in the sketch and is 2" long after being bent. A soft iron plug ¼" x ¼" is inserted in the back end of each solenoid, and three holes are bored into the plugs; one 1/16" in diameter, containing a piece of brass wire; and two 3/64" holes used as vents. A piece of ½" x 1/16" iron strip, 2" long, should join the plugs as a yoke.

Contributed by LESTER E. KENDALL.

INK ERADICATORS

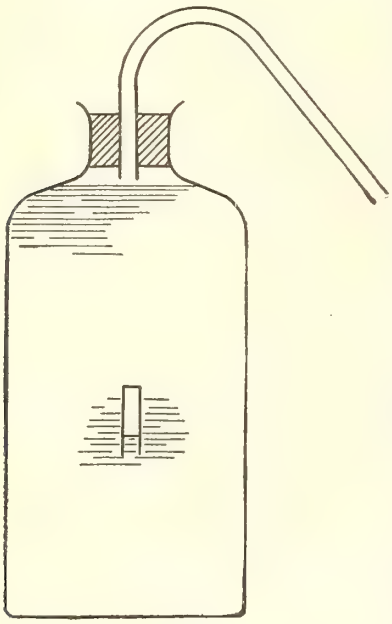
First solution, saturated aqueous solution of borax (two ounces), citric acid (one ounce), and water (eight ounces); the second solution is composed of three ounces of chlorinated lime, saturated aqueous solution of borax (two ounces), water (eight ounces). Another excellent ink remover consists of potassium chlorid, potassium hypochlorite (KClO) and oil of peppermint mixed in equal parts for solution A. Sodium chloride, hydrochloric acid and water in equal parts for solution B. To use: moisten the spot with A, allow to dry and then pencil over lightly with B. Rinse in clear water. Contributed by J. H. K.

Interesting Chemical Experiments

By O. IVAN LEE

The Magic Lung-Tester

Find a large bottle which is square, or better, oblong, in cross-section and the walls of which appear to be thin enough to allow of a slight amount of "give" or yielding



This Magic "Trick" Lung Tester Is Constructed From a Large Glass Bottle Fitted with a Tight Fitting Cork and a Glass Tube, Together with Rubber Hose Leading to a Hole in the Center of the Cork as Shown. A Mica Disc Is Placed in the Center of the Hole Thru the Cork, and Between the Ends of Two Pieces of Glass Tubing, So as to Prevent a Flow of Air From the Rubber Tube Down into the Bottle.

when strongly prest. You can not see any movement of the glass but can sense that it is not as solid as that of an ordinary round bottle when squeezed between the fingers. Also get a straight glass vial small enough to slip easily into the neck of the large bottle, a tight-fitting cork stopper for the latter, a piece of glass tubing about six inches long and a quarter of an inch in outside diameter about six inches of rubber tubing to fit over the glass tubing, and a little piece of thin transparent celluloid or mica.

Using a small rat-tail file, make a hole in the cork into which the glass tube will slide snugly. With a sharp three-cornered file nick the glass tube about an inch from one end, break it, and file one end of each piece flat and smooth by rubbing down on a flat file with a little water. Cut out a little circle from the celluloid or mica, just the size of the glass tube. Fill the large bottle brimming with water. In a glass jar or pitcher, float the little glass vial mouth downward so that the bottom of the vial is flush with the surface of the water in the dish. This can be done by admitting more or less air into the vial, and when the best adjustment is reached, the merest touch to the floating vial will send it downwards only to bob up again. While the little bottle is floating on the surface, slip your middle finger very carefully under the mouth; putting your thumb on the bottom end transfer it to the large bottle. Be careful not to press any water up into the vial when you put your finger over it, and also not let any air in when you are floating it in the neck of the large bottle. Push about half the water out of the neck of the large bottle (do not try to pour it out), and slowly push in a cork without any hole in it. At a certain point you will be surprised to see the little bottle quickly drop to the bottom; and it will stay there until the cork is drawn out a little, when it will bob up again. Push the cork in again, little by little, until you find that just a twist is enough to start the vial down. If this adjustment has been carefully made, the little bottle delicately floated, and the large bottle properly selected, you will be astonished to find that you can make the little bottle go up or down or stay anywhere commanded, just by more or less pressure on the flat sides of the big bottle. The thumb and fingers of one hand should be sufficient to do this.

Arrived at this point, take out the cork and replace with the cork with the hole in it, first inserting the glass tubes with the mica or celluloid circle between the filed ends hidden inside the cork.

The upper tube should be five inches long, the lower one, one inch, and should project but a very short distance (⅛" to ¼") *i. e.*, it should not touch the water. Adjust this cork with the tubes just as you did the other, so that a fairly strong pressure on the big bottle will make the diving bottle submerge.

Finally, slip on the rubber tubing on the upper tube and you are ready to try out your "lung tester" on the young man who prides himself on his chest measurement. Demonstrate how easily you can "blow" the little bottle down, and then pass the "tester" to him.

He will doubtless get very red in the face, but will have no luck at all. After he is discouraged a little, remove the rubber tubing and let him peer down through the glass tube, after which he will be more mystified than ever.

If the cork is a good one, and the connections are carefully made and air-tight, the apparatus will work without any adjustment for a long time; but of course it is always best to make a private trial before a public exhibition.

How to Prepare the Essential Oil of Cloves

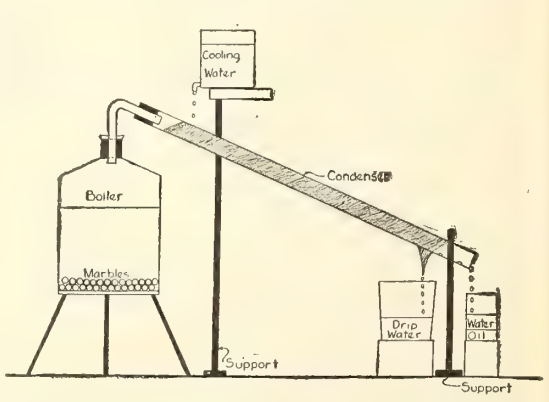
In the spice known as cloves consisting of the dried flower-buds, there is a very considerable amount of an oil of a spicy, agreeable odor, reminding one of carnations. It is very interesting to obtain this oil in a pure form by the process called *steam distillation* and this operation may be carried out very successfully with comparatively simple apparatus.

After obtaining several ounces at least of whole cloves from the grocer, grind them in a coffee mill. Then get a tin can (one with a conical top is to be preferred) of a capacity of about two quarts, and put in enough marbles or small clean pebbles to cover the bottom to a depth of an inch or so. After this, get a section of gas- or water-pipe between a half and one inch in diameter outside, and about six feet long, and clean it out inside as thoroly as possible; do the same to the can. With a round file, drill a hole in each of two clean corks fitting the ends of a short bent tube of glass, brass or copper. This gooseneck tube, as it is called, is to connect the outlet of the "boiler" with the upper end of the gas-pipe which is placed in a sloping position. Support it firmly at top and bottom with wooden uprights. Loosely wrap the whole length of the pipe between the points at which it is supported, with a long strip of soft absorbent cloth, letting the lower end hang down in a pail or large pan. Above the upper end of the gas-pipe which is to serve as the condenser for the steam, place a large tin can with a small nail-hole in the bottom. Have this opening of such a size and in such a position that as much water as possible soaks the cloth and runs down into the pan below without dripping off much on the way. If any trouble is experienced in adjusting the flow of cooling water make the slope of the pipe a little steeper. Provide a glass jar or vessel to receive the condensed water and oil coming from the open end of the pipe. Some source of heat such as a gas or kerosene stove must, of course, be provided to boil the water in the boiler.

When everything has been set up as described, fill the boiler can about half full of water, put in the ground cloves, connect the bent tube to the sloping gas-pipe, and light the fire.

As soon as the water comes to a boil, start the water running down the condensing pipe. The cooling water may be dippered back into the upper reservoir from time to time, but after a while it will probably get so warm that steam comes from the end of the pipe. Fresh cold water should then be used. Too big a fire, too

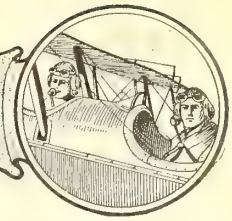
(*Continued on page* 1236)



Laboratory Apparatus Set Up For the Preparation of the Essential Oil of Cloves. The Process Here Shown Is Known as the "Steam Distillation" Method and the Apparatus Required Is Very Simple.



RADIO DEPARTMENT



Radiophone on Motor Car



Photo at Left Shows Disposition of Antenna Wires on Automobile as Worked Out by Two Young Radio Experts of Omaha, Nebraska. Intercity Wireless Communication Is Possible When a Sufficiently Sensitive Receiving Set Is Used.

View of Interior of Radio-Equipt Automobile Is Shown Below. Several Stages of Audion Amplification Are Utilized to Boost the Strength of Signals.



WHEN Wilbur R. Cramer and Fred W. Swain, both of Omaha, Neb., take their evening ride in their automobile now, they can chat with friends in nearby cities by wireless telephone.

This pair of amateur radio inventors has completed an apparatus, on which they have been experimenting for several years, which can be attached to their automobile and operated while traveling.

Tests of the telephone and telegraph instruments which they have attached to their automobile have proved successful, and Cramer and Swain now plan to place their invention on the market.

Their experiments with amateur wireless telegraphy began four years ago while they were attending the Omaha High School of Commerce. Following completion of their courses there both young men have continued their intensive study and have several inventions already in operation.

During the war, all United States Navy wireless sets were equipt with a standard recording dial which was first perfected by young Cramer, it is said. One of these dials was used by the crew of the NC-4, which was the first air craft to complete a non-stop trip over the Atlantic ocean.

While experimenting with their wireless telephone apparatus for automobiles, the young men have been testing out another invention, which controls the operation of any standard make automobile by wireless.

Another channel for their wireless efforts will be the conveying of orchestra music from one Omaha motion picture theater to another and the transmitting of a speech by a nationally known orator while in Chicago to a theater in Omaha.

The young men have organized a radio company to place their inventions on the market. They have received recognition for their efforts from several of the national radio magazines. Both of these young men are 20 years old.

Radio Aids to Navigation

ADMIRAL W. H. G. BULLARD, U. S. N., director of naval communication service, in a paper read before the Franklin Institute said that wireless telegraphy is making navigation simple and safe.

"There will be a time when ships will be without chronometers and will be in constant wireless touch with New York until they reach the British Channel," said Admiral Bullard. "This is not a dream; it is near at hand.

"By means of the radio compass a ship can get her bearings, when she calls for them anywhere along the coast of the United States. This instrument has already saved ships which were headed straight for the shore.

"The depth of water under the ship can now be accurately determined by the hydrophone, which works on the reflection from the ocean bottom of the sound of the ship's propeller. By this device shallow water can be avoided and even the proximity of icebergs detected. Ships also can communicate with each other by underwater waves, sent out by oscillators.

"By means of a cable laid along the bottom of New York channel and energized with current, a pilot blindfolded, guided a destroyer safely to port, never getting more than fifty yards from the line of the cable. The waves sent out from the cable were detected in telephone receivers, one on each ear, telling him whether he was to right or left of the guiding cable.

"Hurricanes can be detected by sensitive radio telephones, and even the general direction of storms is now sent broadcast by coastal stations, and the time given for wireless receiving apparatus. By wireless methods the ship can tell its location. Weather warnings and location of wrecks, derelicts and icebergs are given out."

Articles to Appear in March Issue of "Radio News"

The Radio Station at Rome

A "B" Battery of the Edison Type
By W. H. Farr

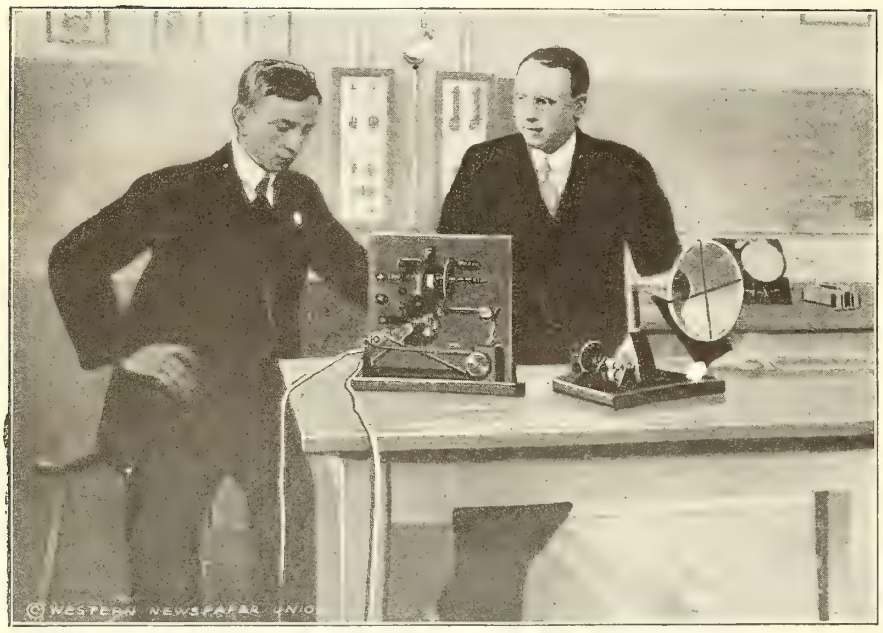
A Practical Portable Receiver
By S. G. Cline

The Phantom and the Circuit
By C. O. Parks

Short Wave V T Transmitter and Regenerative Receiver with Two-Step Amplifier
By W. Hyndman, 1 A. T.

A Complete Radiofone Set
By Frederick J. Rumford

New Danish Radio Invention



Two Danish Radio Engineers With Their New Radio Recording Apparatus Which Promises Much for Future Radio Developments. It Is Adapted to Record Either Radio Telegraphic or Telephonic Messages.

A new Danish invention in radio-telephony was presented at the recent Congress of Physical and Natural Sciences held in Copenhagen, Denmark. This invention is due to Messrs. Leck and Johnson, two radio engineers.

These inventors have perfected a system, it is said in cable reports, whereby it is possible to permanently record wireless telegraph or telephone messages. Radio-telegraphic signals have been recorded at high speed, by their newly devised instruments on a paper tape, similar to those found in district telegraph offices, and used in connection with a telegraph tape recorder, with which most of us are familiar.

Wireless telephone messages are recorded on a phonograph in a special and very effective manner which is said to be superior to that in use heretofore. In one of the experiments recently made, violin music was transmitted via radio-telephone and reproduced from the recording machine, perfected by Messrs. Leck and Johnson, and the music came forth in great sonority and purity.

These two Danish engineers, who bid fair to further the art of radio to a very large extent, are here shown with their new apparatus for recording radio-telegraphy and telephony communications.

The Edison Effect and the Audion

By DONALD McNICOL

In the litigation conducted during the past few years to determine the relative status as an invention of the De Forest audion and the Fleming valve, reference was made to the work along similar lines by Elster and Geitel in the year 1882, to Wehnelt's incandescent cathode rectifying tube of 1903, and to the Edison "effect" described in a paper presented to the American Institute of Electrical Engineers, New York, in 1884. In this paper diagrams were presented showing an incandescent lamp globe with regulation filament and in addition one or more insulated terminals sealed in the globe with the filament, the outside terminals of the latter connected thru a galvanometer to the source of current heating the filament. When the current was increased and the filament made highly incandescent the galvanometer indicated a considerable flow of current, notwithstanding that one of its terminals was connected only to an insulated wire or plate within the lamp bulb.

At the time of its discovery, and for many years thereafter, the effect observed was regarded merely as interesting phenomena. When, however, Fleming, in England, and De Forest, in the United States, in 1905-1906, developed their evacuated bulb detectors for electromagnetic waves, the early experiments of Edison were soon recalled.

It is a remarkable fact that in all of the search for priority the earliest work uncovered by the investigators was that of Elster and Geitel in 1882.

De Forest's patent No. 867,877; original

(*Continued on page* 1247)

Concerts Via Radiophone

Radio amateurs within a fifty mile radius of Philadelphia and some even farther away, have been enjoying evening concerts given by the Philadelphia Wireless School.

The accompanying photograph shows the powerful radio transmitter whereby the music is sent out broadcast from a talking machine. The phonograph is placed in front of the telephone transmitter or microphone of the radio set and one-half dozen records are played.

All the amateur radio operators even as far as New Brunswick, N. J., Wilmington, Del., and Baltimore, Md., have "listened in" and enjoyed the concerts.

Before the evening radio concert, which is destined to become quite *de rigeur,* the performance starts with a few jokes and with a summary of the day's news and the official weather report. Then the bank of audion tubes start whirling the electrons around and cut loose via the antenna atop of the school, with the latest thing in jazz music and syncopation.

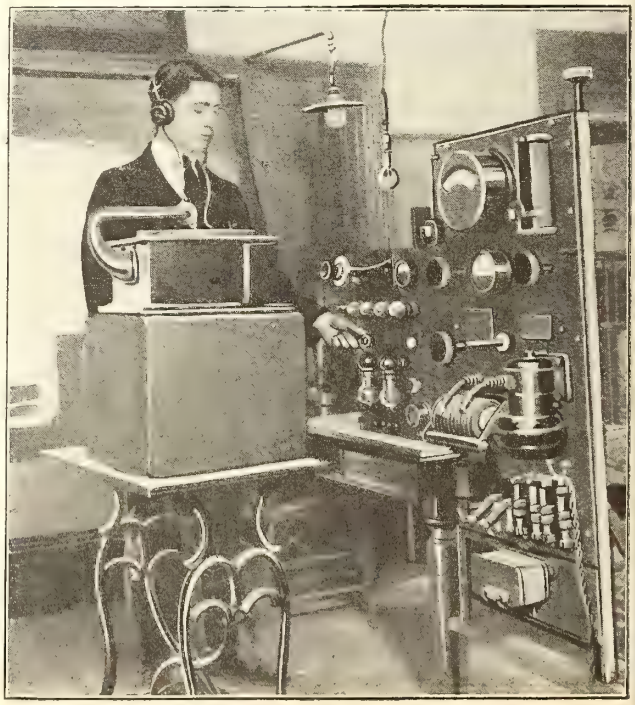
Radio telephone concerts have or are about to take on a new aspect, especially for ships at sea, and in supplying music for other occasions. This is rapidly being brought about by the employment of powerful multiple stage audion amplifiers, whereby the received music is intensified so as to be heard in a room or hall.

The popularity of radio telephone concerts whether small amateur affairs in local circuits or whether large concerts such as that given a short time ago by Mme. Tetrazzini at New York to the U. S. sailors at sea, has rapidly increased as time goes on.

A Phonograph Is Placed in Front of the Telephone Transmitter and a Half Dozen Records Are Played. All the Amateur Operators—Even as Far as New Brunswick, New Jersey, Hear All the Latest Jazz Tunes Given in the Concert by the Philadelphia Wireless School. The Evening Concert Starts with a Few Jokes, a Summary of the Day's News and the Official Weather Report.

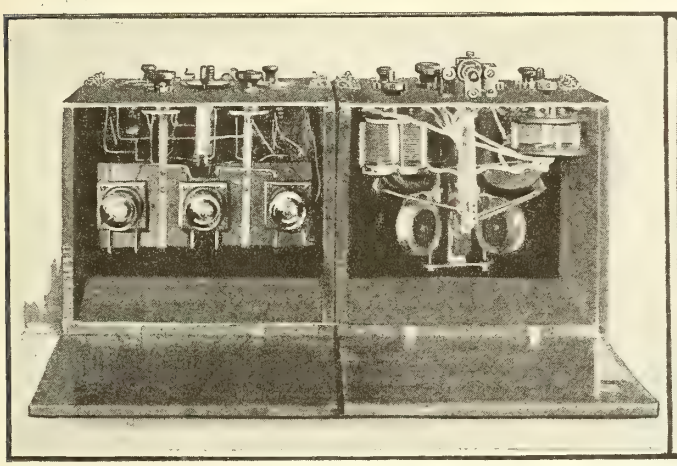
Photo (c) by Keystone

Who wouldn't rather listen to wireless telephone speeches than to code dots and dashes? Nothing is more exciting and interesting, especially to the members of the family.

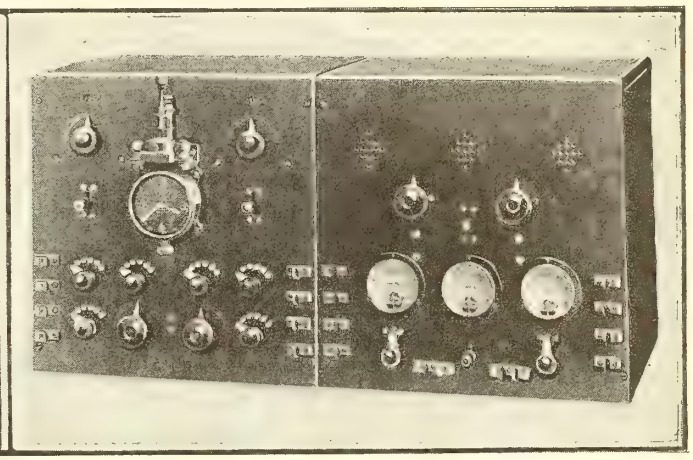


Building a 150 to 20,000 Meter Radio Receiver

By BERTRAM C. ROGERS



View of 150 to 20,000 Meter Radio Receiving Set Showing Interior Arrangement of Vacuum Bulbs, as Well as Honeycomb Coils and Variable Condensers.



Front Appearance of Two-Panel Receiving Set Employing Three Vacuum Tubes. The Set Comprises V. T. Detector and Two-Stage Amplifier, with Common Plate Battery.

THE accompanying photos and diagram with a few words of explanation are presented to the amateur who has wanted a long and short wave set complete in one cabinet which will not approach a "baby grand" in size. The panel is 12 inches by 12 inches, the cabinet being 10 inches deep. The detector and two-stage amplifier are of similar size in order to match up.

The outstanding features of this set that will appeal to the radio man desirous of building a universal set are the use of standard parts, maximum efficiency, simplicity of operation and permanency, the six honeycomb coils doing the work of the dozen and a half necessary in the usual coil-mounting set.

The antenna and ground are connected to the two lower left-hand clips, proceeding to the two centrally located switches. The diagram shows clearly the method of deadending the coil not in use. Coils are standard tapt Radisco honeycombs; the 325 turn coils will bring in anything up to and including "NAA." On a single eighty-foot wire sixty feet high and using very loose coupling and maximum regeneration, "NAA" is readable thruout the entire house. The 1200 turn coils have tuned in Arlington's arc set, which is around 5,000 meters and practically all of the longer wave stations operating, including the naval stations, Nauen, and a great many others whose signatures have not been obtained by the writer. The primary condenser is a .001 mfd. Murdock, but we would advise using a balanced type variable. The same holds true for the .0005 mfd. Murdock used for tuning the secondary circuit.

The right-hand key-switch is connected so as to place the primary variable condenser in three positions—series, aperiodic and shunt—the aperiodic position being obtained by bending the antenna terminal of switch to make contact in the center position of key.

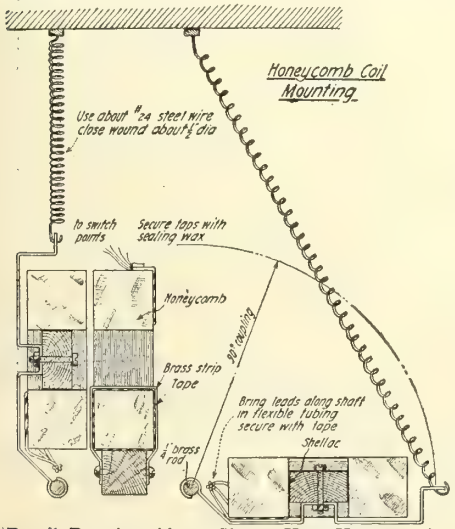
The eight-day clock is very conveniently adjusted occasionally by time signals and is used to record time only. This statement should not allow anyone to be misled into thinking that "tikker" reception is used as well as crystal and autodyne.

The crystal is ready for emergency use by placing phone tips in the two upper left-hand binding posts and adjusting the point, leaving it off the crystal, of course, when using the tubes. Thus it is not necessary to suspend operation because of a defective "B" battery, etc.

We now come to the coil mounting: The two fixt coils are strapt with thin sheet metal, extreme care being taken to insulate with tape and to use only sufficient pressure to hold the coils firmly; any excess will crush the coil and possibly short-circuit some turns. The movable coils are mounted by fastening maple centers to the coil with shellac. A rigid strip of brass is soldered to the shaft, which may be a one-fourth inch brass rod. Drill the other end of the strip and maple center for a one-inch brass machine screw and nut. An 8-32 or 6-32 screw will answer.

Taps should be brought out along the shafts of the moving coils, all leads and wiring should be spaced wherever possible and should positively be encased in good

(*Continued on page* 1245)



Detail Drawing Above Shows How Honeycomb Coils Are Mounted with Spring Controls, About a Central Axial System, Greatly Economizing on Space.

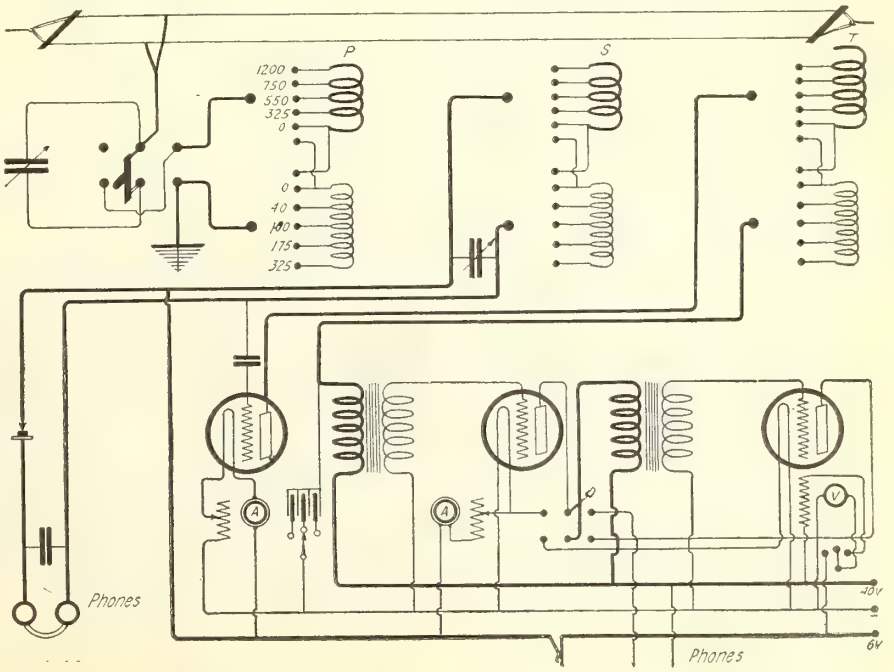


Diagram at Right Shows Disposition of Primary, Secondary and Tickler Windings, Designated "P," "S" and "T" Respectively. Battery Current and Potential Meters Are Provided.



WITH the AMATEURS



Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest in this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

This Month's $5.00 Prize Winner—E. H. Bitner



THE accompanying two photographs show my electrical and mechanical laboratory containing a lathe, Tesla coil, miscellaneous electric experimental apparatus such as spark coils, electric magnets, etc., as well as small steam engines which I have built myself.

The bench lathe is driven by an electric motor and was rigged up by myself, in the manner here shown. Part of my work-bench equipment includes a powerful hand-operated drill press and vise for holding the parts to be drilled. I have several electric motors of various sizes suitable for both battery and 110-volt service.

On the wall in the center of the first picture may be seen my switchboard by means of which various test circuits can be arranged as desired, giving different potentials for high or low-voltage resistance apparatus, as the case may be.

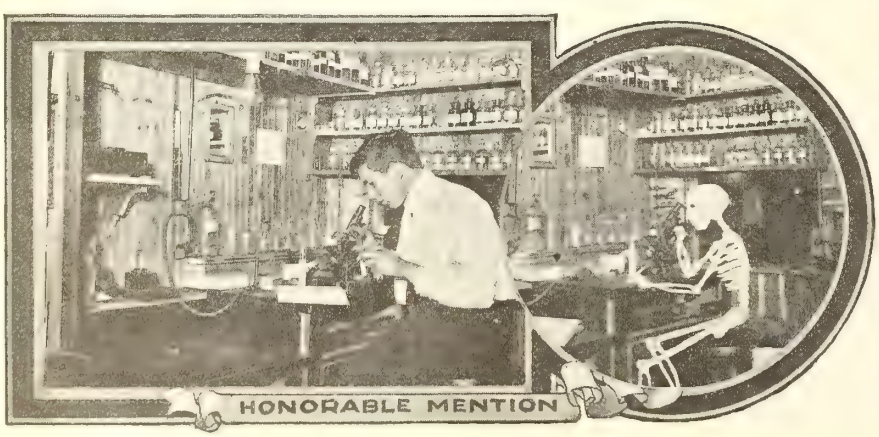
I have spent many pleasant evenings in my laboratory endeavoring to work out in practise, some of the interesting devices described in various text-books and magazines.

With the lathe, drill press and by the aid of a complete set of hand-tools which I keep in the drawer of the work bench, I find it possible to turn out some very creditable work indeed.

There is nothing so absorbing as experimental philosophy, especially when your experiments are successful, as mine usually are.—E. H. Bitner, 1510 Catherine Street, Harrisburg, Pa.

Honorable Mention—Harry Baird, $2.00 Prize

I HAVE recently taken the two accompanying photographs of my chemical and "Brownian Movement" laboratories, which, as you will see, are very interesting. The illustrations show clearly how carefully my materials are kept—each in its proper place. This arrangement is very practical and saves much time and trouble for me when I perform experiments.



The skeleton effect shown in one of the photos is an unusual one, and the position occupied by the spectre is the place where the experimenter would sit. The skeleton was painted in black on the negative and then printed in the usual manner.

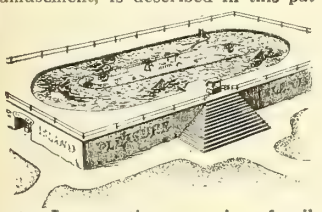
In working with Brownian Movements, I have found that one of the best substances to demonstrate the motion of the minute particles with is colloidal suspension of resin. I prepared this mixture by dissolving a small particle of resin in 5 cubic centimeters (c.c.) of alcohol, and then diluting to 50 c.c. with water.—Harry Baird, 6436 Emerald Avenue, Chicago, Ill.

LATEST PATENTS

Sailing Amusement Device.

(No. 1,357,995 Issued to Alexander Kitterman.)

An amusement, that is a real amusement, is described in this pat-

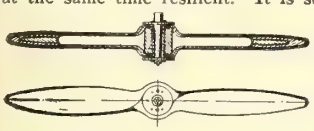


ent. In operation, a series of sailing boats are caused to travel over a body of water on an elongated course and they tip to either side as the wind affects the sail areas. This apparatus consists of an endless flexible chain-like member that is carried along the elongated course submerged below the surface of the water; to it the sail boats are flexibly connected so that they can be propelled by wind power, which power is transmitted to the endless carrier or chain. On either side of this endless carrier and also submerged is a platform or guideway, which prevents the vessels from tipping over too far.

India Rubber Propeller.

(No. 1,360,596 Issued to Miles C. St. John.)

This is one of the cleverest devices in airplane propeller design which has yet come to our attention. Due to the increased scarcity of suitable wood for propellers, it has become necessary to construct them of some other material. The inventor here describes a propeller made of rubber suitably reinforced with fabric which is weatherproof and which is extremely light, being at the same time resilient. It is so

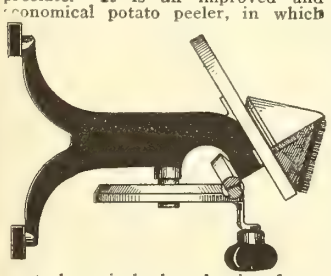


arranged that each blade is built as a clincher tire and can be removed. The hub contains valves so that the propeller can be inflated with air to a very high pressure, thereby adding to the strength and rigidity of the propeller construction. The tips of the blades are vulcanized to any degree of hardness and due to the inherent elasticity of the rubber and fabric construction, this propeller is much more able to resist shocks than the wooden type now in use.

Household Potato Peeler.

(No. 1,355,393, Issued to Anselm De Ghetto.)

This is a nice little household article which every woman will appreciate. It is an improved and economical potato peeler, in which

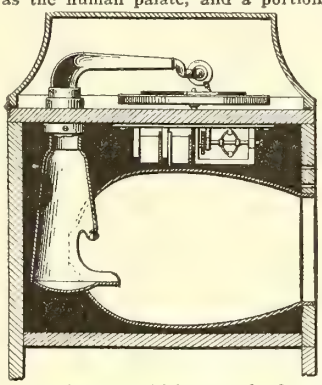


a steel conical shaped wire frame is used to scrape off the peel and therefore less waste results. It consists of a wooden core covered with a steel wire frame, the wires of which are inserted in a fabric strip screwed to the cone.

Phonographic Amplifier.

(No. 1,360,577 Issued to William Edward Pugsley.)

The inventor of this device has gone back to the olden days when musical instruments and telephones were made to resemble the appendages and organs of the human being, and he claims that his device is acoustically perfect. The system consists of a conduit leading from the reproducer of a phonograph constructed and shaped to approximate the human throat as much as possible. This is called the "throat." It opens into a large amplifier chamber resembling the mouth of the human being, thru the agency of a peculiar irregular opening. The top of this opening is such that it forms a depending portion, which the inventor terms the "palate," because it is shaped as the human palate, and a portion

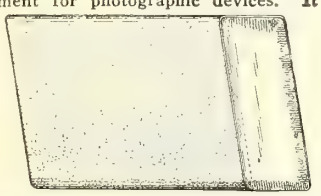


at the bottom which extends for a considerable distance is termed the "tongue." A means for bringing about the circulation of air is also embodied in the claims. Almost half a century ago the telephones were made to resemble human organs such as the ear and mouth. This style has been found to be non-essential for accurate reproduction, and we are just wondering how this particular device will fare.

Photographic Envelope.

(No. 1,360,624 Issued to William L. Dodge.)

This is a rather novel arrangement for photographic devices. It

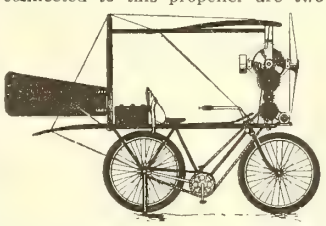


consists of an envelope for the reception of exposed photographic film which has embodied therein the developing chemicals or the combination developing and fixing chemicals, whereupon by simply soaking the envelope in a water bath, the resulting film will be both fully developed and fixt. This action may be carried on in daylight. The envelope must of course be used in cameras where the film may be removed and inserted into the envelope without coming in contact with the light. Therefore, the above operation may be completed without fear of spoiling the negative. Arrangement is also made so that the envelope itself will be composed of absorbent material sufficiently saturated with the necessary chemicals for developing and fixing.

Airplane.

(No. 1,355,315 Issued to Albert Covello.)

This machine consists essentially of a frame-work resembling a bicycle with the exception of the fact that an extra chain is connected from the sprocket to a propeller, thru a coaster brake; also connected to this propeller are two

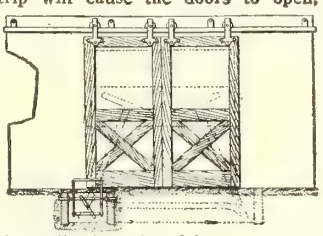


handles which serve to drive it should the operator's feet become tired or should more power be desired. Upon the super-structure placed upon this bicycle a large airfoil is fastened and at the rear elevating and steering rudders are pivoted. So far the flying range of such a machine has remained somewhere around forty feet.

Garage Door Opener.

(No. 360,479 Issued to Robert M. Wallace and Edward J. Scott.)

The device consists of two "T" shaped levers connected together at the lower ends by means of a link, so that both will move at the same time; the upper portion of each "T" is heavily leaded so as to constitute the weight in order that when the levers are slightly off the vertical, the weights will cause them to swing over due to gravitational pull and cause the door to either open or close, depending upon the direction they are falling. A crank or automatic trip is fastened into the driveway, so that the front wheels of a car passing over the trip will cause the doors to open,

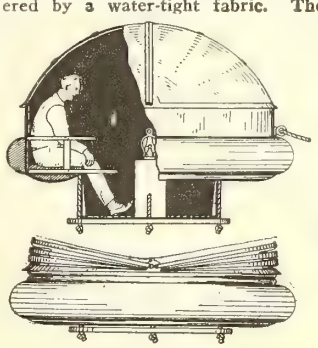


thus allowing the driver to enter the garage without stepping from the machine to open the door.

Life Saving Apparatus.

(No. 1,360,755 Issued to Harold Jordan.)

This apparatus consists mainly of a large, light buoy, the inner edge of which is formed as a seat for a number of persons. Its central opening is covered by a collapsible watertight bag having a rigid bottom. The buoy ship body is provided with a collapsible frame-work of ribs covered by a water-tight fabric. The

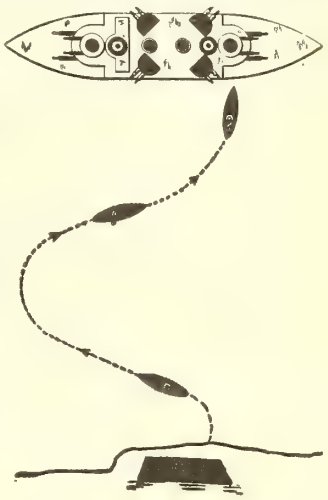


entire device is collapsible and therefore occupies very little space when in a vessel.

Visible Guide for Vessels.

(No. 1,357,976 Issued to John Hays Hammond, Jr.)

This is another issue to the well-known American authority on radio-control and deals with visible guides for torpedoes and torpedo boats and other vessels operated from a distance either by wire or by radio. A light is stationed in a tower containing vari-colored glass windows turning with the vessel and a reflector placed partly around this light and moving with it, not the vessel. The torpedo when started will have its light projected toward the transmitting station and should it swerve from this course, a different color window will be visible, due to the fact that the color screens turn with the vessel while the light proper is connected

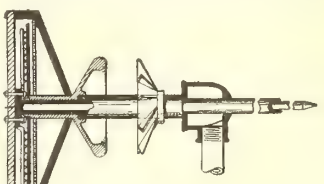


directly to a gyroscope, which keeps the light ray directed toward the shore regardless of the direction taken by the torpedo. A compass may also be used to control the light in place of the gyroscope.

Apparatus for Electrically Charging Fluids.

(No. 1,360,665 Issued to Edgar Earl Littlefield.)

This is a rather clever invention and relates to a unit which at the



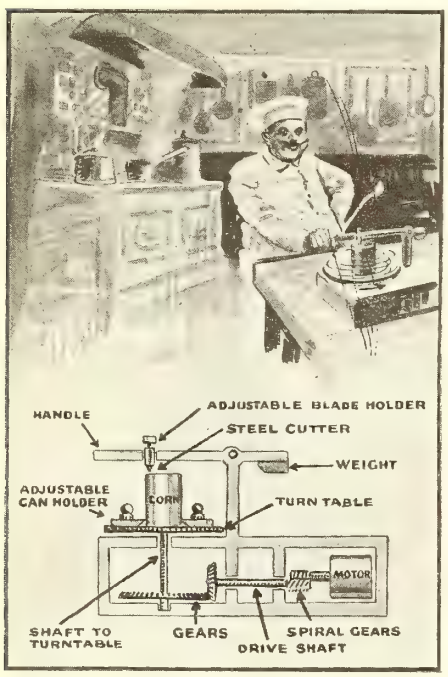
same time both charges water with electricity and sprays it upon various objects such as plants and other vegetation. The inventor has found that beneficial results are obtained when plants and vegetation are sprayed with chemicals dissolved in water and also with electrically charged liquids; the fungi and other insect pests are removed and destroyed thru this action. Essentially it consists of a device resembling a water motor, which in turn rotates the armature of a generator, or in another form the rotors of a static machine. Brushes collect the current so formed and charge the water streams either by induction or by direct contact thru the nozzle. Provision is made so that one terminal can be grounded if desired, in which event the ground acts as one pole and the stream, or streams, the other.

What To Invent

By JAY G. HOBSON

Renewable Electric Light Bulb

SOME statistician has figured out the enormous loss to electric light users from the burning out of the delicate wire filament which is the heart of the light. Oftentimes it happens that the slightest jar snaps the vital thread, making the light bulb dead—



Why Not an Electric Can-Opener for the Restaurant and Sampling Room? Hundreds of Cans Can Be Opened Hourly with Such a Motor-Driven Device.

of no further use whatever. If I remember correctly, the stupendous sum ran into ten or fifteen million good, American dollars, yearly. At any rate the amount of loss suffered, throwing away broken electric light bulbs after a little use, impressed me with the great need of an improvement along this line.

An improvement capable of saving only one-tenth of the total loss would be a wonderful achievement with instant success. But I will admit the accomplishment is not as easy as the suggestion; however, the idea recorded here may start someone on the worthy task with a successful solution as the result.

Recently an inventor patented an improved electric light embracing two filaments, to give double duty; in fact it was two lights in one and may prove of some merit; but I doubt if the solution rests in combining two delicate constructions of equal durability, because both are liable to break simultaneously if the one can break singly. The logical plan of experimenting for an improvement of this kind would be in an adjustable and removable filament, one that could be replaced in the glass bulb without losing the proper condition inside required for brilliant illumination. The large electric light companies certainly would bid eagerly for this improvement, and needless to say the inventor would profit in a handsome manner.

Electric Can-Opener

In wholesale grocery, fruit and canning plants hundreds of canned foods are opened daily by the old hand method which is not only slow and botchy, but often disastrous to the fingers of the operator. The purpose of opening large quantities of canned goods is to examine the edibility of same and allow buyers to sample the different brands offered for sale.

An improvement in can-openers undoubtedly would meet with hearty acceptance and soon become a large commercial success because of its speed and saving in both time and the hands. An electric opener constructed along the line of the accompanying illustration, having the cutting element adjustable to different size cans and operated from a small motor properly geared for lending sufficient power to the cutter to open the hardest tin. Every wholesale grocery house in existence would immediately appreciate an invention of this nature when presented to them. The machine must be practical and sell within reason having regard to the cost of its operation and ownership.

Four-Edge Safety Razor Blade

Now, boys, here's a gem of an improvement we close observers have completely failed to recognize. Just think how wasteful and extravagant we have been throwing away our perfectly good razor blades after using only two edges of it, when we could have obtained twice the number of shaves had there been four edges instead of two.

And when you stop to consider, the "Square Four-Edge Safety Razor" is entirely practical, yes, decidedly economical, you must admit there's merit in the idea. The tons of steel blades going to waste each year, from the hands of the shavers, who usually discard them when dull, would furnish enough steel to build several sky-scrapers along our busy streets.

It is reasonable to believe that four edges could be given to a square blade as easily as two edges now accepted as standard. But in reality nothing is standard for conditions and requirements are changing so rapidly; what is called standard today may be one of the antiquities tomorrow as evidenced by the first horseless carriage and that wind-



A Four-Sided Safety Razor Blade Should Prove a Boon to Mankind. Four Sharp Edges Are Available Instead of the Usual Two or One Now Supplied.



And Speaking of Finger Nail Clippers, Why Doesn't Someone Give Us a "Real" Clipper That Will Not Mangle the Nails and Which the User Can Manipulate Equally Well with Either Hand?

splitting demon of today—the airplane. So four-edge safety razor blades are within the bounds of possibilities for tomorrow; and may some agreeing colleague inventor bring one of this kind out soon, as I am always running out of sharp blades and can use the four-square beautifully.

Improved Finger Nail Clipper

Now that the dear women have the vote, are citizens and can become just as notorious in politics as the worst politician, if desired, I expect to see considerable activity in the ranks of women inventors, as there should be. But ever since our sinful ancestors moved from the Garden of Eden men have been inventing new conveniences for women, and the women have neglected their pals by not reciprocating. Here is the chance they have been looking for to get even; an improved nail clipper for men is badly needed. There are nail clippers and nail clippers on the market, but none that I have ever seen are entirely what is desired for the masculine manicure. Those offered for sale simply pinch the nail off instead of cutting it, which would be more satisfactory. Why not design a clipper with the scissor movement and action so that the nail would be easily and evenly cut instead of pincht off unevenly as with the present kind.

I am sure there is only one man out of a thousand who can use the scissors on his right hand.

Copyright, 1921, by Jay G. Hobson.

Scientific Humor

Ours Says "Stillbusy."—A suburban housewife relates overhearing this conversation between her new maid and the cook next door:

"How are you, Hilda?"

"I'm vell," said Hilda. "I like my yob. We got cremated cellar, cemetary plumbing, elastic lights and a hoosit."

"What's a hoosit, Hilda?" the puzzled cook exclaimed.

"O, a bell rings. You put a thing to your ear and say, 'Hello' and someone says, 'Hello,' and you say, 'Hoosit.'"

—*Creston Hutchinson.*

Paid Attention.—"I can't stand the tension," sighed the convict as the electric chair ended his earthly sorrows.

—*Ross Brearty.*



Alchemy.—In the little town of Beulah, New Mexico where it is a rare occurrence to see a white woman, two men, Stone and Wood, were standing on the sidewalk, when a well drest young lady came tripping down the street. Wood turned to Stone, and Stone turned to Wood, and as she past they both turned to *rubber.*

—*S. L. Barker.*

And Then "Pat-Ended."—An Irishman stood looking at an electrical contrivance, when an inventor walked over to him and asked, "Some machine; I wonder who the inventor is?"

The Irishman looked at him and replied: "Shure it was a son o' the Sod. Can't you see his name there.—'Pat. Pending.'"—*J. J. Beaty.*

Applied Chemistry.—Chemistry Professor: "What happens to gold when it is exposed to the air?"

Student (after long reflection): "It is stolen."—*Albert Schilling.*



Zoo-Logical.—"And you give the giraffe only one lump of sugar?" asked the little boy at the zoo.

"Oh, yes," replied the keeper. "One lump goes a long way with him."

—*Frank W. Shannon.*

A Scientific Postmaster.— A postmaster received a letter in the mail and it was addressed thus:

Wood
a
Mass.

He finally puzzled it out thus:

A. Underwood
Andover
Mass.

—*John Fenling.*

Did They Keep Time?—"In a recent flood in the Mississippi a man was seen riding down the river on a big bass violin. When he was rescued from his perch he was asked if his wife had escaped. "Yes," he answered, "she accompanied me on the piano."—*Carl A. Fanton.*

FIRST PRIZE $3.00

Cold Facts.—Teacher: "When two bodies come together violently they generate heat."



Pupil: "Not always. I hit a guy once and he knocked me cold."

—*S. W. Coleman.*

He Must Have Been Hoarse!—"Say, did you know that Jiggs was choked to death up in the restaurant this morning?"

"No, how did it happen?"

"He was eating some horse meat and when a piece got half way down someone hollered 'WHOA'!"—*No Name, Kirkville, Mo.*

Perpetual Motion.—Salesman: "This machine will do the work of three maids."

Mrs. Knicker: "I want one to do the work of 30, we have that many a month."

—*Frank Mirolli.*

We receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

Where Ignorance is Bliss.—Bud: "Well, Jim, I see you are instructing Ed Simmons to become an aviator."

Dick: "Yes, I have taught him everything I know and he's still an ignorant fool."—*William Tuman.*

Some "Boner."—Instructor: "What is all that noise I hear in the biology laboratory?"

Student: "That's the biology students rolling the bones."—*No Name.*

Why Not Wireless.—Dubb: "Where do you live in the city—close by?"



Stubb: "Fairly so — thirty minutes on foot, fifteen by motor car, twenty-five by street car, and forty-five by telephone."—*No Name.*

Yes, While the Blonde Took Peroxide and Dyed!—An exchange says that a man who had been dumb for years picked up a *hub and spoke.* That's nothing! A blind carpenter reached out for his *plane and saw;* a deaf ranchman went out with his *dog and herd;* a noseless fisherman caught a *herring and smelt;* a defunct hatter was tenderly deposited on a pile of *hair and felt;* and an elephant inserted his trunk in a *grate and flue.*

—*H. E. Zimmerman.*

Was the Spring Wound Up?—Mrs. Jones: "The butcher said it was a tender spring lamb."

Mr. Jones: "He is right. I've been chewing one of the springs for the last half hour."—*Old Red.*

"Star-Tling."—Browne: "Her teeth are like the stars in the heavens."



Greene: "Why?"

Browne: "They come out every night."

—*M. Zimmer.*

Watch-Ful.—Sharks: "The other day my watch stopt, and when I took it to the jeweler he found a tiny bedbug in it."

Sparks: "That so? How did it get in?"

Sharks: "Why, it crawled in between the 'ticks'."—*Perry D. Wilson.*

Logic Arithmetic.—Arc: "If 2 in 1 is shoe polish and 3 in 1 is oil, what is 4 and 1?"

Spark: "I don't know."

Arc: "Five!"—*Lawrence Arthur.*

'Way Down South.—*News item:* "The 8 year old son of Mr. and Mrs. Silas Parker was struck by a falling electric cable and badly burnt on the South Side."

—*H. B. Conant.*

Forewarned Is Forearmed.—"Your honor," said the lawyer. "I submit that my client did not break into the house at all. He found the parlor window open, inserted his right arm, and removed a few trifling articles. Now, my client's arm is not himself, and I fail to see how you can punish my client for an offense committed only by one of his limbs."



"That argument," said the Judge, "is very well put. Following it logically, I sentence the prisoner's arm to one year's imprisonment. He can accompany it or not, just as he chooses."

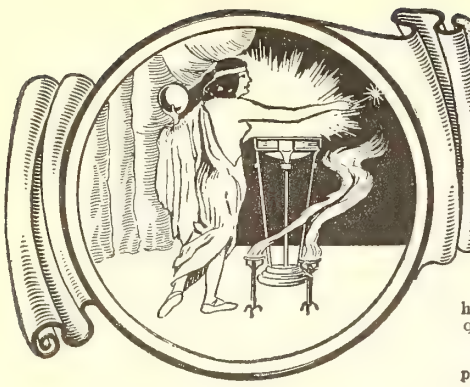
Whereupon the prisoner calmly unscrewed his cork arm and walked out.

—*Raymond H. Klumpp.*

That's Why He Was Sick!—Physician: "I'm sorry sir, but we can't quite be sure as to what is wrong with your arterial system unless we put you under the X-ray."

Publisher: "That's all right. I never made any secret of my circulation."

—*E. McEvoy.*



THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Radio Questions

(1080) F. L. Arnot, North Sydney, N. S. W., Australia, asks several radio queries.

A. 1. We cannot give you very much encouragement on the use of a crystal detector with underground receiving systems. The audion for wireless reception with the underground and loop antennæ systems is the best scheme.

For reception of high power European stations you should have an aerial about 600 feet long, single wire, or more if possible. Two loading coils, three feet long, and about five and a quarter inches in diameter, wound with No. 28 single cotton covered wire will answer for the inductance, and added to this of course the rest of the outfit. Inasmuch as most of the stations use undampt waves, you will have to employ a detector for undampt wave reception—i. e., an audion or other vacuum valve capable of oscillating or else a Poulsen tikker.

Since we do not know the English laws pertaining to radio as they stand at present, we are not in a position to advise you as to whether or not you could erect your receiving station and receive without a license. Consult your local government officials; the Post Office authorities should know about such matters.

Crystal detectors have been known to receive about 4,000 miles under favorable conditions. This is not by any means the record, nor are we in a position to post you as to what the actual record of crystal reception is. One or two variable condensers, a good three slide tuning coil and a vacuum valve detector together with the necessary loading inductance will enable you to attain a very good range indeed.

Are "Spigot and Pipe Line Motors" Practical?

(1081) Joseph Pacyk, Glassport, Pa., inquires:

Q. 1. Having read the illustrated article on the workings of a device invented by a French scientist which is a water turbine attached to a house water main which would produce electricity without cost, such as described in the January issue of SCIENCE AND INVENTION, on page 962, I wish to ask how this device can be practically a saving proposition in the cost of producing electricity.

Since the turbine gets its power from the pressure of the water, then where does the water get its power for nothing? For instance, if every house would harness one of these devices to their water lines, then there would not be enough pressure to go around. If the water is forced at stations by pumping methods, then if all houses would have the device installed, I believe that the pumping stations would require extra power to force the water thru the mains, since the small turbines in each house would take up a large amount of this water energy.

A. 1. With regard to the electric power from water spigot or conduit. This idea is intended to be carried out on a small scale, of course, and not by loading the house water mains with a large turbine so as to exert any noticeable loss in pressure on the system, which would be affected in the manner you state, if such were the case.

M. Colardeau's scheme is feasible if a small water motor or turbine is used to drive a small dynamo so as to charge a storage battery gradually by small increments of energy. This is the whole secret of the Colardeau scheme.

Furthermore, in many cases there is a far greater pressure than that required in many houses and in places where highly elevated reservoirs are used.

Action of the Scott Transformer

(1082) James Thompson, Troy, N. Y., asks:

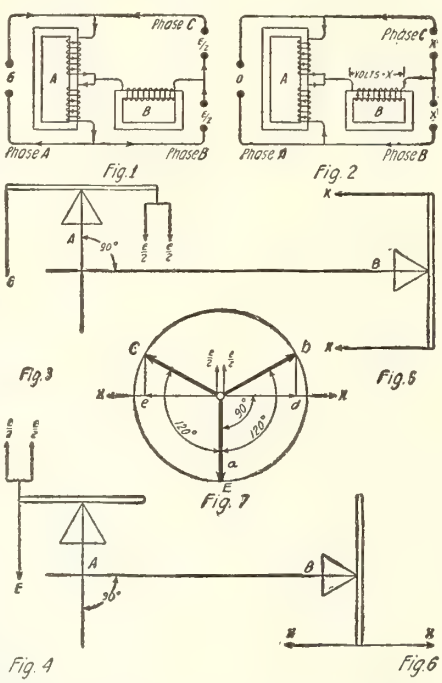
Q. 1. Can you solve for me the development of the three phases in a Scott transformer by the theory of forces.

A. 1. Figs. 1 and 2 represent the secondary windings of transformers A and B connected to a two phase circuit. When the secondary pressure of transformer A equals E, we are to find the secondary pressure of transformer B in terms of E, that will produce three equal phases, 120 electrical degrees apart and each equal to E.

Fig. 1 represents the condition when only transformer A is excited. There is no magnetic flux in transformer B, therefore no current is flowing through the secondary windings. The pressure in phase A equals E, while in each phase of "b" and "c" the pressure equals $\frac{E}{2}$ and in the same direction.

Fig. 3 is a diagram of these forces which are in equilibrium, while Fig. 4 represents Fig. 3 with the forces transposed.

Fig. 2 represents the condition when only transformer B is excited. The resultant magnetic flux in transformer A is zero, due to equal opposing currents as shown. The pressure in phase "a" equals zero, while in each phase of "b" and "c" it is equal to X (unknown).



Diagrams Used in Explaining the Action of the "Scott" Transformer by the Theory of Forces.

Figs. 5 and 6 are diagrams of these forces 90° relative to those of Figs. 3 and 4.

By combining the forces of Figs. 4 and 6 we will have the composite primary action of transformers A and B, as shown in Fig. 7.

With a radius equal to E construct a circle.

Draw lines *o b* and *o c* at an angle to *o a* equal 120°, to represent phases *o b* and *o c*. Perpendiculars through *b* and *c* to X, X intercept at points *d* and *e*.

Then *o d* and *o e* are the pressure components of phases *b* and *c* due to transformer B.

The resultant of the two right angular forces E/2 and o d equals o b. Therefore o d equals $\sqrt{E^2-(E/2)^2}=\sqrt{\frac{3\,E^2}{2}}$ which is the voltage of the secondary of transformer B. We have proved by the theory of forces that to transform with a Scott connection a two phase current into a balanced three phase, the voltage of the secondaries of the two transformers must be as E is to $\frac{\sqrt{3}}{2}$ E.

Answer by Russel E. Taylor.

Storage Battery Plate Filler

(1083) B. F. Walburg, Toledo, Ohio, asks for any storage battery plate filler.

A. 1. An oxide of lead is generally used in these batteries. It is applied to the grid in the form of a paste as either litharge, Pb 0, or red lead, $Pb_3 0_4$, and then substances may be added for one or more of the following purposes: to increase the hardness, porosity, toughness or conductivity. They may include glycerine, graphite, potassium silicate, and ammonium sulphate. These are then *formed* by being placed in a bath of dilute sulfuric acid with *dummy* lead plates for the opposite electrodes. A *forming* charge is now past thru, followed by a discharge with frequent repetition.

Negative plates are formed by passing a current thru in the opposite direction, reducing the lead oxide to spongy lead and converting the positive electrode to lead peroxide. After *forming*, the plates are dried and are ready for the market.

The proportions depend entirely on the plate manufactured by the different companies, and which are about nine parts of the lead oxide to about one part of the additional substances. This, however would depend entirely on the quality of the mixture, etc. In the case of glycerine just enough is added to form a nice thick paste.

Radio Condenser Specification

(1084) Wesley T. Meyers, Milwaukee, Wis., writes the Oracle:

Q. 1. For size of condenser to be used with ½ K. W. open core transformer.

A. 1. For a ½ K. W. open core transformer set the secondary condenser capacity should be about .08 microfarad. This will require eight 5x7 inch photographic plates, covered to within 1 inch of each edge with tin foil. This gives about 120 inches of tin foil, the inductivity factor of the glass being here taken as 3.13 in order to ascertain what the approximate capacity would be.

Keeping your wave length within 200 meters will depend largely on the size of your aerial. Altho we do not recommend hooking up the condenser in series with the ground, such procedure would cut down your wave length considerably.

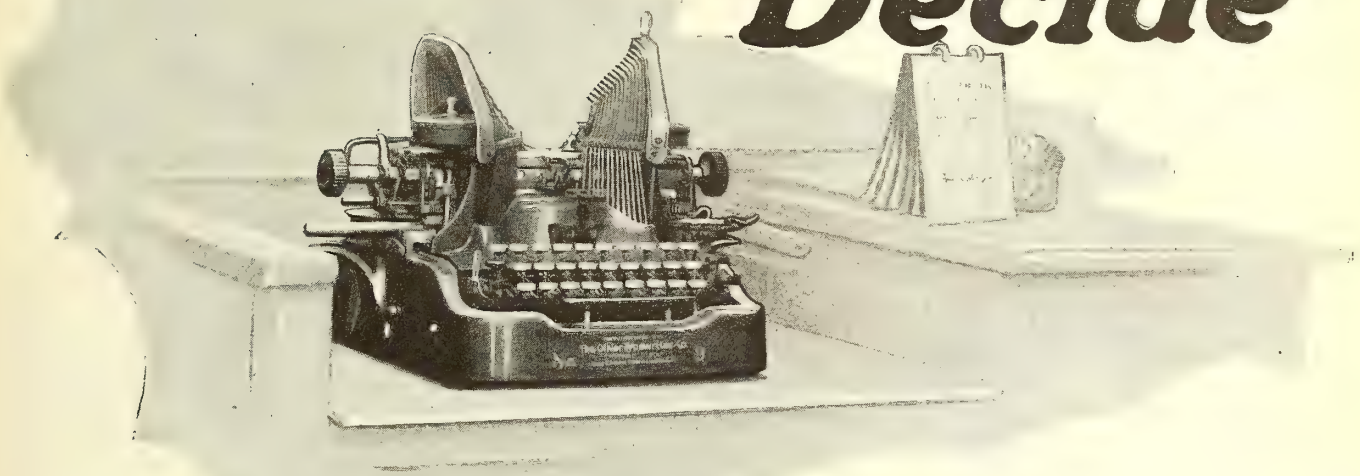
Bichlorid of Mercury Tablets

(1085) Rex Towgood, Sandon, B. C., asks about a patent on changing form of bichlorid tablets:

A. 1. Bichlorid of mercury tablets at the present day do not at all resemble Aspirin tablets. In New York City it is against the law to sell bichlorid except under physician's prescription. Then the tablets may be obtained only in the following forms: One, in the form of triangles (note the resemblance to your invention). These tablets are contained in triangular bottles which are incidentally covered with minute glass embossments. The rough surface of the bottle thus formed will warn any one attempting to take them by mistake. Furthermore, the bichlorid tablets are colored blue with some inert innocuous substance.

There is another form on the market which comes in a casket shaped bottle. The tablets likewise are casket shaped, colored and an embost poison mark upon them. No such tablets would be mistaken for Aspirin tablets, which as you know are round. Accordingly we believe that it would be useless for you to obtain a patent on either of these two forms of bichlorid tablets.

Use It 5 Days Free—Then Decide



Over 900,000 Sold

A New Oliver Nine

$36.00 less than pre-war price

THERE'S the whole story. A brand new Oliver Nine direct to you without paying a cent—you keep it 5 days, try it out in your own office, test it to your complete satisfaction and then if convinced you send us only $4.00 a month until you've paid $64.00 and the machine is yours. (If you wish, you return the machine at our expense and the deal is closed.) A typewriter of finest construction, of easiest operation, of national reputation at a saving of $36.00 over its pre-war price—figure how prices have increased since then and the saving mounts even greater.

You ask—"how can it be done?" The answer is simply this. The war taught us economy. Instead of supporting hundreds of salesmen and scores of branch offices we determined to offer it to the people direct—to let it prove itself on merit alone. The enormous increase in orders is indisputable evidence of the plan's success. And the saving—it all comes to you.

Don't confuse this with offers on second hand typewriters. This is a brand new Oliver Nine, direct from the factory—the same machine that you'll find in offices all over the country—that has everywhere won unqualified approval.

The Oliver incorporates all the features that make for excellent service. It's the original visible typewriter, perfected to the highest degree. One third lighter touch, perfect alignment due to arch shaped bars. Every machine tested at 800 strokes per min. Built for hardest usage, famed for dependability. It's a good buy even at the old price. With our plan it's an opportunity.

Save $36.00

A Finer Typewriter at a Fair Price

The Oliver is backed by a $2,000,000 concern of national reputation for sincerity and fair dealing—over 900,000 Olivers are in use today—some of the users are U. S. Steel Corporation, National City Bank of New York, Ward Baking Co., Encyclopedia Britannica, Boston, Maine R. R., Otis Elevator Co., Curtis Publishing Co., Morris & Co., New York Central Line and hosts of others.

Free Trial—Send No Money

You have not a thing to lose. Send no money. Simply fill out the coupon below and mail it at once. When the machine arrives try it out as above. We trust you—we know the Oliver will convince you. Avoid disappointment—order now to secure immediate delivery.

The OLIVER Typewriter Co.

673 Oliver Typewriter Bldg., Chicago, Ill.

THE OLIVER TYPEWRITER COMPANY
673 Oliver Typewriter Building, Chicago, Ill.

☐ Ship me a new Oliver Nine for five days' free inspection. If I keep it, I will pay $64 at the rate of $4 per month. The title to remain in you until fully paid for.
My shipping point is.....
This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name.....
Street Address.....
City..... State.....
Occupation or business.....

Send No Money

Just Your Name and Address Will Bring You Postpaid Your Choice of either of these amazing "DYNITE" GEM BARGAINS



Ladies' Solitaire "DYNITE" Ring

You will be the envy of all your girl friends with this fine engagement ring. It is a very beautiful solid gold-filled ring with a first quality, fiery, brilliant "DYNITE" gem in special high-pronged "DYNITE" setting. Just your name and address brings this wonderful ring to your door, postage paid. Give finger size. Order by No. D895 Pay postman the astonishing low bargain price of **$3.79**

***All the Fire and Brilliancy of a* Flashing Diamond**

Men's Fine "DYNITE" Ring



A truly wonderful ring at a real bargain price. Solid gold-filled with first quality, fiery, brilliant "DYNITE" gem set in special construction "DYNITE" tooth mounting. Very latest style. Just your name and address brings this amazing value to your door, postage paid. Give finger size. Order by No. D915. Pay postman the special bargain price of **$3.79**

SEND NO MONEY WITH YOUR ORDER

NO FUTURE PAYMENTS

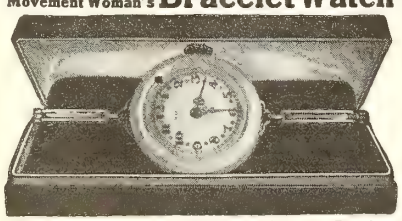
Don't send a penny with your order. Order any article shown here by simply sending your name and address and number of the articles you select. If you select a ring, be sure to send strip of paper fitting around second joint of finger for size. These amazingly low bargain prices are all there is to pay—there is no long string of future payments. Every article shown here comes in a beautiful specially made case.

WE PAY ALL POSTAGE

Every article mailed to its customers by this famous and reliable house is sent with all postage paid. All you pay is the low prices which are possible because of our great buying power and the savings we pass along to our many customers. Satisfaction guaranteed or money back.

Biggest Bargain Ever Offered

In Genuine Swiss Movement Woman's Bracelet Watch



Here is the smartest bracelet watch ever offered to the public—and at a price which will cause them to go like wildfire. Get your order in now. Genuine gold jeweled Swiss cylinder movement with gold hands and beautiful white enameled dial. Bezel around dial is mother of pearl. Crown and center are gold plated. Entire back of watch is mother of pearl, fine white quality. Bracelet is extension and self adjusting and is solid gold filled. Just your name and address brings this beautiful bracelet watch. Order by No. D219 Pay postman bargain price of **$6.39**

Men's Octagon Watch Bargain



12 size, octagon, open face, gold plated case, plain polished with triangular bow and jeweled crown. Has a genuine 7-jewel Swiss movement, full nickel, lever escapement, exposed winding wheels, gold dial. A big bargain in a high grade Swiss watch. Just send your name and address and back will come the watch, postage paid. Order by No. D215. Pay postman the low special price **$7.35**

THE PEARLS COMPANY

Dept. D., Box 826 Chicago, Illinois

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(*Continued from page* 1183)

volume, yet of a density so small that its surface gravity is not more than *one hundredth* of the value of gravity at the earth's surface. An object weighing two hundred pounds at the earth's surface, and two and a half tons at the surface of the sun, would weigh only about two pounds at the surface of the star Betelgeuse.

Almost simultaneously with the determination of the angular diameter of this star at the Mt. Wilson Observatory by means of the Michelson interferometer, there appearad in an astronomical publication a paper upon "The Probable Diameter of the Stars," by Prof. H. N. Russell, in which the diameters of a number of stars, including Betelgeuse, were found from determination of the relative surface brightnesses of the various types of stars depending upon observations of the relative amounts of red and blue light in a star's spectrum, or its "color index," which is now known for a great number of stars. It is of particular interest at this time to know that the angular diameter of Betelgeuse determined by this method, thirty-one thousandths (".031) of a second of arc, agrees closely with the value determined by direct measurement with the Michelson interferometer. Two men attacking this problem of the diameters of the stars by two entirely different methods, one observational, the other theoretical, obtain almost identically the same value.

From these published results of Russell's investigation, it appears, as has been suspected for some time, that the deep red stars of certain types are the stars that have the greatest diameters.

In seeking out stars with large angular diameters upon which to test the new interferometer method, then, the astronomer turns to the red stars, since among them he finds the giants of the universe with angular diameters exceeding one hundredth of a second of arc. Antares, in Scorpio, the conspicuous red star visible in the southern sky in summer evenings, is another red giant that, according to Russell's computations, has an angular diameter of nearly three hundredths of a second and an actual diameter of over two hundred and fifty million miles. It is, therefore, a close rival of Betelgeuse in size. Stars of no mean size, tho far inferior to the two just mentioned, are Aldebaran and Arcturus, familiar first magnitude stars which according to the computations have diameters of twenty million and twelve million miles respectively.

A most remarkable star noted in Russell's paper is a deep red, variable star, known in star catalogues as VX Andromedæ. For this star the computed angular diameter is five hundredths of a second, which is the greatest angular diameter found for any star in the sky. Since this star is not a near neighbor of the solar system, such an angular diameter must represent a diameter for this star comparable to that of the solar system itself. Of course the values given for the diameters of the stars by this method are considered only as rough estimates, but they at least indicate that the red giant stars surpass all others in actual size, and that compared to them our own sun is a dwarf.

For one of these dwarf stars whose distance from the earth is not great, a density four times that of the sun and a diameter of only three hundred and sixty thousand miles was found by this method.

(*Continued on page* 1218)

Pearl La Sage Cold Cream



The highest grade cold cream made is Pearl La Sage. You note the difference immediately. The bland, soothing ingredients used, not only cleanse, but *nourish* the skin. The beneficial effects of a face bath each night with Pearl LaSage cream are remarkable and *definite*. You are not left in doubt, because your skin tells the story—of new and surprisingly exquisite texture and softness. 50c or 75c, of your dealer or by mail.

A Sample for a Name!

Just write us the name of your favorite dealer and we will send you, *free*, a generous sample of this wonderful cold cream. Write today.

PEARL LA SAGE, Inc.
4325 Drexel Blvd., Chicago

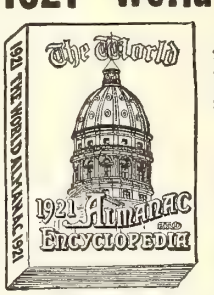


SENT TO YOU FREE TO WEAR 10 DAYS

Just send your name for a beautiful Rosebrite ring. Wear this wonderful new sparkling stone ten days at our risk. All the dazzling fire and brilliance of a genuine diamond. Mounted in solid gold ring, men's or women's style. **SEND NO MONEY!** Simply write today, stating style and finger size (send strip of paper just long enough to meet over second joint of ring finger). When ring arrives deposit only $4.75 with postman. Wear it 10 days. **We guarantee to refund your deposit if you can tell it from a genuine diamond.** If you keep it send $5.00 a month for four months. Write today before this amazing offer is withdrawn.

Rosebrite Diamond Co. 30 North Dearborn Street Dept. 353, CHICAGO, ILL.

1921 World Almanac



Published by the NEW YORK WORLD

and ENCYCLOPEDIA

Are you familiar with the vast storehouse of up-to-date, valuable information to be found in this

Popular Reference Book?

Just send your name and address to

Publisher
The World Almanac
205E Pulitzer Building,
New York City,

and a complete table of contents will be mailed you free.

BE A REAL MAN!

LOOK LIKE ONE AND FEEL LIKE ONE



Broaden your shoulders, deepen your chest, enlarge your arms, and get a development that will attract attention. Fill yourself full of energy and be powerful.

My New Book
"Muscular Development"
Will Explain How

This book is illustrated with 25 full page photographs of myself and of some of the world's finest developed athletes I have trained. It will interest and benefit you greatly.

Send 10c (stamps or coin) for a copy NOW, today, while it is on your mind.

EARL LIEDERMAN, Dept. 203, 305 Broadway NEW YORK CITY

$2 Now!



PERFECT HEARING

Put a New Standard Theraphone Earpiece on your telephone today and say "goodbye" to petty irritations, faulty hearing and inefficiency. This simple, yet marvelous little device fits any instrument, is adjusted instantly and guaranteed to give Satisfaction, Service and Results. Otherwise we'll refund your money. The effect is startling! Makes every word clear and distinct. Saves time, money and energy. Thousands in use and every user a booster. Invest $2 NOW and be convinced. *You will be!*

THE EVOLUTION PHONE CO., Inc.
48-CE Greenwich Avenue, New York City

CLIP THAT COUPON





Are You Technically Trained? If Not, Clip That Coupon

Chicago Technical College, 345 Chicago "Tech" Bldg., Chicago, Illinois

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below:

[ ] Architectural Drafting	[ ] Auto. Engineering
[ ] Machine Drafting	[ ] Aero. Engineering
[ ] Electrical Drafting	[ ] Gas Engines
[ ] Structural Drafting	[ ] Plan Reading—Buildings
[ ] Sheet Metal Drafting	[ ] Estimating—Buildings
[ ] Topographic Drafting	[ ] Plan Reading—Machinery
[ ] Surveying	[ ] Plumbing—Estimating
[ ] Designing	[ ] Heating and Ventilating
[ ] Contracting—Buildings	[ ] Steam Engineering

Name .....

Address .....

Post Office.....State.....

College or Home Study. State which.....

Free Lesson when inquiry is for Draftsmanship or Plain Reading.

Learn Draftsmanship At Home



THE employer today knows the value of technical knowledge. He surrounds himself with experts—not merely good mechanics but technically trained practical men. He is ready and willing to pay their price, for he wants expert advice and service.

Get the facts about the Chicago "Tech" Course in Draftsmanship (or any of the other big paying professions listed on the coupon). You can master all these courses quickly by spare time study at home. Draftsmen earn bigger salaries than ever before, because trained men are scarce. Hundreds of big paying jobs waiting and not enough experts to go around

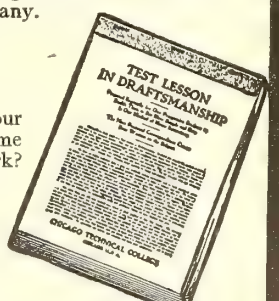
Constant and Growing Demand for Trained Draftsmen

Proficient men are needed badly in the drafting departments of big manufacturers, architects, railroads, electrical plants, etc. Many experts earn $60 to $150 weekly.

This is your big chance. See how well qualified you are before you spend one penny. Send for the Free Test Lesson described below. Also learn how and why a Chicago "Tech" course will make you the man chosen from among many. Clip and mail the coupon—now.

Experts Teach You Their Practical Methods

The Chicago "Tech" method trains you under experts who equip you for important positions in the shortest practicable time. You learn exactly the methods which they use in their own practical work. They give you the training that ranks you with draftsmen of long experience—that is required of men who aim to hold executive positions. Why be content just to take orders when you have it in you to *Give* orders, once your training gives you the confidence to assume charge of the men who do the actual work? The practical knowledge you get from Chicago "Tech" experts fits you to step right out and earn a big salary.



Choice of 18 Courses that Will Increase Your Salary

There is no better way to spend your leisure hours than in fitting yourself for the big jobs above you. If you want to master quickly any other technical study, make your choice from the wide range of big paying professions listed on the coupon. If you cannot come to the College, you will get the same course—the *same thorough individual instruction from the same experts by mail.* It does not matter where you live. Your lessons are directed and every exercise read and corrected by experts who make every point clear. You progress as quickly as your lessons show that you have mastered their subjects. With the practical knowledge you have gained from a Chicago "Tech" course, an employer need not take long to decide. You will be the man chosen—the man pushed ahead—because you will not only *know how to do things* but *why they should be done.* And no matter which course you decide on, you learn just the things you need know from practical men who give you the benefit of their long training. They fit you to start at a good salary and to win rapid promotion.

Send for FREE Test Lesson

Shows you how well qualified you are for draftsmanship. Other schools ask you to enroll and send money first. We send the free lesson first. Read it—practice the exercises—no obligation. Decide for yourself whether you want to take the course or not.

FREE OUTFIT

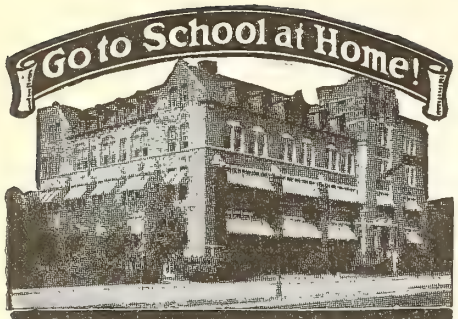
With our home study course is included a complete set of high-grade instruments, drawing board, T-square, etc. Same as leading draftsmen use. Credit given if you already have an outfit.

Act Today Decide right now—get the facts. Find out how hundreds of ambitious men have prepared themselves for high positions merely by using their spare time for study. This information costs you nothing. Just put X in the square on coupon opposite the course you want to know about. Then clip, sign and mail the coupon today.

Chicago Technical College

345 Chicago "Tech" Bldg.
Chicago, Illinois

CLIP THE COUPON NOW



HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competition is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

AMERICAN SCHOOL
Dept. H-326, Drexel Ave. & 58th St., Chicago

American School

Dept. H-326, Chicago, Ill.

Explain how I can qualify for position checked:

.....Architect $5,000 to 15,000	.....Lawyer $5,000 to $15,000
.....Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Certified Public Accountant $7,000 to $15,000	.....Telephone Engineer $2,000 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telegraph Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....High School Graduate In two years
.....Electrical Engineer $4,000 to $10,000	.....Fire Insurance Expert $3,000 to $10,000
.....General Education In one year	

Name..... Address.....

Popular Astronomy

(*Continued from page* 1216)

What extremes, then, exist among the stars of the universe! On one hand, there is the giant red Betelgeuse of nebulous density, and on the other the red dwarf of a density as great as our own planet earth, shining as a tiny sun, with a diameter less than half of the sun, and resembling in some respects a huge planet more than a sun. Surface gravity on this star is one and two-thirds that of our own sun and about forty-six times the surface gravity of the earth. An object that weighs two hundred pounds on the earth, about two pounds on Betelgeuse, and two and a half tons on the sun, would weigh over *four tons* on this dwarf sun.

Sirius, the most brilliant star in the sky, belonging to the class of extremely hot, white, hydrogen stars, has, according to Russell, an angular diameter of only seven thousandths of a second of arc, which at its distance from the earth of only eight and four-tenths light years, corresponds to an actual diameter of only one and a half million miles.

Rigel, the brilliant bluish-white helium star diagonally opposite Betelgeuse in the constellation of Orion, considered by some to be a super-giant of the universe, has a diameter of forty million miles if we accept the latest determination of its distance, which places it six hundred and fifty light years away. It is, therefore, far inferior in actual size to the red giants, Betelgeuse and Antares, tho it is a much denser and hotter body than these huge suns.

It appears now as if the diameters of these brilliant and tremendously hot white stars are on the average only *one-tenth as great* as the diameters of the red giants, and therefore that they are only one-thousandth as large. Enormous as the brilliant Rigel is in comparison to the sun (it would take one hundred and twenty-five thousand suns the size of ours to equal Rigel in size) compared to Betelgeuse it is quite an insignificant body, for *over four hundred* such stars as Rigel would be needed to make up the mighty bulk of Betelgeuse.

The Movie Theater of the Future

By H. GERNSBACK

(*Continued from page* 1173)

the repair has been made, so all the films will always run absolutely in step. There is no technical difficulty in doing this stunt, and it will be understood that inasmuch as the projectors are "behind" the screen, the films must be reversed or turned over, as otherwise the lettering, for instance, will read backwards as in a mirror. For this reason no special film is needed for a scheme of this kind.

After the screen and projecting arrangement has been lowered, a revolving stage, which the writer proposes, is unmasked as shown in our right-hand illustration. The space that was occupied by the projectors now is occupied by the raised platform on which an orchestra with the conductor is placed. Of course, this stage does not revolve very fast when the orchestra is sitting upon it; with just speed enough to make it interesting. The idea of the revolving stage is that the audience may see the conductor from all angles,

(*Continued on page* 1220)

You Can KNOW all about AUTOS, TRACTORS, AEROPLANES, STARTING and LIGHTING SYSTEMS, STORAGE BATTERIES, VULCANIZING, etc.

Valuable Book FREE

"How to Succeed in the Automobile, Tractor and Aeroplane Business," gives much new and very useful information; also tells all about the many splendid advantages and practical training you can get at this college in a few weeks. Tear this out and write for a copy, FREE, today.

GREER COLLEGE OF AUTOMOTIVE ENGINEERING
Dept. 123 1519 S. Wabash Ave.
CHICAGO



A Valuable Book FREE BRINGS BIG PAY

Do you want to increase your income by home study in your spare time? Our new catalog of **home self-helps** will show you how. No matter what your line of work, you will find in our FREE CATALOG of self-help books many valuable suggestions as to how you can **easily** increase your income. Especially valuable to all interested in **Electricity, the Automobile, Machine Shop, Carpentry, Painting, Farm Mechanics and Machinery, Gas and Steam Engineering, Railroading or Modern Languages.**

Sent ABSOLUTELY FREE. A postal will bring it. Send for your copy **now.**

Frederick J. Drake & Co.
1009 Michigan Ave. Chicago

Free Book
Containing complete story of the origin and history of that wonderful instrument—the

Easy to Play Easy to Pay

SAXOPHONE (4)



This book tells you when to use Saxophone—singly, in quartettes, in sextettes, or in regular band; how to transpose cello parts in orchestra and many other things you would like to know.

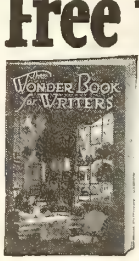
You can learn to play the scale in one hour's practice, and soon be playing popular airs. You can double your income, your pleasure, and your popularity. **Easy to pay** by our easy payment plan.

MAKES AN IDEAL PRESENT

Send for free Saxophone book and catalog of everything in True-Tone band and orchestra instruments.

BUESCHER BAND INSTRUMENT CO.
604 Buescher Block, Elkhart, Ind.

Free to Writers!



A WONDERFUL BOOK—read about it! Tells how easily Stories and Plays are conceived, written, perfected, sold. How many who don't DREAM they can write, suddenly find it out. How the Scenario Kings and the Story Queens live and work. How bright men and women, without any special experience, learn to their own amazement that their simplest Ideas may furnish brilliant plots for Plays and Stories. How one's own Imagination may provide an endless gold-mine of Ideas that bring Happy Success and Handsome Cash Royalties. How new writers get their names into print. How to tell if you ARE a writer. How to develop your "story fancy," weave clever word-pictures and unique, thrilling, realistic plots. How your friends may be your worst judges. How to avoid discouragement and the pitfalls of Failure. ***How to win!*** This surprising book is ***absolutely free.*** No charge. No obligation. *Your* copy is waiting for you. Write for it *now.* Just address

AUTHORS' PRESS, Dept. 187, AUBURN, NEW YORK

LEARN ENGINEERING

Electrical and Mechanical Engineers receive fabulous salaries. Thousands wanted. We give you thorough personal training from 3 mos. to 2 yrs., under expert instructors. NOT A TRADE SCHOOL but a PRACTICAL-TECHNICAL COLLEGE teaching electricity, steam, gas, auto-tractor, armature winding, drafting. Extensive laboratory and shop equipment. DEGREES AWARDED. Day and night sessions; enroll any time. Write for free catalogue. Earn-while-you-learn plan.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, M.

DETROIT

The Auto Center is the Logical Place To

LEARN AUTOMOTIVE ELECTRICS



A few weeks of M. S. A. S. factory outlined training has put thousands of men into big money jobs or started them in business for themselves. It can do the same for you. Previous experience is not necessary. At the M. S. A. S. you learn automobiles and tractors from A to Z. You learn the way the men who built the machines say you should learn. The leading manufacturers, their engineers and service managers know their business, and they endorse our methods. Our courses were planned and are given as outlined by these leaders of the industry.

Unlimited Opportunities

The big rush of repair and service work is on; there is no limit to the opportunities for trained men. You can start a garage, repair shop or service station of your own. Production is again increasing and trained men are moving forward. Trained men are needed to operate, repair and sell tractors and automotive equipment used on the farm. Experts are needed to install and do service work on lighting systems. Salesmen who understand mechanics and electrics are winning big success. More brazing and welding shops, more tire repair shops are needed. There is no other line of business where a man can go out and do what our graduates do in such a short time. Many of our graduates who had no experience before training now

Make $500 to $1000 a Month



H. A. BRADLEY was working for $12 00 a week. Says he didn't know a carburetor from a magneto. He trained at the M. S. A. S. and now has a garage business of his own in Cleveland, paying a profit of over $500 a month.



J. S. STECKLE, of Coplay, Pa., was working for small pay. He trained at the M. S. A. S., increased his income to $100 a week. Mr. Steckle also made a good record in the army, due to M. S. A. S. training.



ELDRIDGE BROOKS, of Meadville, Pa., is just 18 years old and has a garage business of his own with sales agency for Oakland and Nash cars. This is a splendid record for a young man just 18.



OSCAR PETERSON, of Denmark, came to the U. S. A. to learn the auto business. M. S. A. S. training has done much for him. He has a thriving business of his own in Denmark and says he owes his success entirely to M. S. A. S. training.



C. F. SWANSON, of Sioux City, Ia. Before training at the M. S. A. S., Mr. Swanson was working by the day. He now has a business of his own and makes over $500 a month. He attributes his success absolutely to M. S. A. S. training.



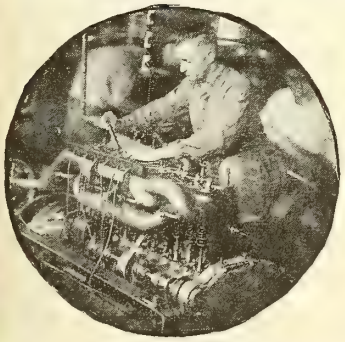
CHAS. CHAMBERS, of Oakton, Ky , is farming 3,000 acres of land. Says he would find it impossible to farm without tractors and other motor equipment and that his M. S. A. S. training saves him many hundreds of dollars each season.



This is 20 - year - old **BEN KOEHLER**, M. S. A. S. graduate, at Pulaski, Wis. He has done $93,810 worth of business with $10,000 profits in six months.

Leading Manufacturers Say

Train at the M. S. A. S.—the manufacturers know from experience that M. S. A. S. trained men know their business. In fact many of the leading manufacturers, their service managers, engineers and officials assisted in outlining M. S. A. S. courses. They know M. S. A. S. courses are right. They recommend M. S. A. S. training because of its factory outlined system. Nowhere else can this factory outlined, factory endorsed course be found. Therefore, get your training as recommended by leaders of the industry.



Showing individual work on motor in M. S. A. S. block test

Now Is The Time To Start

This is the very best time to get your training. All the latest automobiles and tractors are now in our equipment. Hundreds of men are coming every week from all parts of the country and are going back in ten weeks with a training that will enable them to get the best job and to start businesses for themselves.

There is nothing ahead but success for the man with an M. S. A. S. training and an ambition to get ahead. If you have this ambition, write today for our free 124-page catalog and information on the auto industry. Or, better still, take the first train to Detroit, look over the M. S. A. S. and then decide.

Catalog
Michigan State Auto School
Detroit, Mich.
U. S. A.

Get This FREE BOOK

The World's Leading Vocational Training School

MICHIGAN STATE AUTO SCHOOL
"The Detroit Auto School"
Endorsed by all Leading Automotive Manufacturers
663 Auto Building, 3729 Woodward Avenue
DETROIT, MICHIGAN, U. S. A.

MICHIGAN STATE AUTO SCHOOL
663 Auto Building, DETROIT, MICH. 3729 Woodward Ave.,

Gentlemen: Please send me absolutely FREE, New 124-page illustrated Catalog, "Auto School News" and information as checked below.

[ ] Auto and Tractor Course
[ ] Tire Repairing
[ ] Brazing and Welding

(Mark each course you are interested in)

Name.....
Street.....
City..... State.....



Do you want to be a good Boxer?

DO you want to be able to put the gloves on with any of your pals, and more than hold your own? Do you want to be able to defend yourself if attacked? Do you want to be able to use the blows and guards developed by the top-notchers of the ring—the Benny Leonard Triple Blow, the Jack Dempsey Triple, the Fitzsimmons Shift, the Mike Donovan Leverage Guard, etc.? In short, do you want to become a very good boxer in a very short time, and at very little cost?

Marshall Stillman's Shortcut Course teaches boxing, jiu-jitsu and wrestling in an entirely new way. He starts with movements you're already familiar with, such as holding out your hand for a coin, the breast stroke in swimming, etc., and quickly leads you into striking scientific blows, ducking, feinting, side-stepping, etc., like a professional. When you've mastered the fundamentals, you're taught shadow boxing, to develop your speed.

Then you're taught every good blow and guard used in the ring; when to land the blow; where to land it; and how to guard against your opponent's counter.

To complete your training in self-defense, you're taught 14 wrestling and 15 jiu-jitsu holds, including such tricks as breaking the strangle hold, waist holds, etc., of stronger men.

And there's a **History of 69 Great Boxers**, with their pictures. There are 246 illustrations in the entire course.

Send No Money

We send the entire course on approval. If you decide to keep it you send us $5 in complete payment on the 15th of the following month. Otherwise you return the course, and no questions asked. You're taking no risk, so mail the coupon now to **The Marshall Stillman Association, Suite E-203, 461 Fourth Avenue, New York.**

---- FREE APPROVAL COUPON ----

MARSHALL STILLMAN ASSOCIATION,
Suite E-203, 461 Fourth Avenue, New York.

You may send me your complete course in Boxing and Self-Defense, including extra instruction described above. I give you my pledge that you may feel safe in trusting me as agreed, and that I will pay $5 ($6 in Canada, $7 in other countries) for the course on the 15th of next month, or return it in 10 days after I receive it.

Name.....

Address.....

Make Your Own Selenium Cells

Complete Selenium Cell Outfit

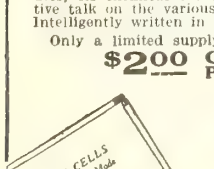
Just the Thing for the Experimenter

A complete selenium cell outfit shipped in metal carton, including fully illustrated book on selenium cells entitled, "Selenium Cells and How They Are Made," by Samuel Wein (the only book of its kind on the market), together with a piece of selenium, a slate slab and sufficient wire to make a selenium cell.

This book contains a very valued analysis of selenium, giving such information as to its discovery, its source and manufacture for commercial uses, its chemical characteristics and an instructive talk on the various cells in which it is used. Intelligently written in very plain language.

Only a limited supply of these books on hand.

$2.00 COMPLETE Postage Prepaid



Order today

The Steen-Bleyer Chemical Company
1807 Candler Building
220 West 42nd Street
New York City

The Movie Theater of the Future

(*Continued from page* 1218)

which is not possible at the present time where a conductor always turns his back to the audience; this is often commented upon. Such a revolving stage, if necessary, can be used for many different subjects and various ideas suggest themselves immediately. By revolving the stage at a greater speed, trick bicycle performers or roller skate performers will be able to give some new thrills to the audience. A ballet performed by dancers will also present various new aspects on a revolving stage, as can be readily imagined.

Violin or piano performers may play readily on a revolving stage of this kind, and thus everyone in the audience will be able to watch the performer, not only by viewing his back but by seeing his face as well at times.

As a theater of this kind is rather large, the sounds naturally would be weak at the rear of the house, and for this reason the well-known electromagnetic loud-talkers are used thruout the audiences as shown. Thus, anything going on on the stage, such as music or talk, etc., will be heard loudly at any part of the auditorium.

How Rotogravure Pictures Are Made

By OSWALD R. SCHULTZ

(*Continued from page* 1197)

anism. To be certain that all pictures which are placed in such a large frame have good contact, a vacuum pump is connected by a flexible hose with a rubber blanket. This air pump sucks out the air which is between the form and blanket. In this way it guarantees good contact between the picture form and carbon paper. Powerful arc lights are turned on and given a certain length of time exposure, which operation is also called *printing*. Fig. 3. The carbon tissue with the printed pictures on it, is now put in another vacuum printing frame and placed on top of an engraved glass screen of from 150 to 175 lines to the inch, and given a second exposure. The tissue, which is really a paper, resembling "Solio" photo print stock, is now ready to be transferred to the copper cylinder.

The cylinders can be solid copper rolls or, better, hollow copper cylinders, slightly tapered on the inside so that they can be forced on a mandrel. Some are steel tubes on which a shell of copper has been deposited by electrolysis. Fig. 4. These rolls are polished and turned absolutely true in a lathe before they reach the carbon transfer room. See Fig. 5.

Transferring Picture to Copper Cylinder

To transfer the printed carbon tissue to the *copper cylinder*, it is soaked in a solution of alcohol and water. When the tissue begins to flatten, it is quickly lifted out of the solution, adjusted to the position indicated by pencil marks which have been drawn on the cylinders and squeegeed securely to it. All the water possible is prest out and all surplus moisture is wiped from the back with a soft cloth.

(*Continued on page* 1222)

DIAMONDS WATCHES ON CREDIT



Send for FREE Catalog



We are offering wonderful values in Diamond Rings, in all the popular mountings, plain and fancy engraved. special at $85, $100, $125, $150, $175, $200, and up. EVERY ARTICLE IN OUR CATALOG is priced unusually low. Whatever you select will be sent prepaid by us. You see and examine the article right in your own hands. If satisfied, pay one-fifth of purchase price and keep it, balance divided into eight equal amounts, payable monthly.

WATCHES, Guaranteed 25 years, on terms as low as $2.50 a month. LIBERTY BONDS ACCEPTED.

LOFTIS BROS & CO. The National Credit Jewelers
Dept. L-22 108 N. State St.
CHICAGO, ILL.
STORES IN LEADING CITIES

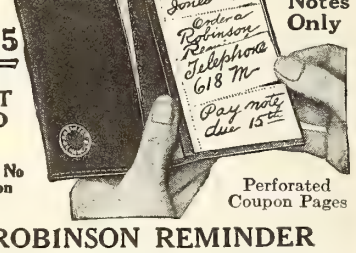
Order Your Scientific and Technical Books *Now.*

They are difficult to obtain and prices are constantly increasing. We will quote present price on any book of this nature and the price will hold unless the publisher should increase his price in the interim.

Write for our 96-page catalogue—the most complete scientific and practical catalogue now issued. In addition, our 1920-1921 list will be sent you, and the prices in this list will hold good in possibly 80 per cent. of cases; but you will be notified of any change before filling order.

There will be no obligation in requesting catalogue, for we want you to know our Book Department. Write today. You'll find it valuable for suggesting books you need.

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Room 655, Woolworth Bldg., New York City



$1.25 POST PAID

Live Notes Only

Accept No Imitation

Perforated Coupon Pages

ROBINSON REMINDER

Tear Out When Attended To

Each memo a perforated coupon, which when attended to, is torn out, **Leaving Live Notes Only.** No searching thru obsolete notes. Everything ready for instant reference. Pocket in cover.

	Size B	Size A
Reminder with extra filler	3x5 in.	3½x7 in.
Black Leather	$1.25	$2.00
Cross Grain Leather	1.75	2.75
India Calf	2.50	3.50
Cowhide	2.75	3.75
Genuine Morocco	3.00	4.00
Imitation Leather	.75	1.00
Cloth (without extra filler)	.25	.50
Ladies' Shopping Reminder		Size L
With Pencil and Extra Filler		2¾x3¾
Black Leather		$1.50
Patent Leather or Cross Grain		1.75
Morocco, Cowhide or India Calf		2.25

Extra Fillers—Per dozen: Size B, 75c; Size A, $1; Size L, 70c. Gold name on cover 25c extra. Prices changed without notice. If not at your stationer's, order from us. (Stationers write.)

Robinson Mfg. Co., 131 Elm St., Westfield, Mass.

Make Your Own Machine For Telegraphing Pictures

Something never offered before—secret, blue print and complete instructions for most marvelous invention of the age. Machines easily and inexpensively made from material and simple articles already in the hands of every experimenter. Will transmit pictures, maps, drawings and handwriting. This picture transmitted on set of these machines. Only $2. Send today.



L. J. LEISHMAN CO.
Dept. T Ogden, Utah







PRICE REDUCED

Down goes the price on these famous Books. We have induced our printers and binders to cut the price they charge us. We pass this saving on to our customers.

Mail Coupon Now For FREE TRIAL

Take Your Choice of These Big Paying Jobs

THOUSANDS of men like you are wanted to fill these big-paying jobs in the automobile engineering field. Thousands of places are open, too, for chauffeurs and garage managers. It's easy to get one of these good jobs and to prepare yourself to hold it. You don't have to go to school. You don't have to serve an apprenticeship. Spare time only is needed. These great automobile books will teach you everything you need to know. Fifteen of the greatest engineers and experts in the business wrote them in simple language that anybody can understand.



Auto Books

6 Volumes Shipped Free

Just off the press—the 1920 model—an up-to-the-minute six-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Packed full of advance information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or the owner or prospective owner of a motor car ought to know. Anybody can understand them. Tastefully bound in American Morocco, flexible covers, gold stamped, 2650 pages and 2300 illustrations, tables, blueprints and explanatory diagrams. A library that cost thousands of dollars to compile but that comes to you free for 7 days' examination. Over 50,000 sets of previous editions have been sold.

Partial Contents

Automobile Motors; Welding; Motor Construction and Repair; Carburetors and Settings; Valves, Cooling; Lubrication; Fly-Wheels; Clutch; Transmission; Final Drive; Steering Frames; Tires; Vulcanizing; Ignition; Starting and Lighting Systems; Shop Kinks; Commercial Garage; Design and Equipment; Electrics; Storage Batteries; Care and Repair of Motorcycles; Commercial Trucks; Gas Tractors.

128 Blueprints of Electric Wiring Diagrams

Only 10c a Day!

Not a cent to pay in advance. First you see the books in you own home or shop. Just mail coupon and pay express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books, send only $2.80 in 7 days and $3 a month until the special introductory price of $24.80 has been paid. (Regular Price $30.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.) This part of our offer will be withdrawn when the membership is filled. Mail the coupon without delay.

Don't Send Money Now!

Don't take our word for it. **See the books without cost.** Here is a chance for you to get a real man's job with a man's size pay. Don't waste a minute in sending the coupon. **Put the coupon in the mails today. Send no money—just the coupon!**

American Technical Society, Dept. A-253 Chicago, Ill.

FREE Examination Coupon

American Technical Society, Dept. A-253 Chicago

Please send me the 6-volume set of Automobile Engineering for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within 7 days and the balance at $3 a month until the $24.60 has been paid. Then you send me a receipt showing that the $30 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after 7 days' trial, I will notify you to send for them at your expense. [*Please fill out all lines.*]

Name .....

Address .....

City ..... State .....

Reference .....

Big Money for Boys!



Learn ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into good positions and get experience that will give them a real start toward success in life. Good salaries are offered with rapid promotion.

For 29 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6184-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ SALESMANSHIP
☐ Electric Lighting and Rys.	☐ ADVERTISING
☐ Electric Wiring	☐ Window Trimmer
☐ Telegraph Engineer	☐ Show Card and Sign Ptg.
☐ Telephone Work	☐ Railroad Positions
☐ MECHANICAL ENGINEER	☐ ILLUSTRATING
☐ Mechanical Draftsman	☐ Cartooning
☐ Machine Shop Practice	☐ BUSINESS MANAGEMENT
☐ Toolmaker	☐ Private Secretary
☐ Gas Engine Operating	☐ Business Correspondent
☐ CIVIL ENGINEER	☐ BOOKKEEPER
☐ Surveying and Mapping	☐ Stenographer and Typist
☐ MINE FOREMAN or ENG'R	☐ Cert. Pub. Accountant
☐ STATIONARY ENGINEER	☐ TRAFFIC MANAGER
☐ Marine Engineer	☐ Railway Accountant
☐ Ship Draftsman	☐ Commercial Law
☐ ARCHITECT	☐ GOOD ENGLISH
☐ Contractor and Builder	☐ Common School Subjects
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Concrete Builder	☐ Railway Mail Clerk
☐ Structural Engineer	☐ AUTOMOBILES
☐ PLUMBING AND HEATING	☐ Mathematics
☐ Sheet Metal Worker	☐ Navigation
☐ Textile Overseer or Supt.	☐ AGRICULTURE
☐ CHEMIST	☐ Poultry Raising
☐ Pharmacy	☐ Spanish ☐ Teacher ☐ Banking

Name_____

Present Occupation_____ Business Address_____ 1-1-21

Street and No._____

City_____ State_____

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada

FOR ONLY $2.00

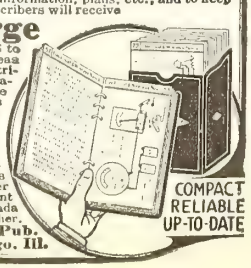
You will receive the regular **$5.00 Electrical and Wireless News**, published in loose leaf pocket form. Much of the information described has never been published in books. As, for instance, how to obtain electric current from trees, wireless without aerials, a pocket size wireless set that really works, and hundreds of other wise tips for the non-technical experimenter and advanced mechanic. **Electrical and Wireless News** consists of a handsome gold-lettered pocket binder, desk file and over 200 pages of information, plans, etc., and to keep it absolutely up to date all subscribers will receive

Free of Charge

every month for four months, 16 to 24 renewal pages of the best ideas obtained on how to make electrical, chemical and wireless apparatuses, supplies, etc., at little cost. You insert the new pages in the pocket binder and file the old pages in the desk file for further reference. All the above described sent securely packed, postpaid, for **$2.00.**

Note: The 16 to 24 monthly renewal pages after the 4 months will be $3.50 per year thereafter or only $3 if remittance is sent with the above order. In Canada and foreign countries, 25% higher.

IRVING B. ABRAMS, Pub.
1305 Peoria St., Chicago, Ill.



How Rotogravure Pictures Are Made

(*Continued from page* 1220)

The roll is allowed to set for at least twenty minutes, while the trough is cleaned and prepared with hot water. When ready it is steadily turned over the developing trough until the paper backing is loosened and finally stript off. The soluble gelatin can be washed away until the image shows proper development. The image will be found on the cylinder in gelatin relief corresponding to the lights and shades of the positive, thru which the light entered. Where the positive is densest the light penetrated least and the film of gelatin is consequently thinnest. Where the positive was most transparent, the light acted to the greatest extent and the carbon film is thickest. The tissue is then treated with alcohol and water, gradually increasing the alcohol until pure alcohol is used to drive out all the water possible from the film to accelerate and ensure its drying.

It is now ready to have the margins covered with asphalt varnish to prevent the acid from etching them, and when perfectly dry the cylinder is ready for etching. Fig. 6.

Perchloride of iron of different strengths is the mordant used. The iron solution penetrates the thinnest parts of the *gelatin resist* first and therefore etches the cylinder most under these parts. Where the gelatin resist is thickest, corresponding with the high light of the positive, the mordant has the least effect on the copper and the etching is slightest. The important point to observe is that the screen lines are not etched away, for on the preservation of these lines as partitions between ink cavities and as bearers for the metal wiper, commonly called "doctor," the whole success of rotogravure printing depends.

After cleaning the asphalt protection from the roller with kerosene and removing the gelatin resist with a solution of acetic acid and water the cylinder is ready for the press.

The press (Fig. 7) which receives these copper cylinders is constructed in the usual method to allow the cylinder to revolve in a fountain filled with specially prepared ink. Since the design is etched below the surface this ink fills the design. By scraping all superfluous ink off the outside of the copper cylinder with the aforementioned "doctor" blade, the surface of the cylinder is kept perfectly clean and with the assistance of the rubber-covered roller or impression cylinder, the design from the copper cylinder is transferred to the web of paper when it passes between the rubber impression roller and the copper cylinder. As the inks are used in a very liquid state, it has been necessary to introduce drying apparatus to dry the webs between printing on one side and the other, and also after printing on both sides before passing to the further operation of folding and delivering the printed product in sheets.

The use of rotogravure printing is spreading rapidly. An increasing number of newspapers and magazines are adopting this type of printing for feature sections in their Sunday issues or as inserts in their magazines. The fact is that the wealth of detail and the distinct reproduction of features, especially in group pictures, make the new process a wonderful agent for the reproduction of scenes and photographs of current events and advertising in any form or size.

MEN'S FINE DRESS SHIRTS



3 for $3.48

Only because we secured an enormous lot of these Men's Fine Dress Shirts from an overstocked manufacturer can we offer them at this amazingly low price. We claim this great bargain cannot be matched anywhere in America. And to prove it we gladly send them to you without one penny in advance. After examination if you're not convinced—don't take them. It won't cost you a cent to see for yourself that this is a world beating bargain.

Send No Money!

Made of finely woven Supertex Percale in the most popular striped patterns in smartest colors. Cut extra full in coat style. Double soft French Cuffs. Pearl buttons. Excellently made in every detail, they have a snappy, dressy appearance and give splendid wear. Colors guaranteed fast. Why pay $3.00 each for such shirts when you can get three for only $3.48 and postage on arrival? Just send your name, address and neckband size for three of these wonderful Dress Shirts. Pay only $3.48 and postage on arrival, our smashing low price for this sale only. Your money back if you are not perfectly satisfied. State your size. Write quick before this offer is withdrawn.

DAVID STRONG COMPANY
Dept. W-873 *"Same Management Since 1885"* **Chicago**



Send Your Name and We'll Send You a Lachnite

DON'T send a penny. Just send your name and say: "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will send it prepaid right to your home. When it comes merely deposit $4.75 with the postman and then wear the ring for 10 full days. If you, or if any of your friends can tell it from a diamond, send it back. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.

Write Today **Send your name now. Tell us which of the solid gold rings illustrated above you wish (ladies' or men's). Be sure to send finger size.**

Harold Lachman Co., 204 S. Peoria St., Dept. 1253 **Chicago**



SEXUAL—KNOWLEDGE

320 Pages ILLUSTRATED Cloth
By Winfield Scott Hall, M. D., Ph. D.

SEX FACTS MADE PLAIN

What every young man and Every young woman should know
What every young husband and Every young wife should know
What every parent should know

$1.00 Postpaid. Mailed in plain wrapper. *Table contents & commendations on request*

AMERICAN PUB. CO. 345 Winston Bldg., Philadelphia



STUDENTS **ART** MAGAZINE

Publishes cash artassignments, lessons and articles on Cartooning, Designing, Illustrating, Lettering and Chalk-Talking. Criticises amateurs' work. Full of information for artists and art students. Satisfactory or money refunded.

20c a copy, $1 for 6.

Send $1 NOW. Thrift Stamps Taken

G. H. LOCKWOOD, Editor, Dept. 657, Kalamazoo, Mich.

Make Your Own Violin

from exact reproductions of 12 old masters. Complete plans and specifications, one dollar, postpaid.

Violin Outfits from $15 Up

JOSEF DEULIN Violin Maker and Repairer "Everything for the Fiddle"
1414 Broadway :: DETROIT, MICH.

Are You Electrically Inclined?



The boy with his home-made laboratory can be the big electrical man of the future. Use your electrical talent to advantage. Go to a school that specializes in electricity.

Take this Short-Cut to the Big Electrical Job

It isn't a big step from the first boyish experiments at home to working out problems on real equipment and apparatus. Take advantage of this school's proved method of instruction in practical electricity. In a surprisingly short time you will have made yourself an expert. We can give you the thorough theoretical knowledge and practical training that will insure YOUR success. You will be prepared for a definite, high salaried usefulness when you graduate and we will also help to place you in the position you desire.

Select Your Own Field—Below we give a brief outline of our electrical courses. For complete information write for descriptive booklets.

Practical Electricity—Prepares student for general installation and maintenance work. Eighth grade education desirable. Electrician's diploma granted. Entrance at any time. Six months full time.

Electrotechnics—Open to men with common school or some high school credits. 2 and 3 year courses. An electrotechnician bridges the gap between the electrician and the electrical engineer. Diploma admits without examination to the College of Electrical Engineering.

Electrical Engineering — Open to men with full high school education, or its equivalent, and to electrotechnicians. 36 months study. Degree of B. S. in E. E. granted. Entrance every three months.

Armature Winding — Motor generator repair and maintenance. 3 months full time. Common school education required. Entrance at any time. Diploma granted.

Drafting — Electrical and mechanical. Common school education required. One year course. Entrance at any time. Diploma granted.

Automotive Electrotechnics—A course on starting, lighting, ignition, storage batteries and farm lighting plants. No special educational requirements. Three months full time.

Extension — Division — Home study courses that include Practical Electricity with home laboratories; Drafting and Automotive Electricity. If interested, ask for the "Short Cut" booklet.

Only Electricity Taught

Instruction here is more thorough. You learn more in a shorter time at less expense because non-essentials are eliminated. Largest faculty of any similar institution. Experts PERSONALLY instruct and direct you.

A Place for Every Student

Whatever your age, your past education or present ability, there is a proper starting place for you here. The chief requirement is ambition to succeed. We will place you where you belong and advance you as rapidly as your work and willingness permit.

Earn While You Learn

In addition you may be employed part time and study at school part time. Thus you may obtain actual technical experience and the salary earned helps pay your way through school.

Join for the New Term

Enroll now. Prepare to make your dreams of a big electrical future come true. Get the full particulars about this great, long-established school and learn about the many SUCCESS possibilities in store for you here.

Mail the Coupon Today

SCHOOL of ENGINEERING of Milwaukee

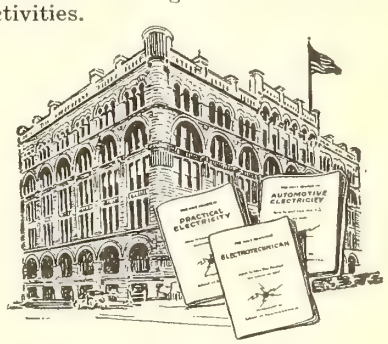
"Leading Electrical School of America"

Established 1905

MILWAUKEE, WIS.

2,300 Students

in 1920 from 46 States and 22 foreign countries attended class in our big electrical school. Healthful and helpful environments, pleasant surroundings — Fraternity house — Sports — Athletics—boating and other student activities.



Send Coupon for Interesting Illustrated Books

SCHOOL OF ENGINEERING
Dept. SI3—Milwaukee, Wis.

Please send illustrated book and information on:

Course.....

Name.....

Address.....

Town.....State.....

Age.....

Education.....

Don't Waste Your Electrical Ability—Develop it for your Success



On the Basis of Facts

The life of our country is built around its Public Utilities. Our social, industrial and Government activities could not exist today without the continued operation of their indispensable services.

That such services may be extended and developed to be of the greatest use to the greatest number, the Federal Government and practically all the states have appointed Public Service Commissioners as permanent tribunals to regulate public utilities with fairness to all concerned.

Facts as to the past and studies as to the future, the Bell Companies find are essential to the proper management and development of their business. This information is open to study by these Commissioners and through them by the public generally.

The solution of the problem of building up and maintaining the public utilities, which is of the greatest importance to the people of this country, is assured whenever all the facts are known and given their due weight.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

And all directed toward Better Service

JUNIORPHONE

A THERMO TELEPHONE
WITH
COMPLETE TALKING AND SIGNALLING SYSTEM

A PRACTICAL SCIENTIFIC TELEPHONE OPERATING ON A NEW PRINCIPLE.
EASILY ASSEMBLED FOR INSTANT USE
CAN NOT BE EQUALLED AS A DISTINCTIVE, INSTRUCTIVE AND INTERESTING NOVELTY.
APPEALS TO ALL UP-TO-THE-MINUTE YOUNGSTERS AS WELL AS TO THE GROWN UPS.

MANUFACTURED BY
AMERICAN THERMOPHONE COMPANY

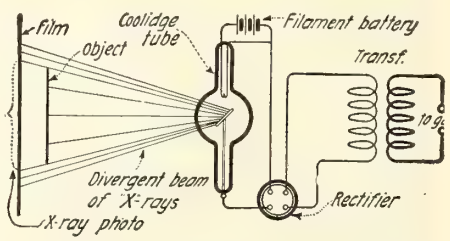
114-116 BEDFORD ST. BOSTON, MASS.

X-Ray Movies--Why Not?

By PROF. HAROLD F. RICHARDS, PH. D.

(*Continued from page* 1178)

angular skeletons make ardent love to each other. Dorothy and Percy are in the midst of their great moment. The scene is the porch of a country house in the summer time. It might as well be winter for all the X-ray will reveal of the setting. The two stars are seated in a hammock, which is invisible, so that apparently the skeletons are resting easily on air. Their jaw bones move grotesquely up and down as they exchange sweet nothings. The small-boned figure bears numeral "1" on its arm, produced by a piece of lead which has been fastened to the arm during the filming of the scene, but even without the number we have come to recognize the favorite star by the excessively slender ulna of her right arm and the peculiar three-pronged hairpins which stand out distinctly above her shapely skull. Percy wears the numeral "2," but his enlarged hip-joints, monogrammed belt buckle and



The Ordinary Type of X-Ray Tube Spreads Out the Energy in a Divergent Beam and Cannot Produce the Sharply Focused, Reduced Photographs Required for X-Ray Movies.

heavily crowned wisdom tooth suffice to reveal his identity to the seasoned theatregoer. The jaw-wagging quickens—the situation is becoming more tense. Percy's right humerus and ulna creep stealthily around the twelfth rib of the slender-boned Dorothy. She struggles, and we see her ribs contract as the bony arm tightens its hold. Now she lays a submissive skull upon the clavicle of her lover. His ribs heave up and down as he realizes that the object of his adoration is his at last. The shadow in the left side of his chest fluctuates rapidly and we know at once that his pulse has quickened With gentle claws of bone Percy grasps Dorothy's delicate skull, deliberately raises it until her empty eye-sockets are on a level with his own, then suddenly draws it to his jaw. Teeth rest against teeth as the ardent kiss lingers its sweet length. A small skeleton on bicycle rides up, a monkey wrench and screwdriver bouncing merrily around in the tool bag. The loving couple spring guiltily to feet, the ball and socket joints at their hips moving smoothly. The rider dismounts, fingers with a bony hand at the left of his sternum, and extends something towards Percy. The latter accepts the offering and thrusts his fingers towards the front of his right hip. We see coins moving about as he feels for a dime. The messenger departs, while Dorothy and Percy appear to be reading. Apparently the news is good, for they dance a few joyous steps on the porch. We note with a pang of regret that Percy's tarsus has fallen so low that he has flat feet.

(*Continued on page* 1226)

LEARN WIRELESS AT HOME

The Demand for Good Wireless Operators Far Exceeds the Supply

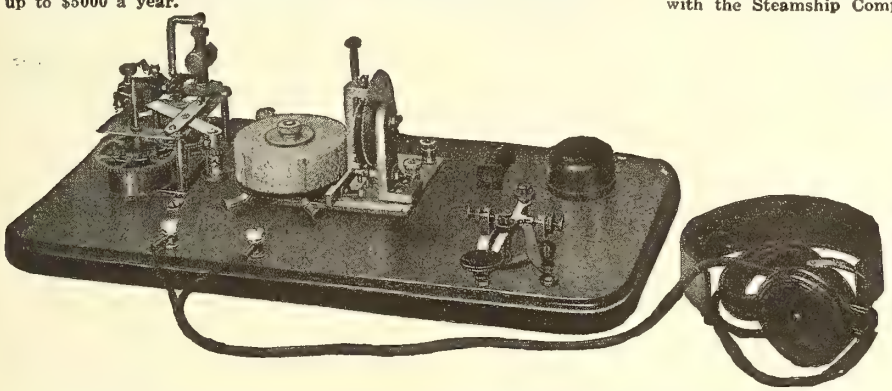
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, formerly Chief Radio Inspector, Bureau of Navigation, N. Y. He resigned last August to accept a position of still greater responsibility with one of the largest Commercial Radio Corporations in the United States. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course.

FREE Instruments and Text Books

We furnish free to all students, during the Course, *the wonderful receiving and sending set exactly as shown in the illustration.* **This set is not loaned, but *given* to all students completing the Course. One cell of dry battery all that is required. No additional wiring, aerials, etc., needed.**

The Transmitter shown is the celebrated **Omnigraph** used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the **Omnigraph**, place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the **Omnigraph**—the same model **Omnigraph** as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

Wireless Telephony Course

We have incorporated in our Institute an up-to-date and complete Course in Wireless Telephony, written by our Chief Instructor, Mr. L. R. Krumm. **This Course is also furnished free.**

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in New York City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

The Department of Commerce of the U. S. Government

recognizing the value of the instruction furnished by us, allows all of our graduates a five-point credit in their examination for first-grade license.

THE U. S. SHIPPING BOARD will also testify as to the value of this instruction.

America's Fastest Growing Wireless Institute

There Must Be a Good Reason. There Is—

The Best Course in Theory available.

The Best Instruments obtainable.

The Best Text Books and Diagrams on the market.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—but do it today.

NEW YORK WIRELESS INSTITUTE,

Dept. 201, 258 Broadway New York City

New York Wireless Institute
Dept. 201, 258 Broadway, N. Y. City.

Send me, free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your Free Instrument offer.

Name .....

Address .....

City or Town.....State.....

AGENTS---SALESMEN
SALES MANAGERS
EXCLUSIVE TERRITORY ON NEW INVENTION

Will you listen when opportunity knocks? Fortunes have been made in new automobile inventions. **Grab this one quick.** Your minutes are like dollars—**don't waste them now. Read—investigate—then act.** The Speederator for Ford cars is a new invention that **makes any Ford run like a Packard.** Stops **stalling, bucking and motor racing.** Gives a smoothness to Ford driving that is wonderful. And just think—**Speederator** is put on **without boring holes** or special tools of any kind. Any Ford driver can put one on complete in **twenty minutes.** Never wears out—never needs attention—**operates automatically. Sells like lightning.** Old Ford drivers say best and only necessary Ford part. **Get full information.**

The Greatest Ford Invention



Ford Owners Buying Everywhere

LISTEN This is not a ready-made fortune, but it is the **opportunity to secure** the **exclusive sales agency** for this new invention. **Don't take our** word—get the proofs. Just be honest with yourself and **investigate. Let the money you make talk** from now on. Smashing records of success will show the way; **Helton, Utah,** sold six hundred in five weeks—**profit $1,800.00. Crist, N. Y.,** sold 23 first day—said would have sold more if he had had them—now averages more than 400 a month—**profit $1,200.00. McAllister, Ills.,** says sold four first afternoon. He is now using 100 a week. These straight-from-the-shoulder facts point the way. **Hoover** down in **Ohio** sold 29 one day, **profit $87.00. Benke, Mo.,** averages 200 a month. **Campbell, Tenn.,** 1000 a month. **Crandall, Iowa,** put on thirty sub-agents in one week. **Dryden, Calif.,** sold 150 in ten days. **Grace, Hawaiian Islands,** 200 in two weeks. **Teeters, Mich.,** first three dozen in ten days. We say you can make

$55.00 TO $300.00 WEEKLY

selling the Speederator. Best article to advertise itself you ever saw. Once on a car the driver will never let you take it off. Sales are made fast and furious. Boyer, Penna., made $72 first day. Cook, N. Dak., 150 sold first two weeks. Cahan, Ariz., 72 in two weeks—$216.00 clear. Join the ranks of successful men in this work.

NO EXPERIENCE NECESSARY

Just show us that you mean business and are ready for business and we will show you how. But first, make us prove these facts. We have nothing to apologize for. **The Speederator is a grand success**—you can make money fast if you have the territory—so get busy now. Write today for the necessary information and see for yourself. Don't delay—**plenty of good territory left**—if you are a hustler you can have money in the bank in a few weeks. **Just write—now—to**

THE PERRIN METAL PARTS CO.
1089 HAYWOOD BUILDING
DETROIT, MICH.

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.
Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. Guaranteed by the maker. Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness. Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.
EASTERN NOVELTY CO., DEPT. 67. 172 E. 93d STREET, NEW YORK.

$2.98



6 YEAR GUARANTEE

SAMPLE WATCH FREE
Genuine full standard size railroad style watch with locomotive on dial and locomotive handsomely engraved on back. Full nickel plated case, extra dust proof, Arabic numerals on dial, heavy R. R. style figures. Genuine American make, stem wind and set, fully **GUARANTEED for 5 YEARS.** To advertise our business and introduce this wonderful watch and our great catalogue of Elgin, Waltham and Hampden watches we will send this elegant watch to any address by mail postpaid for **ONLY $2.98** and if you sell two of these watches we will give you **ONE SAMPLE WATCH FREE** for your trouble. Send this advertisement with $2.98 and watch will be sent by mail postpaid, or send $5.96 for two and we will send **ONE EXTRA WATCH FREE.** Order today as this offer may not appear again. Address **CHALMERS WATCH CO., 638 So. Dearborn St., CHICAGO, ILL.**

X-Ray Movies--Why Not?

(*Continued from page* 1224)

The X-Ray "Villain" Approaches

Another skeleton advances stealthily from behind a tree. He is number "3," Hubert, the villain. His bony claws tighten about the vertebræ that connect Percy's head with his shoulders. Dorothy's tiny fingers clutch wildly at her skull while the two men clinch. We watch the conflict with breathless interest, for we see plainly the revolver inside Hubert's pocket. He draws the pistol and fires. Percy stretches his bones upon the earth. Hubert lifts Dorothy to the back of a huge, four-footed skeleton, which must be a horse, and they dash off. We look thru the gaps between their ribs and see trees flitting past!

How the Ordinary "Movie" Works

Before describing a possible mechanism for the production of X-ray movies I must direct attention for a moment to the requirements for ordinary movies obtained with the camera. As everyone now knows, the movement seen on the screen is simply an optical illusion produced by the rapid sequence of a number of still photos. Suppose that one second is required for the actor to draw a gun. The operator, in turning the crank of the camera, alternately closes and opens the diafram at such a rate that approximately sixteen exposures are made per second. In other words, sixteen instantaneous snapshots are made of the actor's arm while it is in the act of drawing the revolver. If these pictures are then flashed upon the screen at the same rate and in the same order as taken the effect upon the observer will be one of continuous motion, for the abrupt changes of position which would be observed if the snap-shots were thrown separately upon the screen at greater intervals of time are imperceptible when the succession takes place so rapidly. A similar phenomenon is obtained with sound. If successive sound impulses are sufficiently far apart in time the effect upon the observer will be that of a succession of noises, whereas if the impulses follow each other with sufficient rapidity the separate impulses will not be detected but the effect may be that of a musical tone. The rapid succession of "stills" is, then, the first requirement for motion picture photography.

The Elements of X-Ray Movies

Ordinary movies are produced by light which is *reflected from* the objects portrayed. An X-ray photograph, however, is due to the action of rays which have been *transmitted thru* the object depicted. When X-rays pass thru a material body they are absorbed by an amount dependent upon the density and thickness of the matter traversed, and the shadows upon the film simply reveal this absorption. Thus when X-rays penetrate the human body they are more nearly absorbed, *i. e.*, destroyed, by the dense bones than by the lighter flesh, so that the outlines of the bones are clearly shown upon the film. Obviously the requirement for X-ray movies is a means of focusing X-rays thru a wide aperture in sufficient strength to produce sixteen instantaneous snapshots per second.

We shall have two distinct classes of difficulties to overcome if X-ray movies are to be realized. These may be re-

ferred to as difficulties of *focus* and difficulties of *energy*. With the aid of Figure 1 the meaning of these terms can be made clear. The diagram represents the usual Coolidge X-ray tube, which consists of a hot cathode and a tungsten target inside a highly evacuated glass tube. The high voltage drives the electrons from the heated filament to the target with such a velocity that they produce X-rays when they strike. The X-rays are electromagnetic waves in the ether of the same nature as visible light but of much shorter wave-length. These rays are given off from only a small spot in the ordinary tube, so that we may consider them as *diverging* from a point. It is apparent that so long as we have only divergent beams of X-rays there will be no hope of obtaining satisfactory movies, for the smallest photograph that can be made is at least as large as the object, and is even larger when the object is not placed next to the photographic plate. It is readily seen that the size of the image formed on the film will depend upon the distances of both the tube and the object from the film. It is impossible to regulate the size and definition of the images by use of a lens in focusing, for *no substance has ever been found to refract X-rays.* The ordinary type of X-ray tube would have to be placed very far from the actors in order to produce sharply defined and not greatly enlarged photographs of them. In this case the amount of energy sent thru the actors in the form of X-rays would be so small, due to the divergence of the beam, that exposures of long duration would be required for even a single photograph. The highest powered apparatus now available enables us to obtain an X-ray photo of a man's hip-bone with an exposure of three-quarters of a second when the hip rests on the plate and the tube is two feet distant. If the hip were farther away from the film, say six feet, it would be necessary to place the tube at a distance of thirty-six feet in order to produce an image of the same size as before (assuming the mean thickness of the hip to be eight inches). The distance of the tube has been increased eighteen times and the X-ray energy passing through the hip *decreased* by 324 times, since the energy falls off as the square of the distance. In this case a five-minute exposure would be necessary, and even then the picture would be very much blurred. Under such conditions there would be no hope of obtaining movies.

Apparatus for Making X-Ray Movie Dramas

Without going farther into the theory of the matter, I shall call attention at once to the large wash drawing where there is diagrammed a possible disposition of apparatus to obviate the difficulties of energy and focus described above. The small diagram represents a cross-section thru the whole set-up. The X-rays may be produced by a single tube—an enormous one, perhaps thirty feet in diameter. Special reinforcements would be necessary to prevent the collapse of the glass walls when the tube is evacuated. [A metal bulb might be used, fitted with a glass window. Ed.] The target consists of a segment of a huge paraboloid of tungsten or other metal capable of emitting rays of the necessary penetrating power. The hot filament to supply electrons consists of a great network of electrically heated wires placed before the target. X-rays will be given off in all directions and will *diverge* from the target. However, it would be more feasible, perhaps, to employ a "bank" of standard X-ray tubes as shown in the wash drawing reproduced herewith.

Learn Mechanical Drawing



Are you earning less than $35 a week? Can you reasonably expect your present position to pay you $35 to $100 a week in the near future? If not, this offer will interest you. We offer to qualify you for a profession which, at the very start, pays higher salaries than the average man receives. We offer you the best personal service obtainable. We offer you personal instruction in mechanical drawing and teach you expert Draftsmanship in your spare time, at your home, by mail, in the same practical way that you would learn it in any big Drafting department. We offer to qualify you for one of the many high-salaried positions in the Drafting field, and to keep you in touch with openings for Draftsman in big machine shops, industrial plants, manufacturing concerns and United States Government Departments. We guarantee to start you on real Drafting work at once qualifying you as a thoroughly trained professional Draftsman, capable of succeeding from the very start. We offer to do all of this at a low cost for such service and in a comparatively short time.

I personally stand back of the Columbia School of Drafting—founded, directed and owned by myself—and guarantee the training given by it to be absolutely as represented. The work of each one of our students has my personal supervision. We seek "Quality" students rather than "quantity," as our proposition is of the highest character in every respect.

Roy C. Claflin
President

Become a Chief Draftsman

You cannot make a mistake by taking up mechanical drawing. The field is not crowded, nor can it be. No single profession today offers better opportunities. The great need for trained Draftsmen continues to increase. Each step forward in mechanical development creates a need for more trained Draftsmen. Promotion in this field is sure and certain. Men who start as Draftsmen are often advanced to Chief Draftsmen, Chief Engineer, Production Manager or other high-salaried positions. There is a constant demand for our graduates. We cannot supply them rapidly enough. Many of them are accepted even before they complete their training. This unusual demand for "Columbia Trained Men" is explained by the fact that our students enter upon actual drawing work the day they receive their first lesson. They spend no time with unnecessary preparation or useless theory.

One of the Finest and Best Equipped Institutions in America Teaches You Mechanical Drawing at Your Home

This is the mechanical age in world history. The day of big opportunities for technically trained men is here. Especially is this true in the case of Draftsmen, on whom the mechanical industries of America and the entire world depend. On no one profession does the continued development of machinery so nearly center. With the training which we can give you at your home, your services will always be in demand, at a premium, in this permanent, highly paid field.

Drawing Instruments Furnished

We supply our students with complete drawing equipment. A professional outfit is furnished, together with a highest grade set of Drafting instruments for your permanent use.

No Previous Training Necessary

As our students are put into actual practice at the beginning, they grasp the essentials of drawing quickly. The lessons supplied are thorough, clear and easily understood even by those who have had no previous technical training of any kind. No previous experience or special education is necessary.

Return the Coupon Today

It Brings to You a Valuable Book of Information FREE. Your future depends upon what you do now. We cannot begin to tell you here, in so few words, of the advantages afforded you by this unusually practical course in up-to-date mechanical drawing. If you are in earnest and desire to learn a big-paying profession, we urge you to act now by returning the following coupon. We will immediately send you our valuable book free. "Your Future in Drafting," which tells of our new method of teaching mechanical drawing and outlines our offer to you fully.

COLUMBIA SCHOOL of DRAFTING
Roy C. Claflin, *President*
Dept. 1367, 14th and T Streets
WASHINGTON, D. C.

FREE COUPON—RETURN TODAY

COLUMBIA SCHOOL of DRAFTING
Dept. 1367, 14th and T Sts., WASHINGTON, D. C.

Without obligation to me, please send me your illustrated book on Drafting, telling how I can secure your complete home study course (with which is furnished the professional set of drawing instruments and equipment), and your help in securing a position as Draftsman.

Name.....

Address.....

City.....State.....

STRENGTH
IS BUILT BY THE PROPER EXERCISE







Get it from Your Light Socket

Exercise the Body Cells—Build Strength Without Fatigue or Strain

Use the modern electric treatment in the privacy of your own home—Science's greatest boon to the weak and suffering. Thousands of volts of electricity but no shocks or pain—just wonderful benefits and as pleasant as a ray of sunshine. Harmless yet powerful in effects. Fills your body with new vitality and vigor. Imparts new "pep". Relieves aches and pains and restores normal conditions. Affords a stimulating cellular massage with the benefits of Physical Culture (except bi-ceps building). Improves circulation—releases purifying ozone into the blood streams—Imparting *Health—Strength—Beauty.*

Used at Home for:—
Rheumatism
Neuritis
Lumbago
Chest Pains
Catarrah
Headache
Ear Diseases
Hardening of Arteries
Wrinkles
Skin Diseases
Falling Hair
Etc., Etc.

Renulife VIOLET RAY

Learn how electricity from your light socket is transformed into this wonderful health giving agency, so soothing, effective and perfectly safe. 25,000 Renulife Generators in use, with most remarkable record of results. You should know what it can do for you. Write for full information.

Send for Book

Explaining in detail the marvelous Renulife high frequency Violet Ray.

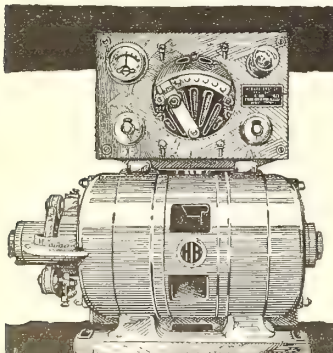


Renulife Electric Co.
DETROIT, MICH.
1203 Marquette Building

In Canada, Netting Bldg., Windsor, Ont.

Exclusive Sales Distributors Wanted

CASH PROFITS!!



$150 to $300 CASH PROFITS EVERY MONTH

Garage men everywhere are making big money charging batteries. Cars now being overhauled for coming season. An HB Battery Charger can easily be your biggest money-maker. No electrical knowledge needed to install or operate. No repairs, no expensive renewals, nothing to wear out or break. Thousands in use making big, steady profits for garages and service stations. Sizes to recharge 10, 16, 32 or 70 batteries at once. Choose size you need, then write us for information. Small cash payment, almost a year to pay balance on easy terms. Money-back guarantee. Write today.

HOBART BROTHERS CO., Box 37E, Troy, Ohio

Small Cash Payment Brings You any HB Charger—Balance Easy Terms



AGENTS 500% PROFIT

Gold and Silver Sign Letters

For store fronts, office windows and glass signs of all kinds. No experience necessary. Anyone can put them on and make money right from the start.

$75 to $200 a Week!

You can sell to near-by trade or travel all over the country. There is a big demand for window lettering in every town. Send for free samples and particulars.

Liberal Offer to General Agents

METALLIC LETTER CO.
433Y No. Clark St. CHICAGO, ILL.

We require, however, a *converging* beam focused on the opening of the X-ray camera. For this purpose I have devised what I venture to call an "X-ray lens," which consists of a thick shield of lead honeycombed with very narrow slits whose directions converge upon the opening of the camera. Any rays not traveling in the direction of the slits will be absorbed by the thick lead, and those rays that do emerge will be *focused* in a *converging* beam upon the diafram of the camera. The moving film travels automatically past the opening, which is alternately closed and opened by a diafram of lead so as to produce sixteen instantaneous exposures per second. The actors perform their parts in the space as diagrammed. A large transformer, or perhaps several transformers in parallel, will be necessary to supply the enormous amount of high-voltage electricity required to send the electronic current from the filament to the target and thus excite the X-rays. From the present knowledge of X-ray tubes it is impossible to state what power of current would be necessary to enable a tube of this design to emit the energy requisite to produce instantaneous photographs through the human body at such a distance. *The first development of X-ray movies will probably be accomplished by the use of large batteries of the X-ray tubes now made,* but there seems no doubt that higher powered tubes can be developed. X-ray photographs produced by the method outlined above could be developed, transferred to celluloid films and projected in the customary manner.

It is interesting to observe that the actors would be obliged to exercise care never to get behind one another, for in that case the skeletons of the two would be merged into one blurred image. The result would be analogous to that of a double exposure with the ordinary camera. Furthermore, it would be advisable for the actors to wear lead-glass goggles over their eyes and thin rubber shields about the pelvic regions, since these parts of the human body are most susceptible to the harmful effect of X-rays. In no case would the performers be able to act longer than a few minutes a day without harm to themselves, so that a considerable length of time would be required to produce a complete play.

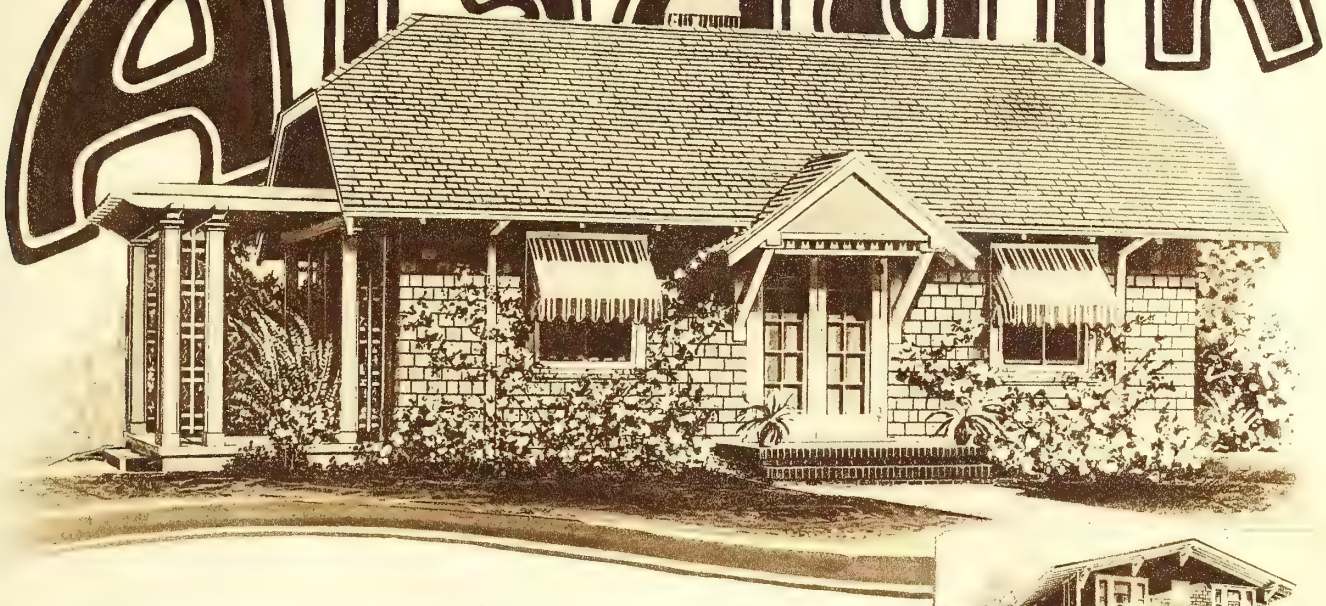
In conclusion I must insist that my suggestion of this plan as a possible means of producing X-ray movies is only a tentative one at the present time. I feel, however, that there are no difficulties entailed which cannot be surmounted by research along the lines suggested, and I believe that moving picture companies might make the experiment with favorable outlook for profit. The possibilities for trick effects of a highly amusing nature seem unlimited, and weird results could be obtained by inserting a few feet of X-ray movies in the "legitimate" ones now made with light.

WOMAN FINDS NEW STAR

Another new star has been discovered at the Harvard Astronomical Observatory. The Nova is in the constellation Sagittarius, and was at its maximum brightness on Aug. 11 and 12, 1914, being then of the eighth magnitude, and since then has declined in brilliancy.

Miss Woods of the observatory staff detected the star, the position of which is given as right ascension 17 hours 59 minutes 44 seconds, declination minus 31 degrees 44.9 minutes (190). The discovery is the fortieth of its kind in the history of astronomy and the twenty-second in the records of the Harvard Observatory.

Aladdin





Building Cost Cut $576.00

What Mr. Proulx Did—You Can Do. Read His Letter, It Is Interesting

Frank Proulx, 324 West Elm St., Chippewa Falls, Wis., writes: "The Aladdin idea is the right idea in house building; it is one of the most money-saving propositions of today. I saved $576 net. Can you beat that anywhere in the building line? I had no waste lumber, no mistakes, if you follow the blue prints furnished free of charge by the Aladdin Company.

"The lumber was A-No. 1 in every respect and all complete to the last nail, hardware, windows, sash, cord, window weights, paint, varnish, valley tin, ridge cap, etc.—everything came and even had some over. Aladdin saves you a big percentage of cost. If I was to build a house again, it would be an Alladin Home, because the Company is right and the houses are all right."



National Homebuilding Service

Aladdin Homes are manufactured and shipped direct from the Aladdin Company's own Mills in Michigan, Mississippi, North Carolina and Oregon. Wherever you live, Aladdin Homes come to you in a straight line from the nearest timber region.

Aladdin's National Homebuilding Service means shorter routes, quicker delivery, and lower freight rates for builders in every part of the United States. Three days to a week are saved in shipments reaching destination.

Complete Sales and Business offices are maintained in connection with each mill.

Price Includes All Materials

The Aladdin Book of Homes has a message for you. Amongst its pages, profusely illustrated in colors, leading home designs are represented.

Aladdin Homes are cut to fit as follows:

Lumber, millwork, flooring, outside and inside finish, doors, windows, shingles, lath and plaster, hardware, locks, nails, paint, varnishes. The material is shipped to you in a sealed box-car, complete. Send today for a copy of the book, "Aladdin Homes." It gives complete information on the Aladdin Dollar-a-Knot guarantee which assures you of highest quality of material. Ask for book No. 109.



30 Per Cent Saved on Labor—18 Per Cent Saved on Lumber

Fifteen years' success of the Aladdin System of construction have firmly established its many advantages. THE LUMBER THAT'S WASTED COSTS JUST AS MUCH AS THE LUMBER THAT'S USED. The only possible way to reduce high prices of lumber and labor is to save usual waste. The Aladdin System prepares all the lumber in our mills ready to be nailed in place. Cost of lumber is reduced 18 per cent. Cost of labor is reduced 30 per cent. One man will do in seven days, with Aladdin Materials, what it requires ten days to accomplish without Aladdin's System. Send for the book—"ALADDIN HOMES" No. 109.

THE ALADDIN CO.

Bay City, Mich.

Branches: Wilmington, N. C. Portland, Ore. Hattiesburg, Miss. Toronto, Ont., Can.





THE ALADDIN CO.

Enclosed find stamps for the book, "Aladdin Homes" No. 109.

Name .....

City .....

Street .....

State .....

CIRCULATION LARGER THAN ALL OTHER RADIO JOURNALS COMBINED

FOR SALE AT ALL NEWS STANDS

ARTISTIC TWO COLOR COVER



"THE 100% WIRELESS MAGAZINE"

VERY SPECIAL

FOR A SHORT TIME

Science and Invention

AND

RADIO NEWS

BOTH FOR

$3.95 USE COUPON

Save $1.05

What "Radio News" Is:

RADIO NEWS now in its second year holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO NEWS leads all other wireless magazines. The January issue had 80 pages; there were seventy-nine separate purely radio articles and 130 illustrations. *Over forty-four thousand copies were printed and circulated.*

Each issue of RADIO NEWS contains 80 pages (or more) and an artistic cover in two colors. The illustrations average 130 every month and there are from 60 to 80 up-to-date articles, some by our greatest radio scientists, in every issue.

REGULAR DEPARTMENTS:

Latest Radio Achievements.
General Radio News.
Radio Telephony.
"Radio Constructor."
Radio Stories.
"Radio Digest."
"Club Gossip."
"With the Amateurs."
"Junior Section."
"Junior Constructor."
"I-Want-to-Know."
"Correspondence from Readers."
"Dictionary of Radio Terms."

80 PAGES
130 ILLUSTRATIONS

20c The Copy
$2.00 A Year
Canada and Foreign **$2.50** A Year

SEND 10c FOR SAMPLE COPY TODAY

EXPERIMENTER PUB. CO., 231 Fulton St., New York City

SPECIAL OFFER

Gentlemen:

Please enter my subscription for both "RADIO NEWS" and "SCIENCE AND INVENTION" for the term of one year for which I enclose herewith $3.95. (Add $1. for postage if for foreign country.) I have written my name and address in margin below.

Enjoy Wonderful Sparkling Health

Through Magic-Like VIOLET RAYS *In Your Own Home*

FEEL the thrill of the bounding vitality of youth! Increase your store of energy, revitalize your worn out cells, make every fibre of your body tingle with a new vim and vigor! All this you can have through the magic of Vi-Rex Violet Rays right in your own home!

Violet Rays penetrate to every cell in the body, imparting that stimulating vigor which brings the glow of health, tones up the entire system, putting life into over-taxed and sluggish tissues. As a quick relief from pain Vi-Rex has no equal. Its soothing rays quickly find the source of distress and afford speedy comfort. Headaches, nervousness, skin blemishes and many other complaints vanish as if by magic through this marvelous treatment. You will be amazed at the splendid, quick results through the use of this wonderful new Vi-Rex Violet Ray Machine—right in your own home!



For building health and strength there is nothing like Vi-Rex. For chest and bronchial affections it is invaluable

TRY VI-REX RAYS FREE

You don't have to take any risk in giving Vi-Rex Violet Rays a trial. Take 20 treatments in your own home. Use this marvelous machine for ten days. If you do not find quick relief—if you do not feel better, sleep better, **look** better, send it back and you will not be out one penny. This special offer may be withdrawn at any time, so act quickly!



The Violet Ray is especially effective for inducing a clear and healthy skin, free from blemishes and sallowness

Use Vi-Rex Violet Rays for



Asthma
Boils
Blackheads
Catarrh
Colds
Corns
Eczema
Falling Hair
Hay Fever
Headache
Insomnia
Lumbago
Sore Throat
Nervousness
Neuralgia
Paralysis
Pimples
Rheumatism
Skin-diseases

We Have Just Published a Remarkable Book for Your Benefit

This book explains in detail the manifold uses of Violet Rays in treating almost every known human ailment. This book also contains charts and diagrams of the nervous system and organic locations and fully describes just how the Violet Ray works its many seeming miracles, written in a simple style—devoid of all technical language.



Send for This Book at Once

Mail Coupon for FREE BOOK

Find out how Violet Rays will help you. Read what hundreds of users say about the Vi-Rex and astonishing results which have been obtained. Learn why it is the most economical and practical machine of its kind available. You may use it to gain health, vitality, beauty! There is no limit to its beneficial powers. Mail the Coupon or send a postal. Do it now.

A Copy Is Reserved for You—Send for It

VI-REX ELECTRIC CO.
326 W. Madison St. Dept. 42 Chicago, Ill.

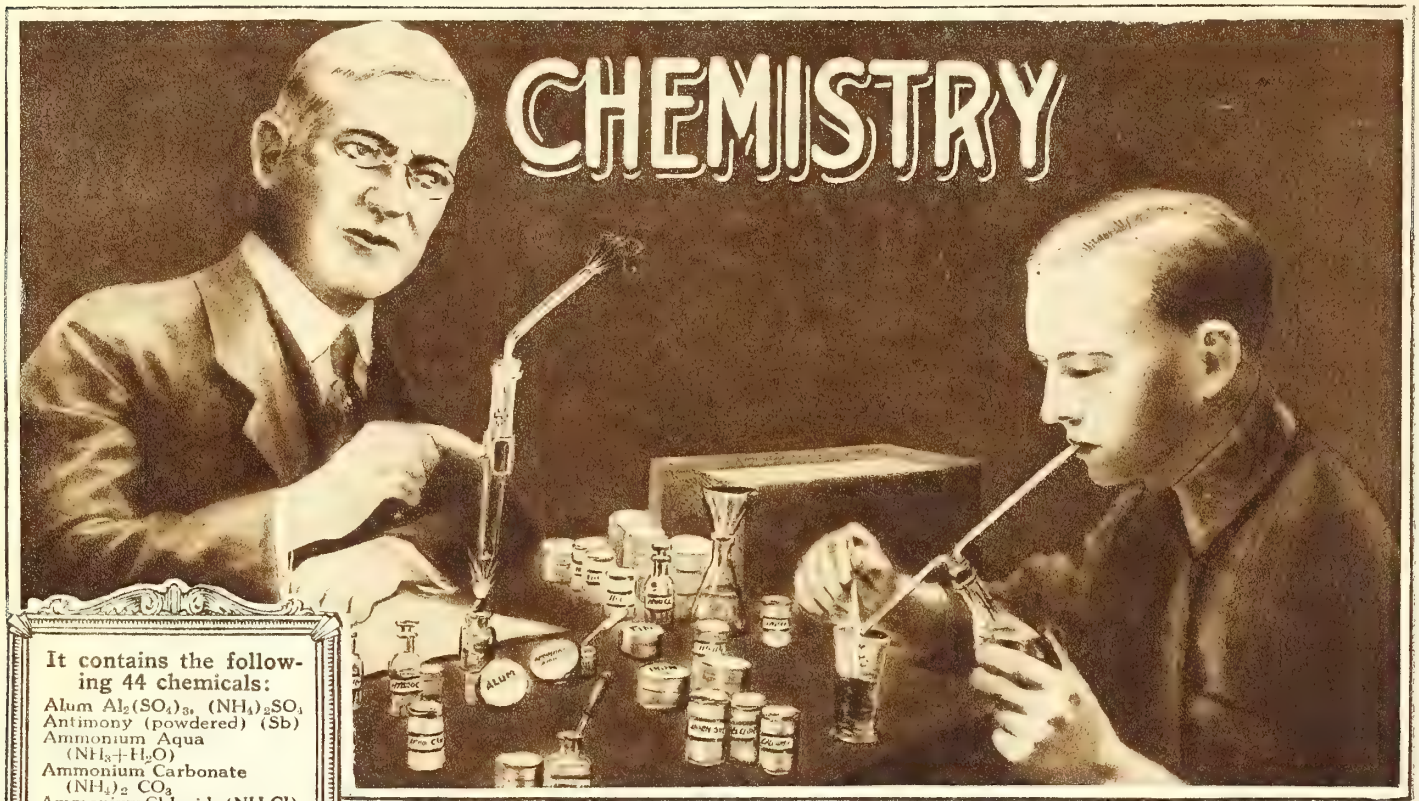
VI-REX ELECTRIC CO. **Dept. 42**
326 W. Madison St. **Chicago, Ill.**

Please send me without cost or obligation your free book describing your wonderful Violet Ray Machine.

Name .....

Address .....

City ..... State .....



"The Joy of Father and Boy."

Chemical Laboratory

We present herewith to our friends our new **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform **real** chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

DESCRIPTION OF THE OUTFIT

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each. See list of Chemicals herewith.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. A list of the 17 pieces of apparata furnished with this outfit is printed also herewith.

The Instruction Book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid: Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English system and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the **100 Experiments** are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make chemical colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

The Price is $6.75 **Shipping Weight 10 lbs.** **(Can be shipped by Express only)**

It contains the following 44 chemicals:

Alum $Al_2(SO_4)_3$, $(NH_4)_2SO_4$
Antimony (powdered) (Sb)
Ammonium Aqua (NH_3+H_2O)
Ammonium Carbonate $(NH_4)_2CO_3$
Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2SO_4$
Barium Chloride ($BaCl_2$)
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride ($CaCl_2$)
Calcium Oxide (CaO)
Calcium Sulphate ($CaSO_4 2H_2O$)
Charcoal (Carbon) (C)
Chloride of Zinc ($ZnCl_2$)
Copper Sulphate ($CuSO_4$)
Ferrous Sulphate ($FeSO_4$)
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride ($FeCl_2$)
Iron Oxide (Fe_2O_3)
Lead Acetate Pb $(C_2H_3O_2)_2$
Litmus Paper
Magnesium Carbonate ($MgCO_3$)
Manganese Dioxide (MnO_2)
Mercury (Quicksilver) (Hg)
Nickel Chloride ($NiCl_2$)
Oxalic Acid ($H_2C_2O_4$)
Sodium Bicarbonate ($NaHCO_3$)
Sodium Borate ($NaBO_2$)
Sodium Carbonate (Na_2CO_3)
Sodium Chloride (NaCl)
Sodium Nitrate ($NaNO_3$)
Sodium Phosphate (Na_2HPO_4)
Sodium Sulphate (Na_2SO_4)
Sodium Sulphite (Na_2SO_3)
Stannous Chloride ($SnCl_2$)
Sulphate of Nickel ($NiSO_4$)
Sulphate of Zinc ($ZnSO_4$)
Sulphuric Acid (H_2SO_4)
Tin (Granulated) (Sn)
Zinc (Metal) (Zn)
Zinc Carbonate ($ZnCO_3$)

The following apparata are furnished:

One Standard Washbottle
One Alcohol Lamp
One Conical Glass Measure
One Erlenmeyer Flask
One Glass Funnel
One Delivery Tube
Six Assorted Test-Tubes
One Test-Tube Holder
Ten Sheets of Filter Paper
One Glass Dropper
One Spoon Measure
Glass Tubing
One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.

THE ELECTRO IMPORTING CO., Mfrs.

TRADE MARK **231 FULTON STREET, NEW YORK CITY** TRADE MARK

"THE LIVEST CATALOG IN AMERICA"

Our big new electrical cyclopedia No. 23 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 80 Big Pages, 300 illustrations, 200 instruments and apparatus, etc. Big **"Treatise on Wireless Telegraphy."** 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 23 measures 6x9. Weight ½ lb. Beautiful stiff covers.

ELECTRO IMPORTING CO.
231 Fulton Street, New York City

I enclose herewith 10 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 23 as described.

NAME .....
ADDRESS .....
STATE .....S. & I. 3-21

The Devil's Understudy

By CHARLES S. WOLFE

(*Continued from page* 1188)

The telephone bell jingles just then, and the Chief leans his ear against the receiver and grunts. We hears someone yappin' on the other end of the line, and then the Old Man slams her back on the hook and glares at us. "Six more," he says, coldly, and poor Bill Lawrence groans.

I ventures to horn in. "Poisoned needle, maybe, eh?" I says, and the Chief looks thoughtful. "Maybe—yes," he says slowly, lighting a cigar. "Yeh, Marten, most likely you said it. That would leave only a small pin prick and wouldn't show up until the doctor gave the bodies a careful goin' over. Come on, you two, I want to look into this thing myself."

So the three of us whizzes down in the Old Man's Lizzie into the financial district where all this slaughter is goin' on.

Everything's on its neck when we gets down there. The people is standing around in mobs, everybody lookin' scared and ready to run. The boys on the corners is havin' the time of their young lives tryin' to keep cars from comin' together, as scared chauffeurs makes desperate attempts to get worse scared big guys away from there. Things looks just right for anything to happen.

The Chief runs the Lizzie into the curb alongside of the nearest hitching post. Habit he can't get out of since he sold his horse and buggy. We all jumps out, and just as we hits the sidewalk a portly old guy keels right over at our feet.

The Chief rips out an oath and blows his whistle as the crowd surges in. I pulls my gat and uses it as a club and Lawrence does likewise. Between us we keep the Old Man from being trampled to death until two harness bulls comes up and takes over. Then we kneels with the Chief and looks the unlucky old codger over.

All three of us has had considerable experience in these matters, and it only takes a minute for us to see that he's been gathered to his fathers, sure enough. But the funny part of it is, that we can't see no trace of what took him off. No bruises, wounds or anything. And you simply can't croak a guy without doing something to him.

A couple of more "flat-feet" is on hand by this time, and the Chief sends for the wagon. "Want the Doc to go over this stiff with a fine-tooth comb," he says to us briefly; all three of us keepin' right on lookin' for some clue as to how the deadly work is being got away with.

There's some commotion in the crowd, and I looks up to see a guy elbowing his way thru the mob as if he meant it. After a minute I make him. One of our gang, Frank Nelson. I nudges the Chief, and he beckons Nelson to join us. "Just the bird I want now," he says to me under his breath.

Nelson was the only "high-brow" in our outfit. College man, he was. One of them unlucky lads what's fitted for better things, but just can't seem to get their hooks on 'em. When Frank got out of college he made about a dozen starts and drew just that many blanks. Finally he's down to the point where he can take his choice between the "force" and "going to work." Some influential friend takes pity on him, pulls a few strings, and he lands in our midst—a full-fledged plain clothes man. Wasn't long before the Chief was right glad to have him hanging around. He wasn't nothing extra for

Quick Success in Electricity!

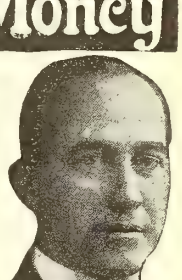


Amazing Opportunities in the ELECTRICAL INDUSTRY

Get Ready to Make Big Money

THOUSANDS OF ELECTRICAL EXPERTS NEEDED

Electricity is King. No other industry in the world offers the wonderful chances for big money and quick success that the Electrical Industry offers to ambitious men today. Trained Electrical Experts are needed to fill big paying jobs. This is truly the electrical age—electricity is rapidly taking the place of steam and hand power. Thomas A. Edison says Electricity is still in its infancy. So get into it now. Those who get in now are the ones who will cash in big.



A. W. WICKS
Elec. Engineer
My extensive electrical experience has been gained with such important industrial concerns as General Electric Company, Jenney Electric Co., Fairbanks, Morse & Company, also as Advisory Engineer for such mammoth companies as Corn Products Co., Quaker Oats Co. and the Corporation Steel Plants.

To $150.00 a Week—and MORE

Go as high as you like. No limit to salaries in Electricity. In the Electrical Industry it is not a question of pay, it's a question of trained men—electrical experts are needed to fill big jobs as Power Plant Superintendent, Chief Electrician, Sub-station Operator, Electrical Inspector and hundreds of other positions.

Electrical Contractors also make big money. There is also big money in conducting Electrical Stores.

F R E E

Here are some things I give and do for my students Absolutely Free.

1. **Complete and Valuable Electrical Tools. Instruments and Equipment.**
2. **Monthly Bulletin of interesting facts and news of what's doing in Electricity.**
3. **Practical Training in Electrical Draftsmanship and Blue Print Reading.**
4. **Prepay charges on everything I send you.**
5. **An indispensable Electrical Dictionary.**
6. **Full benefits of my Employment Service.**
7. **Complete supply of Examination Paper, Envelopes and Stationery.**

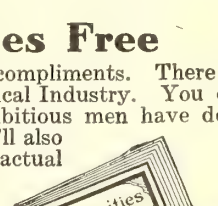
Space does not permit me to detail the scores of other things I do for my students Absolutely Free.

Learn at Home—I Teach You Myself

I am an authorized Electrical Engineer. Every student is under my personal instruction, assisted by an Advisory Staff of prominent Engineers and Electrical Manufacturers. The Wicks Electrical Institute is known nationally as the largest and foremost school giving home training in Electricity, and its policies and methods are highly endorsed by the Electrical Industry. Its system of instruction is positively "Best by Test", for its graduates make good.

Big Book of Opportunities Free

Let me send you this big book of Opportunities with my compliments. There is no obligation. Find out for yourself what is doing in the Electrical Industry. You owe it to yourself to investigate. This book shows what other ambitious men have done in this field and what you can do. With this wonderful book, I'll also send you complete outline of my method of instruction and actual letters from my students and graduates testifying to what my training has done for them.



Save $43.00 Tuition Now

Send Coupon Today—Don't Delay

Those writing now will save $43.00. This offer is special and is made for a limited time. So mail coupon at once. This is the most unusual offer ever made to ambitious men. So hurry.

A. W. Wicks, E. E., Pres.
WICKS ELECTRICAL INSTITUTE
3601 Michigan Avenue, Dept. 7443, Chicago, Ill.

FREE COUPON

A. W. Wicks, E. E., Pres., WICKS ELECTRICAL INSTITUTE
Dept. 7443 3601 Michigan Ave., Chicago

Without any obligation send me your Big New Book, "Opportunities in the Electrical Field" and full particulars regarding your method of training.

Name.....

Address.....

City..... State.....



$100 WEEK AND MORE FOR YOU!

TIRE SURGERY—the NEW and BETTER tire repair method is making men RICH! Chas. Evans, carpenter, past 50, now MAKING $100.00 a week in shop shown here. Gibbard of Mich., age 62, learned TIRE SURGERY, has shop in small town, writes: "Cash receipts for May, June and July, 1920, $30,000.00."

HAYWOOD'S **TIRE SURGERY**

is easy to learn. I will teach you in two weeks. Within thirty days you're started on road to fortune. Car owners EVERYWHERE demand this NEW repair method, as it DOUBLES life of Tires. 28 million tires wearing down DAILY. ONE THOUSAND MORE Tire Surgery shops needed badly. ANY MAN can succeed QUICKLY. It's a SHORT, EASY step into automobile industry—the field that has made men rich. It put $6,000.00 in bank for John W. Blair, Ohio, in 12 months; got $8,000.00 for Fleming, of New Zealand, within 1 year; and has done same for hundreds of others. There's money in this business for YOU. Investigate! Get details. Send coupon at once for the FREE book.



WRITE

Mr. Haywood, Pres., Haywood Tire & Equipment Co.
1261 Capitol Ave., Indianapolis, Ind.
Dear Sir: Send full details of Tire Surgery, as I want to get into big paying business quickly.

Name_____

Address_____

6000 MILES GUARANTEED



Inner Tube Free

Here is the limit in tire bargains. 6000 miles—or more—from our special reconstructed double tread standard tires, and a practically puncture proof, standard make inner tube FREE with a purchase of one of our standard make double tread tires.

We Risk All—You Nothing
Your satisfaction guaranteed.

See the Saving

Inner Tube FREE

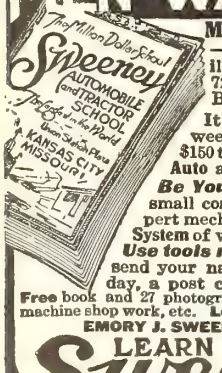
SIZE	PRICE	SIZE	PRICE
30x3	$6.45	34x4	$10.95
30x3½	7.75	34x4½	12.75
32x3½	8.95	35x4½	12.95
31x4	9.95	36x4½	13.25
32x4	10.25	35x5	13.95
33x4	10.65	37x5	14.25

Free Reliner With Each Tire

Write Today! Send $2.00 deposit for each tire ordered. Balance C. O. D., subject to examination. 6% discount allowed if cash is sent with order. Specify whether straight side, clincher, non-skid or plain is wanted when sending in orders for these tires.

SUPERIOR TIRE & RUBBER CO.
79 East 31st St. Dept. 85 Chicago, Ill.

MEN WANTED



Mechanically Inclined—to send for my big illustrated 72-PAGE BOOK—**FREE!**

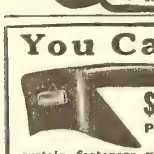
It tells how in a few weeks you can earn from $150 to $400 a month in the Auto and Tractor business.

Be Your Own Boss. At small cost learn to be an expert mechanic by the Sweeney System of working on real cars. ***Use tools not books.*** Simply send your name and address today, a post card will do, for our Free book and 27 photographic reproductions of machine shop work, etc. **Let's Go---Write Now!**

EMORY J. SWEENEY, President

LEARN A TRADE—Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
138 SWEENEY BLDG. KANSAS CITY, MO.

You Can Save $50.00



$7.65 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

going into a downtown saloon and picking out the particular dip he wanted, which is our everyday work, but whenever an odd case came up, he generally was there with both feet. He had a stock of odd and end knowledge that would take you off your feet, and the Old Man used him as a kind of a human cyclopedia.

Well, Nelson joins our family group and looks over the body. Finally he straightens up and gazes down on the corpse admiringly. "Excellent!" he beams at us. "I've seen so much killing of various sorts since I got into this business that I fancy myself as a conoosier. Now this is one splendid example of the art. Here we have a perfect specimen. The chap that did this certainly knows his business, and I can heartily recommend him to any one in need of such service as a thoro, all-around man."

The Chief frowns. "Can the small talk, Frank," he growls. "Got any idea how this fellow was bumped off?"

Nelson shook his head. "Not the slightest," he said, "except the conviction that some entirely unknown weapon is being used."

The Old Man jerked his thumb at me. "Marten has an idea it's a poison needle stunt."

"Marten's wrong," replied Nelson, decidedly. "I'm just from the morgue, where the department doctors are working on some of the others. There isn't a pin prick nor scratch on any of them. But it's murder, all right, for in the clothes of practically all of them we are finding notes warning them that they are marked for death, and counciling prayer and repentance. Some kind of a Red, judging from the tone of the notes."

"Well," the Old Man fairly bit out his words, "whatever he is, or whatever he's usin' don't make any difference in what we gotta do. We gotta get this gink, and we gotta get him quick. At his present rate he'll wipe out the town in a week. You don't know when he'll take it into his head to start on us, and if he does that you'll all wish you had used your brains a bit more. Scatter—dig into it! Here comes the wagon. Mix into this crowd and see what you can do."

Nelson grabbed me by the arm and drew me along with him. We got out of the jam, and Nelson pilots me into the back room of a nearby saloon. Over a couple of glasses of the nearest beer they had he opens up.

"Now then, Marten," he says, "I've been on the jump since the first guy got his, and I got a idea of how maybe this is bein' done. But I ain't got a ghost of an idea of who is doin' it. The only way that I can see we got a chance of finding that out is to lay a trap for the fiend. And traps are always baited. Now I know you got lots of nerve. Are you game to be the piece of cheese?"

"Tip me a little more," I says, cautious-like. "The idea of bein' a target for whatever this guy's workin' ain't none too pleasant to contemplate. What's your idea?"

"Do you know Simonds, the big broker?"

I nodded.

"Well, he's on the list. Got a note, like the rest of 'em. I just left him before I joined you fellows. He's over in his office, scared to come out. Don't blame him much at that. You're about his build, and with a little alteration of your jib, some nice alfalfa like he wears, and so forth, I think we could ring you on this chap for the genuine article. We'll go over to his office, make you up; you come out on the street, me trailin' you, and see if I can get him."



Keep It 10 Days Free
Wear a LIZNITE GEM RING and be the envy of your friends. See if you can tell it from a high priced diamond. Send your Name, Address and Number of Ring you select, and one of these wonderful LIZNITE GEM RINGS, with all the fire and sparkle of the finest diamond will be sent you by return mail.

Solid Gold Mountings
And all rings are hand engraved, set with full carat weight LIZNITE GEM.

Select the one you like best:
No. 1—$21.50 2—$17.50 3—$15.50
No. 4— 15.50 5— 12.50

Size must be included when ordering. When your LIZNITE GEM RING comes, pay the mail man $4.50, balance $3.00 monthly until paid. Money back any time within 10 days if not perfectly satisfied.

Get a Liznite Gem Ring Today

THE LIZNITE GEM COMPANY
"The House of Quality and Price"
Dept. 325—128 N. Wells St., Chicago, Ill.

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $600 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



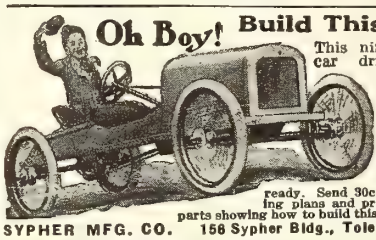
Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2202 Fourth St. Waupun, Wisconsin

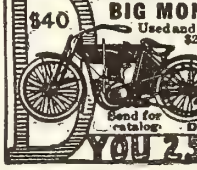
Oh Boy! Build This Car



This nifty little car driven by gasoline motor can be built by any boy. New 1921 plans, bigger, better than ever, now ready. Send 30c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO. 158 Sypher Bldg., Toledo, Ohio

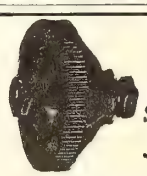
$40 ENINGER WILL SAVE BIG MONEY SAVINGS FOR YOU



Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog. Doninger Cycle Co., Rochester, N.Y.

YOU 25 TO 50 DOLLARS



J. Skinderviken.
TRADE MARK
Skinderviken Transmitter Button
U. S. and Foreign Patents
J. SKINDERVIKEN
Inventor and Sole Manufacturer
$1.00 154 W. Randolph St. Chicago, Ill.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER LONGMONT, COLO.



250 MAGIC TRICKS
with cards, coins, handkerchief, egg, ring, glass, etc. Simplified and illustrated so that a child can perform them. To introduce catalogues of tricks and entertaining books.

Price 25c. UNITED SALES CO. Springfield, Illinois

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**

"That'll be nice," I remarked. "And when the wagon's carted this bloomin' assassin away, you'll turn to the flat-feet and say: 'Now, boys, one of you shin around to Marten's widow and break it to her gently.'"

"Chances of that are about fifty-fifty," says Nelson promptly. "If my guess is right, you won't run much real risk. If I'm wrong, there'll be a strange copper in hell sudden. Are you on?"

Well, it's all in the day's work, you know. I shrugs my shoulders. "Lead on, Macbeth," I says, grimly. "I'll be the goat."

Nelson's already on his feet. "Outside," he orders. "Let's get going before you change your mind."

Well, we beats it around to headquarters and picks up a bit of make-up. While I'm gettin' my things together, Nelson blows out to do a little shopping and blows in again with a bundle. Off we go to Simonds' office.

We find Simonds in a funk. Scared stiff. We explain our idea, and he peels out of his duds. I study his phiz, and imitate it with Nelson's help. Finally Frank is satisfied.

"Now strip, son," is the next order, and I peels to the buff. Then Nelson unwraps his bundle and I see it's thin rubber sheeting. "Best I could do, old boy," says Nelson, as he wraps it around my carcass, fastening it as best he can. "No time to get you a suit of this stuff made."

"What's the idea?" I complains, for the stuff don't feel none too comfortable.

"It's your life preserver," says Frank, grimly. "Don't kick on it. It's the fifty chances that I said were with you."

Well, it's his party, so I dresses in Simonds' duds over my rubber wrappings, and out into the street I go to invite some boob to kill me. Out of the corner of my eyes I see Nelson loppin' along in the rear.

After a half hour of nothing happening, I kind of forgets the darned case. Got interested in readin' a big sign. And the first thing I know there's a commotion behind me.

I wheels, and there is Nelson wrestling a big old bird with bushy whiskers, who is hanging on for dear life to a black leather satchel. The crowd is already gatherin' in, so I double quicks into the melee. The next few minutes ain't quite so clear. That boy put up one terrific scrap, and we both had our hands full. I tried a couple of times to bore him, but I couldn't get a chance without shootin' right thru Nelson. But finally I gets the butt end of my gat against his dome and down he comes. Pantin', Frank slips on the wristlets, and up charges the harness bulls. "Wagon," orders Frank, and we keep a half hitch on the old boy till it gets there.

We drives around to the station, and the Old Man has a coniption fit when he sees what we got in the cart. The rest the world knows.

Our man turns out to be Professor Gleason, and the doctors find out he's warped from the Adam's apple up. And, brother, when we frisked that lad he had machinery strewed all over his clothes, including his satchel, which contained the "power plant."

He wouldn't give us a tip as to what it was all about, and somehow Nelson never could get the darned thing to work, altho he fust over it for months. I ain't sure, and neither is anybody else, just exactly how he done it. Nelson says he is sure, but I got my doubts.

Anyway, here's how Frank figures her. Maybe you know more about fancy "juice" work than I do. Most of it's over my head.

WHAT IS AN INTERNAL BATH?

By R. W. BEAL

MUCH has been said and volumes have been written describing at length the many kinds of baths civilized man has indulged in from time to time. Every possible resource of the human mind has been brought into play to fashion new methods of bathing, but, strange as it may seem, the most important as well as the most beneficial of all baths, the "Internal Bath," has been given little thought. The reason for this is probably due to the fact that few people seem to realize the tremendous part that internal bathing plays in the acquiring and maintaining of health.

If you were to ask a dozen people to define an internal bath you would have as many different definitions, and the probability is that not one of them would be correct. To avoid any misconception as to what constitutes an internal bath, let it be said that a hot water enema is no more an internal bath than a bill of fare is a dinner.

If it were possible and agreeable to take the great mass of thinking people to witness an average post-mortem the sights they would see and the things they would learn would prove of such lasting benefit and impress them so profoundly that further argument in favor of internal bathing would be unnecessary to convince them.

Few people realize what a very little thing is necessary sometimes to improve their physical condition. Also they have almost no conception of how a little carelessness, indifference or neglect can be the fundamental cause of the most virulent disease. For instance, that universal disorder from which almost all humanity is suffering, known as "constipation," "auto-intoxication," "auto-infection," and a multitude of other terms, is not only curable but preventable through the consistent practice of internal bathing.

How many people realize that normal functioning of the bowels and a clean intestinal tract make it impossible to become sick? "Man of today is only fifty per cent. efficient." Reduced to simple English this means that most men are trying to do a man's portion of work on half a man's power. This applies equally to women.

How many can you name, including yourself, who are physically vigorous, healthy and strong? The number is appallingly small.

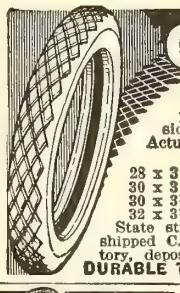
It is not a complex matter to keep in condition, but it takes a little time, and in these strenuous days people have time to do everything else necessary for the attainment of happiness, but the most essential thing of all, that of giving their bodies proper care.

Would you believe that five to ten minutes devoted to systematic internal bathing can make you healthy and maintain your physical efficiency indefinitely?

If you would keep your blood pure, your heart normal, your eyes clear, your complexion clean, your mind keen, your blood pressure normal, your nerves relaxed and be able to enjoy the vigor of youth in your declining years, practice internal bathing and begin today.

Now that your attention has been called to the importance of internal bathing, you will probably want to know WHAT an internal bath is, WHY people should take them, and the WAY to take them. These and countless other questions are all answered in a booklet entitled "THE WHAT, THE WHY and THE WAY OF INTERNAL BATHING," written by Dr. Chas. A. Tyrrell, the inventor of the "J. B. L. Cascade," whose lifelong study and research along this line have made him the preeminent authority on this subject Not only did internal bathing save and prolong Dr. Tyrrell's own life, but the lives of a multitude of hopeless individuals have been equally spared and prolonged. No book has ever been written containing such a vast amount of practical information to the business man, the worker, and the housewife; all that is necessary to secure this book is to write to Tyrrell's Hygienic Institute at No. 134 West Sixty-fifth Street, New York City, and mention having read this article in SCIENCE AND INVENTION and same will be immediately mailed to you free of all cost or obligation.

"Procrastination is the thief of time." A thief is one who steals something. Don't allow procrastination to cheat you out of your opportunity to get this valuable information, which is free for the asking. If you would be natural, be healthy. It is unnatural to be sick. Why be unnatural, when it is such a simple thing to be well? (*Advertisement.*)



CORD TYPE TIRES

An Honest Serviceable 8000-Mile Tire—This casing is not sewed, patched or retreaded but is rebuilt throughout of new material. Reinforced side walls and a Standard Non-skid tread of new live rubber. same as cut. Actually guaranteed for 5000 miles against defects in materials and workmanship.

A High Grade Tube Free With Each Tire Ordered

28 x 3 .. $ 7.15	31 x 4 .. $10.80	32 x 4½ .. $12.40	36 x 4½ .. $14.85
30 x 3 .. 7.85	32 x 4 .. 11.15	33 x 4½ .. 12.95	35 x 5 .. 15.35
30 x 3½ .. 8.95	33 x 4 .. 11.60	34 x 4½ .. 13.60	37 x 5 .. 15.45
32 x 3½ .. 9.55	34 x 4 .. 11.95	35 x 4½ .. 13.85	

State straight side or clincher. Send $2.00 deposit with your order. Tire will be shipped C. O. D. with section left unwrapped for examination. If tire is not satisfactory, deposit will be returned. 5 per cent discount if full amount is sent with order.

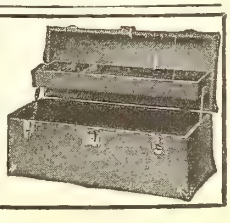
DURABLE TIRE AND RUBBER CO. 2817-J Wabash Ave., Chicago, Ill.



Ask for free Catalog

UNION TOOL CHESTS

Ask for free Catalog



Protect your tools from rust, knocks, bangs and theft in absolutely the best tool chests made for Machinists, Toolmakers, Carpenters, Auto Mechanics, Electricians and Household use.

Write for prices and "Satisfaction-or-money-back" guarantee.

Union Tool Chest Co., Inc. 36 Mill St., Rochester, N.Y.

6000 Miles Guaranteed
Less Than 1/2 Price

SEND NO MONEY

Don't miss this chance to cut your tire cost in half. Our standard make Rebuilt Tires in excellent condition selected by our experts are guaranteed for 6,000 miles or more. We ship at once on approval. Don't send any money. Just your name brings tires. **NOTE.** These are not two tires sewed together.



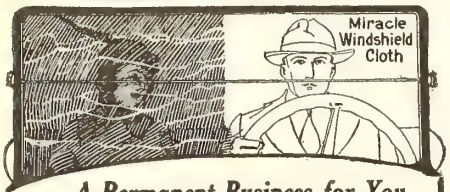
Prices Smashed

Size	Tires	Tubes	Size	Tires	Tubes
28x3	$ 6.25	$1.55	34x4	$ 8.75	$2.60
30x3	6.40	1.60	33x4½	9.50	2.80
30x3½	6.50	1.75	34x4½	10.00	3.00
32x3½	7.00	2.00	35x4½	11.00	3.15
31x4	8.00	2.25	36x4½	11.50	3.40
32x4	8.25	2.40	36x5	12.50	3.50
33x4	8.50	2.50	37x5	12.75	3.75

SEND NOW!

Just your name and size of tires wanted. No money in advance. Pay only on arrival. Examine and judge for yourself. If not satisfied return them at our expense and your money refunded.

MITCHELL TIRE & RUBBER CO.
109 East 39th Street Dept. 427 Chicago, Ill.



A Permanent Business for You

Step into this permanent, profitable, year 'round business—10 million auto and truck drivers, motormen need, want Miracle Windshield Cloths. Keeps rain, steam, snow, sleet, frost off windshield, both sides. Just rub Miracle Cloth on shield—the miraculous chemical causes moisture to run off, leaves glass clear. One wiping lasts through any storm. Provides safety to passengers and pedestrians.

MADE $123.35 IN ONE DAY

Others are coining money with Miracle Windshield Cloth. E. S. Earle, Ohio, writes: "I have made as high as $123.35 in a single day. Consider it poor day when I made less than $20 profit." You may do even better. Write today for proposition or, better still, send Dollar Bill for Two Miracle Cloths (One Free), telling us exclusive territory you want. ACT NOW.

MIRACLE MFG. CO., 1063 Miracle Bldg., Toledo, O.

From factory to you FREE



Easiest riding, most comfortable wheel built. We'll ship it to you on approval. You'll want it sure when you see the 18 exclusive features of the splendid 1921 model electrically equipped

BLACK BEAUTY

Big color-illustrated catalog shows large variety of styles—describes features fully. Choose the wheel and we'll ship express prepaid on approval without cost. A small deposit and A DOLLAR A WEEK makes it yours. Our direct factory price saves you money—a saving you cannot afford to overlook.

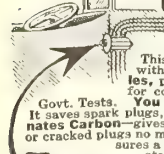
5 year guaranty and 6 months' accident insurance with every wheel. Send now for big color-illustrated catalog—it's **FREE!**

Haverford Cycle Company
Established 25 years
Dept. 623 Philadelphia, Pa.
Be a Black Beauty Owner Agent

THE ALSOP-ALL-SPARK

BEST BY GOVERNMENT TESTS

This simple little device does away with **Spark Plug and Carbon Troubles,** pays its owner big dividends. Ask for copy of report showing severe U. S. Govt. Tests. **You Cannot Afford to Be Without It.** It saves spark plugs, gasoline battery and starter—**Eliminates Carbon**—gives your car greater power—will fire old or cracked plugs no matter how full of oil or grease. Insures a hot spark. Prevents misfires. Makes starting easy. Send your order today and put an end to your engine troubles. Cost complete, with Money-Back Guarantee, **$7.50**



ALL-SPARK IGNITION CO.
Mail Order Dept.
13 Water St., N.Y. City

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. **Guarantee Bond for 8000 Miles.** (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write today.

MELLINGER TIRE & RUBBER CO.
901 Oak St. Kansas City, Mo.

Nelson says Gleason managed to electrocute his victims with juice from a few ordinary dry batteries. What? Yeh, I didn't think it could be done myself, but Nelson says it was a cinch.

There was two jiggers in the satchel that Nelson called the ray generators. They had lenses fitted on them. Frank says they brought the rays to a focus. Seems that there's some light that you can't see at all—ultra or infra something or other. Well, it is doped out that this old bird found one that would carry a current just as good as a chunk of copper wire does.

Nelson says he thinks the professor must have got a altogether new one, altho he says that there is at least one that's known to be a pretty good juice carrier.

Now the real big idea was this. These bloomin' rays of light penetrated like the X-rays do. Right under the hide they went. And along went the current, too.

Nelson says that once you get under the skin, which has great resistance, an awful weak current means a quick trip over the Big Divide. Forget now, but he did say. Let's see. Ain't sure, but it runs in my mind that it was seventy-five milli-amperes across the heart, or something like that. Don't know, but the doctors seemed to think that would do it.

All the old gink needed was a little outfit to make these rays and a few dry cells. He just bored you with two beams of them like any circuit, and turned on the juice.

Seems Nelson guest it was something like that and wound me up in rubber, hoping that that would be a insulator for the thing. *I know it was.*

And a little tip, brother. Gleason ain't the only bird that knows about light rays bein' conductors and all that. Get yourself some rubber underwear made. I got mine on right now.

Interesting Chemical Experiments

By O. IVAN LEE

(*Continued from page* 1206)

short a gas-pipe, or too little cooling water may cause the same result.

A more or less milky mixture of oil and water will drip from the end of the pipe, but in a short time you will see a clear pale yellow oil sink to the bottom in a layer underneath the water in the receiving vessel.

Continue the distillation as long as any oil drops seem to be coming over, changing the receiver, if necessary. Of course, there will be much more water than oil, but from three ounces of cloves almost half an ounce of oil should be obtained. With a little care, the water can be drawn off or decanted from the heavier oil. The oil of cloves remaining may then be freed of any water still mixed with it, by passing it thru a little cone of dry white absorbent paper into a small vial. To make this filtering cone, simply cut out a three-inch-wide circle of the paper, fold it across the middle and crease the semi-circle into quarters, opening one fold.

Naturally, the essential oil of cloves is about six times as strong as the clove itself, representing as it does, the very *essence* of the spice. Bearing this in mind, it may be used for the same purposes and, in fact, it is really much superior.

"Type It Anywhere—Yourself"



The FOX
(7 pound)
Portable Typewriter

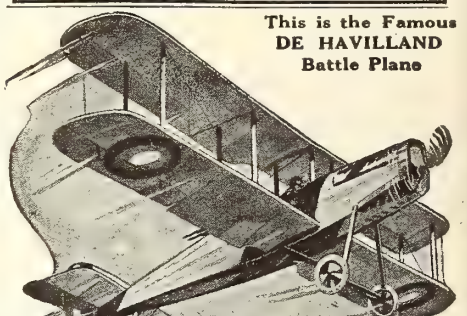
Speed, ease of operation, durability, and portability, are inherent qualities of the "Baby Fox" Portable.

Take it with you wherever you go—on the train, in your home, anywhere—it is always at your service for better letters, more easily written — more easily read.

SWIFT—EFFICIENT—DURABLE

Send for a Catalogue
FOX TYPEWRITER CO.
634-666 Front Ave., Grand Rapids, Mich.

This is the Famous DE HAVILLAND Battle Plane



Build and Fly Your Own
Model Aeroplane!

Any bright boy can build an IDEAL Model of a real Aeroplane and learn lots about big machines. It will fly in the air under its own power.

Complete Parts to construct an IDEAL 3-ft. Scale Model of the DE HAVILLAND Battle Plane shown here, including Building and Flying Instructions.....**$8.50**

Ask Your Dealer or Order Direct

Plans and Instructions *only*, with catalogue of Parts needed, postpaid.....25c.
Catalogue alone, listing many other types of Model Aeroplanes, postpaid.....5c.

IDEAL AIRPLANE & SUPPLY COMPANY
Making Model Aeroplanes Continuously for 10 years
159-161 Wooster St., Cor. West Houston St., N. Y.

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

A few hours interesting work saves over half and gives you a machine to suit your ideas. We furnish motors, tone arms, case material, blue prints and full instructions Plays any record. Make fine profit building phonographs for your friends.

Write today for our Blue print offer. **FREE**

AGENTS wanted for Choraleon King Phonographs

SAVE OVER HALF



Choraleon Phonograph Co.
321 3rd St., Elkhart, Ind.

***Why continue to* STAMMER?**

Send for (free) illustrated 200-page book. It tells how Stammering and Stuttering can be quickly cured by the most **Advanced Scientific Method** in the world. THE LEWIS SCHOOL, **40** Adelaide, Detroit, Mich.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page* 1201)

solution any impurities that may be present tend to remain in the solvent. Because of this fact the purification of many substances becomes a comparatively simple matter. In the chemical industries, too, such processes are carried out on a very large scale. The Chili saltpeter beds, long the world's sole supply of nitrogen compounds for the manufacture of nitric acid, explosives and fertilizers, contain sodium nitrate mixed with rock and other foreign matter. To purify the salt, the ore is crushed, leached with water and then filter-pressed to remove the insoluble matter and obtain a clear solution. A considerable portion of the liquid solvent is evaporated and the remaining solution allowed to cool. This results in the separation of the saltpeter, i.e., sodium nitrate, in the form of crystals and leaves in the remaining liquid portion, called the "mother liquor," the impurities. One of these so-called impurities is a very valuable by-product, sodium iodate, from which is obtained a large part of the world's supply of iodine. The potash salts of Strassfurt, Germany, so valuable for fertilizers and chemical industries are

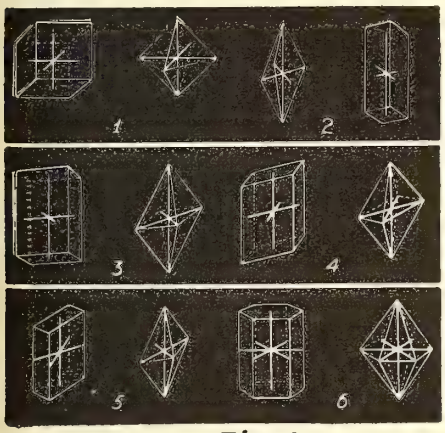


Fig. 1

The Six Systems of Crystals.

purified in a similar manner. And so, too, is the cream of tartar used in baking powders and obtained from the crude argol that crystallizes on the insides of wine casks.

In these processes of purification it is desirable to obtain as small crystals as possible and this condition is brought about by stirring the mixture thoroughly while the crystals are forming. If the crystals are large they will enclose small quantities of mother liquor. Where a very high-grade of purity is desired it is often necessary to recrystallize the product by dissolving in a small quantity of water, evaporating and cooling. After the crystals are formed they should be filtered from the mother liquor and washed with a small quantity of the pure solvent.

The purity of a crystal substance may often be tested by the determination of its melting point. Every crystal substance has a definite melting point, which is changed by the presence of any impurity. Therefore, to test the purity of a substance determine its melting point and compare it with the value obtained from a table of physical constants.

Preparation of Alum: In each of two beakers or other containers place 500 cc. of water. In one beaker dissolve 87 grams of potassium sulphate and in the other 171 grams of non-crystalline aluminum sulphate, using heat in each case if neces-

40 Years of Progress with Fine Tools

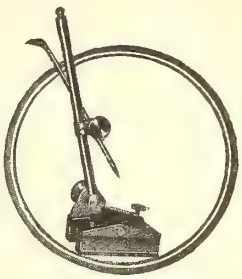
in 1880—

—when engines had balloon stacks, Starrett Tools were making a reputation for unvarying accuracy and fine workmanship.

For forty years Starrett Tools have been helping mechanics to work out the ideas that designers have put on paper.

Machinists in the big locomotive shops know the value of tools they can always depend on for the exact measurements required in their work. That's the reason why so many of them, for years, have been using Starrett Tools.

If you're interested in fine tools write for a copy of Catalog No. 22 "L.E."

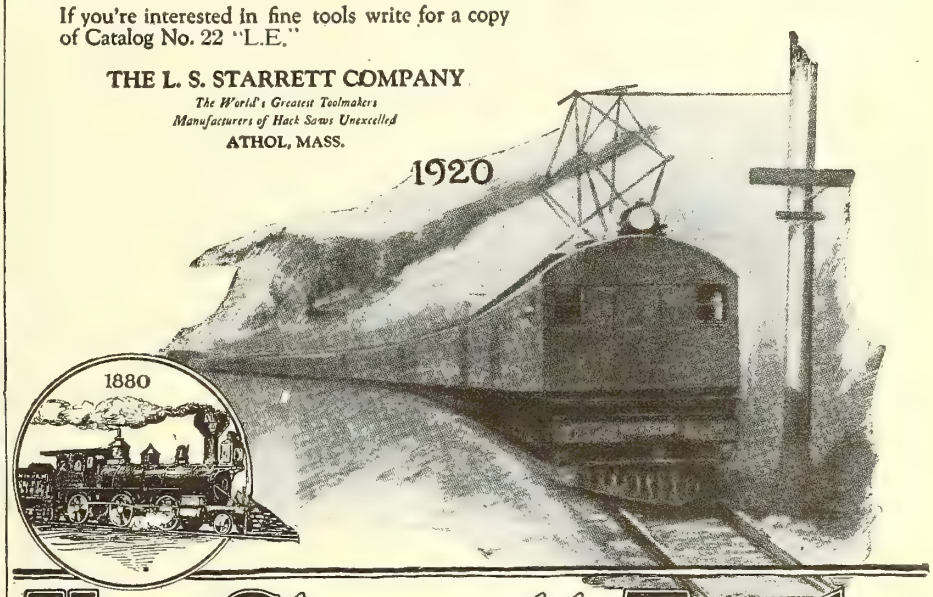


THE L. S. STARRETT COMPANY

The World's Greatest Toolmakers

Manufacturers of Hack Saws Unexcelled

ATHOL, MASS.



Use Starrett Tools

42-110



Free Trial

YOU may have any instrument with complete musical outfit, for a week's free trial at home. No obligation. Return it at our expense after trial if you wish. Outfit includes velvet lined case, self instructor, music and all accessories at factory cost. A tremendous saving.

Convenient Monthly Payments

A few cents a day will pay for instrument and outfit if you decide to keep it. Wurlitzer instruments are known all over the world for artistic quality.

Send Coupon for Beautiful New Catalog

Every instrument known illustrated with price, easy terms and free trial blank. Catalog absolutely free. No obligation. Send this coupon now.

The Rudolph Wurlitzer Co., Dept. 1253
117 E. 4th St., Cincinnati, O.—329 S. Wabash Ave., Chicago
120 W. 42nd St., New York, N. Y.

Send me your new catalog illustrated in color with full details of Wurlitzer Complete Outfits and free trial and easy payment offer.

Name _____

Address _____

(State instrument you are especially interested in.)

Trade Mark Registered

WURLITZER

200 YEARS OF MUSICAL INSTRUMENT MAKING

Copyright 1920 Rudolph Wurlitzer Co.



Don't Marry Until You Read These Private Lessons On SEX FORCE

To anyone contemplating marriage, the great value of these wonderful lessons on Sex Force can not be overestimated. Sex Force is the most vital power of attraction. When properly understood and controlled, as these lessons clearly teach, it makes men noble, virile and attractive; women beautiful, sweet and lovable, and paves the way for happy marriages.

These private lessons, now for the first time published in book form, impart **sex secrets** that every man and woman should know. It is the only work published that breaks down the criminal silence concerning Sex—that rises above hypocracy and divests the subject of all uncleanliness.

Priceless Truths You Should Know

Chapters covering Preparations for Entering Wedlock; Important Problems of the newly married; Duties of Husband and Wife; Secrets of Sex-Anatomy; Sex Physiology and Psychology; Sex Control; Sex Morality; Evolution of Marriage; Fall and Rise of Woman; Mistakes of the Bride groom; Unusual Theories of Sex-Life; Standards of Sex-Morality; and hundreds of special subjects that every young man, young woman, young husbands and wives, fathers, mothers and teachers should know.

Special Now for a short time only, these remarkable private lessons will be sent to any address **prepaid** for only $1.60. Endorsed by highest authorities—educators, clergymen, doctors. Order today. Your money refunded if you are not more than satisfied.

FREE Send at once for large folder giving full description and table of contents.

But to **be sure** of securing your copy of **Private Lessons**—send your remittances of $1.60 **now**—TODAY.

UNITED SALES CO. Dept. 160 Springfield, Ill.

YOU Can Do YOUR Own SOLDERING and All Metal Repairing With

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR



25c PER TUBE

A Paste That Turns Into Metal When Heated

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. E,
129 Sussex Avenue, Newark, N. J.

Dealers Send for Quantity Prices.
LOOK FOR TRADE MARK "SOLDERALL"
BEWARE OF IMITATIONS WITH SIMILAR NAMES

AGENTS: $8 a Day



Selling concentrated, non-alcoholic food flavors. Always fresh. Put up in collapsible tubes. Ten times the strength of bottled flavors. Guaranteed under U. S. pure food laws. All flavors. Sells in every home. Used every day. Not sold in stores. Big demand. Big repeater. 100% profit.

MEN OR WOMEN

can make big money. Haut sold over $300 in one month. You will find this a big, easy seller and a sure repeater. Must satisfy customers or money back. Write for territory and sample outfit. Get a big line of customers. Get repeat orders every month and have a steady income. Write quick.

AMERICAN PRODUCTS CO., 3017 American Bldg., Cincinnati, Ohio

FREE



$20

Violin, Hawaiian Guitar, Ukulele, Guitar, Mandolin, Cornet, Tenor Banjo or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.

SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 613 CHICAGO, ILL.



"Lighting Fixtures"
Ready to Hang
(Direct from Manufacturers)
Completely wired, including glassware. New designs.
Send for catalog No. 20
ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

sary. In a large evaporating dish mix the two solutions and placing the dish on a tripod over a Bunsen burner evaporate off from one half to two-thirds of the water. Upon allowing the contents of the evaporating dish to cool crystals of alum, which is a double compound of potassium and aluminum sulphate, will separate out. If small crystals are desired stir during the process of cooling. See Figure 2.

Growing an Alum Crystal: Make a saturated solution of alum by dissolving 100 grams of the salt in a liter of hot water and allowing the solution to cool. Then select a small crystal of alum and suspend it by a thread in the saturated solution that you have prepared. Allow this to stand undisturbed for a considerable period of time and slowly a very perfect crystal will grow. Figure 3.

Preparation of Glauber's Salt: This salt, chemically known as sodium sulphate, may be prepared in the same manner as alum. In 500 cc. of water dissolve 200 grams of the dry salt, using heat with constant stirring to bring it into solution. As before evaporate off about a third of the water and allow the mixture to cool. Clear, ice-like crystals will result. To preserve these crystals they must be kept in a glass container well stoppered so as to exclude the air.

Preparation of Chemically Pure Sodium Chloride: In a 500 cc. beaker place 150

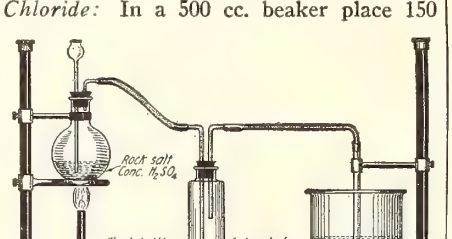


Fig. 4

Preparation of Chemically Pure Sodium Chloride.

grams of ordinary table salt. Add 360 cc. of distilled water and stir vigorously until no more will go into solution and the water is saturated. Then filter into a clean beaker and add concentrated hydrochloric acid until the salt just begins to separate from solution. Now set up a hydrochloric acid generator, as shown in Figure 4, connecting it with a wash bottle containing concentrated hydrochloric acid solution. With the wash bottle connect a delivery tube terminating in a 2-inch funnel and allow the latter to dip beneath the surface of the saturated salt solution.

Place in the generator a quantity of rock salt and cover it well with concentrated sulphuric acid and heat very gently. This generates hydrochloric acid gas which on passing into the salt solution drives chemically pure sodium chloride out of solution and precipitates it in crystal form. This results from the fact that sodium chloride is less soluble in hydrochloric acid than in water, and therefore the more chloride is thrown out of solution. Allow the salt to settle and pour off the clear liquid leaving the salt in the beaker. Cover it with pure dilute hydrochloric acid, agitate the contents of the beaker with a rotary motion, allow to settle and again pour off the clear liquid. Repeat this several times. Then filter through a filter paper and allow to dry. The product is chemically pure sodium chloride.

Preparation of Crystals of Iodine: Crystals are sometimes prepared without the aid of solution. Such is the case with iodine crystals.

Arrange apparatus as shown in Figure 5. In the test tube place a mixture consisting of 1 grain of potassium iodide and

BLUE PRINT READING

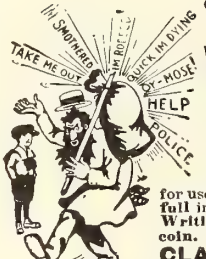


Electricians, Carpenters, Bricklayers, Mechanics, Shipyard, Sheet Metal, Structural and Concrete Workers, Boiler Makers, Plumbers, Pipefitters and others can earn big money if they can read Blue Prints. Get into the big-pay class. By our simple method we train you in a short time. Write for Catalogue 15-B, **stating trade.** Do it today.

BE A DRAFTSMAN
Earn $35-$150 a Week

Employers everywhere are looking for draftsmen. They are offering big salaries and good positions are always open. By our practical method we train you quickly in your spare time. Drawing outfit, books, etc., furnished FREE. We help you to obtain position when qualified. Write for Catalogue 15-G. DO NOT DELAY.

COLUMBIA COR. SCHOOL
Dept. 1, Drexel Bldg., Phila.



Oh Boys, Girls! Great Sport with CLAXOPHONE

Voice Thrower

Throw your voice under the **table, back of a door, into a trunk,** desk in **School,** any old place. **Big FUN** fooling **Peddlers, Policeman, Friends,** anybody. This **Claxophone** is a small device that lays on your tongue unseen, **always ready** for use by **anyone. Claxophone** with **full** instructions, also **Set** of **Secret Writing Tricks,** all sent for **10c** coin. (No stamps.)

CLAXO TRICK CO.,
Dept. K. New Haven, Conn.

THE MIDGET "FIVE-IN-ONE" SLIDE RULE



is a combination Mannheim, Log-Log, Add and Subtract, Polyphase and Binary Slide Rule. It will instantly add, subtract, multiply and divide any combination involving whole numbers, fractions, decimals and mixed numbers. Gives every possible root and power of every quantity. The graduations are printed on metal, coated with white celluloid and are grease and waterproof. While it is the most versatile calculator ever invented, its operation is simple and easily understood. Diameter 4 inches.

Price with 16 page Instruction Book, $1.50. Leatherette carrying case 50c extra. Catalogue Free. Your money back if you are not satisfied.

GILSON SLIDE RULE CO. Niles, Mich.

BUILD A WHITE FIREFLY $2.00
CARRIES FULL GROWN MAN



World's lightest and simplest aeroplane. Designed by George D. White, America's foremost aeronautical engineer. Weight 150 pounds, length 15 ft. Needs 8-12 H.P. motorcycle engine. Lands and takes off at 24 miles per hour. Useful load 165 pounds. Can be built in a few weeks at home. Send $2 for complete working drawings, building instructions and price list of parts. SEND $2 NOW!

WHITE AIRCRAFT WKS.
Dept. 18, 425 Merchants Trust Bldg., Los Angeles, California.

CONVERT YOUR BICYCLE INTO A MOTOR CYCLE



by using a STEFFEY ATTACHMENT
Simple-Reliable-Economical

Fits any ordinary wheel, diamond, double-bar or truss frame. Easy to attach. Send stamp for circulars.

STEFFEY MFG. CO.
Dept. E, 5025 Brown Street, Philadelphia, Pa.

Learn Autos and Tractors



Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O

Book on Law Free



Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.

Write Today—now while we are making a special reduced price offer.

American Correspondence School of Law
7443-3601 Michigan Ave., Chicago, Illinois

STAMMER NO MORE

Kill the fear of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Order a copy today. **THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago, Illinois**

one-fourth its bulk of manganese dioxide. Upon this pour 2 cc. of concentrated sulphuric acid and warm the contents *very gently.* The beautiful violet vapor of iodine will at once appear and condensing upon the cold funnel will form a mass of iodine crystals. The crystals may be preserved in a well stoppered bottle.

This process, whereby a substance vaporizes and recrystallizes without first melting, is called *sublimation.* It is frequently employed to purify commercial samples of iodine. The apparatus for this purpose is illustrated in Figure 6.

Formation of Crystals by Supersaturation: A very interesting condition known as supersaturation is possible with certain salts. In a small beaker or Erlenmeyer flask place 50 grams of ordinary photographer's hyposulphite and cover with 10 cc. of water. Heat the mixture until it has dissolved and then allow it to cool without disturbance. When the solution has reached room-temperature drop into it a tiny crystal of the same substance and at the same time give the flask a quick shake. Immediately a mass of crystals will appear and the flask will become decidedly warm, illustrating the fact that a change of physical state is accompanied by an energy change.

Water of Crystallization: Many salts depend for their crystalline form upon water chemically combined with the salt. When this water is driven off the salts lose their crystalline form and crumble to an amorphous powder. Many of the rocks and mineral deposits of the earth contain water chemically combined. Thus the gypsum which covers the bottom of Great Salt Lake is crystallized calcium sulphate containing about 21% of chemically combined water. When we take this gypsum into our laboratories and drive off approximately half of this water we obtain a non-crystalline substance known as Plaster of Paris. When this Plaster of Paris is again mixed with water it chemically combines with it and sets into a hard substance. Hydraulic cement owes its marvelous property of indestructibility to its chemical union with water into a stony substance.

Water of Crystallization in Copper Sulphate: Into a dry test tube drop a crystal of copper sulphate, or blue vitriol. Heat the test tube and immediately water vapor will issue from it and condensing will cover the cold upper portions of the tube with water. At the same time the copper sulphate will lose its blue color and when cold you can readily crumble it to a non-crystalline powder between your fingers.

Now replace the powdered almost colorless salt in another test tube and cover it with a very little hot water. Heat the bottom of the tube gently in the Bunsen flame and when the sulphate has dissolved pour the solution into a watch glass. When the solution has cooled a deposit of blue crystals will appear on the watch glass, thus showing that the salt is able to take back its water of crystallization.

An Efflorescent Salt: Some salts containing water of crystallization will give it off simply on exposure to the air. Such salts are called efflorescent.

On one side of a horn pan balance place a watch glass containing a quantity of crystallized sodium sulphate, or Glauber's Salt. Counterpoise this with lead shot and allow the balance to stand for several hours. Soon you will notice that the bright crystals are losing their lustre and assuming a dull opaque appearance. At the same time the side of the balance containing the salt will grow lighter. These results are due to the fact that the salt is losing its water of crystallization.

Determination of Water of Crystallization: Simple quantitative work always appeals to the amateur chemist and the determination of the percentage of water



New Easy Way to Become An Artist

THIS wonderful new method makes it possible for *anyone* to learn Illustrating, Cartooning, or Commercial Art. Hundreds of our students are now making splendid incomes. And most of them never *touched* a drawing pencil before they studied with us.

The simplicity of this method will astound you. You will be amazed at your own rapid progress. You learn by mail—yet you receive *personal* instruction from one of America's foremost Commercial Artists—Will H. Chandlee. Get into this fascinating game, NOW. You can easily qualify. A few minutes' study each day is all that is needed.

Crying Demand for Trained Artists

Newspapers, advertising agencies, magazines, business concerns — all are looking for men and women to handle their art work. There are hundreds of vacancies right this minute! A trained commercial artist can command almost any salary he wants. Cartoonists and designers are at a premium. Dozens of our students started work at a high salary. Many earn more than the cost of the course while they are learning! YOU—with a little spare time study in your own home—can easily and quickly get one of these big-paying artists' jobs.

No Talent Needed

This amazing method has exploded the old idea that talent is an absolute necessity in art. Just as you have learned to write, this new method teaches you to draw. We start you with straight lines, then curves. Then you learn how to put them together. Now you begin making pictures. Shading, action, perspective, and all the rest follow in their right order, until you are making pictures that bring you from $50 to $500 or more! Many artists get as high as $1,000 for a single drawing!

Write for Interesting Free Book

Mail coupon now for this interesting free book "How to Become an Artist." Explains about this amazing method in detail. Tells of our students—and their wonderful progress — and how we can qualify you for a high-salaried artist's position. Also tells of our free artist's outfit and special low offer to a limited number of new students. Mail coupon NOW!

Washington School of Art, Inc.
Room 1594, Marden Bldg., Washington, D. C.

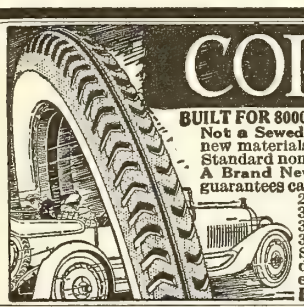
FREE COUPON

WASHINGTON SCHOOL OF ART, Inc.,
Room 1594, Marden Bldg., Washington, D. C.

Please send me, without cost or obligation on my part, your free book, "How to Become an Artist."

Name .....

Address.....



CORD MILEAGE TIRES

BUILT FOR 8000 MILES SERVICE and guaranteed against defects for 5000 miles. **Not a Sewed, Patched or Retreaded Tire**—but a sturdy fabric casing rebuilt of new materials, which we are confident will give mileage equivalent to a cord tire. Standard non-skid, geared-to-the-road tread, of new live rubbe. same as drawing. **A Brand New Tube Free With Every Tire Ordered**—Good Tires backed by real guarantees cannot be sold any cheaper.

28x3	$7.30	31x4	$10.95	32x4½	$12.55	36x4½	$14.50
30x3	8.00	32x4	11.30	33x4½	13.10	35x5	15.50
30x3½	9.10	33x4	11.75	34x4½	13.75	37x5	15.60
32x3½ SS. only	9.70	34x4	11.95	35x4½	14.00		

State SS. or Clincher. SEND YOUR ORDER TODAY with $2.00 deposit. Tire shipped balance C.O.D., with section left unwrapped for examination. If not satisfactory, deposit will be returned in full.
FIELD TIRE & RUBBER CO., Dept. 208 28th & Wabash Av., Chicago

SUCCESS OPPORTUNITY

UTTMARK'S NAUTICAL ACADEMY RADIO SCHOOL

Offers a thorough course in all branches of wireless telegraphy. Radio Operators earn at the start $125.00 per month, and first-class board, etc., free.
Our school prepares you for your license in three to four months. Positions guaranteed to first-grade licensed operators.

Day and Evening Classes

8 State Street, New York, N. Y.
Phone, Bowling Green 8079

Your Choice 75c a Week



FREE!

With every set is included—FREE—a Consulting Membership which gives you the privilege of submitting your perplexing problems to a corps of experts for an entire year. This Consulting Membership regularly sells for $12.00.

No matter what your occupation, one of the home study sets listed below will quickly fit you for a better job and bigger pay. Any set you select will be sent for seven days' examination, and if you decide to buy you may pay the rock-bottom price at the rate of only 75c a week. But you must act now! When our present supply of paper and binding materials, bought at pre-war rates is used up, production will cost more and prices must be raised.

These books are the work of recognized authorities. They are written in plain, easily understood language, by recognized authorities, and contain hundreds of photographs, diagrams, tables, etc., that make difficult points as simple as A-B-C. Handsomely and durably bound in half or full morocco leather (except as noted), and stamped in gold.

Pay-Raising Books

At Greatly Reduced Prices

Accountancy and Business Management, 7 vol., 2700 pages, 1000 pictures. Was $52.50....Now $29.80
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $37.50.....Now 24.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures. Was $67.50.....Now 39.80
Electrical Engineering, 8 volumes, 3000 pages, 2600 pictures. Was $60.00.....Now 34.80
Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures. Was $45.00.....Now 24.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures. Was $45.00.....Now 24.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was $52.50.....Now 29.80
Law and Practice (with reading course), 12 volumes, 6000 pages, illustrated. Was $97.50.....Now 49.80
Fire Prevention and Insurance, 4 vols., 1500 pages, 600 pictures. Was $30.00.....Now 19.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was $30.00.....Now 19.80
Sanitation, Heating and Ventilating, 4 volumes, 1454 pages, 1400 pictures. Was $30.00....Now 18.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blue-prints, etc. Was, $30.00.....Now 19.80

Send No Money

Shipped for 7 Days' Trial

Yes we'll gladly ship any set right to your home or office upon your simple request. Pay only shipping charges when the books arrive. Don't send a penny until you have used them seven days, then remit only $2.80 or return them at our expense. Pay balance at the rate of $3.00 a month—75c a week.

Act now—while these splendid books are being offered at 20% to 50% less than regular prices. This offer is open to every person within the boundaries of the U. S. and Canada. Grasp your opportunity—fill in and mail the Coupon NOW!

American Technical Society, Dept. X-253, Chicago

American Technical Society, Dept. X-253, Chicago, U. S. A.

Please send me set of.....

.....

for 7 DAYS' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3 each month, until I have paid the special price of..... If I decide not to keep the books, I will notify you at once and hold them subject to your order: Title not to pass to me until the set is fully paid for.

Name.....

Address.....

Reference .....

of crystallization affords an excellent opportunity for such activity.

Exactly counterpoise a porcelain crucible on one side of a hornpan balance with lead shot. Then add to the lead shot a 2-gram weight and counterpoise it with crystallized barium chloride placed in the crucible.

Now place the crucible on a pipe-stem triangle over a Bunsen burner as shown in Figure 7. Using a small flame at first gradually increase the temperature and continue the heating for 20 minutes. When perfectly cold replace the crucible in the balance. Remove the 2-gram weight and again balance the crucible using a 1-gram weight and the small foil weights.

In order to be sure that all the water has been driven off heat the crucible again for 5 minutes, cool and weigh. If the weight is constant subtract this weight from the 2 grams of salt originally taken and divide this difference by 2. The result is the percentage of water of crystallization.

If you repeat the process a number of times the result should always be the same, for the water is chemically combined, and its percentage is invariable.

Crystals of Sulphur: Sulphur has the property of forming crystals of two distinct types—rhombic and monoclinic.

To form rhombic crystals dissolve a piece of roll sulphur about the size of a pea in a little carbon disulphide and allow the solution to evaporate on a watch glass. As it does so small diamond shaped crystals of the rhombic type separate out. Examine them with a small magnifying glass.

Monoclinic crystals are formed by just melting sulphur in a test tube and then pouring the liquid into a folded filter paper. Watch it closely and when the contents of the filter paper have just solidified over the surface open up the filter and pour out the still liquid center. A mass of needle-like, prismatic crystals will stand out from the paper. In a few days they will change into the rhombic form.

If instead of melting the sulphur it is heated until it boils and is then poured into cold water the sulphur assumes a non-crystalline plastic form.

Preparation of Potassium Nitrate: A very important application of crystallization together with differences in solubility due to changing temperature is to be found in the preparation of potassium nitrate. Hot saturated solutions of potassium chloride from one side of the Atlantic Ocean and Chili saltpeter from the Pacific Coast are mixed and allowed to cool. The result is potassium nitrate.

In 100 cc. of water dissolve 85 grams of sodium nitrate, using heat if necessary. In another beaker dissolve 75 grams of potassium chloride in 100 cc. of water. Heat the solutions to boiling, mix them and evaporate off part of the water. Then allow the mixture to cool and the potassium nitrate will separate out. Sodium chloride which forms at the same time remains in solution because it is nearly as soluble at low temperature as it is at higher temperature. A more complete separation may be effected by cooling the container with ice.

This article by no means exhausts the subject of crystallization, but it gives a start and will perhaps stimulate the reader to further investigation in this very interesting field.



Voice Thrower 10c

Learn to throw your voice into a TRUNK, under the bed, out in the hall or anywhere. Lots of FUN fooling the Teacher, Janitor, Policeman, Parents, Neighbors, or Friends.

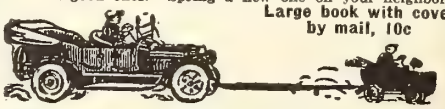
THE VENTRILO

is a little instrument that fits into the mouth out of sight. BOYS or GIRLS can use it in conjunction with the above for imitating birds and animals. Never fails. A 32-page book on Ventriloquism sent with the Ventrilo for 10 cents.

NEW FORD JOKE BOOK 1920

All the latest jokes on the Ford auto. Hundreds of them, and all good ones. Spring a new one on your neighbors.

Large book with cover by mail, 10c





ROGEN X-RAY

Price 12 cents

HERE, BOYS, is just what you want. With this instrument you can apparently see the bones in your fingers. Think of the fun you can have with it. Sample by mail, TWELVE CENTS.



SKULL RING

Here is a handsome, up-to-date Ring, representing a Skull and Cross-bones. Has stones in the eyes and looks something frightful. Women won't like it, but for men or boys it is a great novelty. Sample, by mail, 20c.



Gee! What a Wad!

This is STAGE MONEY

Looks like the GENUINE STUFF. Some Green backs and some Yellow backs. Create a BIG sensation among your friends. The girls will all be after you when they see the wad. BIG roll of 15 pieces by mail, 10 cents.



ENCHANTED BARREL

The Most Wonderful Pocket Trick Made

CHANGE A CENT INTO A DIME

Ask your friend to drop a dime in the barrel. When he takes it out, Behold! It is a CENT. You make 9 cents every time you fool them. Never fails. They cannot get on to it. Sample barrel, with directions, only.... 12c

BIG VALUE for 10 Cts.



6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Baseball Book, giving rules for games; 1 Toy Maker Book; Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 5 Puzzles; 12 Games; 30 Verses for Autograph Albums. All the above by mail for 10c.

Any of the Above Mailed with Catalogue

ROYAL NOVELTY COMPANY

491 East Ave. South Norwalk, Conn.



SAVE 25% to 60%

on slightly used GRAFLEX-KODAKS

Cameras and Lenses of every description. Equal to new. Save money. Write now for Free Bargain Book and Catalog listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 10 days' Free Trial. Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.

CENTRAL CAMERA CO., Dept. 113 124 S. Wabash, Chicago

MATHEMATICS MADE EASY



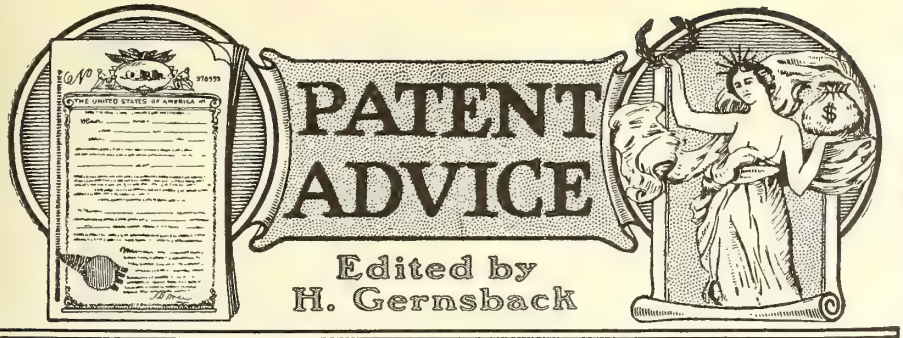
The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only One Dollar Postpaid. Order today before you forget.

Dept. J. L. J. LEISHMAN CO., Ogden, Utah

You can be quickly cured, if you

STAMMER

Send 10 cents for 288-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering 20 yrs. B. N. Bogue, 776 Bogue Bldg., 1147 N. Ill. St., Indianapolis.



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Making Money from an Invention*

By JAY G. HOBSON

MAKING money from an invention is similar to making money from anything else, the proposition must be right, the article must give the service promised for it at the price it is offered, and the inventor must thoroly understand the fundamental law of success.

This law is as old as the hills; used by the great and near great, the noble and the common and everyone who succeeds. It is a law requiring a substantial understanding of the proposition a person desires to promote for profit. It is a system, a combination of vision, knowledge and common sense applied to the business in question; a collection of data and facts of commercial requirements that surround any successful business. In a word the fundamental law of success is knowing the article or invention to be sold, the information necessary to manufacture or market it and the field of the possible demand it will have after it has been placed on the market.

The customer's point of view must be seen and catered to. The article must be put up attractively. The advertising matter disclosing the merit of the invention must be in harmony with the rest of the proposition.

All these details should be taken into careful consideration in order to assure quantity production of the product. Only in quantity production can money be made. To obtain quantity production the article must be practical, simple and capable of being standardized. It must be extensively advertised to acquaint the prospective customer with its merit and usefulness.

Many a good invention has failed because so few people knew of it. When you have a useful improvement let the

*No queries are publisht this month owing to the article by Mr. Hobson.

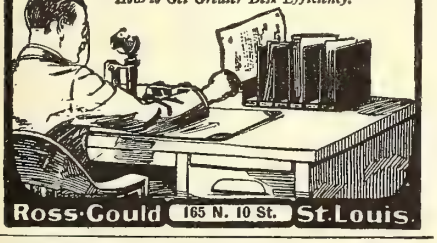
Kleradesk

Saves time—clears your desk. Sorts, classifies and distributes your correspondence, papers, memos, etc. Occupies much less space than wire baskets. No more shuffling through piles of papers many times daily.

A Steel Sectional Device

Each compartment a separate section. Any number of compartments for flat or vertical filing can be added as required. Width of each compartment is adjustable, one to ten inches. Indexed front and back. Green, oak or mahogany finish.

Write for free, instructive, illustrated folder, "How to Get Greater Desk Efficiency."



Ross-Gould 165 N. 10 St. St. Louis

"I Would Not Part with it for $10,000"

So writes an enthusiastic, grateful customer. In like manner testify over 100,000 people who have worn it. Conserve your body and life *first.*

The Natural Body Brace



Overcomes WEAKNESS and ORGANIC AILMENTS of WOMEN AND MEN. Develops erect, graceful figure.

Brings restful relief, comfort, ability to do things, health and strength.

Wear It 30 Days Free at Our Expense

For Children Also

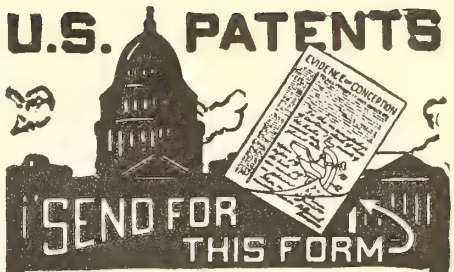
Does away with the strain and pain of standing and walking; replaces and supports misplaced internal organs; reduces enlarged abdomen; straightens and strengthens the back; corrects stooping shoulders; develops lungs, chest and bust; relieves backache, curvatures, nervousness, ruptures, constipation. Comfortable and easy to wear.

Keep Yourself Fit

Write today for illustrated booklet, measurement blank, etc., and read our very liberal proposition.

HOWARD C. RASH, Pres. Natural Body Brace Co.
286 Rash Building SALINA, KANSAS

U.S. PATENTS



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg.
Pittsburgh Offices: 514 Empire Bldg.
Philadelphia Offices: 135 S. Broad St.
San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... *Address*.....

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free. Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50¢

PATENTS & TRADE-MARKS

SEND SKETCH AND DESCRIPTION for report on patentable nature, and instructions. Preliminary advice without charge. Full, prompt report in strict confidence. Reasonable terms, reliable service by Registered Patent Attorneys. WRITE TODAY.

CLARENCE A. O'BRIEN & CO., PATENT LAWYERS
1023 WOODWARD BLG., WASHINGTON, D.C.

PATENT-SENSE
The Book for INVENTORS and MANUFACTURERS
SIXTH EDITION

"The Book for Inventors and Manufacturers"
SIXTH EDITION.
By return mail FREE. Write LACEY & LACEY
Dept K. Washington, D.C.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

PATENTS

C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

PATENTS & TRADE-MARKS
—FREE BOOKLET ON REQUEST—
MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES—
WARNER I. CUBBERLEY, PATENT ATTORNEY
22 NATIONAL UNION BUILDING
WASHINGTON D.C.

world hear about it. Shout it from the house tops! Advertise in every conceivable manner. Spread the news before everyone, everywhere — and everyone everywhere will become your customers. After public patronage has been secured, render service, be square in all dealings and see that each customer is well pleased with the goods and they will reciprocate by sticking to you. The repeat business is where the largest profits are made.

I recall the experience of two clever young men who started a small business of their own with a good product, but limited capital, which is a handicap. Their product was a patented safety razor blade sharpener of considerable merit. They put it up in an attractive form and sold it through sideline salesmen calling on stores, premium stands, distributors and the like. They could not afford regular full-time salesmen on account of their limited finances; but their sideline salesmen were faithful and sold a sufficient quantity to keep their little factory on a fair paying basis, but nothing compared to the business and profits these two live members desired. They had visions of becoming the largest in their line.

Their ambition and willingness to pay the price of success was plainly evident, but they could not decide upon the best plan to accomplish the desired result. Careless experiments might prove disastrous. Their funds were limited and had to be carefully calculated in order to avoid any misstep that might lead to failure. For months they pondered over this subject.

One day they were eating lunch together in a popular café. Two other gentlemen occupied the seats on the other side of the table. These men were all smiles and deeply interested in their own conversation which concerned their respective businesses. The two young men opposite could not help hearing every word of what was said, which proved to be a revelation to them. One of the other men was explaining the details of how his company had grown from a little hole-in-the-wall to one of the largest of its kind in the field.

He outlined it step by step, carefully telling how it was done; that the secret of the entire progress was national advertising and quantity production, which made for a lower manufacturing cost by being able to distribute the lump cost over a greater quantity of their goods, thereby reducing the individual expense of each article and increasing their total net profits.

Through extensive advertising they were able to turn the capital invested several times yearly, making a smaller working capital possible. Then he further explained that dealers and jobbers preferred to handle a highly advertised article; and that their salesmen were able to interest new distributers who would not represent them before, because their goods were in small demand.

All this interesting conversation was eagerly devoured by the two young men who consumed more facts than food that day. However, it was just what they wanted; just the spark that would start their little idea toward the goal they had long dreamed of. Reaching their offices they delved into the firm's financial condition to see to what extent they too, could do national advertising and bring their factory to a quantity basis.

Many days were consumed going over details to ascertain their true position. Finally both agreed that it was possible. They consulted an advertising man and laid their plans before him for advice.

(To be concluded in next issue)

LAW Degree LL. B. Conferred IN YOUR SPARE TIME AT HOME FOR BUSINESS FOR PROFESSION

Study law with only Institution which gives same Course by Correspondence through Lecture System as was given for years at resident classes of this College. Business today demands a knowledge of law for those who want success. Big opportunities in the legal profession. We coach you free to pass Bar Examination in any State. Special consultation privileges. Complete 24-volume library (12 books) specially prepared by leading professional and law trained business men. Organized 1910. Low enrollment fee, easy terms. Write for Free illustrated book.

HAMILTON COLLEGE of LAW, 403 Morton Bldg., Chicago

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?

Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.
1926 Broadway, New York

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney

"Inventor's Adviser" mailed free on request. Gives full information as to Patents, Trade Marks and their Cost.

OFFICES
364 University St. Montreal, Canada
919 F St., N. W. Washington, D. C.

Free Book on PATENTS

HOW TO OBTAIN A PATENT

Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 74 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.

MUNN & CO., 618 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 625 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

PATENTS Thirty-five years experience. Send model or sketch for opinion as to patentability. Free "Inventors' Guide." Highest references and personal attention assure best results.

FRANKLIN H. HOUGH
520 Washington Loan & Trust Bldg.
Washington, D. C.

PATENTS

Write for free INVENTOR'S RECORD form for establishing the date of your Invention, and INVENTOR'S BULLETIN Confidential Service

WM. H. MULLIGAN, PATENT LAWYER
110 Woodward Bldg. Washington, D. C.

ALL MAKES



Underwoods, Monarchs, Remingtons, L. C. Smiths, Olivers, Royals, Coronas AT REDUCED PRICES. Prices as low as.... $20.00

Write for our Catalog No. 15

BERAN TYPEWRITER CO.
Dept. 21, 58 W. Washington Street, Chicago

MEN

Intensely interesting booklet free.
Wonderful results.
H. Gyde Co., Washington, D. C.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

The Velocity of Light

By PROF. JAMES S. STEVENS

(*Continued from page* 1198)

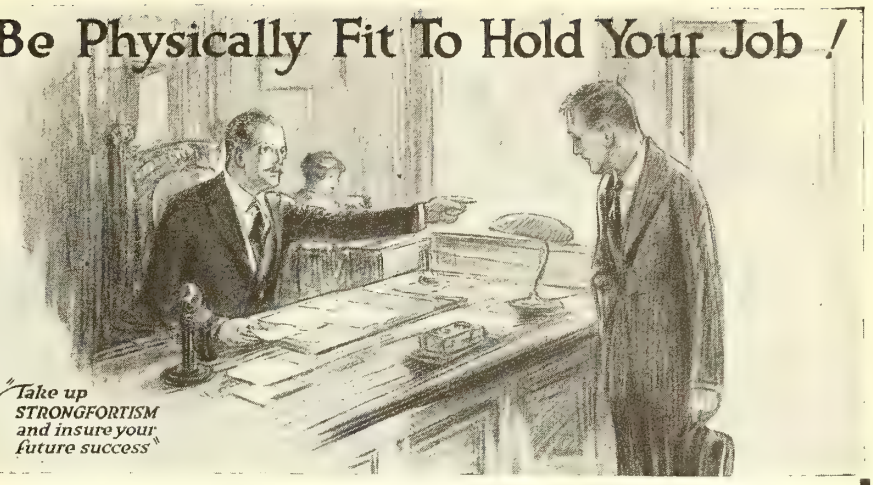
experiment and afforded another illustration among the many of the mutual helpfulness of mathematics and physics.

Recently the value of the velocity of light has assumed especial importance in connection with the theory of relativity. It has been known for sometime that this constant represents the greatest value that a moving body can have. It has also been shown both from mathematical and experimental considerations that the mass of a body is closely dependent upon its velocity. *If it had no velocity it would have no mass; and if it moved with the velocity of light it would have an infinite mass.* Both of these conditions are, of course, impossible to realize. We should be careful to note that in the *theory of relativity* the velocity considered is the velocity with reference to the observer. If two particles were shot towards each other each with the velocity of light their relative velocities would obviously be twice the velocity of light; but the velocity of each particle with respect to an observer on the other particle would only be the velocity of light.

We may indulge in a few interesting speculations along this line with a distinct understanding that they will not be realized —at least in our generation. If a heavenly body was situated at a distance of a hundred light-years from the earth and on that body there was an astronomer with a telescope sufficiently powerful to permit him to see what was taking place on the earth, he would at present be observing events which took place in 1821. See Fig. 4. He would, for example, notice that a certain document was being signed by which the State of Maine was set off from the State of Massachusetts, and this would be his report to his fellow astronomers who might inquire what was going on in the planet Earth. If the distant heavenly body were moving toward the earth with the velocity of light the last one hundred years would be accomplished in just fifty years. At the end of fifty years the light and the moving body would meet and the astronomer who was observing would report facts happening in 1921. If the body were moving away from the earth with the velocity of light, the distant astronomer would be obliged to report that the earth was a very unprogressive planet. He might watch our operations for an indefinite period of time and he would find no change from the events which he first noted, namely, those events which were happening in 1821. If he moved with a velocity greater than that of light he would, of course, never see the surface of the earth.

This is a situation analogous to that presented by Jules Verne in his "Journey to the Moon." It will be recalled that the tremendous explosion which sent the projectile to the moon was never heard by the people who traveled with it. This was readily explained by remembering that the velocity of the projectile was considerably greater than the velocity of sound which was following along after it. A paper printed in the ELECTRICAL EXPERIMENTER a few months ago explained at considerable length a problem somewhat analogous to the one we have been discussing, namely, the relative motion of the earth and the ether. It is greatly to the credit of American science that in the absolute measurement of the velocity of light, the relative velocities of light in various media, and the question of relative motion of ether and matter American physicists stand out pre-eminent.

Be Physically Fit To Hold Your Job!



"Take up STRONGFORTISM and insure your future success"

HUNDREDS of captains of industry and managers of big business state, in no uncertain terms, that they will not employ weak, impotent, physically unfit men and that those of their employees who do not measure up to their standards of physical and mental efficiency will soon be dropped from the pay-roll. *How about you?* Will you be discarded because of physical deficiencies—will you be hunting a new job one of these days and be unable to qualify physically for a new job? Don't wait until you are "fired"—THINK NOW before it is too late.

Have You Been Slipping and Backsliding?

Don't think for one moment that you and your work have not been watched. Being long established won't count when your employer realizes that you are not up to the mark. There is no sentiment in business. You may be well liked, but he can't afford to keep your name on the pay-roll if you don't get busy and produce real value for the money you get on pay day. Times have changed—men were scarce and jobs were plentiful—now men are plentiful and jobs are scarce. Business demands big, red-blooded, healthy men with big mental powers backed up by strong, vigorous bodies and an unlimited supply of endurance. That means that only the physically fit will be kept on the pay-roll. You must get strong and healthy or **GET OUT!** Where are you headed for? What will your future be? It's up to you NOW.



STRONGFORT
The Perfect Man

Make Yourself Fit!

Look the facts squarely in the face. If you were head of a big business, would you keep a weak, sickly, deficient man on your pay-roll? If you knew that an employee was a physical weakling, rotten with Constipation, Biliousness, wretched with Nervousness and Bad Habits, would you keep him on his job? If you knew that he came to work every morning with a dopy, wozzy brain and the pep and ambition of a dead cat, would you continue to pay him good money for poor work? No, you would not. You would "fire" him. That's what your employer will do to you if you don't wake up and make yourself physically fit. You must build up your body and brain and stop falling down on your job. You can win with

STRONGFORTISM

The Modern Science of Health Promotion

For over twenty-five years I have applied the natural health and success building Principles of Strongfortism in every corner of the globe. Thousands of men and women, boys and girls have been restored to health, strength and success under my guidance. These are the same principles that I can apply in your case and keep you off the "Dead Head" list. Strongfortism will put pep and courage into you — rehabilitate your flagging powers and Manhood and boost you up into the front line with the winners.

Send For My Free Book



The result of a lifetime's research and experience in physical and health building are contained in my FREE book **"PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY."** Clip the free consultation coupon, checking the items upon which you want special information, and send it to me, with a ten cent piece (one dime) to help cover the cost of packing, mailing, etc. I'll send your copy at once. It will prove a revelation to you—a life saver and a job saver. Send for it TODAY.

LIONEL STRONGFORT
Physical and Health Specialist
Department 269 Newark, New Jersey

FREE CONSULTATION COUPON

Mr. Lionel Strongfort,
Dept. 269, Newark, N. J. Personal.

Please send me your book "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH and MENTAL ENERGY," for postage on which I enclose a 10c piece (one dime).
Send me special information on subjects marked X below, without in any way obligating me.

S. & I. 269

..Colds	..Stomach Disorders	..Despondency
..Catarrh	..Constipation	..Skin Disorders
..Hay Fever	..Biliousness	..Impotency
..Asthma	..Torpid Liver	..Great Strength
..Obesity	..Indigestion	..Falling Hair
..Headache	..Nervousness	..Weak Eyes
..Thinness	..Poor Memory	..Pimples
..Rupture	..Rheumatism	..Blackheads
..Lumbago	..Gastritis	..Round Shoulders
..Neuritis	..Heart Weakness	..Lung Troubles
..Neuralgia	..Poor Circulation	..Female Disorders
..Flat Chest	..Increased Height	..Weak Back
..Deformity (Describe)	..Successful Marriage	..Muscular Development
..Insomnia	..Easy Childbirth	..Advanced Course
..Vital Depletion	..Drug Addicts	..Healthy Children
..Youthful Errors		..Manhood Restored
..Short Wind		
..Flat Feet		

Name .....
Age.....Occupation .....
Street .....
City.....State.....



You can Ukulele!

You can easily play quaint, dreamy Hawaiian music or latest songs on the Ukulele. Prof. Harry J. Clarke's latest method enables you now to play the Ukulele in a few weeks. We give you a genuine Ukulele absolutely FREE with complete course of lessons. Write at once for FREE narrative of Hawaiian music and offer. No obligations! Send No.

Hawaiian Institute of Music, 1400 Broadway, Dept. 5M New York

NEW MOTOR BARGAIN

GENERAL ELECTRIC



$\frac{1}{4}$ HP Motor 110 V. A. C. 60 cycle single phase, 1750 Speed. Complete with Cord, Plug and Grooved Pulley.

Will operate $21.00 Washing Machines, Sewing Machines, Small Lathes, Grinders, Bottle Washers, Etc. Satisfaction guaranteed or money refunded.

Illustrated catalog of motors and supplies FREE

HYRE ELECTRIC CO.
631 M. South Dearborn Street Chicago, Ill.

Thousands Are Nervous Wrecks

Cross, Crabbed and Care-worn

From Weak, Thin Watery Blood

without ever suspecting the real cause of their trouble—Iron-starvation

A New York Physician says that MORE THAN ONE-HALF THE POPULATION OF AMERICA PERISHES BEFORE MIDDLE AGE and that one of the chief contributory causes of this terrible waste of human life is the devitalizing weakness brought on by lack of iron in the blood.

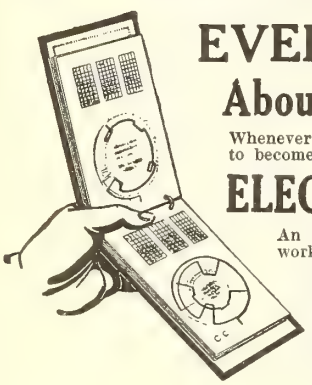
THERE ARE 30,000,000,000,000 RED BLOOD CORPUSCLES IN YOUR BLOOD AND EACH ONE MUST HAVE IRON.

An enormous number of people who ought to be strong, vigorous and in the prime of life are constantly complaining of weak nerves, headaches, pains across the back, disturbed digestion, shortness of breath, a general "run-down" condition, melancholy, bad memory, etc., when the real cause of all their suffering is IRON STARVATION OF THE BLOOD.

The proof of this is shown by the fact that when organic iron is supplied to their blood, that all their multitude of symptoms often quickly disappear and the very men and women who were formerly so complaining now become strong, healthy and vigorous, with even dispositions and a sunny, cheerful nature. Nature put plenty of iron in the husks of grains and the skin and peels of vegetables and fruits to enrich your blood, but modern methods of cookery throw all these things away—hence the alarming increase, in recent years, in anæmia—iron starvation of the blood with all its attendant ills.

If you are not willing to go back to nature then you should eat more such iron-containing vegetables as spinach and carrots and reinforce them by taking a little organic iron from time to time. But be sure the iron you take is organic iron and not metallic iron which people usually take. Metallic iron is iron just as it comes from the action of strong acids on small pieces of iron and is therefore an entirely different thing from organic iron. Organic iron is like the iron in your blood and like the iron in spinach, lentils and apples. It may be had from your druggist under the name of Nuxated Iron. Nuxated Iron represents organic iron in such a highly condensed form that one dose of it is estimated to be approximately equivalent (in organic iron content) to eating one-half quart of spinach, one quart of green vegetables or half a dozen apples. It's like taking extract of beef instead of eating pounds of meat. Over 4,000,000 people annually are using Nuxated Iron. It will not injure the teeth nor disturb the stomach. A few doses will often commence to enrich your blood and revitalize your wornout, exhausted nerves. Your money will be refunded by the manufacturers if you do not obtain satisfactory results. Beware of substitutes. Always insist on having genuine organic iron—Nuxated Iron. Look for the letters N. I. on every tablet. At all druggists.

NUXATED IRON ENRICHES THE BLOOD-GIVES YOU NEW STRENGTH AND ENERGY



EVERYTHING You want to know About A. C. Motors and Repairing

Whenever any question arises regarding motors, or if you are anxious to become a specialist on electrical motor work, you need the

ELECTRICAL WORKERS FRIEND

An invaluable collection of diagrams and instructions for electrical workers, students, amateurs, etc.

This book contains 66 motor diagrams with complete instructions for rewinding and reconnecting A. C. Motors. Shows how to put each coil in the slots, giving all internal and external connections. For reconnecting they cover all practical changes showing which diagram to use for the change wanted.

Bound in loose leaf form for handy reference. The only complete book of its kind on the market. So simple anyone can understand. It is helping thousands of other workers—it will help you too, as hundreds of testimonials prove.

SPECIAL PRICE, COMPLETE $4.00. Order today. If desired we will ship C. O. D. by Parcel Post, U. S. only.

YOU CAN EARN YOUR COPY FREE

We offer all owners of the Electrical Workers Friend a commission of 50c on every book they help us sell. All you have to do is show your book and recommend it. You can earn the full price of one of these books in a few days. Write immediately for full particulars—this offer is limited.

SMITH & SMITH PUB. CO. 1524 Lowrie St., N. S. Dept. B, Pittsburgh, Pa.

PIMPLES

Blackheads—Acne Eruptions

Now Are Easily Removed at Home at a Small Cost!

Banish those unsightly blemishes easily and quickly by using **"CLEAR-TONE"**—a simple home treatment that has cured chronic cases of long years standing. Use like toilet water. Leaves the skin clear, smooth and without a blemish. Has made many friends with both men and women. Elegant for men after shaving. If you have ***Pimples, Blackheads, Acne Eruptions*** on the face or body, ***Enlarged Pores, Oily or Shiny Skin***—never mind how bad—**"CLEAR-TONE"** has cured the worst cases I ever saw. **FREE**—simply send name today for *FREE Booklet,* "A CLEAR-TONE SKIN," telling how I cured myself after being afflicted for 15 years. And I know every embarrassment one has to endure with a bad complexion. **$1,000.00 Cold Cash says I can clear your skin of the above blemishes.**

E. S. GIVENS 168 **Chemical Building** **KANSAS CITY, MO.**

Why We Grow Bald

By DAVID J. CALICCHIO, M. D.

(*Continued from page* 1180)

A few of the fine branches or capillaries of the left side unite or anastomose with the capillaries of the opposite side. Others do not unite and thus form terminal vessels.

These arteries fit in shallow depressions of the bones of the head. The vessels are not deep but very superficial. And since their bed is a solid, hard bone, one can easily understand, how the slightest compression, such as that produced by the wearing of hats, especially stiff hats, will stop the flow of blood, and deprive the roots of the hair of its blood supply or food.

The arteries are very elastic tubes. With each beat of the heart, enough blood is sent to the hair, in order that it may thrive and grow. But if there is an obstruction, either within or without an artery, or capillaries, the blood current stops and it ceases to flow, exactly as pressure on a gardener's hose, would prevent the outflow of water.

The brim of hats fit about one to three inches above the ears, and one cannot fail to notice, that the *hair always falls out from that point upward.* Below this line, that is, at the sides of the head (parietal regions) and back (occipital region) the hair grows very exuberantly. Accordingly there is no interference here with the circulation of the blood, since these parts of the head are always exposed and free from compression.

The forehead (frontal region) is relatively always free of hair, the reason being, that no part of hair here is exposed, and no part free from compression.

Hence the three quarter ring of hair around the head with an interval at the frontal region, seen in bald people.

Women lose their hair less frequently than men. This is due to their ways of fixing their hats, which are held in position, not by tight fitting, as practiced by men, but by pinning the hat to the hair.

Of course, it is an established fact, that many diseases, and sometime fear, or worry, are responsible for the falling of hair or *alopecia.*

The daily wetting of hair and its improper drying, interfere with the flow of blood and growth of hair is damaged.

The falling of hair defies all our strenuous methods of making the hair grow, such as daily applications of hair tonics, singeing the hair, and the practice of massaging the scalp.

There is only one way to prevent the losing of hair, and that is, *the flow of blood which is the food of the hair must be kept free.*

Wear soft hats winter and summer. Keep the scalp free from all possible constrictions. Be bare-headed whenever possible. Stimulate and increase flow of blood to the roots of the hair by bending the head from left to right and *vice-versa,* and forward and backward.

Five of these movements night and morning is enough at first. Increase the number of movements daily until you can repeat them twenty-five times, without becoming dizzy.

Remember that whenever the blood supply of any part is shut off, that part will die.

And it is only loss of time, money, and good faith to use expensive hair tonics, because they are useless, other than imparting a pleasant fragrance.

No doctor would be so unreasonable as to apply and employ liniments, ointments; massage and friction to a limb, whose blood vessels are severed, in the hope of restoring it to normal state. What he would do

is to provide the limb with blood vessels, so that blood could be brought to it.

The hats of conductors and motormen, are well provided with openings, to insure good ventilation. This is done with a view of preventing the hair from falling. And yet almost every other conductor and motorman is bald.

You know what happens to flowers, trees, and vegetables when irrigation is wanted. They die. The same happens to the hair.

The cause of gangrene is the sudden or gradual deprivation of blood for the affected part. And the only cure for gangrene is amputation of the gangrenous part. No treatment can save it.

No treatment can save your hair, but an abundance of blood supply to the roots of the hair.

If your head is not entirely bald, even if very fine hairs or *lanugo* are still to be seen or left, then by increasing the flow of blood to their roots, you will not only prevent and stop their falling, but actually increase their growth, both in number and thickness.

General hygienic attention is also of value and important as an adjunct to what has been already suggested.

Drink plenty of water, seven to twelve glasses a day. Bathe your body frequently. Walk in the sun a few hours daily. Sleep with the windows open winter and summer. Outside air is always purer and better than inside air. Outside air contains more oxygen which is prepared by the vegetable kingdom and is the supporting element of life; and less carbon dioxide which is prepared by the animal kingdom, and is destructive to the body.

Building a 150 to 20,000 Meter Radio Receiver

By BERTRAM C. ROGERS

(*Continued from page* 1209)

insulating tubing or sleeving. It is a good time to state here that the successful operation and high efficiency of this outfit depend on careful workmanship. This holds true of any radio equipment, but any amateur who has progrest thru the more elementary stages should have no difficulty if ordinary care and some good judgment are used. The relative arrangements of coils and switches does not matter except that taps to switch points should be made as short as possible. The writer found it convenient to arrange taps as per diagram, the switches rotating outward from the center for an increase of inductance, thus eliminating mistakes when wiring. The large coils connect to the left-hand set of switches, the smaller being controlled by those on the right.

It will be noticed in the internal view that springs wound from steel piano wire (non-magnetic phosphor bronze wire is best) are used to counterbalance the weight of coils. As successful tuning depends on delicate adjustment of coupling, it will be necessary to detail the method of counterbalancing.

Referring to our trigonometry: If the length of spring is made approximately equal to the radius of swing of coil, force in downward direction at any position tending to rotate the coil is proportional to weight of coil times the sine of the angle at that point. $F = W \sin \theta$. Now the pull of the spring varies directly in proportion to its length, provided double its normal length is not exceeded. Therefore as the length of the spring must also vary with the sine of the angle θ the pull of the spring will be equal to and opposite

Beauty—
those Hidden Charms you haven't noticed



Good Health is the foundation of Attractive Beauty. Restore a normal circulation of rich pure blood—and you bring about the condition which makes the skin healthy and beautiful and the hair luxuriant. No cosmetics can accomplish these fundamental results. But you may do wonders in improving your own health and appearances by the marvelous forces of electricity. Treat yourself with

Renulife Violet Ray High Frequency

It is delightfully pleasant and the most effective method ever discovered to retain a youthful appearance and gain beauty. When the Face, Chin, Neck and Bust are treated the blood is brought to the surface, the soft muscles gently massaged, the lines fill out, the wrinkles disappear and the bloom of health is renewed. It is the treatment to remove blemishes, warts, moles, wrinkles, crows' feet, pouches under the eyes, blackheads and sagging lines of face and chin.

While treating locally, you benefit also the entire physical being. The irresistible, revitalizing powers of the Renulife Violet Ray are carried at once to every nerve cell, fibre and part of the body. Oxygen in the blood is increased, enriching and purifying it. Poisonous waste products which cause disease are eliminated.

Learn all about this new, simple, harmless, shockless, yet powerful and beneficial home treatment.

RENULIFE ELECTRIC CO.
1203 Marquette Bldg. Detroit, Mich.
In Canada, Netting Bldg., Windsor, Ont.
Exclusive Sales Distributor Wanted

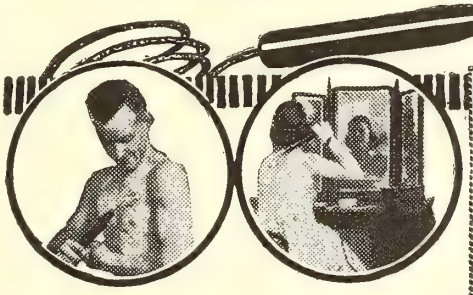
Every Beauty Parlor

Uses the Violet Ray. You can now treat yourself at home not only to gain beauty—but for many physical ailments—See list on coupon—Send for full information.

Use at Home

Send Coupon





Treat Yourself at Home with Health and Beauty Giving Renulife Violet Ray

COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO.,
1203 Marquette Bldg., Detroit
Please send me your book "Health" also literature and various samples of your Renulife Violet Ray treatments with Renulife Generators, also all particulars as to the application for ailments checked below.

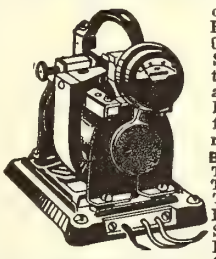
TREATS SUCCESSFULLY

Abscesses	Facial Neuralgia	Obesity
Anemia	Falling Hair	Pain in Abdomen and chest
Asthma	Female Complaints	Paralysis
Arteriosclerosis	Goitre	Piles
Baldness	Gout	Pimples
Blackheads	Hemorrhoids	Psoriasis
Brain Fag	Hay Fever	Rheumatism
Bronchitis	Infantile Paralysis	Scars
Bunions	Insomnia	Sciatica
Catarrh	Leucorrhea	Skin Diseases
Colds	Locomotor Ataxia	Sore Throat and Throat Diseases
Chilblains	Lumbago	Sprains
Dandruff	Nervous Affections	Sterility
Deafness and Ear Diseases	Neuritis	Toothache
Eczema	Neuralgia	Weak Eyes
Enlarged Prostate	Rheumatism	Wrinkles
		Worn and Holes

Name .....
Address .....

AUTO OWNERS—BATTERY USERS—WIRELESS OPERATORS—EXPERIMENTERS

10c CHARGES YOUR BATTERY AT HOME WITH AN F-F BATTERY BOOSTER



SIMPLE—SAFE SURE ACTING

or Magnetic Rectifier for 110-120 Volt 60 Cycle Alternating Current at a 1914 Price. F-F Battery Boosters are entirely automatic and operate unattended. Adjustable Carbon Electrodes rectify the current and operate for thousands of hours. Screw the plug in lamp socket in your garage, snap charging clips on battery terminals without disconnecting or removing battery from car, turn switch and lock garage door, knowing your battery will be charged in the morning. Keeping your Starting Storage Battery in charged condition makes it delightfully responsive and lasts so much longer, requiring fewer expensive battery renewals, that it actually costs you less to buy a Booster than to be without one.

Bantam type 6-6 ampere for 6 volt battery.$15
Type 16-8 ampere for 6 volt battery.....$24
Type 166-12 ampere for 6 volt battery...$32
Type 1626-12 amperes or 7 amperes in combination for both 6 volt and 12 volt batteries.$48
Bantam type 12-5 ampere for 12 volt battery.$15
Type 112-6 ampere for 12 volt battery..$24
Type 1612-7 ampere for 12 volt battery.$32

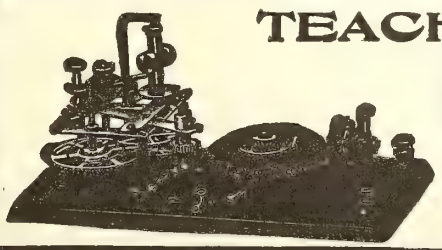
High ampere charging rates are best for large batteries, or where time is limited. Shipping weight complete with AMMETER and BATTERY CLIPS, 11 to 15 lbs. Include postage and insurance with remittance for parcel post shipment. Other F-F Battery Boosters for Farm Lighting Plants and Direct Current. Battery Stations and Garages Use the F-F Rotary Rectifier for Group Charging.

WRITE FOR BULLETINS 12 AND 12-A, OR MAIL CHECK WITH ORDER.

THE FRANCE MANUFACTURING CO., Offices and Works, Cleveland, Ohio

"THERE'S MONEY IN IT"

AT HOME LEARN TELEGRAPHY AT HOME
MORSE AND WIRELESS

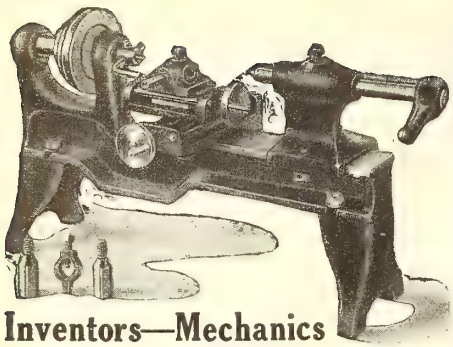


TEACH YOURSELF

In half the usual time, at trifling cost, with the wonderful Automatic Transmitter, THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
26 L Cortlandt St. New York



Inventors—Mechanics

HERE'S THE LITTLE LATHE YOU'VE WANTED AT THE PRICE YOU'VE WANTED TO PAY

23.75 F.O.B. NEW YORK

Compound Slide Rest Included!!

Send for Circular

PRODUCTION EQUIPMENT CO., INC.

Machine Tool Dept.

5 Union Square New York City

The Boys' Magazine

FREE!

Send us the names and addresses of 5 boys (from 10 to 16 years old) and we'll send you a copy of this splendid magazine FREE. Great stories—beautiful illustrations—handsome covers in colors. Departments devoted to Wireless, Electricity, Mechanics, Athletics and Physical Training, Moving Picture Plays and Players, Cartoons and Jokes. (Write plainly.)

Address

THE SCOTT F. REDFIELD CO.

6028 Main St., Smethport, Pa.

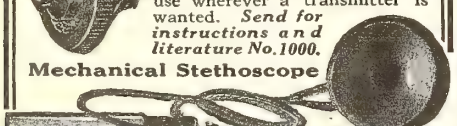
THE BOYS' MAGAZINE on sale at all newsstands, 15c a copy



SKINDERVIKEN TRANSMITTER BUTTON

Made in several types for use wherever a transmitter is wanted. *Send for instructions and literature No. 1000.*

Mechanical Stethoscope



PRICE $7.50

Improved type for detecting knocks in all running machinery. Test your automobile motor. Descriptive literature sent on request, *without obligation.*

GENERAL SOUND TRANSMISSION CORP.

Room 507 2 Rector Street New York

Handwriting Tells You Secrets

Be successful. Find out what holds you back. Send us an ink specimen of your handwriting and $1.00. Our expert Graphologists will tell you your faults, virtues, talents, etc. Your $1.00 back if you are not satisfied.

ROBERT R. ROSS, 110 West 40th St., N. Y.



$4 A MONTH AND **$5 WILL BUY**

A Standard, Guaranteed

TYPEWRITER

With Every Modern Writing Convenience

WRITE TODAY FOR ILLUSTRATED CIRCULAR Explaining Try-Before-You-Buy Plan

HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

Sex Books Clean, authoritative books on Sexology for those married or contemplating marriage. Catalogue free.

UNITED SALES CO., SPRINGFIELD, ILL.

to the pull of gravity on the coil. With a little experimenting with springs of various tensions, coupling control may be made very sensitive and the coils will "stay put" in any position.

In general loose tickler, tight coupling and shunt primary condenser is the order for long waves. Variable tickler, fairly close coupling and series primary condenser will control the shorter waves. Positions vary with characteristics and constants of tubes and antenna systems and are determined only by trial.

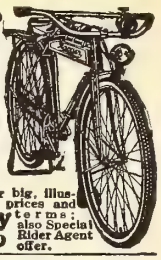
The bulb unit is conventional, a key or anti-capacity switch making a complete change-over from one-stage amplification to the second stage, 0–1 ammeter for detector filament, 0–2 ammeter for amplifier filaments and 0–10 voltmeter for testing "A" battery and switch and external resistance having a multiplying factor of ten with a three-point switch (middle point dead) for control to read "A" or "B" battery voltage at will. The top binding post to the right is for positive amplifier plate voltage, next is the detector plate, then comes the common negative and the lower six volts positive. Clamps and leads are being added so as to allow placing of block "B" batteries inside of cabinet. The cabinets were made from one-half inch birdseye maple.

Double phone clips and a filament current interrupting plug are on the bottom of the panel. The three-point switch to the left will cover two points at once and with studs connected respectively to 1, 3 and 2 plates of fixt bridging condenser it is possible to obtain values equivalent to 1, 4, 3, 5 and 2 plates. Plates are 2x2 sheet copper, tinned, thirteen plates total, separated by 2 mil mica. This gives sufficient capacity and regulation for the entire range of wave lengths. Transformers are of the Navy type 1:3 ratio and are mounted on a sub-panel below bulbs.

The amplifying unit is due for rewiring—as a great many changes were made on both sets trying out different hook-ups. The key switch on the left of the receiving cabinet was used to series both sets of coils, then to throw primaries, secondaries in parallel, etc., as well as for other experiments, but none of them were found worth while, the best results being obtained with the conventional three circuit hook-up as shown.

It will be found advisable to use a double cotton or silk covered stranded copper conductor for wiring the receiving cabinet. The bulb cabinet should be wired with No. 12 soft drawn bare copper wires, separating these wires at least one inch where it becomes necessary to run them in parallel; all crosses to be at right angles and in short, spacing tubes, transformers and wiring as far apart as possible, keeping all runs short. Bridging condenser leads must be short to prevent howling when receiving long waves. For practical purposes the one stage only is used for all work, especially the longer waves. When listening to music, time signals, etc., it is often convenient to place phones on table and throw over to the second stage. Western Electric P-11 phones are used. Marconi bulbs are shown, but an Audiotron for detector and Western Electric's bulbs for amplifiers produce the best results. Disregarding "A" battery and rectifier, the complete parts for the set may be bought in the market for about one hundred dollars ($100.00) and will take a week or two to assemble, depending on the builder's skill and old apparatus he may have on hand. The writer studied a great many sets to determine which would be satisfactory, but they all had some drawback, which was the reason for the design of this receptor. Six months' continuous use has proven its worth and permanency.

Delivered to you Free



for 30 days trial on approval. Your choice of **44 Styles**, colors and sizes of famous **Ranger** Bicycles. **Factory-to-Rider** lets you buy at wholesale prices, *express* prepaid, direct from maker.
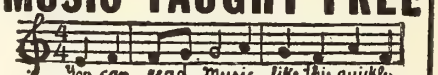
12 Months to Pay lets you enjoy your **Ranger** at once. Many boys and girls easily save the small monthly payments. The **Ranger** is a better bicycle than you can buy anywhere at any price.

Tires lamps, horns, wheels, parts and equipment at half usual prices.

SEND NO MONEY. Simply write for our big, illustrated free **Ranger** catalog with lowest prices and terms; also Special Rider Agent offer.

Mead Cycle Company Dept. D-107 Chicago

MUSIC TAUGHT FREE



You can read Music like this quickly

In Your Home. Write today for our booklet. It tells how to learn to play Piano, Organ, Violin, Mandolin, Guitar, Banjo, etc. Beginners or advanced pupils.

American School of Music, 57 Lakeside Bldg., Chicago



GET ON THE STAGE

I Tell You How! Stage Work and Cabaret Entertaining successfully taught by mail. Your **BIG** opportunity. Travel, see the world as vaudeville actor or actress. My great Professional Course—only one of its kind—**COVERS ALL BRANCHES.** Develops **Personality, Confidence, Skill** and tells you **just how** to get on the Stage. Send 6c postage for illustrated booklet, **"All About Vaudeville."** State age and occupation. Write for this free Stage Book **today!**

FREDERIC LA DELLE Box 557-W **LOS ANGELES, CALIF.**

TELEGRAPHY

(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.

DODGE'S INSTITUTE **A Street, Valparaiso, Ind.**



FIVE DAYS FREE TRIAL

SEND NO MONEY—Just size of finger and ring desired. We'll send you this beautiful Brilliante Gem in gold filled ring by return mail; deposit **$3.50** with postman on arrival, wear this emblem of prosperity five days, if not delighted, return the ring and get your money back. The Brilliante has all the loveliness of a genuine diamond and fairly sparkles with a lasting beauty and brilliancy. (Agents wanted.)

HATTON AND HATTON

Dept. S1 4436 Calumet Ave. Chicago, Ill.

LEARN WATCH REPAIRING



You can learn by our modern and original system of instruction every part of the **Watch Repairing Trade** at home as good or better than at a shop. You **can earn money while learning and secure a well paying position or start in business after completing our course of instruction. Good watch repairers are always in demand and earn from $30 to $65 per week. For particulars apply to the**

MILWAUKEE SCHOOL OF WATCH REPAIRING, 166 Mason St., MILWAUKEE, WIS.

5 Master Keys

The world's most wonderful and only set of keys of its kind. They open and also test **thousands** of different locks. No home should be without them is the opinion of locksmiths, janitors, detectives, firemen, real estate men, travelers and many other users of our keys. They are highly endorsed as a precaution, convenience and household article. Send $1.00 for this set and novel key chain.

Master Key Co., 42 Manhattan Bldg., Milwaukee, Wis.

STAMMER

If you stammer attend no stammering school till you get my large FREE book entitled "STAMMERING, Its Origin and the Advanced Natural Method of Cure." Ask for special tuition rate and a FREE copy of "The Natural Speech Magazine." Largest and best school for stammerers in the world. Write today.

The North-Western School, 2331 Grand Ave. Milwaukee, Wis.

Be an Artist

Comics, Cartoons, Commercial, Newspaper and Magazine Illustrating, Pastel Crayon Portraits and Fashions. By Mail or Local Classes. Write for terms and List of successful students.

Associated Art Studios, 111 Flatiron Bldg. New York

BE AN EXPERT

Penman

Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. **Complete outline FREE.** Write C. J. Ozment, Dept. 44. St. Louis, Mo.



Printing Cheap

Cards, circulars, labels, book, paper. Press $12. Larger $35 Job press $150. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE, cards, etc. **THE PRESS CO., D-47, Meriden, Conn.**

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

The Edison Effect and the Audion

By DONALD C. McNICOL

(*Continued from page* 1208)

application filed February 2, 1905, claims substantially as follows: "This device is intended to take the place of the coherer in wireless telegraphy. It consists of a receptacle with electrodes containing a gas. This is rendered partly conductive by electric heating, which brings the gas into ionic activity and makes its conductivity sensitive to electrical oscillations."

The Work of Buff

The *National Telegraph Review,* New York, of July, 1853, contains the following significant report:

"Professor Buff, of the University of Giessen, has recently published an interesting paper on the electrical properties of flame. He has come to the conclusion that gaseous bodies, which have been rendered conductive by strong heating, are capable of exciting other conductors, solid as well as gaseous, electrically.

"Two small strips of platinum were introduced into a glass tube closed at one end; they were separated by an interval of a thin line of air. The air within the tube could not be heated to a degree sufficient to permit the electricity from two Daniell's cells to pass thru it. When the glass became soft by heating, and both pieces of platinum were permitted to touch it, a strong deflection of the needle of a galvanometer was the consequence.

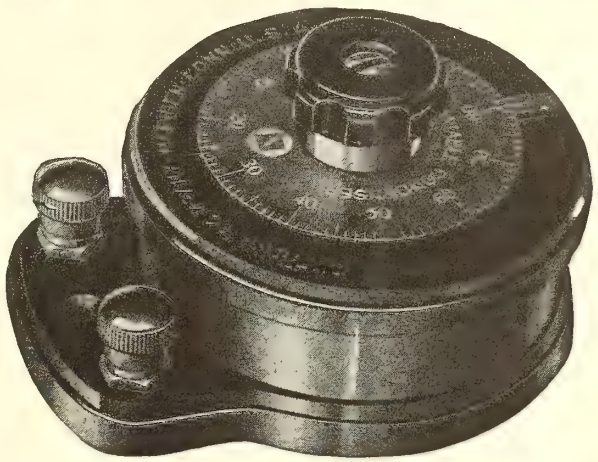
"When the strips of platinum were exposed to the direct action of the flame of a spirit-lamp, the first notice of the passage of electricity was obtained when they were placed at about three inches above its extreme point, and began to show signs of redness. The deflection increased as the strips were lowered in the flame. When the flame was strongest there was a permanent deflection of 70 degrees. The flame current past always from the hottest platinum strip, thru the separating interval of gas to the other strip. When the metallic wires or other conductors connected at one end were brought into contact with highly heated gas, it formed an electric circuit. One platinum wire was introduced into the obscure center of the flame of a lamp, and the other wire was brought near the outer surface of the flame; a current of electricity immediately exhibited itself, which past thru the flame from the inner to the exterior wire. By properly connecting a platinum wire, which was dipt into the center of the flame, with a condensing plate, the latter became charged with negative electricity, and hence Prof. Buff concluded that positive electricity is given off by the outer surface of the flame."

Had Buff been able to heat the interior of his glass tube by means of an incandescent filament he would have made the same demonstration Edison made, but it was not until nearly thirty years after Buff made his experiment that the incandescent lamp was perfected by Edison.

INSTITUTE OF RADIO ENGINEERS ELECTS OFFICERS

The annual election of officers recently held by the Institute of Radio Engineers resulted in the election of E. F. W. Alexanderson, president; Fulton Cutting, vice-president; A. N. Goldsmith, secretary, and W. F. Hubley, treasurer. The Board of Direction of the Institute is made up of the officers and the following managers: E. H. Armstrong, W. H. G. Bullard, E. H. Colpitts, L. Espenschied, J. V. L. Hogan, L. R. Krumm, R. H. Marriott, Donald McNicol, and George O. Squier.

CONNECTICUT RADIO



This Amateur "found it far superior"

Read this letter (from Pennsylvania) on the CONNECTICUT Variable Condenser.

"Have been using your unique two plate condenser for several weeks. Have tried it on a number of crystal hook-ups and have found it to be far superior in actions and stability than a ——— condenser which I am also using in my present hook up.

"I have also been able to cut out entirely N A A and other stations with your condenser, while it is impossible with the other.

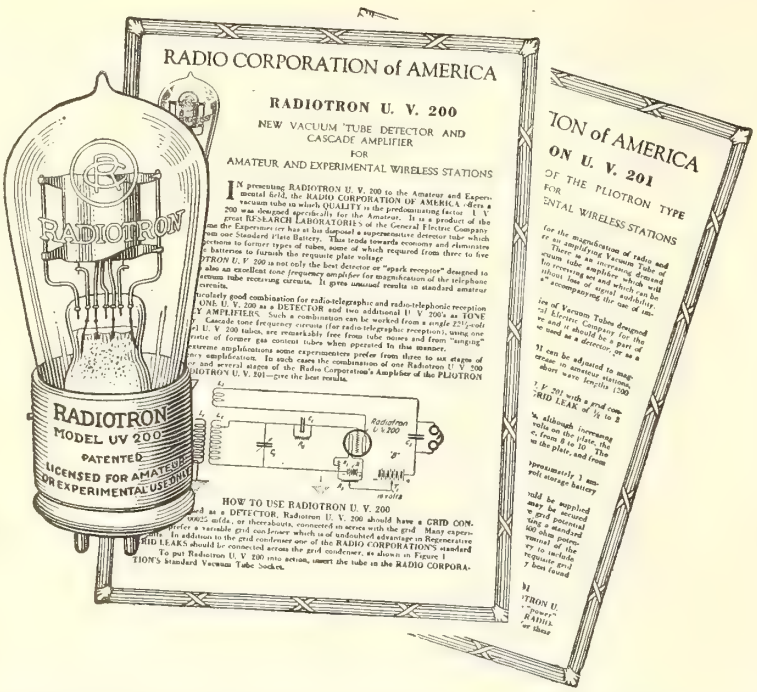
"I can sincerely say that this instrument for its size and work cannot be equalled. It is also a very fine addition to a Radio Outfit as it not only increases the receiving capacity, but also adds to the fine appearance of many outfits.

"Wishing you the best success with your new condenser, I remain,"

Your results can be just as good.

Our booklet tells all about the new Condenser—Send for it. Mention your dealer's name.

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut



HAVE YOU RECEIVED YOUR COPIES?

Two descriptive bulletins covering the detector tube—Radiotron U.V. 200, and the amplifier—Radiotron U.V. 201, are now available to every amateur and experimenter in the United States.

These important bulletins contain practical circuits and detailed instructions which will enable the experimenter to obtain the maximum results from Radiotrons. If you have not already received copies, visit your local radio dealer and ask for them or write us direct—they are free.

DEPENDABLE PRODUCTS	
Radiotron U V. 200 . .	$5.00
Radiotron U.V. 201 . .	6.50
Standard Tube Sockets . .	1.50
Grid Leaks, Mounted . .	1.25
Grid Leak Units Only . .	.75
Grid Leak Mountings . .	.50
Intervalve Transformers . .	7.50
Burgess "B" Batteries . .	3.50

The Radio Corporation's tubes are covered by patents dated November 7th, 1905, January, 1907, and February 18th, 1908, as well as by other patents issued and pending. Tubes licensed for amateur and experimental use only. Any other use will constitute an infringement.

Dealers: Let us send you our selling proposition

Address all orders and inquiries to:
SALES DIVISION, COMMERCIAL DEPARTMENT

RADIO CORPORATION OF AMERICA

233 Broadway, New York City

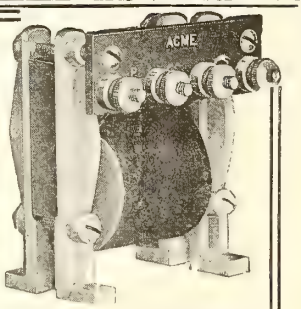
Acme Amplifying Transformer

$5.00

Increased Impedance Ratio

We have found that a gain in efficiency may be obtained by increasing the impedance ratio of our Amplifying Transformer, especially on the newer tubes.

Our latest transformers have this increased ratio.



Carried in stock by leading dealers

Acme Apparatus Company 28 WINDSOR STREET CAMBRIDGE 39, MASS.

Up-to-date Transformer and Radio Engineers and Manufacturers



PIGEONS PAY Easy raised, any small building, very little space required. Build their own nests, feed their own young. Very profitable business. Get your start with a few good pairs. Write today for 1921 Circular.
Pigeon Supply House, Hanover, Pa.

Learn to Rule

I TEACH BY MAIL
WRITE FOR MY FREE BOOK "How to Become a Good Penman" and beautiful specimens. Your name elegantly written on a card if you enclose stamp. Write for it today. F. W. TAMBLYN, 424 Meyer Bldg., Kansas City, Mo.

How We Feel

By JOSEPH H. KRAUS

(*Continued from page* 1179)

particular, on the side opposite to the direction toward which the hair slants. When a repeated rhythm is applied to the skin, such as for instance a hair fastened on to a tuning fork, we are able to perceive a continuous sound from the fork, yet we can feel that this hair when touching the skin gives us a distinct series of discontinuous taps. When faradic currents are applied to the skin, they can be recognized as distinct separate sensations, even when repeated at the rate of 130 per second.

Fatigue of Touch Sensation

If a finger is placed on a small cog wheel from a clock, a continuous sensation is not felt until the cog wheel revolves at such a rate that there are more than 600 serrations making contact with the skin every second. Like nearly all sensations, the sensation of touch finally becomes more and more ineffective yielding to fatigue but not very rapidly. A cavity in a tooth or a gumboil at first is very annoying, but after a while we may not notice it at all.

It is a strange but positive fact that the sense of skin touch is much greater than that in the nerve trunks themselves. Thus, for a nerve trunk it has been found that a stimulus of .2 gram moving at a rate of 140 millimeters per second is necessary to evoke any sensation from exposed nerve areas but for the touch spots in the skin, a stimulus of .2 gram moving at only 17 millimeters per second is adequately sufficient.

Another surprising fact is that the sense of touch is greatly augmented by a profusion of hair on the skin. When a slight touch is applied to the hair proper, it acts on the long lever arm of the hair and multiplies the force of pressure so applied five or more times, because the hair is pivoted at the surface of the skin and the small arm of the lever projects thru the skin, into a hair follicle profusely surrounded by nerve endings.

It has been found that before the skin was shaved, .2 milligram pressure was effective, whereas after being shaved *it required a 36 milligram pressure* to produce the same feeling of touch.

Quality of Discrimination

Let us now consider a different sense, viz., that of discrimination or what is otherwise known as the *spatial quality* of touch. If any part of the skin of the body is stimulated by applying a cork point to the skin, we can instantly tell the exact location of the excited spot. If now, instead of one point, two cork points are substituted in a pair of dividers, there must be a certain spatial distance between these points, varying in different parts of the body, before we are able to definitely determine whether or not there are two points or only one point in contact with the skin.

In calculating this it has been found that at the tip of the finger a distance of 1.1 millimeter is required; any smaller distance will not evoke two distinct sensations. On the palm of the hand, a distance of 6.8 millimeters is necessary, whereas in the middle of the back, 67 millimeters, more than ¼ of an inch separation is necessary.

(*Continued on page* 1250)

LIBERTY AUTOMATIC REVOLVER

HIGH QUALITY - RIFLED BARREL - GOOD VALUE

With Shell-Ejecting Device
PRICE $9.50

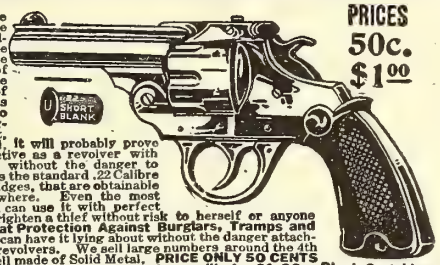
.22 Cal.
.32 Cal.
.38 Cal.



One of the most powerful and effective weapons made. The shots can be fired rapidly and in succession, as fast as you can count. The ideal weapon for Express Men, Bank Agents, Pay Roll Clerks, Automobilists, and all others where quick action is absolutely essential. Accidental discharge impossible. Another feature is the **Automatic Shell Ejector,** that throws the empty shells out when the barrel is tipped down. The Revolver is exceptionally well made of the very finest of materials and scientifically tested for accuracy. Fitted with fancy rubber handle. .22, .32, or .38 calibre, **PRICE $9.50, postpaid anywhere; Cartridges for above Revolvers - by express only, .22 cal. $1.00 per 100. .32 cal., $2.50 per 100; .38 cal., $3.50 per 100.**

BLANK CARTRIDGE PISTOL

PRICES 50c. $1.00



This well made and effective Pistol is modelled on the pattern of the latest type of Revolver, the appearance of which alone is enough to scare a burglar, whilst, when loaded, it will probably prove just as effective as a revolver with real bullets, without the danger to life. It takes the standard .22 Calibre Blank Cartridges, that are obtainable most everywhere. Even the most timid woman can use it with perfect safety and frighten a thief without risk to herself or anyone else. **A Great Protection Against Burglars, Tramps and Dogs.** You can have it lying about without the danger attached to other revolvers. We sell large numbers around the 4th of July. Well made of Solid Metal. **PRICE ONLY 50 CENTS Postpaid. Better make and superior quality for $1.00. Blank Cartridges .22 cal., shipped by express only,** customer paying expressage **50c per 100.**

MELIOR AUTOMATIC PISTOL

SHOOTS .25 CAL. COLT Cartridges



.25 Cal. $15

Best value in Automatics in America. Shoots Colt .25 Cal. Automatic Cartridges. **7 Quick Successive Shots.** The Pistol takes seven cartridges at one loading; extra magazines can be kept ready for instant reloading. Each empty shell is automatically ejected immediately after firing. Fixed stationary barrel, ensuring great accuracy. Trigger action is exceptionally light and quick, and must be pulled back for each shot. Never misses fire or jams. Has Safety Lock for disconnecting the pistol when not in use. **LENGTH OVER ALL - less than five inches, 2 in. Barrel.** Material, workmanship and finish of the highest possible grade throughout. A wonderful combination of **ACCURACY** and **RELIABILITY.** Superb shooting qualities; as easy to aim as pointing the finger; works as smooth as an engine; will shoot through four inches of pine wood. Fine for target shooting. Weighs only 12 oz. Sold under postive guarantee to shoot equal to any pistol on the market or money refunded. **PRICE, $15.00 ppd. Cartridges** (express only) **$3.75 per 100.**

MELIOR AUTOMATIC .32 CALIBRE PISTOL

This Pistol may also be had in 32 Calibre, same as above, length of barrel nearly 4 inches, length over all less than 7 in. **PRICE, $20.00 postpaid. .32 Cal. Automatic Cartridges,** (by express only) **$4.50 per 100.**

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures But 4¼ Inches Long. Takes Regular .22 Calibre Cartridges $5.00



The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability.** It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. **The ammunition used is the standard 22-calibre cartridge obtainable anywhere. The** operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 6¾ ounces. **The price of the Baby Revolver is only $5.00. sent by mail, p.pd. to any address.**

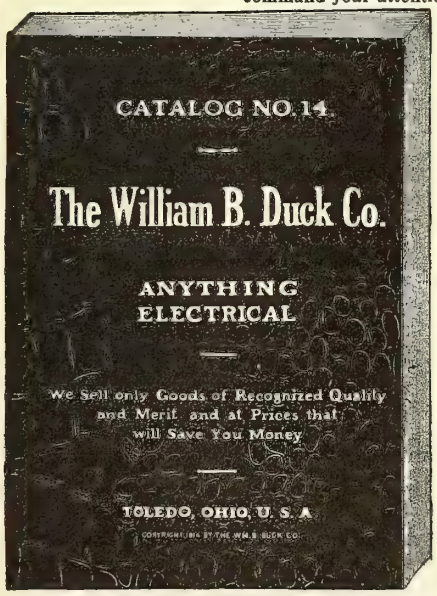
Write For FREE Catalog of Revolvers.

JOHNSON SMITH & COMPANY, Dept. P.M. 54, 3224 N. Halsted St., CHICAGO

"The Greatest Radio Catalog in the World"—*The Universal Verdict of Tens of Thousands of Radio Amateurs*

DUCK'S No. 14 BIG 200 PAGE WIRELESS CATALOG

A Veritable Treasure House of Everything Worth While and Dependable in Radio. The largest, most comprehensive, artistic and educational wireless catalog published. The Beacon Light to guide you right in the selection of your radio purchases, and at prices that will command your attention. Every instrument guaranteed with privilege of return if not satisfied.



Mail 12c in stamps or coin (*not sent otherwise*), which amount you are privileged to deduct on first dollar purchase. Revised price list to first edition of catalog, with prevailing prices, mailed on request

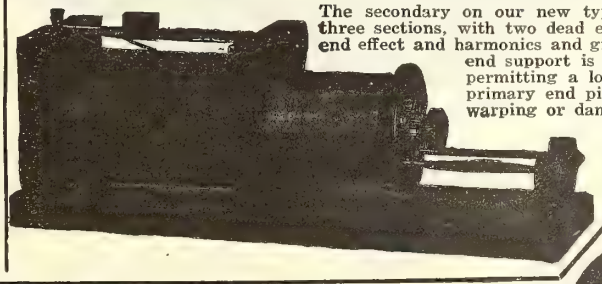
Announcing Permanent Reductions on 3 of our most popular Radio Instruments

The demand last month for our Navy Type, Arlington, and No. 7721 Receiving Transformers at the greatly reduced prices convinced us that with large quantity production, because of the exceedingly attractive prices on these instruments, we can continue to maintain these low prices. We therefore announce the following permanent reductions on these instruments.

Model 5BB Navy Type Receiving Transformer, Former Price $27.50. NEW PRICE $21.95
No. 1091 Improved Type Arlington Receiving Transformer, Regular Price $15.00. NEW PRICE $11.95
No. 7721 Receiving Transformer, Regular Price, $9.00. NEW PRICE $7.50

Send your order immediately for your choice of these popular instruments

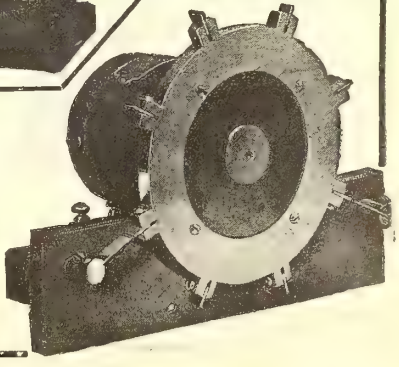
Improved Arlington Receiving Transformers, Regular Price $15.00 New Price, Only $11.95



The secondary on our new type Arlington is divided into three sections, with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy, permitting a looser coupling. The base and primary end pieces have a spline to prevent warping or damage in transit. This feature is also on our Navy. It is a beautifully finished instrument.

Improved Type Sayville Rotary Gap

Embodies the latest and best features in Spark Gap Construction



Our New Type Sayville Rotary Gap is, we believe, far in advance of any rotary gap on the market within a range even of twice the price. It is the final development of many different types made in our experimental Radio Laboratory. It fulfills every requirement of the ideal rotary gap. It is neat and attractive in appearance; simple and durable in construction; possesses a wonderful motor; has a cast aluminum rotary wheel, beautifully polished; every part is in perfect alignment; there is no wobbling of the rotor; produces and maintains a clear and pure 500-cycle note; is instantaneous in action; permits of no dragging of the spark; has contacts of tempered flat copper of proper length and width, easily and quickly removable, and inexpensively renewable; the stationary contacts are adjustable to any length..... **$27.50**

THE WILLIAM B. DUCK COMPANY, 230-232 Superior Street, TOLEDO, OHIO



CUNNINGHAM

TYPE C-300

THE IDEAL AMATEUR TUBE

Read What 6BJ Says:

"No doubt you would like to know the wonderful work I have accomplished using your new C-300 Detector Tube. Since I have installed your tubes at my station located at Burlingame, California, call 6BJ, I have heard more distant amateur stations than I have ever heard in my life. I have been a constant user of vacuum tubes for the past ten years, and believe me, I know a real tube when I see it. I have succeeded in hearing stations in Nebraska and Arizona with only one step of amplification and have established communication with many that I never before could hear. You have my permission to use this letter so the many amateurs throughout the United States will know what I think of your most excellent tube. I use regenerative tuning with Radio Shop Variometers."

(*Signed*) HALL BERRINGER.

TYPE C-300

$5.00

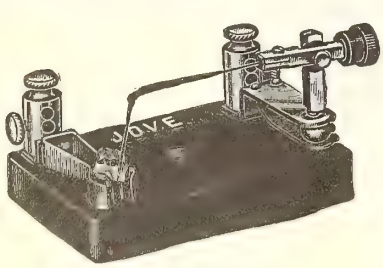
This is only one of many letters already received. Let me know your results—If they are exceptional I should like to publish them.

E. T. Cunningham

TRADING ASSOCIATION

AUDIOTRON MFG. COMPANY

35 MONTGOMERY STREET SAN FRANCISCO



(GHEGAN PATENT)

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

Send stamp for new edition 42E Catalog.

J. H. BUNNELL & CO., 32 Park Place, New York

How and Why of Radio Apparatus, by H. W. Secor. A book every Radio Operator should have—$1.75. Experimenter Publishing Co., 236 Fulton Street, NewYork City.

How We Feel

(*Continued from page* 1248)

Try placing two contact points about ¼ inch apart on your upper arm, and see if you can tell whether there is only one point touching the skin or two. There is a continuous decrease of the distances of discrimination as we pass from non-mobile parts to mobile parts (from the upper arm to the fingers and from the cheeks to the lips), yet any factor which will diminish the sense of touch also diminishes the sense of discrimination such as cold.

How We Tell "Hot" and "Cold"

Let us now consider the *temperature senses* by means of which the skin can appreciate that a body coming in contact with it is either cold or warm. If the body is of the same temperature as the skin, no sensation is generally excited. Neither are the senses of warmth and cold produced by one and the same end organ.

The experimenter can readily determine this for himself by warming a small pointed glass rod and passing it over the palm of the hand. Certain regions in the hand will then give us a sense of warmth. Others give us a medium sense, while in still other spots no sensation will be evoked by touching the skin with the glass rod. If a rod is, on the other hand, cooled to a few degrees below body heat and moved over the same regions, cold spots can be definitely outlined. Note figures 1 and 2.

An investigation of these warm and cold spots shows that the apparatus for the appreciation of cold is much more distributed over the body than that of warmth, as is evidenced by our diagrams. The cold areas are best marked on the chest, the nose, the abdomen, etc., and both cold and heat are less sensitive on the face, hands and mucuous membranes. We can, therefore drink hot drinks, which, if applied to the hand and other more sensitive parts of the body, would prove very painful.

When the skin is very cold or very hot, it is much more difficult to recognize a change of temperature, but even a change of 1/5 degree, between 27 degrees and 32 degrees Centigrade, is recognized. If a cold pencil should be past over heated spots, no sensation whatsoever is registered in our brain.

When pressure is applied beyond a point necessary to evoke a tactile sensation the pressure becomes painful, and this is generally a point just before a sharp instrument will cause penetration of the skin. It is really remarkable that pain may result from the internal organs of a person, which organs are generally devoid of such sensations, as for example: the intestines may be cut, sewn, and otherwise manipulated without causing any sensation. If a strong contraction of the muscular walls of these intestines cause pressure from the catgut, a griping pain will result. A burning sensation is the result of a stimulation of the nerve endings of warm spots as well as pain spots.

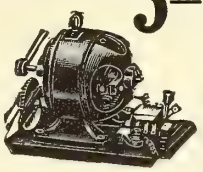
In addition to the areas already charted out, we have certain areas of the skin from which only painful sensations are aroused. If the skin is then anesthetized, the patient will know (if pricked with a needle) that he is being pricked, but has no objection to any amount of repetition since the sensation is devoid of all pain.

All these sensations taken collectively give man the extraordinary power of knowing what is going on about him and protecting himself from dangers which may occur.

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

LEADER

The Big Power Motor for Boys $5.00



A compact, highly efficient reversible motor, perfect in every detail. The reducing gear, easily adjusted, transforms the high speed to more power at slower speed. The reversing switch is positive in action, and operates either as a starting switch, or to reverse the direction of the motor at will. This motor is guaranteed by us to be exactly as represented.

AT ALL LIVE DEALERS

Insist on your dealer showing you the **KNAPP** line—**KNAPP** goods are best. If your dealer cannot supply you, order direct. Send for **FREE** illustrated catalogue showing a complete line of Electrical Motors and Novelties.

KNAPP ELECTRIC & NOVELTY CO.

523 West 51st Street, N. Y. City

What a Dime Will bring You From the Nation's Capital

The little matter of 10 cts. will bring you the Pathfinder eight weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for all the Nation; an independent home paper that prints all the news of the world and tells the truth; now in its 28th year. This paper fills the bill without emptying the purse; it costs but $1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, strongly, briefly—here it is. Send 10c to show that you might like such a paper, and we will send the Pathfinder on probation eight weeks. The 10c does not repay us, but we are glad to invest in new friends. Address: **THE PATHFINDER, 268 Langdon Sta., Washington, D. C.**

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

1/4 H. P., 110 volts, A. C., 60 cycle, single phase, 1750 R. P. M. MOTORS

LARGE QUANTITIES NEW WASHING MACHINE MOTORS

These are of standard manufacture and carry the full factory guarantee. Shipped in original boxes. Complete as cut. Suitable for operating Coffee Grinders, Cream Separators, Bottle Washers, Air Compressors, Small Lathes, Etc.

Mail $5.00 each or Money order. We will send C.O.D. subject to full examination. Money Back Guarantee.

Bargains in Small Motors and Generators. Write for Catalogue. Special Quantity Prices-Value $32.50

$22.75 Each



MANUFACTURER'S DISTRIBUTER

CHAS. H. JOHNSTON - Box 12 W. E., Pittsburgh, Pa.

Experimental Laboratory Apparatus

Most complete catalogue in print—just issued. Describes over five hundred chemicals and apparatus—including electric furnaces, microscopes, balances, weights, glassware, books and Practical Chemical Outfits—all fully illustrated. A combined handbook and catalogue for the chemical experimenter. Let us tell you how to get a free copy.

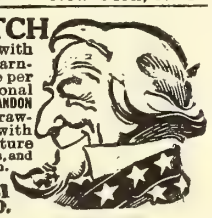
D. ALTMAN COMPANY

Dept. C

223-225 East 110th Street New York, N. Y.

COPY THIS SKETCH

and let see what you can do with it. Many newspaper artists earning $30.00 to $200.00 or more per week were trained by my personal individual lessons by mail. **LANDON PICTURE CHARTS** make original drawing easy to learn. Send sketch with 6c in stamps for sample Picture Chart, long list of successful students, and evidence of what *YOU* can accomplish. *Please state your age.*



The Landon School

412 Nat'l Bldg., Cleveland, O.

Learn to Dance



You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful **Peak System of Mail Instruction.**

New Diagram Method. Easily learned; no music needed; thousands taught successfully; success absolutely guaranteed.

Write for Special Terms. Send *today* for **FREE** information and surprisingly low offer.

WILLIAM CHANDLER PEAK, M. B.

Room 243 4737 Broadway, Chicago, Ill.

DO YOU WANT Prosperity! Power! Happiness! ?

Positive Wonderful Results by Our System. "Success" Lesson and Personality Sketch for 10c and birth date.

THOMSON-HEYWOOD CO.

Dept. 350 Chronicle Bldg. San Francisco

Dr. Pringle Discusses Mind

By JOHN H. DEQUER

(*Continued from page* 1190)

sea, causing the fresh rain water to flow from the land gradually forming creeks and rivers which took up some of the life from the sea. And as the continents became more vast, the lakes and rivers dried up, the fish were left to adapt themselves to the land conditions. This is still going on in some of the drying rivers of Australia. Thus as the continents raised, the land animals evolved. These animals could not survive unless they moved toward food and moisture. From this necessity evolved the greater complexity of brain cells which orientates and reacts to the substances and conditions necessary to organic survival, and this system of orientations and reactions manifested thru brain tissues and expressed thru physical organism, we call intelligence; and the force or forces causing these reactions we call mind. Mind is the cause of intelligence; intelligence is the reaction of brain cells to mind forces. What constitutes the mind force, and how it is related to other subatomic forces, is what I am trying to find out."

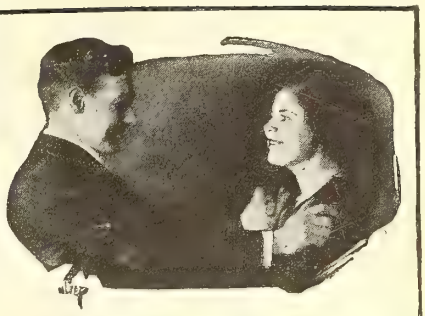
"You are trying to verify the theory of evolution," I interjected.

"No," he replied, "I am not trying to verify or disprove any theory. I am interested only in truth." And then returning to his original subject, he went on, "I have fixt it so that the salt water flowing out of this pool runs into another where the fresh water from the creek flows into it. A little further down is another pool where the sea water is still more diluted. This gives me an opportunity to study the same life under various dilutions, pressures, and light effects. It shows me the effect of changing environment on the structure and functions of the various organisms under my observation."

"You are trying to duplicate on a larger scale the experiments of Loeb on sea urchins and other creatures," I suggested.

"Yes, you may put it that way," he assented, and then pursuing the original thought, he said, "Ultimately we may discover that life and mind are but the positive and negative poles of the same force, or combination of forces. I was just now thinking of the researches of Bose; doubtlessly you have heard of him. He is the great Hindoo who has forsaken his temple for the laboratory, and who in the laboratory is approaching closer to the causative power of the universe than ever did his dreaming ancestors. He tells us that in some mysterious way all matter is alive. That a bar of iron is as irritable as your mother-in-law, as can be shown by the galvanometer; and that it has its periods of activity and rest, as well as other characteristically vital phenomena. It is not improbable that life is the electron-combining force, and that in this sense the entire universe is alive. It may be that the different atoms are combined by vital activity under the influence of catalysing food products, and that mind is primarily a highly complex expression of that force operative in and thru protoplasm. Life may be the power, and living things some of the tools nature uses in her architectural work."

The sun shone warmly thru the window in the south side of the laboratory, and Doctor Pringle arose from his bench and adjusted a convex mirror so that it threw a concentrated beam of sunlight on the plate glass near the bottom of the



A Big Raise in Salary

Is Very Easy to Get, If You Go About It in the Right Way

You have often heard of others who doubled and trebled their salaries in a year's time. You wondered how they did it. Was it a pull? Don't you think it. When a man is hired he gets paid for exactly what he does, there's no sentiment in business. It's preparing for the future and knowing what to do at the right time that doubles and trebles salaries.

Remember When You Were a Kid

and tried to ride a bike for the very first time? You thought that you would never learn and then—all of a sudden you knew how, and said in surprise: "Why it's a cinch if you know how." It's that way with most things, and getting a job with big money is no exception to the rule, if you know how.

We Will Show You How

Without loss to you of a single working hour, we can show you a sure way to success and big pay. A large number of men in each of the positions listed are enjoying their salaries because of our help—we want to help you. Make check on the coupon against the job you want and we will help you get it. Write or print your name on the coupon and send it in today.

AMERICAN SCHOOL

Drexel Ave. and 58th St.

Dept. G-328 CHICAGO

American School

Dept. G-326, Drexel Ave and 58th St., Chicago

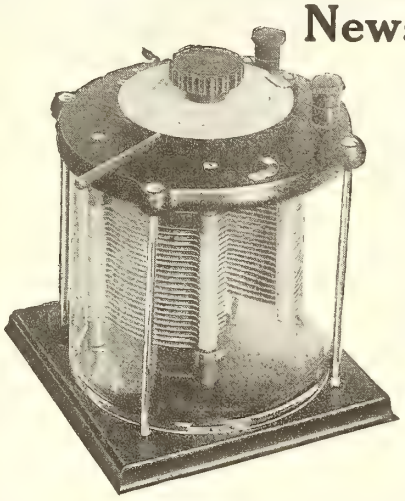
Explain how I can qualify for position checked:

.....Architect $5,000 to 15,000	.....Lawyer $5,000 to $15,000
.....Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Certified Public Accountant $7,000 to $15,000	.....Telephone Engineer $2,500 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telegraph Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....High School Graduate In two years
.....Electrical Engineer $4,000 to $10,000	.....Fire Insurance Expert $3,000 to $10,000
.....General Education In one year	

Name..... Address.....

DE FOREST

Are You Listening to Rome, Lyons, Eiffel Tower, Darien and Nauen on News of World Interest?



Our new Vernier type Condensers, when used in connection with DE FOREST Duo-Lateral Inductance Coils, complete a long wave receiving set which cannot be surpassed for double the money. These Condensers are made in various sizes and priced from $6.25 to $26.40.

Get our Catalogue

containing detailed descriptions of these and many other pieces of better grade Radio Apparatus.

DE FOREST RADIO TEL. & TEL. CO.

Inventors and Manufacturers of High Grade Radio Apparatus

1415 Sedgwick Avenue New York City

THERE may be stores that carry as complete an assortment as the Continental stock; there may be others whose sales people take as keen an interest in their customers; there may be still more that ship mail orders as promptly and carefully; but the unique feature of Continental Service is the perfect combination of all these advantages.

We list below a few representative items of our mail order stock. Order direct from this ad, or send for our new 112-page catalogue. It contains a valuable appendix with tables for easily figuring all radio calculations, also conventional signals and abbreviations, etc. Sent anywhere in the world for twenty-five cents.

BUZZERS

No. 55 Mesco	$2.50
No. 251 Mesco	.95
No. 168 Century	2.50

AMRAD GAPS

No. G-1 1 K.W. Gap.	$41.50
No. G-2 ½ K.W. Gap.	24.50
No. G-3 ¼ K.W. Gap.	12.00

BENWOOD GAPS

No. 1 Benwood Gap complete	$30.00
No. 8 8 Stud Rotor	8.00
No. 10 10 Stud Rotor	8.00
No. 14 14 Stud Rotor	8.00

ANTENNA SWITCHES

No. 463 Murdock	$4.50
F. 658 Clapp-Eastham	12.50

PARAGON R. A. TEN Receivers

"The weaker the signal the stronger the amplification."

Price Eighty-Five Dollars

LINE PROTECTORS

No. 379 Murdock Line Protector	$9.00
No. AM888 Dubilier Line Protector	4.00
No. CD888 Dubilier Line Protector	6.00

TUNGAR RECTIFIERS

Two Ampere Tungar Complete	$18.00
Five Ampere Tungar Complete	28.00
Two Ampere Extra Lamp	4.00
Five Ampere Extra Lamp	8.00

BURGESS "B" BATTERIES

22½ Volts Large "B" Battery	$3.50
22½ Volts Small "B" Battery	2.50

PARAGON CONTROL PANEL

No. 5 Paragon Control Panel $6.00

RHEOSTATS

No. 2110 Porcelain Base	$1.40
Paragon Back Mounted	1.75
G. R. Back Mounted	2.50

Our word of honor to you is our guarantee—Let us prove it

CONTINENTAL RADIO AND ELECTRIC CORP.

J. DI BLASI, Sec. Dept. A11. — *Sole Distributors of the Paragon RA-TEN* 6 Warren Street — J. STANTLEY, Treas. New York



Send for a Copy of Our Manual of Wireless Telegraphy

We now have ready for distribution our Manual of Wireless Telegraphy. It contains 200 pages, fully illustrating and describing the many instruments used in Radio. 45 pages cover general instructions, diagrams, station calls, tables, codes and other information identified with the art.

The book is printed on high finished paper with a two-color cover and measures 9x5¾ inches.

Due to the scarcity of paper, the high cost of publication, and in order that the Manual may get into the hands of those most interested in Wireless, we ask 25 cents for it, give a coupon receipt for the amount, which coupon can be applied on a future purchase.

Get Your Copy Before the Edition Is Exhausted

MANHATTAN ELECTRICAL SUPPLY CO. INC.

17 Park Place New York — 114 S. Wells St. Chicago — 1106 Pine St. St. Louis — 604 Mission St. San Francisco

SEX BOOKS Clean, authoritative books on Sexology for those married or contemplating marriage.
Catalogue free.
UNITED SALES CO. SPRINGFIELD, ILL.

DEN PHOTOS
Beautiful Girl Models. Snappy Poses. 7x10, Mounted 10x14. 3 for $2. $5 per Dozen. Postcards, 15 for $1. 50 for $3. 50 Miniatures FREE with FIRST ORDER OF $1 OR MORE. NO STAMPS. NO C. O. D.
L. GARVEY, 20-S. Perkins Place, Brockton, Mass.

aquarium. In a few minutes the glass where the light entered was covered with small living things which he called, "Spirographis." As I watched these curious little creatures, he called my attention to some hydroid growth in the bottom of the pool. This too was turning its heads toward the light.

"That is heliotropism," he explained. "Solar energy is entering the structures of these creatures causing an effect not unlike that which iron experiences when brought under the influence of magnetism. It activates their photo-sensitive substances according to the Bunsen-Roscoe law."

"But why not grant that these creatures are controlled in their actions by instinct implanted in their nature by an all-wise Providence," I suggested, knowing full well that such a remark would draw his fire.

"That all sounds very well, but as usual in all mere speculative reasoning it removes instead of solves the problem, for I might ask you, what is instinct? How does it arise, and how are you going to reconcile the fact that 'all nature is red in claw and fang' with the conception of an all-wise, and hence necessarily benevolent Providence? No, no my friend. The Providence you dream about may or may not be a reality. I am not searching for it. I search for the secret of life and mind, feeling sure that these things may be explained by the observable and verifiable mechanics of ether.

"Young John Hays Hammond constructed a machine, electrically operated, the circuits of which were attached to selenium cells placed in the focus of two lenses, separated by a wooden board that does duty for a nose. The selenium as you know, becomes an electric conductor under the influence of light, and so John's mechanical device followed a lantern as if it were afraid of the dark. A savage would have called this machine intelligent, believing that it chose to follow the light, while we know that it could not help itself, realizing that light makes selenium a conductor of electricity. But like the average man we say that an animal chooses to follow the light not knowing the effect light energy has upon the protoplasmic granules of its cells. If we knew just what these forces wrought, we would realize that our actions are just as much compelled as those of Hammond's machine."

"You consider the conduct of living things as not due to mind, but rather to forces producing chemical change in the nerve tissues?" I ventured.

"All phenomena, whether physical or mental are due to forces producing electrical, and therefore chemical changes in the substances involved. We know of no mind phenomena that are unaccompanied by physiologic effects, and there are no physiologic effects without molecular change. When you trace it right down you will find that all mental and physical states are due to changes in the tension, stress or strain of the cosmic ether. The fact that we do not see, or consciously experience etheric change is because the atoms of our bodies are but slightly resistant to its movement. This has led men to postulate a universal something capable of brain reactions similar to his own. Superstitions are born of Ignorance and Credulity; these ought to have no place in the Temple of Science.

"Science is slowly but steadily climbing the great mountain of truth. It is learning that this universe is not the result of brain reactions, but of energy operating according to its inherent laws. *Brain is not the cause but the result of energy;* it grew up in beast and man in response to necessity of multiplying numbers and changing environments. These factors caused the life forces to express

Something New in Headsets

WITH recent improvements in our Navy Type Headset we have succeeded in bringing out a headset with an A. C. resistance of 50,000 ohms at 800 cycles, a thing which has never before been accomplished in a commercial headset. It has a natural high pitch and will bring in thousand cycle notes clearly and distinctly and undamped waves can be read clearly and distinctly through static.

The improved Navy is peculiarly adapted to vacuum tube reception.

The Navy is permanently adjusted at its highest point of efficiency and then carefully matched in tone. Because of its rugged construction it remains adjusted indefinitely.



"Navy Type" 50,000 Ohms A. C. Weight 9 oz., complete with head band and polarity indicating cord. Price $14.00.

It is equipped with an improved headband made of galvanized piano wire covered with strongly woven khaki. It is instantaneously adjustable to any size head and check nuts hold the adjustment.

It is also equipped with new style conducting cords, which indicate the polarity of the receivers. This eliminates any danger of demagnetizing the receivers when used in connection with vacuum valve detectors.

The most exacting comparative tests have convinced us that our High Impedance Navy Type Headset is the best on the market, regardless of price. It is the most sensitive, most durable and at the same time the lightest high-grade headset built. Our guarantee stands back of every one of these claims.

If you need a reliable and supersensitive headset, you cannot afford to be without this new high-impedance model. Send us $14 and we will mail you a Navy Type Headset. Try it for 10 days. If you are not absolutely satisfied with your purchase, return the headset and we will refund the money immediately.

C. BRANDES, Inc.

Room 814 32 Union Square

NEW YORK CITY

Also Makers of

Transatlantic Headsets, 25,000 ohms A. C.	**$12.00**
Superior Headsets, 2,000 ohms D. C.	**8.00**

Send 5c for Catalogue "E."

themselves in ever greater complexity thru brain tissue and in whatever direction they flowed the brain cells increased. Thus brain is a creature of this complexity of forces, and not as some suppose their creator. Intelligence is but the result of a greater or less complexity of brain structure thru which the action-determining forces flow."

From an ice box my friend took a piece of fibrous looking substance and suspended it by means of a silk thread to the cross arm on a metal standard. "This is nerve tissue," said he. Then by means of a lever he brought a large iron-cored electro-magnet having a lifting power of four hundred pounds to each pole, into close proximity to one end of the slightly desiccated tissue. To my surprise I saw it leap toward the magnet as if it had been iron.

"That is due to the iron content in the nerve," I suggested.

"Hardly," answered the Doctor. "Iron in combination with other elements is not necessarily magnetic. Take the blood as an example. It is much richer in iron than are the nerves, and yet it is distinctly diamagnetic, almost as much so as is copper.

"One of my reasons for maintaining that the dynamic power exhibited by animals having an active circulatory system is due to a form of electric power evolved in the body, is based upon the fact that the blood being diamagnetic, circulates in the magnetic field of the earth, thereby transforming the potential energy of nature into the kinetic energy of life. But what I want to show you is that not only is nerve tissue affected by magnetic force, but that all other body tissues are influenced as well. All cells are basically the same. They differ only according to the fluid in which they develop."

For the next twenty minutes Doctor Pringle performed a series of experiments with a great variety of tissues, proving that most of them under certain conditions were responsive to, or repelled by magnetic flux.

While performing these experiments he kept up a running fire of conversation. He discussed all the familiar laws of electricity and magnetism, as well as of radioactivity, and other recent discoveries in the domain of chemistry and physics. He talked with ease and familiarity about the great men in these fields of human endeavor as if they were his constant companions. And no wonder, for aside from his continual experimentations Doctor Pringle is an omnivorous reader of scientific literature. I remember only the "high lights" of what he said, my attention being specially drawn to his work. He was placing living animals in an intensified magnetic field and by means of an Einthoven string galvanometer proving how the electric potential of their bodies was increased by the concentration of the magnetic force about their organism.

"Magnetism cut by a diamagnetic substance evolves electricity," he said. "Electricity in motion sets up a magnetic field at right angles to the direction of its flow. At least that is what old man Oersted told us about a hundred years ago. He was not exactly correct in his statement. An electric charge repels the ether in its vicinity causing it to spin about the moving electrons. Thus we have the blood cutting the magnetic lines of the earth causing currents of electricity in the body which concentrates the magnetic field in their vicinity making the body a highly complex mechanism productive of electric, magnetic and radio-active forces. Both mental and physical power I conceive as the result of this interplay of different forms of primal energy."

While he talked he exhausted a bell jar by means of a mercury pump. This done he turned a switch causing a stream

BOYS



Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 29 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you.* Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 6183-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ SALESMANSHIP
☐ Electric Lighting and Rys.	☐ ADVERTISING
☐ Electric Wiring	☐ Window Trimmer
☐ Telegraph Engineer	☐ Show Card and Sign Ptg.
☐ Telephone Work	☐ Railroad Positions
☐ MECHANICAL ENGINEER	☐ ILLUSTRATING
☐ Mechanical Draftsman	☐ Cartooning
☐ Machine Shop Practice	☐ BUSINESS MANAGEMENT
☐ Toolmaker	☐ Private Secretary
☐ Gas Engine Operating	☐ Business Correspondent
☐ CIVIL ENGINEER	☐ BOOKKEEPER
☐ Surveying and Mapping	☐ Stenographer and Typist
☐ MINE FOREMAN or ENG'R	☐ Cert. Pub. Accountant
☐ STATIONARY ENGINEER	☐ TRAFFIC MANAGER
☐ Marine Engineer	☐ Railway Accountant
☐ Ship Draftsman	☐ Commercial Law
☐ ARCHITECT	☐ GOOD ENGLISH
☐ Contractor and Builder	☐ Common School Subjects
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Concrete Builder	☐ Railway Mail Clerk
☐ Structural Engineer	☐ AUTOMOBILES
☐ PLUMBING AND HEATING	☐ Mathematics
☐ Sheet Metal Worker	☐ Navigation ☐ Spanish
☐ Textile Overseer or Supt.	☐ AGRICULTURE ☐ Teacher
☐ CHEMIST	☐ Poultry Raising ☐ Banking
☐ Pharmacy	

Name_____

Present Occupation_____ Business Address_____ 1-1-21

Street and No._____

City_____ State_____

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada

U. S. Government Wants



$1600 FIRST YEAR

Raise to $2300

Common Education Sufficient

Men—Boys over 17

COUPON

FRANKLIN INSTITUTE
Dept. H-183, Rochester, N.Y.

Sirs:—Send me, without charge, (1) sample Railway Mail Clerk Examination questions; (2) schedule showing places of Spring U. S. Government examinations; (3) list of other government jobs now open, and (4) free book describing them.

Name.....

Address.....

THE WORLD'S LARGEST
and
MOST BEAUTIFUL THEATRE

Offers Unusual Possibilities to
Live Advertisers
Through the Advertising Columns of its
Souvenir Magazine Program

The largest volume of Class Circulation of any Theatre Program in the world.



More than 50,000 weekly

A copy of the Program and Advertising Rates will be mailed upon request. Also an illustrated booklet "Some Interesting Facts about the World's Largest Theatre."

TARBEL PUBLISHING CORPORATION
1431 Broadway, New York

We Carry A Complete Line of Hot Wire Meters

Roller-Smith Hot Wire Meters

O—1A - - - $7.00 O—2.5A - - - $7.00 O—5A - - - $7.00
O—15A - - - $7.50

Roller-Smith D. C. Voltmeters

O—150 - - - $12.00 O—500 - - - $14.00 O—600 - - - $14.00

We Also Carry Westinghouse and Western Electric Makes

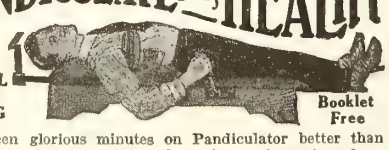
EXTRA SPECIAL **100** Practice Key Outfits for beginners, without coil, now on sale. A bargain—reduced from 75c—now 50c net.

A Full Line of Radiometers from $4.50 up to $8.00

American Electro Technical Appliance Co.
Everything in Wireless Apparatus
235 FULTON STREET - - - - NEW YORK

LEARN WIRELESS
Code is most important feature.
No student of Dodge Short Cut One Hour Method fails to
MEMORIZE CODE
without using Key or Automatic.
Many master Code in One Hour,
LEARN INSTRUMENTS
after and make Rapid Progress to Success and License. Convincing Testimonials from 35 states, free.
INVESTIGATE
DODGE, Box 300, Mamaroneck, N. Y.

PANDICULATE FOR HEALTH



BE WELL
YOUNG
STRONG
Booklet Free

Fifteen glorious minutes on Pandiculator better than two hours in gymnasium. Refreshes, rejuvenates; frees impinged, irritated nerves; corrects contracted muscles, spine ligaments; relieves congestion, improves circulation and body drainage. Doctors recommend it. No electricity, no discomfort; delightfully restful. Write now.

PANDICULATOR CO., 332 Prospect Bldg., Cleveland, Ohio

of cathode rays to play in the highly rarefied air. "That is a stream of electrons," he said. "Now I will show you that some of these cathode rays can be bent by a magnet in the same way that it would bend fine wire. Others of these rays will be unaffected, and still others will be bent in the opposite direction. These three rays are called Alpha, Beta and Gamma after the first three letters of the Greek alphabet. They are penetrating rays and doubtlessly have a far-reaching effect upon the life processes."

From a drawer in the table he took a series of negatives showing how he had actually bent light rays from their course by the action of his powerful electro-magnetic coil. Next he took a large photographic plate wrapped in red paper and laid it on a metal table. He covered it with a piece of wooden board more than two inches thick and adjusted his powerful X-ray tube over it in such a way that the rays would pass thru the intense magnetic field of the coil. After letting the rays play on the board for a few moments he took up the plate and handed it to his assistant for development. He then once more turned his attention to the nerve fiber, and showed how it, like all other magnetic substances, possessed distinct polarity, one end being apparently attracted and the other repelled by the magnet. "All human tissue, whether in health or disease manifests this power," he averred. "Health has been called the electro-positive condition of the cell, and disease its opposite. The electric and magnetic polarity of an organ is now being utilized by some of the world's foremost diagnosticians in their efforts to determine the extent and severity of physical disease. Some day we will speak in familiar terms of normal and abnormal polarity when discussing matters of pathology.

"Life manifests the same characteristics as do magnets, and electrified bodies. Sex is a matter of polarity; it can be demonstrated by suitable devices. The right hand of a man is positive, the right hand of a woman is negative. The right eye of a man is positive, the right eye of a woman is negative. Speaking in general the body of a male is positive, and that of the female negative, altho in each the organs have positive and negative poles of opposite character according to sex, the only exceptions being the heart, the right side of which is positive, and the left side of which is negative in both sexes, and the large arteries and veins, the first being positive and the latter negative. The veins in both sexes are negative. For the rest the polarities of the two sexes are opposite. Dr. Albert Abrams of San Francisco, Calif., and others have done a great deal of work in this field," he explained.

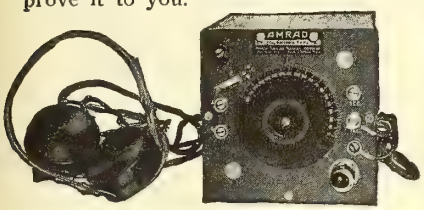
"How is this possible if it is not due to the iron in the substance of the tissues?" I urged.

"All matter conducting electric energy shows polarity, which is only another way of saying that it has a point of taking in, and giving off energy. The polarity is both magnetic and electric, due to the electric currents set up in the organism as a result of magnetic transformation. The contact of the sexes is necessary for the complete oxidation of the system as well a for procreative purposes. The meeting of suitable polarized individuals stimulates the metabolism of both and soon becomes evident in an improved physical appearance of the individuals so united. Iron may play a part in it; but much of it is probably due to molecules, the joint molecular weight of which falls well within the fifty. Such molecules have a magnetic effect, and doubtlessly play rather a complex part in the mechanics of life."

He removed the nerve fiber from the

wireless music in your bedspring

THERE is wireless music in your bedspring. If you didn't know it, the Amrad Crystal Receiver will prove it to you.



THIS wonderful, practical, compact radio receiving set enables *you* to enjoy the mystery of wireless—right in your own home. Has a range of several hundred miles when properly installed and transmitting conditions are favorable. Yet so easy to operate even the village idiot can receive signals.

Radio for Everybody

An elaborate outdoor antenna unnecessary, though, of course, it gives better results. You can use your bedspring for the "aerial," water pipe or radiator as the "ground" and actually hear radio music, radio telephone conversation or radio telegraph messages.

No upkeep cost—no license required—no danger whatsoever. Wave length range from 180 to 750 meters. As the Amrad Crystal Receiver is only 5x5x7 inches, you can easily carry it around with you and use it wherever you choose.

This remarkable wireless outfit is no electrical toy but a scientific product, built by experienced radio engineers—men who have labored long and carefully to make possible such a compact, practical and efficient receiving set as this.

Complete information in Bulletin Y gladly sent free on request. Write for it.

PRICES

Amrad Crystal Receiver.....$23.50
Double Telephone Head Set.... 4.50
Antenna and ground equipment.. 12.00

Informative operating instructions included free with each set.

AMERICAN RADIO AND RESEARCH CORPORATION

17 PARK ROW, NEW YORK CITY
Factory: Medford Hillside, Mass.
Address New York



KNOBS

We have a large stock of knobs as illustrated. This knob is made of "Insulate" and is 1 inch in diameter with a 5/8-inch 3/32 threaded shank. Just the thing for rotary switches.

No. 4 Knob, each 15c; Per dozen $1.50
Shipping weight, each 2 ozs., per doz. 1 lb.

OTHER BARGAINS

Young & McCombs rotary spark gap, shipping weight 4 lbs. $16.00
Young & McCombs saw tooth rotor, shipping weight 1 lb. $4.50
De Forest variable condenser, shipping weight 2 lbs special price $5.75
Skinderviken transmitter button, shipping weight 4 oz. . . $1.00
Acme 1-2 K. W. semi-mounted transformer, shipping weight 30 lbs. $22.00

Send 15c for our big illustrated catalogue. This amount may be deducted on your first order for $1.50 or over. High printing costs make free distribution impossible.

ELECTRICAL SPECIALTY CO.
Dept. E. 48-50 S. Front St. Columbus, Ohio
Dept. E. 20 N. 9th. St. Philadelphia, Pa.

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.

silk string and attached to it a piece of spleen, explaining that this tissue was comparatively rich in iron, but when he brought the magnet in close proximity, the action while positive, was nevertheless much weaker. "These effects," Doctor Pringle continued, "while positive here, are much more so in the living organism. Several prominent physicians are already using this form of energy in their diagnostic work with no little success.

"But what I want to call to your attention, is not the diagnostic value of this force, but rather its physiologic effect. I want to show you that the metabolic and functional activities of various cell groups are stimulated thru the intensification of the magnetic field. For instance, we know that normally the human stomach lies in an atmosphere of tympany, that is, upon percussion it yields a certain degree of resonance. Now if I percuss the stomach of an individual when he faces west and again while he is facing south a perceptible difference in the tone of the organ may be noted by the trained ear. The difference in the direction in which the magnetic lines of the earth traverse the body affects the tonicity of the stomach musculature. You do not consciously experience these effects. That is the reason when I make the bare statement, you are apt to smile, as we all smiled at obscure phenomena before the day of radio-activity.

"Not only does the magnetic field of the earth affect the tonicity of the stomach muscle but its intensification upon the back, at the root of the neck, by means of a powerful electro-magnet will affect the position, not only of the stomach but of the liver and spleen as well.

"Now if magnetism does affect the body cells which are comparatively neutral, how much more will it affect the very susceptible nerve cells thruout the body as well as in the brain. We have seen that the nerves are more susceptible to magnetic action than are the visceral organ, and therefore it is only logical to conclude that the reactions set up by magnetic variations within the brain mass, must be correspondingly more intense as well as more complex than they are in other tissues; that may account for the fact that the brain is the function-governing tissue. If we could compute the effect of the earth's magnetism upon the brain I believe we would find one of the determining causes of human conduct as well as a clue to the real source of energy. But as it is, this universal, uninsulable energy is as yet an unknown factor in the science of psychology and we are to that extent believers in free will."

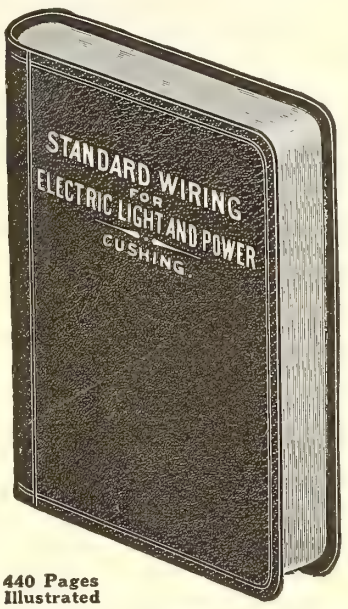
Returning to the laboratory table he drew to himself a rather complex looking instrument between two poles of which he fastened the sciatic nerve in the muscles of a frog's leg. I noticed that to one of the poles there was attached a small metal arm, the other end of which rested lightly upon a rotating cylinder.

"This is a frog leg receiver," said he, "and the waves traced by this little arm on the smoked surface of the cylinder is a message sent by a British Columbia radio station to Shanghai, China. This experiment was first performed by a French physiologist. He connected the frog leg into a microphone circuit and produced this marvelous proof of responsitivity of the nerve cell to magnetic change.

"Radio waves, as you know are nothing but oscillations in the earth's magnetic field and if they affect the nerve cells in a dead frog's leg how much more must they affect the infinitely greater nerve mass of the human brain. This may explain the phenomena of telepathy, if really such exists, for as Dr. Abrams said,

LEARN WIRING
AND EARN $75 a Week

This latest Edition will make you an Expert



440 Pages Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

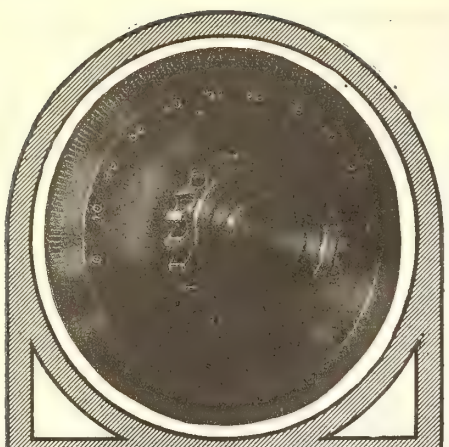
SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. 250 Electrical Units and their Definitions and Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve your wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges. Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.
8 West 40th Street New York



CORWIN DIALS

Judged by time, Corwin Dials are the oldest on the market; judged by design, they are the newest; judged by performance, they are the most satisfactory; and judged by price, they are the best value obtainable.

3" Dial, 75c—with knob, $1.30
3⅞" Dial, $1.00—with knob, $1.70

At all Radisco agencies and other reliable dealers, or sent postpaid anywhere

A. H. CORWIN & CO.
4 West Park St., Newark, N. J.

Service--
the Keynote

There is no guesswork about what GREBE RADIO apparatus will do. In design, workmanship and material it is built for the most exacting Service.

GREBE RADIO

apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service.

If your dealer doesn't carry our line, write us—mentioning his name—for catalogue.

A. H. Grebe & Co., Inc.
70 Van Wyck Blvd., Richmond Hill, N. Y.

PITTSCO

RADIO EQUIPMENT

Our catalog No. 22 illustrates everything in wireless. Send 10 cents in stamps for it.

F. D. PITTS CO.
Boston, Mass.
12 Park Square Dept. D

RADIO CLUB PINS

Special folder of designs and prices in addition to regular School pin catalog free on request. Be sure to see these new numbers which will put new life in your club.

IOWA CITY HIGH SCHOOL RADIO CLUB

METAL ARTS CO.
Dept. 12 Rochester, N. Y.

'all that we know about telepathy is that we know nothing, and we are not even sure of that.' Still it appears to me that the evidence for its existence is quite sufficient to warrant us in accepting the hypothesis of thought transference."

"But how do you explain volition?" I queried, wondering how far he would carry his mechanistic conception of things.

"We will what we must," he answered decisively. "Choice is a delusion due to the fact that we are not conscious of the forces acting upon and thru us. Our will is due to as yet inadequately understood changes in the chemistry of the blood, and, as we know, all chemical action is either due to, or the result of electrical action.

"In the year 1870 Fritsch and Hitzig made an important discovery in brain physiology, when by applying a galvanic current to one hemisphere of a dog's brain they succeeded in producing motion in the muscles of the opposite side of the body. I have experimented a great deal in this field, and have been forced to the conclusion that comparatively weak electric currents will cause the involuntary discharge of certain bodily functions. If a galvanic current thus crudely applied from without will travel down the nerves and act as a motor impulse to the muscles, how much more effective must such an impulse be when born from within in response to the physiologic requirements of the organism.

"It appears to me that the ethero-magnetic impulses stimulate the cells, and that in so doing they are transformed into electronic energy. Perhaps electronic energy developed in the circulation may bring about brain reactions terminating in bodily functions. Be that as it may, I am persuaded that mental phenomena in man, while as yet imperfectly understood, are completely under the domination of natural law. I cannot conceive of man as being the only anarchist in God's Kingdom."

He leaned back in his chair and smoking his cigar, meditatively watched the tiny ringlets as they floated lazily upon the air. He picked up a large magnet and played with it whimsically. I noticed that there was just the faint glint of a smile playing about the corner of his mouth. Evidently he was contemplating another phase of the subject. A moment's silent thought seems to open new vistas of scientific wonders to his mind's eye. He no sooner catches a vision than he takes you with him into it as his mental guest.

Suddenly he whirled around in his swivel chair and remarked: "From your appearance I judge that you are suffering from some chronic malady, the nature of which possibly baffles both you and your physician. Now if you do not mind I will tell you in the latest and most scientific manner just what your disease is, and where it is located, and in doing so, we will step out of consideration of magnetism, and into that of the physical effects of electronic energy.

"If you will strip to the waist and stand upon this zinc plate I will deflect into the body of my Japanese servant the abnormal cell tone to be found in yours."

"Doctor," said I, with mock solemnity, "much reasoning on this subject drives you to madness."

"Ah," he replied, "I wish you were even as I."

At the further end of the laboratory was a low bench extending along the wall, and upon it were two zinc plates to which a small wire chain was fastened. The chain from both plates was attached to a grounded metal. To one of these chains a wire had been attached which connected with a little boxlike affair having a couple of metal levers and a series of buttons

Genuine

BAYER

Aspirin

Always say "Bayer"

Unless you see the name "Bayer" on tablets, you are not getting genuine Aspirin prescribed by physicians for 21 years and proved safe by millions. Directions in package.

Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid.

AFTER 40?

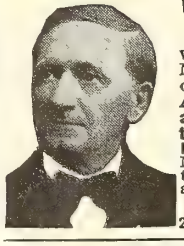
A PLEASINGLY written booklet for men near or past middle life. It concerns a simple, drugless treatment that cannot interfere with daily work or doctor's care. It has delighted thousands, is prescribed by hundreds of physicians and indorsed by intelligent laymen all over the world. A book of wholesome truth and helpful information. Just say: Send me, free of all charge, your

FREE BOOK

on gland faults. If depressed in spirit; if backache, sciatica or tender feet annoy you; if nerves are exhausted; if bladder weakness, gland faults and disturbed slumber undermine your health, you will bless this book. Do it now before you forget where you saw this notice. For complete information be sure to mention your health fault.

ELECTROTHERMAL COMPANY
81F Kirk Bldg., Steubenville, O.

Don't Wear a Truss



We Guarantee Your Comfort

with every Brooks' Appliance. New discovery. Wonderful. No obnoxious springs or pads. Automatic Air Cushions. **Binds and draws the broken parts together as you would a broken limb.** No salves. No plasters. No lies. Durable, cheap. Sent on trial to prove it. Full information and booklet free.

C. E. BROOKS
203D State St. Marshall, Mich.



"BOW LEGS and KNOCK-KNEES" UNSIGHTLY

Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.

PERFECT SALES CO.
140 N. Mayfield Ave., Dept. 50, Chicago, Ill.





X-RAY WONDER!

GREAT CURIOSITY! With it you can apparently see the bones in the fingers, the lead in a pencil, even the flesh seems transparent. Always ready for use. LOTS OF FUN.

Price 50c. **UNITED SALES CO.** Springfield, Ill.

Do you know that we can train you in a short time to become a first class radio operator?

Our school is equipped with the latest in arc and spark apparatus.

We have the most experienced instructors, all of whom have been in radio for years.

You may use our dormitories, swimming pool, restaurant, etc.

Write to-day for booklet

Y.M.C.A. Radio School
152 East 86th Street, N. Y. C.
"The Best Radio School in the East"

"IF IT'S RADIO WE HAVE IT"

We list below a few good values from our large and complete stock, which in addition to our own products includes accessories manufactured by other reliable concerns.

Amplifying Transformer	$5.00	Baldwin Navy Type Receiver	$16.50
Bamboo Spreader, 12 ft.	2.25	Brandes Superior Receiver	8.00
Electrose Insulator, 10 in.	.75	Murdock Receivers, 5,000 Ohms	4.50 and 5.50
Electrose Insulator Ball	.35	Marko Storage Batteries, 6 V.,	
Lightning Switch	4.50	40 A.	16.25
Antenna Switch.	4.50	Marko Storage Batteries, 4 V.,	
B. Batteries, 22½ V., 1,200-hour capacity	3.50	40 A.	10.75
B. Batteries, 4½ V., 200-hour capacity	.40	E. R. Det. Tube	6.00
Variable Condenser, Conn. .001	6.50	Amplifier Tube	7.00
Variable Condenser, C. E. Bal. .001	9.50	Transmitter Tube	7.50
Variable Condenser, Murdock .001	4.75	Radistron Det. Tube	5.00
		Ace V. T. Socket with Grid Leak	1.50
		Wixico Coil Mounting, Table	8.00
		Wixico Coil Mounting, Panel	6.00

Mail orders receive prompt attention. Send 3c stamps for catalogue.

THE PRECISION EQUIPMENT CO.
Dept. E 2437-2439 Gilbert Ave. Cincinnati, Ohio
"You May Pay More But You Can't Buy Better"



Packard

The most powerful transformer that can be used for amateur purposes under the government regulations. Owners of the 1/2 K. W. 13,200 high voltage type report distances of 450 to 900 miles. This cannot be equalled, using any other make of wireless transformer for amateurs.

Adjustable power, large overload capacity, and safety spark gap are but a few of the many good points.

With the PACKARD you will be leader of all operators in your district.

Write for our illustrated bulletin.

WARREN OHIO — The Packard Electric Company

Wireless Transformers

Get your radio goods from

a store where your orders will receive attention from the owners of the business. You can be sure of the utmost in courteous treatment and interested helpfulness from

KELLY & PHILLIPS
The Radisco Agency in Brooklyn
312 Flatbush Avenue, Brooklyn, New York

arranged in circles. He called this little contrivance an "Ohm-meter."

Placing the Japanese on one of these zinc plates, he carefully tapped on his abdomen beginning from the lower portion up, and then from the chest down, and then from the side toward the middle, and as he tapped he marked with a pencil wherever the sounds changed, until he had drawn an odd looking device on the bare abdomen of his subject. "Notice," said he, calling my attention to the figure as well as to the position of his subject. "This boy is standing with his face to the north, now I will place him facing west and we will see what happens." Again he percussed and marked and this time with quite different results.

"You see," he went on, "when the magnetic flux goes thru him sideways the muscle tone is increased, just as it was when I placed a large magnet on his back near the root of the neck. A noted scientist in San Francisco has demonstrated that a concentration of magnetism will affect the stomach dullness of people at a considerable distance.

"Please stand on that other plate and face west," he urged and as I did so, he once more belabored the abdomen of the Jap, and traced out the area of "dullness." It was distinctly different from what it had been on former trials. Untrained as I was, I could clearly notice the slight but distinct alteration in sound.

"You have had malaria," announced Doctor Pringle. "The rate of electronic vibration transmitted from your body over the conductor reveals that condition in this healthy subject."

I was amazed, for more than twenty years ago I really had suffered with malarial chills and since then, with a variety of slight, but nevertheless troublesome symptoms.

"Now then," said Doctor Pringle, "we have seen that the cell is influenced by light in the lower animals, and that magnetism affects the higher animals, and now I will give you a little demonstration that tends to prove that all cells are basically the same, for, as you shall see, light also affects your organism to different extents according to the color and intensity of the light employed."

Placing me in another position he darkened that part of the laboratory and proceeded to drum on my abdomen, while the Jap threw red, blue, green, orange, and other shades of light upon that part of my anatomy, and with each change of light there was a change of tone in the percussion sound.

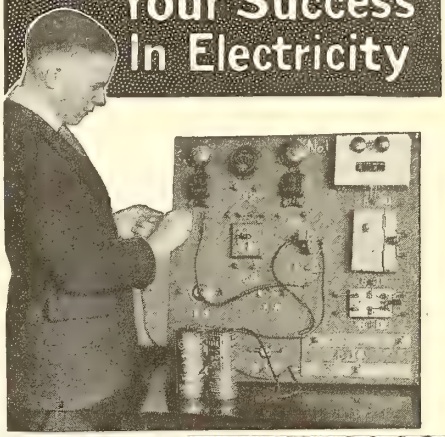
"Yes, you have had malaria," he reaffirmed; "the Star-White light method of diagnosis verifies the findings of the electronic method of Abrams. It is positive."

And so it was, as I was forced to admit.

While I was replacing my garments after this scientific ordeal, the Doctor admitted the light into the laboratory and began replacing the tools he had used in his experiments. While busy with these things he remarked, "I have told you a good deal about these forces that continually play upon us without our knowledge, yet it is true that more of these forces unite and blend together in the phenomena of life than anywhere else in the physical or chemical universe. Life may be the word of creation, the process of ether becoming matter. I sometimes call it the borderland between the etherial and the concrete. Life and mind do not come out of the earth, but mingle with it, and express themselves thru certain elements of it, giving rise to organic forms. And yet Bose may be right that all matter may be the result of life.

"To make a long story short, mind and life are two phases of the same thing. They are the positive and the negative poles of 'creative force.' This force

A Short-Cut to Your Success In Electricity



FREE ELECTRICAL LABORATORIES Sent to your home

NOT toys—but real actual-size, expensive units of electrical apparatus are loaned to you without extra charge while learning. The illustration shows one of the home-laboratories. As fast as you have completed the work of one laboratory, another is sent, until you have mastered the entire field. You, therefore, advance step by step, from simple electrical experiences to complicated, intricate, important practical work.

Learn Electricity This New Way

You can get the finest electrical training at home in your spare time. You need not leave your job, your friends, your home. This wonderful, new home study course in Practical Electricity brings this great, big technical school to your very door—into your very room. It develops ability, step by step and leads you to every reward the great field of electricity can offer. Ninety electrical experts offer you a short cut that combines theory and practice, eliminating all the non-essentials. The plan is so simple—so logical—so carefully arranged, and also so interesting, that in a surprisingly short time you will have made yourself a master of technical electricity.

The Rich Electrical Field

The electrical field is rich in opportunities for the trained man. Billions of dollars are invested in this great industry. Trained experts are in demand and handsome salaries are paid. You can easily master the work through our "home-laboratory" plan of home study so that you can step into the industrial field without additional coaching.

Valuable Illustrated Book Free

Send the coupon today for a copy of "The Short Cut" giving full information on our "home-laboratory" method of home study. You will be surprised to see how easy it will be for you to secure your electrical training. Just fill out the coupon today and make the start toward a great future in the electrical field. Mail the coupon now.

Extension Division
SCHOOL of ENGINEERING of Milwaukee
Dept. SI-3—373 Broadway, Milwaukee, Wis.

(COUPON)

Extension Division,
School of Engineering,
Dept. SI-3—373 Broadway, Milwaukee, Wis.

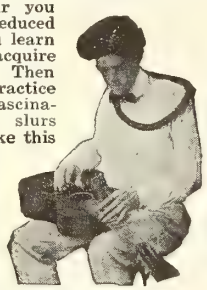
Please send me my copy of the "Short Cut" giving details of your home laboratory method of study in Practical Electricity. This request obligates me in no way.

Name .....
Address .....
Town ..... State .....
Age ..... Education .....

Play the Hawaiian Guitar

Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs and other effects that make this instrument so delightful. The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Your tuition fee includes a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 complete lessons and pieces of music.



Special arrangements for lessons if you have your own guitar.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK

I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc., etc.

Name .....
Address .....
Town..... State.....E. E.
Write Name and Address Clearly

ABC Standardized Radio

Professional Radio Equipment at Amateur Prices!

IT TOOK three years to develop the *ABC* line of Standardized radio apparatus. Many of the instruments, and all of the small parts are now ready for the market. Automatic machines are turning them out quicker, better, and cheaper than ever before. Send a nickel for our advance booklet. It describes the small parts, the *ABC* sectional unit cabinets, the variable condensers, the new mica grid condenser, the Vibratone, Jr., etc. *Send for the booklet to-day.* You'll find it interesting.

Wireless Equipment Co., Inc.
188 Greenwich Street, New York

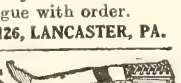


FREE This CAMERA is given to you for selling only 40 packs of "Quality Brand Garden Seeds" at 10c per packet. Order today. **Send no money. We trust you.** When sold return $4.00 collected and the **Camera** is yours. Cash commission if preferred. Many other valuable presents. Catalogue with order.



NATIONAL SEED CO., Dept. 126, LANCASTER, PA.

"FIBRE-LITE" LIMBS



Easy Payments—Do Nature's Work. AGENTS WANTED who wear leg. Good Pay. FREE Fibre Sample.
Describe Stump to
WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.

gives rise to all forms of matter according to the resistance offered by the electronic aggregates upon and thru which it manifests itself.

"The facts that light affects magnetism and magnetism gives rise to electricity and electricity gives rise to atoms, and that gravitation affects them all according to mass and distance, and that none of these forces are constant, lie at the bottom of that complexity of phenomena we call mentality or mind. If we could only measure them accurately enough we could then determine what any brain mass or type would do under any given set of circumstances.

"I have not yet shown you my exeriments in raising plants and animals under differently colored lights. You ought to stay with me a week so that I could give you a better idea of what I am trying to accomplish, but for today we have had enough. Let us go upstairs and see what mother has for the inner man."

Ozone and Its Liquid State

By JOSEPH H. KRAUS

(*Continued from page* 1204)

The cooled air then passes thru one compartment of a two-walled tubular coil thru the other compartment of which, cold nitrogen coming from the ozonizer flows. The effect of the nitrogen is to further cool the air. From here, the cold air passes to an expansion engine where it is relieved of its pressure and assumes a pressure substantially the same as in the atmosphere, and consequently, due to this sudden expansion, it is greatly reduced in temperature and brought to a pre-determined temperature heretofore specified, namely to a point below the liquefication temperature of ozone, but above the liquefication points of both oxygen and nitrogen.

The result is that certain gases in the air will liquefy, such as, for instance, carbon dioxid. This is drawn off in the trap suitably arranged for that purpose, and the liquid carbon dioxid is again used in the dryer.

We now come to the final stage of the process, and perhaps the most important, where the oxygen is converted into ozone, and after being so formed, immediately liquefies. This apparatus, consists of a number of double walled tubes, lined inside and out, as shown in the diagram, with a coating of metal, capable of conducting a current or accumulating a charge of electricity.

The air passing between these walls, changes its oxygen to ozone whenever a high enough potential of electricity is being applied to the metallic electrodes in the ozonators. Due to the extremely low temperature, liquid ozone falls to the bottom of the tank and yet no other gas liquefies. It then circulates into another compartment below the tank, where it is kept cold by nitrogen circulating thru that compartment in coiled tubes.

It can now be drained off whenever required. We are thus able to obtain a liquid ozone, 100 per cent pure, and do not need to quote its concentration in grams per cubic meter.

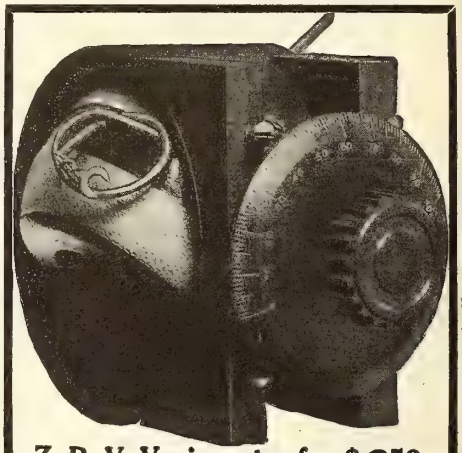
EXPERIMENTORS

Attention

¼-HP New General Electric Motors
110 Volt—Single Phase—1725 RPM
$22.50

⅙-HP New Westinghouse Motors
110 Volt—Single Phase—1725 RPM
$18.00

VIM ELECTRIC & MOTOR CO.
Incorporated
66-68 Cortlandt Street
New York City



Z. R. V. Variometer for $6.50
Short Wave Lengths
Complete catalogs of Radio Apparatus sent for 6 cents in stamps.
CLAPP-EASTHAM COMPANY
131 Main St. Cambridge, Mass.



DEAFNESS IS MISERY
I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my sworn statement of how I recovered my hearing.
A. O. LEONARD
Suite 369, 70 5th Avenue -- New York City

LEARN WIRELESS

At the **OLDEST, LARGEST** and **BEST EQUIPPED** school of its kind in New England. Thousands of satisfied graduates all over the world. Splendid opportunities in the Merchant Marine. Day and Evening classes. Start any Monday. Illustrated Prospectus for the asking.

EASTERN RADIO INSTITUTE
899E Boylston St. Boston, Mass.

TYPEWRITERS



Guaranteed
standard makes, fully inspected, strongly rebuilt, $5.00 down, 6 months to pay balance. Send us your address and we will mail you at once details of the
Most Startling Offer
in typewriter values. Don't miss this genuine opportunity to secure your machine at a price you'll gladly pay.
International Typewriter Exchange
Dept. 23 177 North State Street, Chicago
$5.00 DOWN



$12.50

NEW 1920 REDHEAD PHONES
We announce the new model of the famous Red Head Radio Receivers, greatly improved, 3200 ohms, $12.50 the pair.
THE NEWMAN-STERN CO.
Dept. E. E. Cleveland, Ohio
Distributors for DeForest, Murdock, Signal, Bunnell and other famous lines.

1921 Model Warranted Watch **$2.95**
to introduce our watches. Thin model, beautifully polished silveroid case. Men's and women's size. Fitted with high grade movement, fully tested. Stem set and stem wind.
EVERY WATCH GUARANTEED
$2.95



C.O.D.
Send us your name and address plainly written, at once. We'll send this beautiful watch by return parcel post. Pay postman only $2.95. Test this 1921 timekeeper in every way. If not satisfied return it. We'll refund your money. Send your order TODAY.
Cambridge Watch Co., 350 Cambridge Bldg., Chicago, Ill.



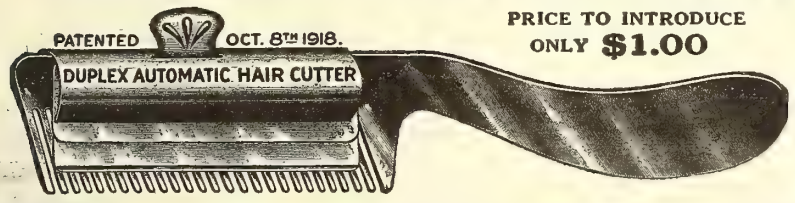
Big Band Catalog Sent FREE
Anything you need for the band—single instrument or complete equipment. Used by Army and Navy. Send for big catalog, liberally illustrated, fully descriptive. Mention what instrument interests you. Sold by leading music dealers everywhere.
FREE TRIAL—EASY PAYMENTS
LYON & HEALY
63-98 Jackson Boulevard CHICAGO

French Scientific Medal Awarded to W. W. Coblentz of the U. S. Bureau of Standards

The French Academy of Sciences has awarded the Janssen Medal to William W. Coblentz, physicist in the Bureau of Standards at Washington, for his discoveries in connection with rays emanating from the earth and stars.

William W. Coblentz is a native of Ohio. He has been attached to the Bureau of Standards for twelve years and has developed a method of measuring radiant heat by infra-red and ultra-violet rays. He has devised an instrument for astronomers with which to measure heat from the stars, and also developed in the course of the war signal instruments for ships at sea and an instrument for detecting moving bodies, such as ships, by their heat emanations in the dark.

CUT YOUR OWN HAIR EASIER THAN SHAVING



PRICE TO INTRODUCE ONLY **$1.00**

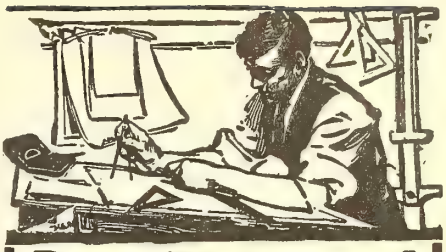


You do not need any experience or practice to use the **DUPLEX AUTOMATIC HAIR CUTTER.** It comes to you ready for instant use, and five minutes after you receive it you can have your hair cut better than it was ever cut before.

The **DUPLEX** will cut as closely or trim as long as you wish it to. No clippers or scissors are needed with the **DUPLEX;** it finishes the work completely. It cuts the front hair long and the back hair short. Trims around the ears, etc.

Inside of a very short time you will have to pay $2.00 for the **DUPLEX.** The price today is $2.00, but while our present stock lasts we will accept this advertisement the same as $1.00 Cash. Cut it out and send it with ONLY $1.00 and we will send you the **DUPLEX AUTOMATIC HAIR CUTTER** ready for instant use, postage paid, to any address. SEND TODAY.

Agents Wanted. **DUPLEX MFG. CO., Dept. 66, Detroit, Mich.**



Be a Draftsman!
Make $40 to $100 a WEEK

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $40 to $100 weekly.
LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial
CYCLOPEDIA OF DRAWING
4 Volumes. 1650 Pages. Thousands of illustrations.
Bound in genuine American morocco. Pages 6½ x 8¼ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.
75c a Week Only $3 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.
Free Membership in This Society.—A Consulting Membership **given free** with each set—worth $12.00.
AMERICAN TECHNICAL SOCIETY
Dept. D-253, Chicago, U. S. A.



AMERICAN TECHNICAL SOCIETY
Dept. D-253
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $3.00 a month until $19.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....

MURDOCK
No. 55

THE PRICES ARE UNUSUALLY LOW

2000 OHM DOUBLE SET

$4.50



THE QUALITY IS REMARKABLY HIGH

3000 OHM DOUBLE SET

$5.50

RIGHT IN PRICE AND IN PERFORMANCE

The substantial success earned by these receivers can be attributed to the instant recognition of their remarkable value by thousands of users. If, by chance, YOU are dubious regarding the possibility of securing really good 'phones at such prices, we suggest a trial, with the customary assurance of "satisfaction or money back." Ask your dealer for them.

BULLETIN No. 20 now ready for distribution. Send for your copy.

WM. J. MURDOCK CO. **55 Carter St., Chelsea, 50, Mass.**
509 Mission Street, San Francisco, Cal.

Opportunity Ad-lets

Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted. Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the May issue must reach us not later than March 22.

The Circulation of Science and Invention is over 140,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York City, N. Y.

Aeronautics

Learn to Fly. America's oldest and most reliable Flying School. Complete Ground and Flying Instruction. We guarantee to make you an expert Pilot. Third Successful Season. Dozens of satisfied graduates. Classes begin the first of each month. Write now for Literature and Catalogue. The Ralph C. Diggins Co., 140 N. Dearborn St., Chicago, Ill.

Aviation. Motor 30-40 H. P., 2 cyl., opposed air cooled, weight 128 lbs., ideal motor for light aeroplanes, motor sleds, wind wagons, hydroplanes, etc. Price only $325 complete, with propeller ready to run. Aircraft Inc., 338 Coney Island Ave., Brooklyn, N. Y.

New Airplane Free. Our Airplane School opens new class March 21, 1921; offers course of study requiring common school education, takes six months, costs $500.00. Course includes aeronautical designing, building, complete course in flying, flyer's license and without further cost a new 3 passenger airplane which has passed U. S. Govt. inspection and cost over $9000.00 to build. Investigate this proposition immediately. Limit under this offer 100 airplanes. Educational Dept. Poll-Eells Corporation, Airplanes and Motors, 157 Pearl St., Buffalo, N. Y.

Auto Accessories

Storage Batteries for Automobiles. We furnish all parts and moulds for making them. Sample plate 40c. Foreign Countries 50c. Windsor Specialty Co., 5419 Windsor Ave., Chicago, Ill.

Tire Agents. Exclusive representatives to use and sell the new Mellinger Extra-Ply Tires. (No seconds.) Guarantee Bond 8,000 miles. Wholesale prices. Sample sections furnished. Mellinger Tire Co., 980 Oak, Kansas City, Mo.

Auto Owners. Cut your gas bills by attaching Auxiliary Intake Plug. Fits any car. Never wears out. No adjustments. Complete with full instructions, $2.50. Big profits for agents. F. Kossatz, New Rochelle, N. Y.

Auto Motors Supplies. Buick, Michigan, Stoddard-Dayton, E.M.F., Cadillac, Overland, Continental and Buda Motors. All types $50 each and up. Special High Tension magnetos 2 and 4 cylinder $9.50 each. Electric and Gas head lamps, coils, carburetors, air compressors, generators, starters, etc. Write for catalog. Address Motor Sales Dept. 12, West End, Pittsburgh, Penna.

Blueprints. Automobile Armatures. See ad under "Electrical." Charles Chittenden.

Fords start easy in cold weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene, using our 1921 carburetors. Increased power; styles for all motors; can attach them yourself. Big profits to agents; money back guarantee; 30 days trial; Air Friction Carburetor Co., 1511 Madison St., Dayton, Ohio.

Ford Accessories, etc.

Ford Car Repair Book sent free. This complete, well illustrated, valuable book explains in a simple way the Causes and Cures of Overheating; Repairing Ford Timer; Curing Piston Ring Troubles; Carburetor Adjustments and Repairs; Connecting Rods; Transmission Troubles; Care and Repair of Rear Axle; Stopping Axle Grease Leaks; also covers practically every other phase of Ford Car Repairing. Send 25c. coin for three months' trial subscription and get the valuable repair book free. Ford Owner and Dealer Magazine, 403 Montgomery Bldg., Milwaukee, Wis.

Motors, Engines and Dynamos

Special Garage Motors. New, manufactured by General Electric Co. ¼ HP $22.75; 1 HP $88.50; 2 HP $126.50; 3 HP $146.50; 5 HP $188.50. All sizes both single and Polyphase Motors for immediate delivery. Special charging generators all voltages. Write for catalogue. Motor Sales Dept. 12, West End, Pittsburgh, Penna.

Motorcycles, Bicycles

Don't Buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 1603, Galesburg, Kans.

Tools, Supplies, etc.

Water Jet Vacuum Pump. Very efficient. Screw to ordinary faucet. Pump with instructions, $1 postpaid. J. Ciuzio, North Bergen, N. J.

Concrete Building Block Machines, and molds. Catalogue sent free. Concrete Machinery Co., 114 S. Second St., St. Louis, Mo.

Rubber Stamps

Rubber Stamps made to order. McCaddon Co., Zanesville, Ohio.

Agents Wanted

Sell Pudding Powders. Delicious dessert. Fast sellers; quick repeaters; big profit. Send for terms and sample. C. H. Stuart & Co., 3 Main, Newark, New York.

Great Magazine of cashable plans, tips, ideas for agents, home manufacturers and opportunity seekers; gives facts about mail business; three months, 25c.; sample copy, 10c. Special Service Magazine, Lancaster, Pa.

Beginners complete Mail Order System. EX. Box 1005, Altantic City.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Agents make big money because sales may be made in every home. Our modern aids to home sanitation have an appeal that cannot be resisted. A brush, mop or duster for every need. Liberal commissions and good territory. North Ridge Brush Company, 127 Clark St., Freeport, Ill.

Agents. $60 to $200 a week. Free Samples. Gold Sign Letters for Store and Office windows. Anyone can do it. Big demand. Liberal offer to general agents. Metallic Letter Co., 433Z N. Clark St., Chicago, Ill.

Agents. Sell our accident and sickness policies in your spare time. Pay $5,000 death, $25 weekly benefit. Premium $10 yearly. Permanent income from renewals. Easy seller. Liberal commissions. Insurance Co., Dept. N-4, Newark, N. J.

Agents. Our soap and toilet article plan is a wonder; get our free sample case offer. Ho-Ro-Co., 138 Locust, St. Louis.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Signs for Stores and Offices. Entirely new. $50 week easily made. Assorted working samples 25c. Chicago Sign System, E 326 River St., Chicago, Ill.

Agents Wanted. Big money-making proposition. Requires no work. Can retain present occupation. Write: Cash Sales Mercanite, 296 Broadway, New York.

Wide-Awake Men to take charge of our local trade; $6 to $9 a day steady; no experience required; pay starts at once. Write today. American Products Co., 2561 American Bldg., Cincinnati, Ohio.

Agents. We pay $9 a day taking orders for INSYDE TYRES. Best and easiest seller ever put on the market. Guaranteed to give double tire mileage. Any tire. No punctures or blowouts. Every auto owner buys on account of low price. Enormous demand. Write quick for agency. American Accessories Co., B684, Cincinnati, Ohio.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Help Wanted

Detectives in Great Demand. Men from 18 to 45. Experience unnecessary. Easily learned. Write Earl H. Wilcox, Dept. A, 232 Sheldon Avenue, Grand Rapids, Mich.

Silvering Mirrors, French Plate taught. Easy to learn, immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

Universal Shorthand Course (Pitman) makes stenographic experts in 36 lessons. Efficiency guaranteed or money back. Helps users of other systems increase pay. Easy terms. Write for Booklet 12. Universal Shorthand Course, 6609 Kimbark Avenue, Chicago, Ill.

Stop Daily Grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 48, Marion, Indiana.

Firemen, Brakemen, Baggagemen, $140-200, Colored Porters by Railroads everywhere. Experience unnecessary. 897 Ry. Bureau East St. Louis, Ill.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Men—learn wireless at home quickly and easily. Attractive positions now open for men qualified as radio operators, electricians, mechanics, inspectors and draftsmen. Beginner operators now averaging $200 per month; no previous experience or wireless education necessary to enter. Opportunity to travel and see the world or locate in land wireless work. Oldest and largest radio school in America; established in 1914. We train you through our home study course, or at our local schools to qualify for official license, and help you secure position on land or sea. Wireless outfit furnished for home practice. Free catalogue on request. National Radio Institute, Dept. 529, 14th and U Streets, N. W., Washington, D. C.

Help Wanted—Continued

Men Wanted for Detective Work. Experience unnecessary. Write J. Ganor, former U. S. Gov't. Detective, 135 St. Louis.

Wanted—By U. S. Government. Hundreds of Railway Mail Clerks immediately. Men; women over 17. Commence, $135 month. Quick raise to $195. Vacation with full pay. Women given office work. Permanent life positions. Common education sufficient. Examinations everywhere soon. List positions open and sample questions free. Write Franklin Institute, Dept. H 25, Rochester, N. Y.

Be a Mirror Expert. $3 to $10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Men Wanted at $35 to $100 a week to make mechanical drawings. Work is easy, pleasant, and leads to higher positions in Industrial Field at excellent salaries. We furnish set of instruments, train you at home, in spare time, by practical method and help you qualify for position. Write today for particulars. Roy C. Claflin, Pres., Dept. 1368, 14th & T Sts., Washington, D. C.

Be a Detective. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. Write American School of Criminology, Dept. B, Detroit, Mich.

Detectives earn big money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

Salesmen Wanted

Salesmen. Earn $3,500 to $10,000 a year. City or Traveling. Experience unnecessary. Quickly qualify through our amazing system. Free employment service to members. Send for Salesmanship book, list of lines and full particulars. Nat. Salesmen's Training Ass'n, Dept. 158C, Chicago, Ill.

American Made Toys

An Opportunity for Home Workers on small scale and manufacturers on large scale to make American Metal Toys. Army, navy, machine guns, cannons, warships, Indians, cowboys, wild animals, whistles, bird-whistles, religious designs and other toys and novelties. Greatest chance for industrious people to have an independent business. Enormous demand for cheap toys offers unlimited field and great future all over United States and foreign countries. Experience or tools not necessary. Hundreds and more made complete per hour. Casting forms, complete outfit from $3 up. We buy these goods, paying fixed prices. Attractive prices offered for painted goods. A strictly business proposition. No one need apply unless he means business. Booklet and information furnished free. We have no sales agents and we warn against worthless and cheap imitations. Toy Soldier Manufacturing Co., 1696 Boston Rd., New York.

Formulas

3,384 Money-Making Plans. Formulas, Trade-Secrets. "Encyclopedia Business Opportunities." 3 volumes $1.50. Ideal Book Shop, 5501-EV North Robey, Chicago.

Mechanics. Make your own Mechanic's hand paste soap. My special guaranteed formula; full instructions, $2. Raymond Harvey, Eitel Bldg. Seattle, Wash.

1,000,000 Formulas. Processes, Trade Secrets for every business. 1016 pages, $2.25. Ideal Book Shop, 5501-EE North Robey, Chicago.

Formulas—All Kinds. Guaranteed. Catalog 2c. Clover Laboratories, 5501-EC North Robey, Chicago.

For the Hair

Dandruff removed quickly, pleasantly, completely. Healthy scalp. For men, women, children. Wonderful benefit. Buy Kotalko at druggist's; or proof box mailed, 10 cents, postpaid. Kotalko Offices, BC-300, Station X, New York, N. Y.

For Men

Detectives earn big money. Travel. Great demand. Fascinating work. Experience unnecessary. We train you. Particulars free. Write, American Detective System, 1968 Broadway, N. Y.

Safety Razor Blades Sharpened. Two Cents each. Good work. Quick service. Send today. C. Wetterstroem, Liberty and Denman, Cincinnati, Ohio.

Send Us Your Dull Safety Razor Blades. We will resharpen them so that they will shave better than new ones for 3 cents each, any kind. Old fashioned razors reground and repaired. Satisfaction guaranteed or money refunded. Send two cent stamps, twenty-five cent books preferred. Keenedge Co., 1 S. Robey St., Chicago, Ill.

Volume VIII.
Whole No. 96

Science and Invention

H. GERNSBACK,- EDITOR
H. WINFIELD SECOR,- ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D.,- ASSOCIATE EDITOR

APRIL
1921
No. 12

APR 9 1921
PATENT OFFICE

200-Mile-Per-Hour Air-Propelled Railway

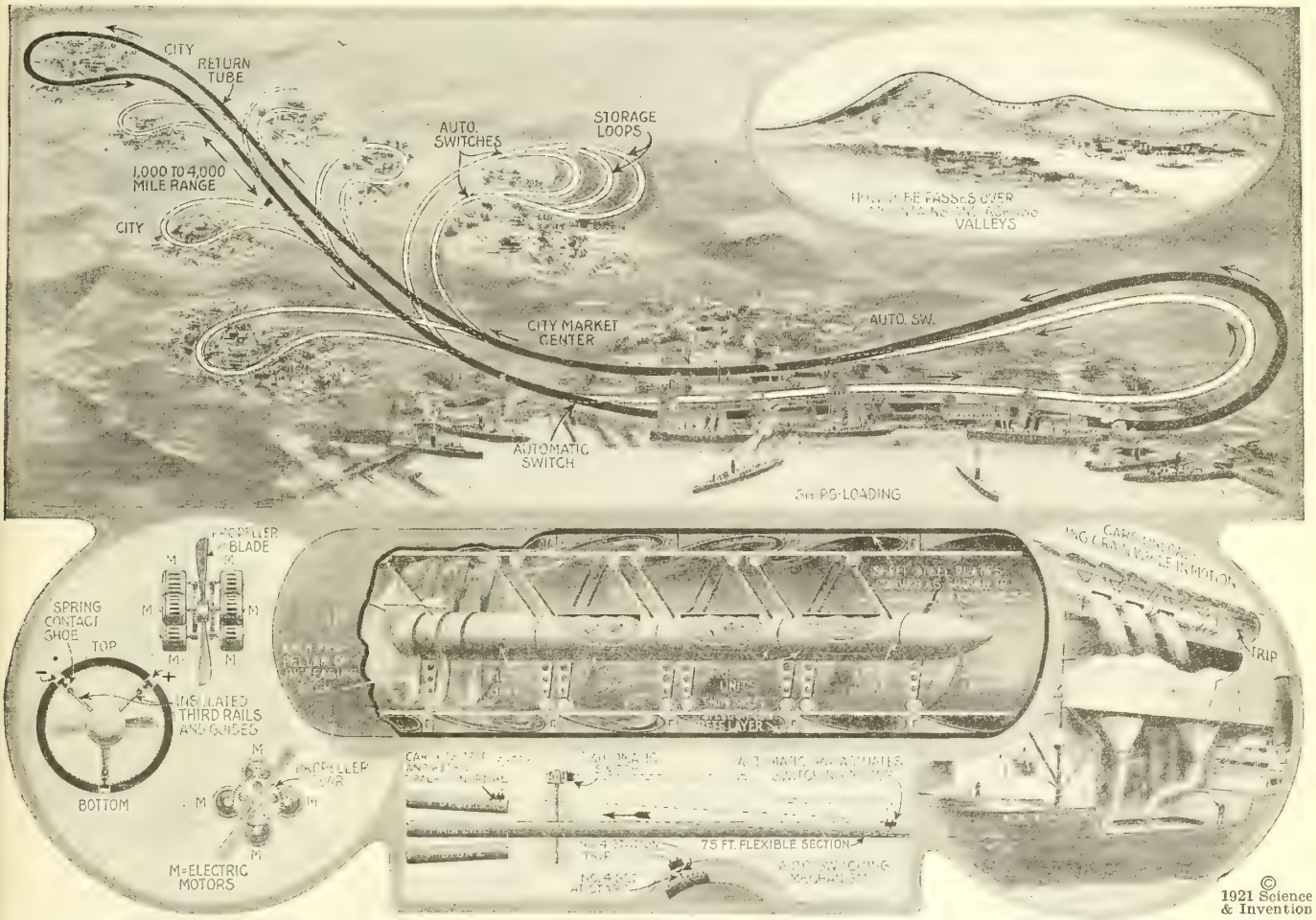
SEVERAL years ago, a Russian engineer and genius who was visiting the United States, proposed a remarkable scheme for carrying passengers as well as freight, mail and other matter thru a tubular railway system at velocities of 200 miles an hour and more, but the principal disadvantage of his system was that it was supposed to operate by a vacuum, i.e., the tubes were to be exhausted of air. Such a system as this would seem to our practical minded engineers, as being really too elaborate both from the operating as well as the constructional cost point of view.

An American inventor, Lester P. Barlow, who devised many ingenious devices successfully applied in the World War, and which helped the Allies to conquer the power of the Teutonic forces, has come forward with what appears to be a very clever invention for carrying mail and other material between different sections of the largest cities as well as between such cities as New York, Chicago, New Orleans, St. Louis, Philadelphia, etc.

In a few words, what Mr. Barlow intends to do, is to provide a steel tube, which need not be air-tight, and thru which a series of carriers or cars will shoot along at a speed of 200 miles or more per hour, being forced thru the tube at this high velocity by means of an aerial propeller or a series of three such propellers, mounted a short distance apart on the forward end of the engine unit of the train as shown.

These propellers are driven by electric motors, the motors receiving their electrical energy thru two insulated power rails as shown in the diagram in the accompanying illustration. The bottom rail is the main carrier member and takes the

(*Continued on page* 1340)

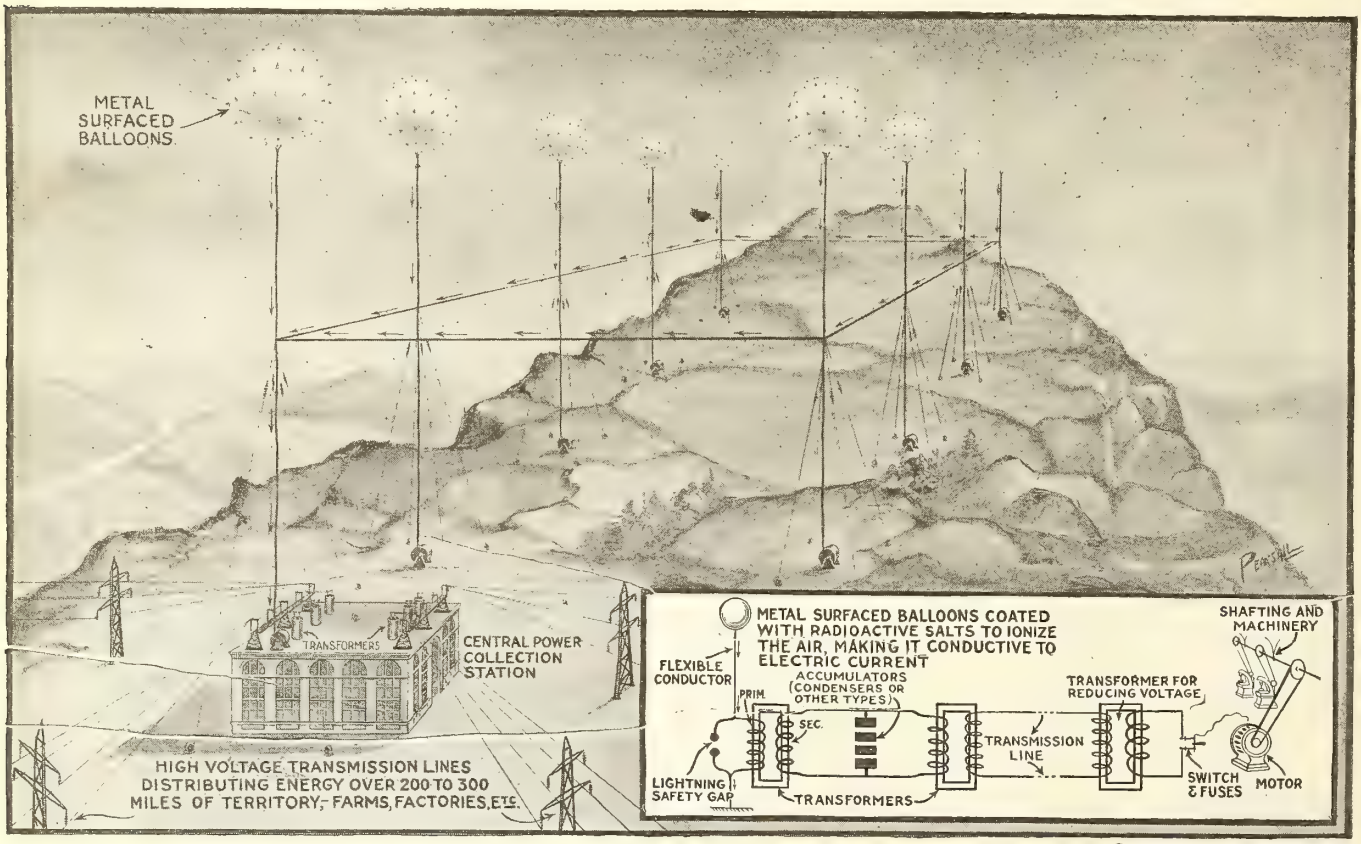


© 1921 Science & Invention

Mr. Lester P. Barlow An American Inventor, Who Developed Valuable Ideas Which Were Used by the Allied Military and Naval Powers During the World War, Has Turned His Talents Towards Peace-Time Uses, and Here Suggests a Remarkable Air-Propelled Railway, the Cars of Which Are to Be Propelled by Air Screws Similar to Those of Airplanes, At a Speed of 200 Miles An Hour or Greater. The View At the Top of the Illustration Shows How the Light Steel Tube Might, for Example, Connect the Principal Cities Along the Mississippi Valley From Chicago to New Orleans, Enabling Grain and Other Commodities to Be Automatically Transported Between Cities or Between the Great Lake Ports At the North and the Famous Gulf Port At the South With a Maximum of Speed and a Minimum of Labor. As the Detailed Drawings Show, the Cars Are Much Smaller Than the Tube So As to Provide Space for the Air Currents. The Cars Are Propelled by Electric Motors, the Current Being Fed to These Motors by Two Insulated Rails and Suitable Contact Shoes. Mr. Barlow Has Worked Out Details Whereby the Cars or Carriers Can Discharge Their Cargoes, While They Are Still in Motion, As Shown At the Left.

Electric Power From the Air

THE utilization of free electrical energy in the atmosphere surrounding our earth, has proven the magic goal towards which inventors have striven for several generations; but until recently there has been practically no headway made toward reaching the desired result—the obtaining of power from the air for economic uses. putting to work this free energy of the atmosphere. It is said that he has successfully demonstrated that if we send up metal-surfaced balloons or other surfaces and tap the atmospheric electrical energy, at elevations in excess of 1,000 feet, we shall be able to realize an average of 200 horse-power per square meter, which area is equivalent to 10.8 square feet. It is winter weather, the potential gradient often rises to as high as 300 volts per meter. This may seem somewhat hazy and in fact almost impossible of belief to the average person, and there are two reasons why we do not notice this startling difference of potential for every meter increase as we are elevated. One of these is that the electrical energy is



© 1921 by Science & Invention

Free Electrical Energy From the Atmosphere Has Long Been the Dream of Electricians and Scientists the World Over, But Little Has Been Done Up Until the Present Time in Trying to Adapt the Tremendous Quantities of Free Electrical Energy Existing in the Atmosphere to the Everyday Utilitarian Requirements of Mankind. The Present Article Deals With Some Recent Experiments Carried Out by Dr. Plauson, a German Engineer, Which Have Shown Some Very Interesting Results. It Is Said That This Scientist Has Successfully Demonstrated That If We Send Up Metal-Surfaced Balloons and Tap the Electrical Energy From the Atmosphere At a Level of 1000 Feet or More, We Shall Be Able to Realize an Average of 200 H. P. Per Square Meter, an Area Equivalent to 10.8 Square Feet.

In the early days of electric lighting, that is, back in the 70's and 80's, there were a number of scientific experiments carried out which received a great deal of publicity at the time, and whose recitals described how in the immediate future we would undoubtedly obtain our electrical energy for lighting and power purposes, from the atmosphere. But, as aforementioned, there has been practically nothing done in this direction until the present time, and there is a very good reason why but little has been done by scientific investigators and electricians in endeavoring to harness the natural electrical forces of nature, as resident in the atmosphere, for the everyday utilitarian requirements of mankind. This reason lies in the fact that the electrical power of nature, particularly when so-called thunder or electric storms hover above us, are not to be trifled with.

Recently there have appeared in a German publication, some notes on the new discoveries and experiments of a German scientist residing at Hamburg,—one named Plauson. Plauson has studied the subject of atmospheric electricity and its utilization for many years, and he has recently come forward with a clever scheme for even claimed that in his latest experiments, as great a quantity of electrical energy as 400 to 500 horse-power has been realized per square meter.

The atmosphere or air above the earth's surface, in normal weather, is charged with electricity, thus constituting an electrostatic field which is almost uniform and in which the surfaces of equal potential are parallel to the earth, or in which the lines of force are vertical. In the event of violent atmospheric disturbances such as before or after, and of course, during the course of electric storms, the atmospheric potential fluctuates and changes in polarity very markedly, as careful scientific investigation and measurements carried out in various parts of the world, have demonstrated.

Under normal weather and atmospheric conditions, the potential gradient, as it is called, of the atmosphere increases with comparative regularity as we rise above the surface of the ground. The atmospheric potential per foot or meter of altitude varies also, as may be well imagined, with the season of the year, and this potential or voltage has been found to average 100 volts per meter (3.28 feet) in the summer months, while during the cold mostly in the form of high voltage static electricity, but of small quantity, similar to that given off from large static machines. If you have ever stood under the discharge terminal of one of these machines and felt the *electric breeze* which sometimes causes the hair to stand vertically from the head owing to the very high voltage (but relatively small amperage or current present), the emf., of which may easily have been several hundred thousand volts, you were given a practical demonstration of how the atmosphere may be highly charged electrically and yet be unnoticed by the usual organs of sense.

Another reason why we know nothing of this increase in potential with elevation is that the experimenters usually do not have the proper instruments with which to measure the atmospheric potential, and therefore often lose sight of the fact that in the winter, for example, we may have present an emf. of 100 volts per foot. These high potentials, owing to their static nature, are measured by a very delicate electro-static voltmeter. Those interested in this phase of atmospheric electricity will find descriptions of the apparatus used, as well as results and meas-

(*Continued on page* 1343)

Lifting Stunts for Your Parlor

Some Interesting Paradoxes in Everyday Physics Including the "Johnny Coulon Lift" and Why Miss Annie Abbott, the "Georgia Magnet," Cannot be Lifted

FOR several months a young American athlete and pugilist, one Johnny Coulon, has been interesting the French public with his remarkable demonstrations of a seemingly mysterious magnetic or other power, which, call it whatever you like, has effectually prevented the strongest men in Europe from lifting his 110-pound body from the floor.

There are a number of interesting and striking preliminary experiments in physics, which, if you have not already tried them out, will provide suitable entertainment for your friends. With the aid of the accompanying illustration, we will attempt to elucidate some interesting preliminary "stunts," before taking up the methods whereby Miss Annie Abbott, the "Georgia Magnet," Johnny Coulon, and others have defied a single man or a group of them, to lift the performer from the ground.

Fig. 1 in the illustration herewith, shows a simple experiment which will prove quite surprising even when performed with a child. It is usually more effective when performed with the aid of a young woman; the lady placing either one or both of her hands firmly on top of her head as shown. You will find that it is practically impossible in most cases to lift a single hand from the head, or if both hands are clasped together with the fingers closely locked and held firmly down on the head, the entire body can be lifted by pushing upward under the arms at the wrists, but rarely is it possible to push the hands upward from the head.

The second experiment is illustrated at Fig. 2. A woman is best selected as the subject, and it doesn't matter whether she is particularly athletic and strong or not. The results will usually prove sufficiently surprising, regardless of this factor. If the subject places her hands firmly against her chest with the finger tips just touching, it will require a strong man to pull the hands apart; if the lady's wrists are grasped firmly an attempt to pull the hands apart is futile. One attempting to separate the lady's hands must not stand sidewise or attempt to jerk the hands, but he must exert a steady pull, at arm's length or with the arms bent so as to improve the leverage, which will give a greater resultant pull.

A simple little experiment to demonstrate the great power of the female of the species over the male, and one which will nonplus any athlete is illustrated at Fig. 3. If the man (it doesn't matter how big or muscular he may be) doubles up his fists and places one over the other, you will be surprised to find that even a young boy or girl can, by simply snapping one finger of either hand against each of the two fists, separate them every time. And more paradoxical still, the harder the "strong man" attempts to hold his fists together, the more easily are they separated.

LIFTING THE HUMAN BODY WITH FIVE FINGERS.

What is known as the *five finger lift* is illustrated at Fig. 4, and this provides considerable fun and scientific entertainment for parlor and club gatherings. If it is desired to put the experiment on with sure-fire success, the manager of this little act should take precautions to have his committee of four men lift the subject, picking out preferably a lady weighing about 130 to 140 pounds. If good muscular men are selected for the committee, which can usually be arranged, a woman weighing 150 to 200 pounds can be lifted with ease. The editors have tried this experiment successfully many times and with four men of the average muscular development, succeeded in thus lifting easily a 140-pound woman.

(*Continued on page* 1352)



A Number of Scientific Parlor Stunts Are Illustrated Above. First We Have a Few Simple Hand and Finger Tricks, Winding Up With the "Georgia Magnet" and "Johnny Coulon" Lifting Stunts, Which Will Surprise You, Once You Have Tried Them.

Typewriting and Stenographic Machines for the Blind

Translated from the French by Prof. T. O'Conor Sloane, Ph. D., LL. D.

WE are indebted for this article to M. Jacques Boyer, already well known to our readers as one of the leading scientific writers of France, and to whom we have already been indebted for interesting material for our columns. The recent introduction of several stenographic writing machines for the blind, notably those by Prof. Villey and Lieut. Muller, was the origin of this article, these machines enabling the blind to produce in relief-characters at stenographic speed, the reports of a lecture or of dictation as quickly as the regular stenographer, but it is quite interesting before going into the description of these machines, to trace the origin of what are called dactylographs for the blind. This is the technical name for a typewriting machine.

Going back to the 16th century, in Spain and in Italy the idea was formed of engraving letters in intaglio on wooden surfaces, to be used in printing for the blind. In 1640 a writing teacher of Paris, Pierre Moreau, made metallic types for the same purpose, but he obtained no success in his enterprise. So it is fair to say that the production of books with characters in relief goes back to the days of Valentin Haüy, a famous French inventor and student. The famous English blind mathematician, Nicholas Sannderson (1682-1739) invented an apparatus which permitted him to do mathematical operations of very complicated order, by the sense of touch. He used a tablet pierced with holes, receiving pegs of various sizes, whose value was determined by the place they occupied on the tablet, so that he was able to do the most varied kinds of calculations.

Shortly after his day, Mlle. Salignac and du Puiseaux, the latter a blind man, used relief characters for reading. Then the German, Weissenbourg, stricken with blindness at the age of seven years, produced relief maps for the blind. This goes back to the days of the celebrated Valentin Haüy. He retained the ordinary letters, putting them in relief, to be read by touch. He taught a special writing to his pupils, and had a special type cast for his books.

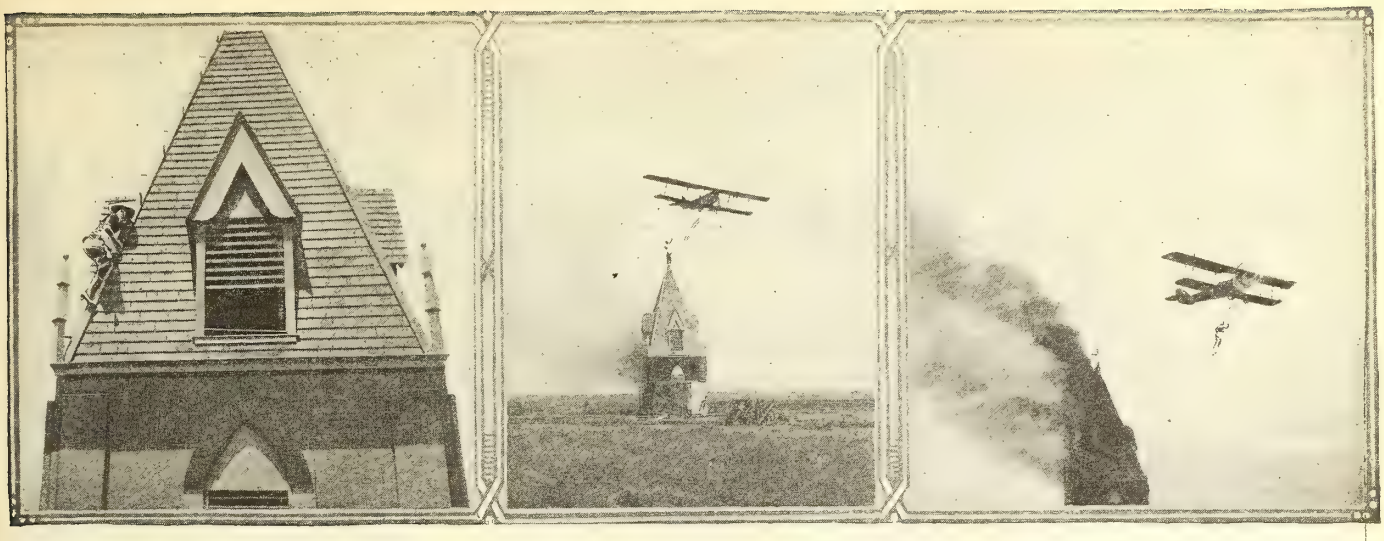
The effect of all this is well exprest in the words of Prof. Villey: "They spoke to the fingers, with the language of the eye." This is claimed to mark a psychological error and this error seems to be eradicated, if for the lines composing ordinary letters definite arrangements of points are substituted.

It is possible to keep the number of points used for each letter, quite restricted, and the origin of this system goes back to Charles Barbier, in 1821, but later Louis Braille, born in Lagny in 1809, blind himself, developed his famous alphabet, sometimes called "anaglyphic"; for a letter he used a maximum of six points, three high and two wide, and out of these he obtained 63 combinations. The Braille system is now universally adopted. The beauty of this system is, that it not only enables quick reading to be done, but by the use of a writing tablet, the blind can write it with a stylus, as easily as the more fortunate seeing people can write with a pen or pencil.

Braille's next effort was to produce a point writing which could be read by eye as well as by touch, putting the blind in direct communication with those who see, and while this was a slower writing, it gave the inspiration to the work of the celebrated blind investigator, Foucaux. He was blind from the age of six years and he invented the machine termed the *raphigraph*,—the first writing machine for the blind. This goes back nearly to 1843. In 1850 the same inventor developed another machine for printing which produces each character by a single blow. The apparatus was rather bulky, having 60 keys; only two such machines were ever constructed, altho the operator received a gold medal at the London World's Fair of 1851. In 1855, an Italian lawyer, Ravizza, produced a machine, which, operated from a keyboard, employed a set of type-arms arranged in a circle. This is suggestive of the early typewriters, and we find that in 1856, Mr. A. E. Beach, editor and one of the proprietors of the "Scientific American,"

(*Continued on page* 1338)





Miss Jean Paige Climbing Church Steeple. The "Church" Ablaze—But an Airplane—Aha! Saves the Heroine With a Rope Ladder

Airplane Rescue in the "Movies"

NOT all moving pictures of thrilling scenes are "faked," as can readily be seen by the photographs showing in detail the aerial rescue here portrayed from a new Vitagraph serial, *Hidden Dangers,* in which Joe Ryan and Jean Paige co-star.

The action came very near terminating in a casualty. Jean Paige, a pretty little actress, was assisted to the top of a church steeple by means of pegs driven in the side, which were removed when she had climbed the spire. There, clinging to the cross, she awaited the onslaught of the flames which were by this time leaping upward toward her.

The church had just been set afire by some diabolical fiends who thought that the fire, added to her precarious position, would now make things "hot" for her, but her hero was on the job at a nearby flying station, tuning up his plane. When word was received at the air station of what was going on some few miles away, he started off post haste to the rescue.

Sighting the heroine and speeding up so that the flames would not set fire to any part of the wing structure or to his gasoline tank, he circled the church steeple while Jean Paige reached for the rope ladder hanging from the fuselage. She mist the bottom rung and was nearly thrown from her lofty perch, while the airplane circled again in another attempt to rescue her from the flaming steeple.

Things were now rather uncomfortable as the lower part of the steeple burst into a vivid roar of flame. The airplane ladder neared her again, and she took a chance. By sheer luck she held tightly to the ladder, and was whisked off at a 60-mile clip, which, is a very high speed to leap into from a stationary position.

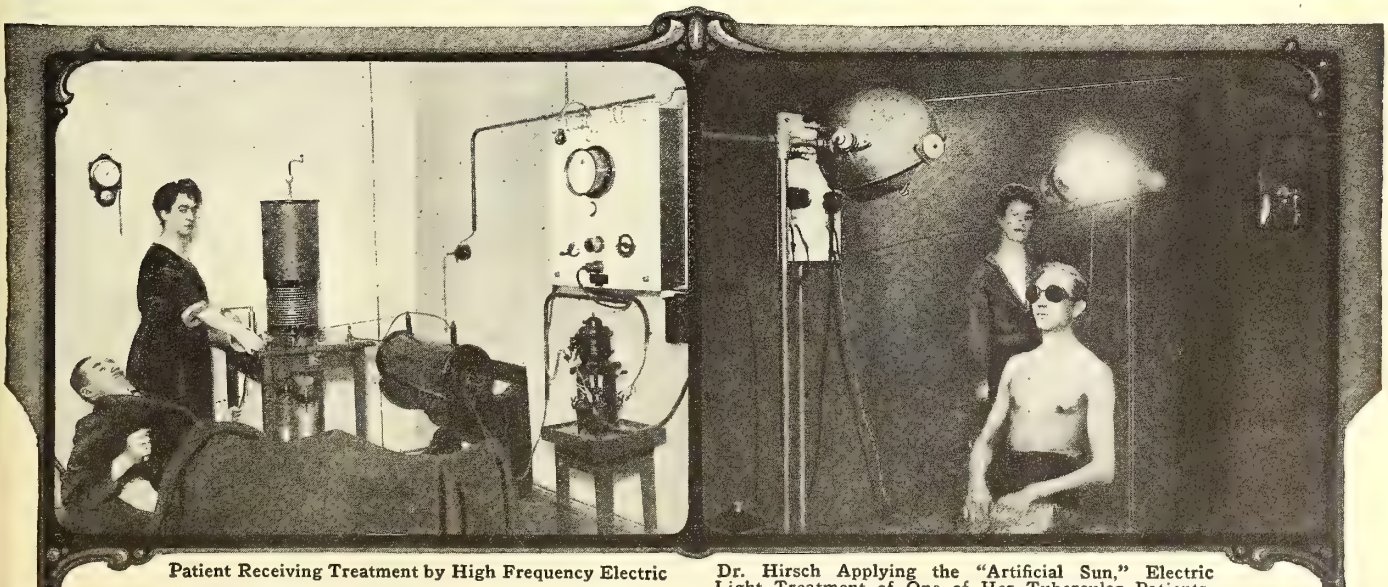
After the scene had been perfected, the aviator congratulated Miss Paige on her wonderful work, and we believe that she was well deserving of such praise. None of these scenes, however, were taken in the studio and the action portrayed is nothing short of miraculous.—*Photos Courtesy Vitagraph Films.*

Woman Doctor Cures by Electricity

THE accompanying photographs show two views of the latest electrical treatment sanatorium located in Berlin, which is presided over by Germany's foremost woman physician, Prof. R. Hirsch. This new electrical hospital has installed multiple sets of X-ray and high-frequency apparatus for the treatment of nervousness and the multifarious other ills which human flesh is heir to, and some idea of the size of this powerful equipment can be judged from the accompanying photographs.

Dr. Hirsch is a great believer in the treatment of diseases by electricity and massage instead of medicines, and in this part particularly, she is seconded by many eminent medical experts all over the world today. Prof. Hirsch has traveled in practically all of the countries of the world in search of the most powerful and the newest electric appliances with which to fit up her institution, which is said to be the finest of its kind to be found anywhere. One of the accompanying photographs shows Dr. Hirsch applying a high power apparatus to a patient suffering from rheumatism, while the second view shows the Doctor using the new high-powered electrically illuminated *artificial sun* in the treatment of a tubercular patient.

As will be noted, the patient wears dark, smoked glasses over the eyes to protect them from the intense brilliancy and heating effect of the rays produced by these lamps. The powerful light and heat rays are generated by mercury vapor lamps.



Patient Receiving Treatment by High Frequency Electric Currents in Berlin Sanatorium, Conducted by Germany's Eminent Physician, Prof. Dr. R. Hirsch.

Dr. Hirsch Applying the "Artificial Sun," Electric Light Treatment of One of Her Tubercular Patients. The Patient Wears Smoked Glasses to Protect His Eyes.

Oddities of Physics

Some Interesting Phenomena in Everyday Physics

By H. WINFIELD SECOR

Associate Member, American Institute of Electrical Engneers

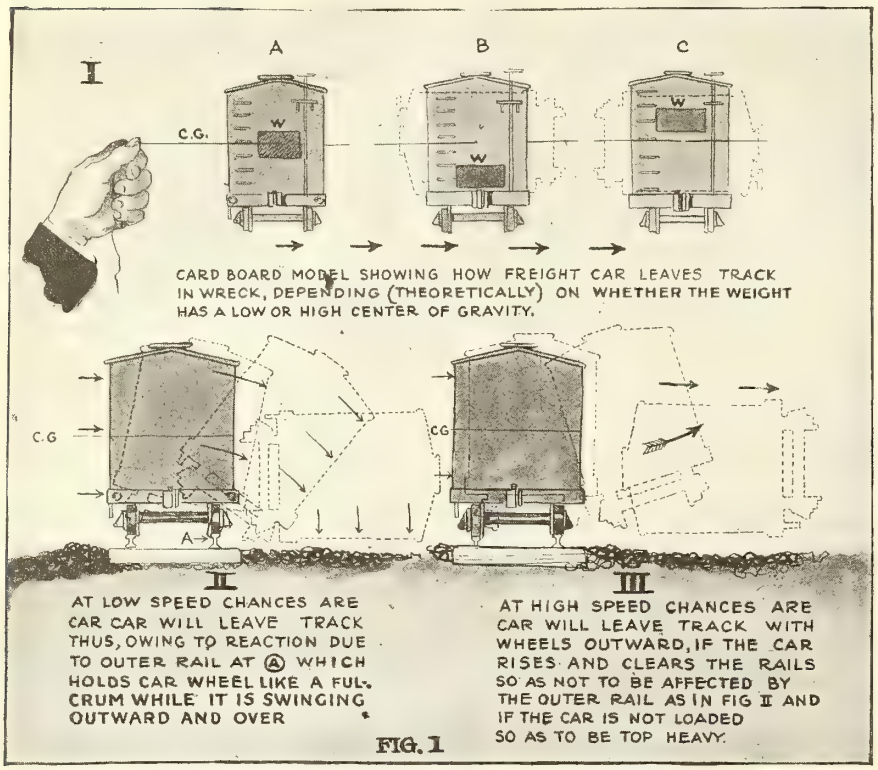


Fig. 1. Which Way do Railroad Cars Fall in a Wreck,—with the Wheels Toward or Away from the Rails? The Three Principal Ways in Which Cars Will Fall When Rounding a Curve at High Speed Are Shown Above.

DO RAILROAD CARS FALL WITH THE WHEELS TOWARD OR AWAY FROM THE TRACKS IN A WRECK?

FREQUENTLY we hear the subject discust, and the question asked as to which way railroad cars, particularly freight cars, fall in a wreck, and the accompanying illustration shows some of the theoretical considerations which apply to this every-day phase of physics. The usual answer by railroad men is that the cars fall with the wheels to the rail and while this figures out theoretically for possibly the majority of cases, there have been cases where the cars fell with the wheels away from the track, and with the top of the car lying next to the rail. The present discussion applies, of course, to a string of cars traveling around a curve.

To convince oneself as to which way a railroad car, under these conditions, would tend to fall when thrown outward from the curved rails if traveling at too high a speed, let us have recourse to the simple cardboard model shown in the figure. This model can be made about 3″ x 5″ and cut to the shape of a freight car. A button or small piece of lead, etc., corresponding to a movable weight "w," and which can be secured in different positions by means of a pin or otherwise, permits us to change the center of gravity so as to give a low or high center of gravity. In the actual freight car the position of the center of gravity depends upon how it is loaded, with the predominating weight toward the bottom of the car and trucks or toward the top. A string is attached to the center of the cardboard car model and when the model is spun around in a circle horizontally, holding the string between the index finger and thumb, the effect will be clearly demonstrated and proves that the car will fall in one of *three* ways, to wit:

If the center of gravity or major part of the weight is low or toward the trucks, the car will fly off the rails with the wheels pointing away from them; if the weight of the car and its load is evenly distributed as by placing the dummy weight "w" at the exact center of the model, then the car will fly outward evenly, with regard to the top and bottom; and finally, if the center of gravity and the major portion of the weight is placed toward the top of the car, then the top will fly outward and the bottom inward, so that the car theoretically at least (and if no other force is present to alter this motion), will fall with the wheels toward the rail.

In actual wrecks, however, photographs frequently show a string of cars laying along side the rails with the wheels toward the rails, and it seems to be the usual result in an accident or wreck. Fig. II, of the accompanying diagram, shows clearly why this is so. Consider that the train is moving at an abnormally high speed around the curve so that the cars are subjected to great centrifugal force tending to throw them outward. If all the conditions are right, such as the center of gravity under the action of centrifugal force, the car will tend to turn outward and over, using the outer rail as a fulcrum—the cars will, in this case, invariably fall a few feet from the track with their wheels toward the rails.

A point often incorrectly entertained is that with cars going around a curve, at such a speed as to keep the wheels at one side only on the rail, the outer wheels would be the ones to lift off the rails and not the inner ones, but the reverse is true as Fig. II shows in demonstrating how freight cars usually fall.

Fig. III shows a case where the cars in a wreck due to rounding a curve at very high speed, can fall with the tops of the cars towards the rails. At abnormal speed which would result in the condition like that shown at Fig. III, and with the center of gravity or load or the major part of the weight placed low or toward the tracks, the car would fly outward by centrifugal force as shown by the dotted lines and the bottom of the car would turn out

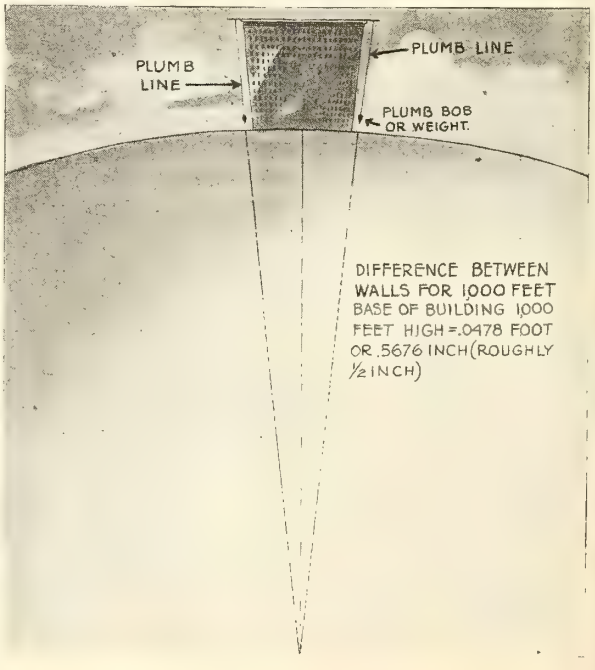


Fig. 2. When Is a Plumb Line Not Plumb?—When It Lies on a Radial Line Passing Thru the Center of the Earth,—*Which is all the Time,* (Taking the Usually Accepted Meaning), and Thus if Two Sides of a Building are Erected to Correspond with Plumb Lines, They Will Not be Parallel, but Will be Found to be Farther Apart at the Roof Than at the Base of the Building. The Accompanying Illustration Shows the Difference in the Length of a Line Spread Between Two Walls of a Building at the Base, and Also at the Roof, the Structure Measuring 1,000 Feet Square and 1,000 Feet High; the Difference in This Case Would be a Trifle More Than ½ Inch.

ward and up as shown by the arrow; the conditions for this result being that the car moves at a sufficiently high velocity to cause it to be virtually lifted from the rails, so that the wheel flanges clear them. Otherwise, the result is more likely to be that of case II, if the wheels do not clear the rails or if the rails do not spread, or otherwise fail so as to nullify or eliminate any reaction pressure on the outer rails.

ARE HOUSE WALLS PERFECTLY PARALLEL?

When we build a house or other building and providing the usual degree of mechanical craftsmanship is applied in its construction, we might expect to find upon accurate measurement, that the four walls measure exactly the same distance apart at the base of the building as at the top. But such is not the case, however, as physics proves to us, for upon a little reflection it is evident to anyone that this is impossible, especially when Fig. II is examined. Where only the usual methods of construction are applied, i. e., plumbing

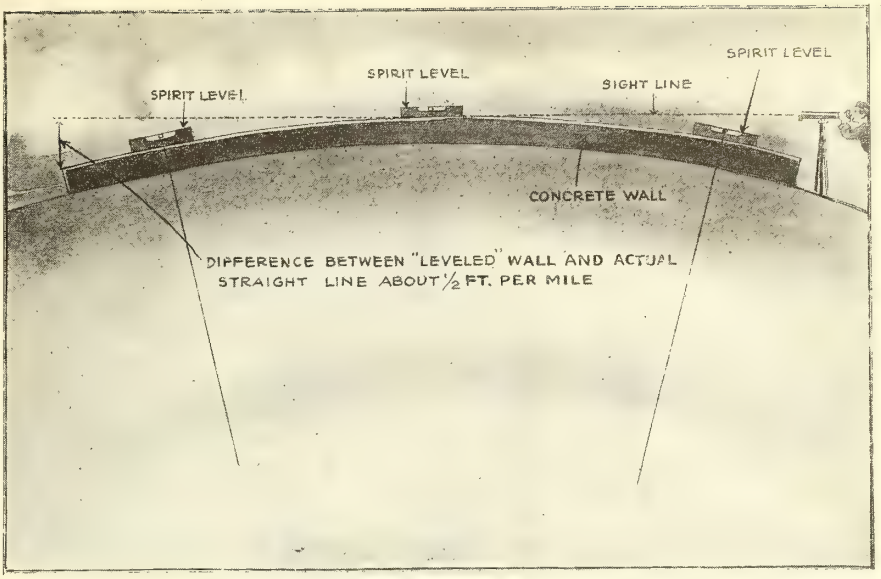


Fig. 3. The Diagram Above Shows that a Wall Constructed with Spirit Levels is not Perfectly Straight, but Curves in Accordance with the Curvature of the Earth. The Only Way to Erect a Perfectly Straight Wall Would be by Means of a Perfectly Taut Wire, or Else by Sighting Thru a Leveling Telescope as Shown in the Picture Herewith.

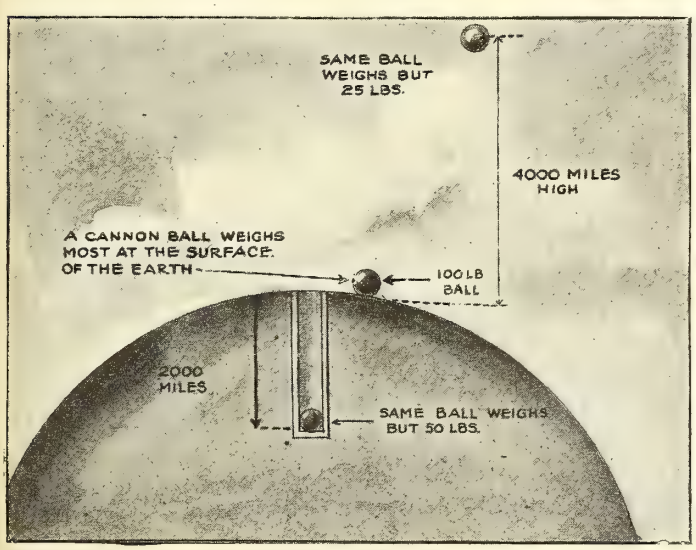


Fig. 5. Where Does a Cannon Ball Weigh the Most? You Might Not Think it, but it is a Fact a 100 Pound Ball (or any Other Body), for Example, Will Weigh the Most at the Surface of the Earth—and Less Than That Amount When Raised Above or Lowered Below the Earth's Surface.

means! The truth of the matter is that such a wall is curved and actually follows the curvature of the earth. The writer remembers hearing this point argued many times, and it makes an interesting point for debate, you can well believe.

Illustration 3 demonstrates that a straight wall cannot be constructed by leveling, that is by leveling in the ordinary manner, for the reason that the level will act the same as the plumb bob, and it simply indicates that the bottom of the level is at right angle to a radial line pointing to the center of the earth, *and at that particular point only.* As soon as you move the level to a new point, even if only a few feet away, and providing you had instruments sufficiently accurate to measure the difference, you would find that the level has indicated a tangential point on the earth's surface for that particular radial line only.

It has been computed that when

(*Continued on page* 1330)

the walls with the usual plumb line and weight or bob, it is not possible for either the side walls, or the front and rear walls to be parallel to each other or the same distance apart at the top and bottom except from inaccuracy of construction.

They must be farther apart at the top than at the bottom, as each individual wall will, if lined up with a plumb bob, be on a different radial line from the center of the earth; and the chord of the angle subtended between two radial lines as shown in the drawing, will increase progressively as we move outward from the center of the earth. Building constructors, architects and engineers are familiar with this fact and in large buildings or other constructional operations, this fact is taken into consideration. It has been computed that for a building 1,000 feet long and 1,000 feet high, the walls, if simply plumbed with a plumb and bob, would be one-half inch farther apart at the top than at the base. As the height increases, so does the difference in the chords or distance between top and bottom walls; further, as the distance between the two walls increases, the difference of chords at top and bottom of the walls will likewise be augmented.

IS A LEVEL WALL STRAIGHT?

When it comes to building long concrete walls, dams and other constructional projects a mile or more in extent, we once again bump unconsciously into the inexorable laws of Nature and for once in our lives find that a *level wall is not straight,* by any

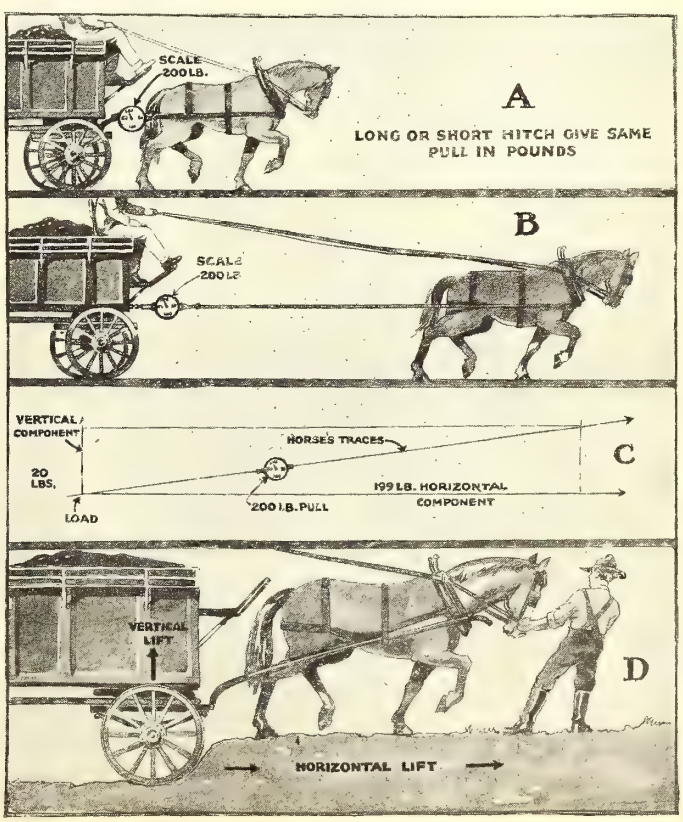


Fig. 7. Which is the Best,—a Long or Short Hitch in Pulling a Given Load? Figures "A" and "B" Show that When the Traces are Straight, this Actually Makes no Difference; But When the Traces are on a Slant or Angle, a Greater Pull Under Certain Conditions is Realized Owing to the Combination of Vertical and Horizontal Forces. In Figure "D," for Example, the Driver Stands a Better Chance of Hauling the Wagon Out of the Gulley with a Short, Angular Hitch Than with the Traces Horizontal, Owing to the Upward Force Brought into Play as the Resolution of Forces Diagrammed at Figure "C" Prove.

How Big Are Molecules?

By ROGERS D. RUSK, M. A.

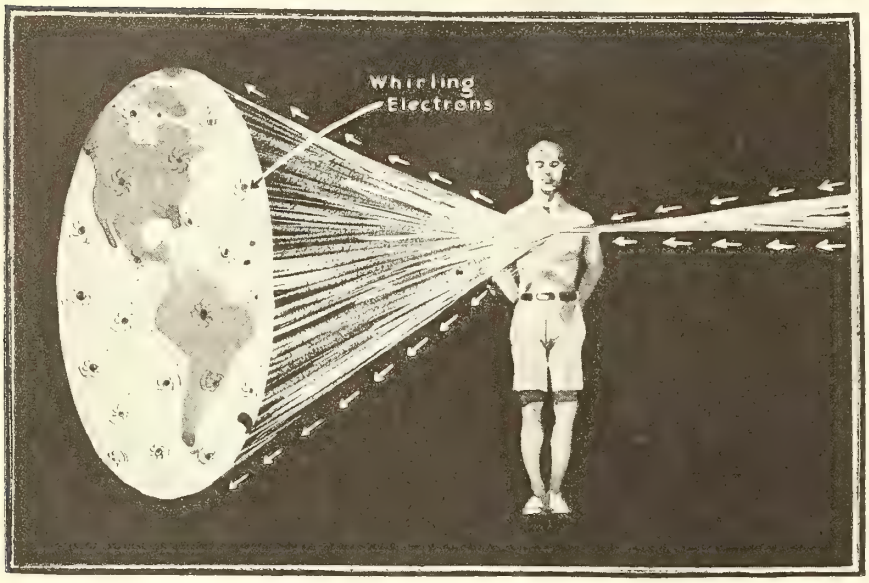


Fig. 5—To Gain Some Idea of the Extremely Minute Size of the Electron, of Which All Matter Is Now Supposed to Be Constructed, Imagine a Powerful Beam of Light Focust on to a Spot on the Human Body as Big as a Pin-Head, and the Reflected Ray Then Magnified to the Size of the Earth, or 8,000 Miles in Diameter. The Whirling Electrons Would Then Appear Visible to the Human Eye in the Manner Shown at the Left.

HOW big are molecules? Nobody has ever seen one and yet everybody talks about them. All matter is composed of them but molecules are in turn composed of atoms which must be smaller still. How big a molecule is depends on the atoms of which it is composed. Of these there are about ninety different kinds known to science that comprise the elements from which all other substances are built up.

Radium atoms are among the heaviest known and hydrogen atoms are the lightest. The former weighs two hundred and twenty-six times as much as the latter, while strange as it may seem, scientists believe radium atoms are but little over twice as large as those of hydrogen. Similarly, an atom of lead is eight times heavier than an atom of aluminum, altho it is but little larger in size, while an atom of tin is about midway between the two as shown in the first diagram.

Molecules, on the other hand, vary greatly in size because they are made up of different numbers and combinations of atoms. A water molecule contains two hydrogen atoms and one of oxygen as indicated by the familiar symbol H_2O, but it is little larger than a large atom. A single starch molecule, however, contains about twenty-five thousand atoms and is one of the largest molecules known (see Fig. 2).

Just what an atom or a molecule looks like no one knows and perhaps no one will ever know, for they are too small to be visible in any present day microscope. It is estimated that a thousand or perhaps a few hundred large molecules might make a visible speck in an ultra-microscope, but even then it would only appear as a point of light and no contour would be visible. However, if we do not know what molecules look like, we know they act just as if they are round balls, and when a liquid is boiled away or evaporates they fly off like miniature rifle balls, forming a vapor or steam.

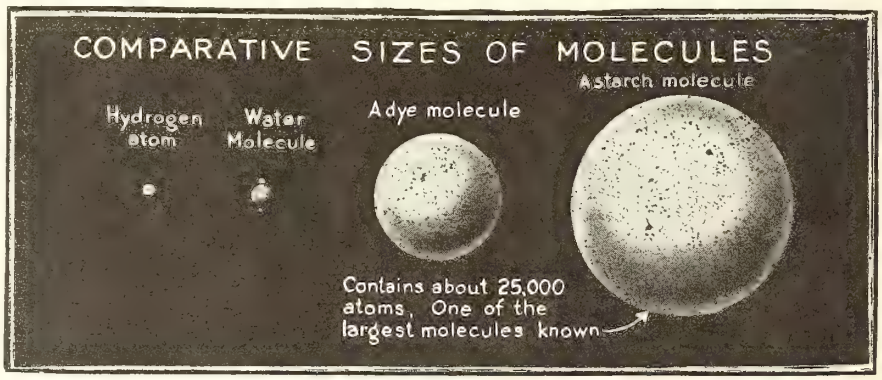


Fig. 2—This Diagram Shows in a Clear Manner the Relative Size, Magnified Thousands of Times, of Course, of the Hydrogen Atom, the Water Molecule, a Dye Molecule and a Starch Molecule—the Latter Containing About 25,000 Atoms, and Being One of the Largest Molecules Known to Science.

Steam is another familiar substance with which everybody is acquainted but which nobody has ever seen. Most people think they *see* steam when they look at the cloud issuing from the mouth of a teakettle or the exhaust of a locomotive, but they are mistaken. What they see is the vapor which has condensed in the form of a fog or a cloud of small water droplets, but steam itself is invisible because it is impossible to see the separate molecules and when the molecules join together they form minute drops of water, which are not steam. This may be easily proved by looking into a teakettle when the water is boiling. It is obviously full of steam, but there is nothing visible. If a baseball and a molecule of steam were magnified until the baseball was as large as the earth, then the molecule of steam would be about as large as the baseball was (see Fig. 4).

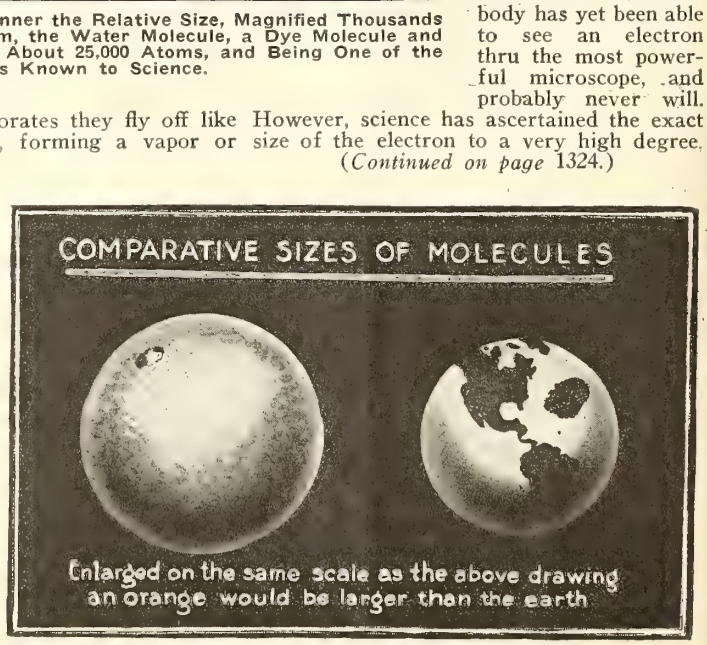
Molecules are pretty small compared with baseballs, but when compared with electrons they are gigantic indeed. An electron is the smallest thing known and it has been proved that all atoms contain these minute electrical charges. The smallest atom known is as big as several million billion electrons, so after all, size is a relative matter and atoms are large or small depending on what we compare them with.

The human body is composed of numberless small cells (see Fig. 5) which we are accustomed to think of as being pretty small. They are easily visible in a microscope, however, and have been so studied for a long time. It is evident they are composed of thousands of molecules, which make the cell a complex organism capable of life and growth. Hence molecules tho small are not to be despised.

It is really never thought of, perhaps, by the average person, that his very body is composed of millions upon millions of tiny particles of live matter, which the scientist calls *electrons*. The electrons form atoms and the atoms in turn, molecules. Some idea of the extremely minute mass of the electron may be obtained from the fact that nobody has yet been able to see an electron thru the most powerful microscope, and probably never will. However, science has ascertained the exact size of the electron to a very high degree.

(*Continued on page* 1324.)

Fig. 3. Enlarged on the Same Scale as Fig. 2 Above, an Orange Would Appear Larger Than the Earth, as Shown by Our Artist in the Accompanying Illustration. This Also Emphasizes the Great Magnification of the Atoms and Molecules at Fig. 2.



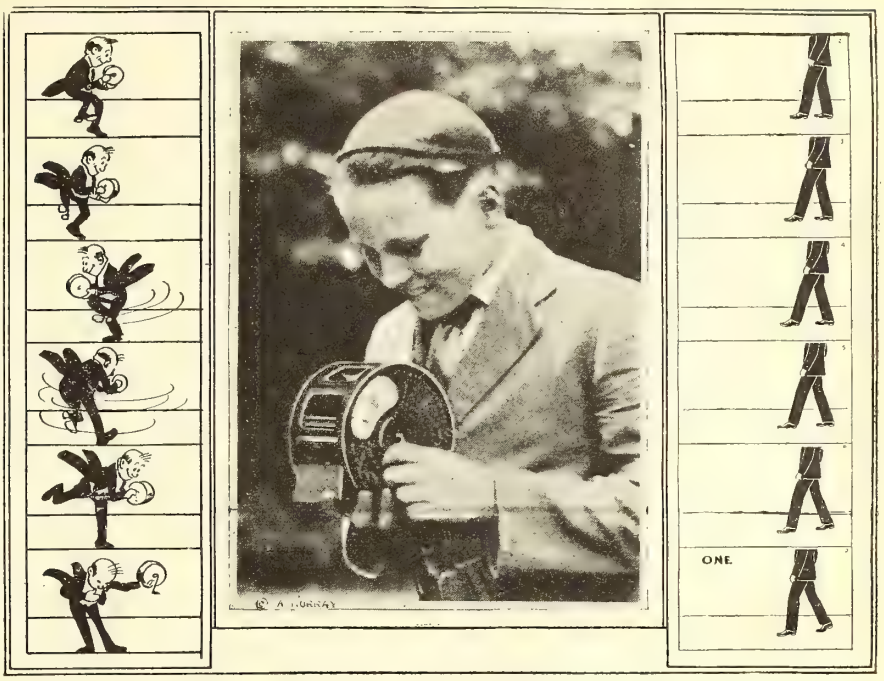
"Moviescope" Teaches Dancing

The boy in our illustration seems pleased with the idea of learning to dance by the aid of moving pictures. As he turns the crank and looks down into the machine, he sees an actual demonstration of the latest steps.

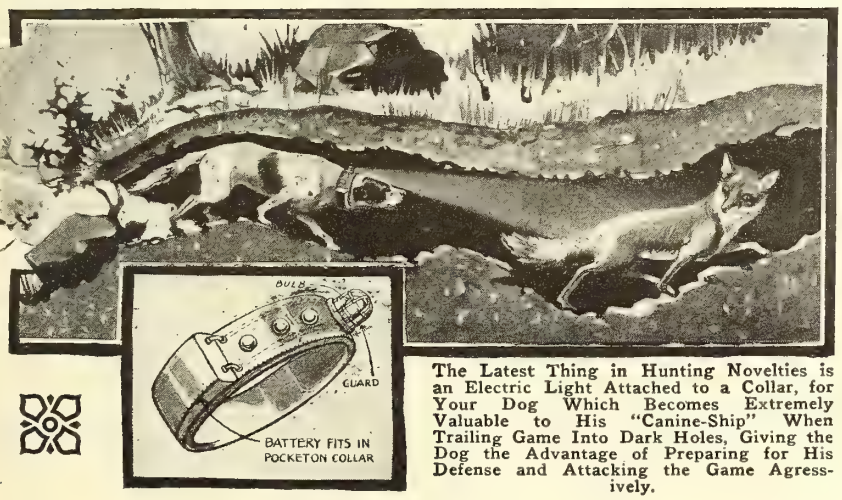
The idea was originated by Arthur Murray, a student at Georgia Tech. Some time ago, *Forbes Magazine* carried an article which stated that Arthur Murray has the largest dancing class in the world and earns $15,000 a year while going to college.

As the crank is turned, forty-two small leaves revolve around a barrel. By the rapid succession of falling leaves, the action of a dancing step is produced. The machine being operated by hand, the learner can turn as fast as he pleases and stop the movement at any time. By looking down into the machine for five minutes, the step is repeated more than one hundred times.

The process of making the finished picture requires some study as the little machine carries but 42 views and the action must be so timed and the step so arranged that the complete dancing step is photographed in exactly the same number of individual pictures. The 42 photographs then are enlarged on paper and are inked in by an artist who prepares them for the engraver, who in turn, makes line-cuts. The printer does the rest.



Dogs Carry Electric Lights



The Latest Thing in Hunting Novelties is an Electric Light Attached to a Collar, for Your Dog Which Becomes Extremely Valuable to His "Canine-Ship" When Trailing Game Into Dark Holes, Giving the Dog the Advantage of Preparing for His Defense and Attacking the Game Agressively.

In all the European countries, particularly Portugal, hunting has been one of the most well famed sports.

However, it has heretofore been an extremely difficult and dangerous task for the hunting dog, following the scent of the fox or badger, to hunt the pursued game out of their burrows; this difficulty being due to the fact that the intense darkness encountered within the long, narrow burrows rendered the dog almost helpless.

But now, it has come to pass, that for the purpose of assisting the dog in his chase for the game, he is provided with a collar to which is attached an electric lamp. In a pocket of this collar there is placed a flashlight battery which supplies the necessary current for lighting the bulb.

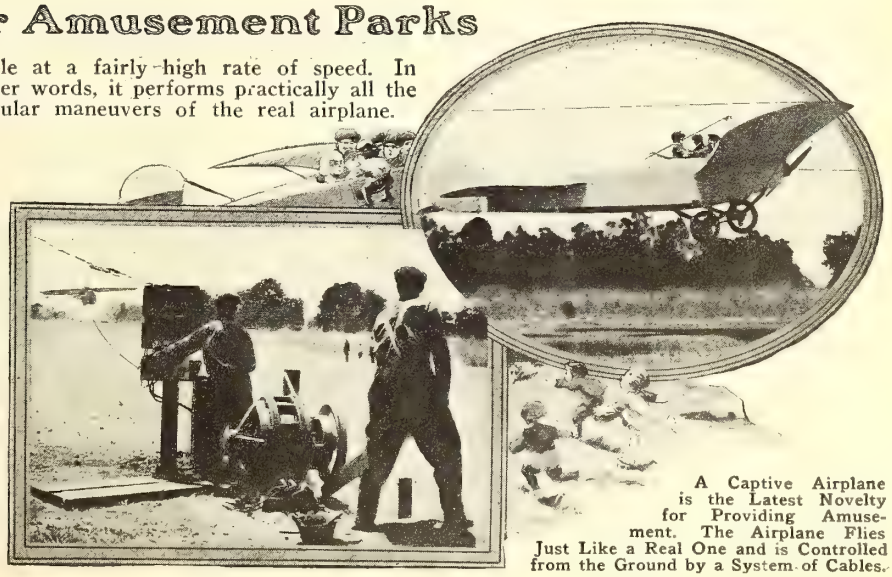
With this electric lamp which casts a beam of light a few feet ahead, it becomes an easy matter for the dog to work his way into the holes bored by the fox or badger.

Unique Thriller for Amusement Parks

One of the latest thrillers for places of amusement, is the new self-stabilizing "paraplane"—invented by R. R. Reed of Oakland, Cal. In the accompanying photograph is shown this new paraplane with its cockpit loaded with happy kiddies, flying without a pilot. It is controlled entirely from the ground, a man operating a switch arrangement for the propulsion of the plane carrying its precious load of children. A fifty horse-power electric motor furnishes the necessary power which is transmitted thru a system of cables.

This new amusement feature provides for the public, a real flight in the air in a real airplane, at a price which all can afford to pay.

What other amusement except a ride in the paraplane, could offer so much pleasure and thrill to the kiddies? It affords a delightful little trip, and is sure to please all after but one ride. The plane guided by cables, rises gradually to a predetermined height, and thence proceeds along a taut cable at a fairly high rate of speed. In other words, it performs practically all the regular maneuvers of the real airplane.



A Captive Airplane is the Latest Novelty for Providing Amusement. The Airplane Flies Just Like a Real One and is Controlled from the Ground by a System of Cables.

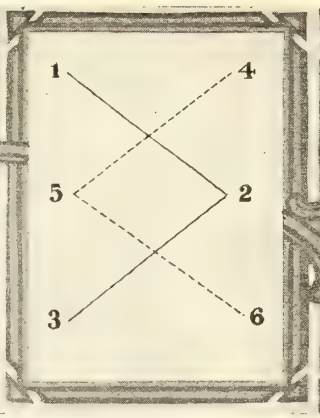
Peculiar Beetle Locomotion



Photo Showing Beetle in Flight With Legs Depending and Wings Extended from Their Coverings.



This Photo Shows a Ground Beetle in the Act of Walking.



How a Beetle Walks: Legs 1, 2 and 3 Move Forward, Then Legs 4, 5 and 6.



Surface Swimming Beetle Enlarged 4 Times. The Double-Eye Permits of Vision Above and Below.

IT is common knowledge that the things seen every day are not observed. One of the most common things in nature is the insect. Beetles are found everywhere. They are seen flying or else one can find them sitting on one and the same particular spot without motion, apparently lifeless. But if slightly disturbed the antennae will be seen to twitch and vibrate and if now closely observed one can see some insects inflate their body with air, spread their wing covers, and lift their membranous wings. All this goes on slowly, deliberately, but suddenly, with a whir, the insect is off on its flight. The peculiar thing about the flight of some beetles is, that the hard chitinous wing covers which are a protection to the delicate folded wings, are not used for propulsion in their flight. In some they are replaced on the back while flying, while in others they remain extended and act as gliders. Here the hind wings are used for flight and describe a figure eight while in motion. Under these circumstances the legs of the insect hang loosely downward.

Other beetles, the diving beetles, have the power of flight and also the power of diving under the water. When diving, these beetles collect a bubble of air on the under side of their abdomen and, with a swimming motion of their hind legs, and a pulling motion of their front legs, they glide under the surface of the water. Their hind legs are especially adapted for this purpose and are enlarged by the addition of hairs which give them a larger thrusting power under water. They use the bubble of air attacht to their abdomen for breathing and when they have exhausted it, they come to the top for a second and dive down again.

The common whirligig is another aquatic beetle. It is the ship of the ponds, a mighty racer, darting hither and thither upon the surface so quickly that the eye can hardly follow the individual. One would almost believe that their motion was more of a gliding on a polisht mirror than a swimming. The eyes of these beetles are peculiar, each being divided in half so that they have *four* eyes. The lower half of each eye remains under the surface of the water as the beetle glides about on the surface, therefore it can see under water. The other half remains out of the water and with it it can see into the distance.

Still another beetle is the ground beetle. These walk on the ground, and, in some species the wings are so rudimentary that they are never used for flight. Altho some of these insects are especially quick on their legs, their method of walking is peculiar. First they move their right leg forward, then their middle left leg, and finally their right hind leg. While their right hind leg is moving forward their left front leg also begins to move forward followed by their right middle leg and their left hind leg. When walking or running their motion is not jerky, but smooth and continuous.—Dr. E. Bade.

The Intelligence of Rats





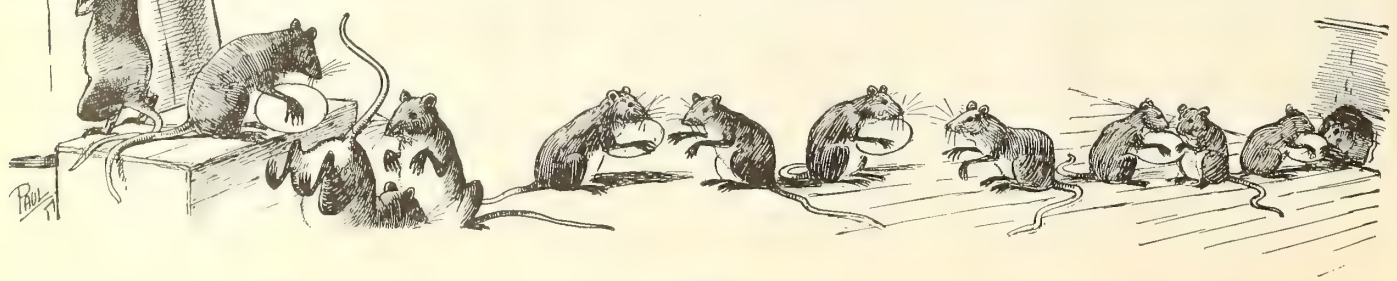


RATS are well known to be highly intelligent animals, altho to the one unfamiliar with their customs this may seem due to their wariness in regard to traps and their boldness and courage in combat. Besides these traits, many others have been noted. Stories are told of ship rats that while gnawing thru the woodwork of a ship always stop before they completely perforate the side.

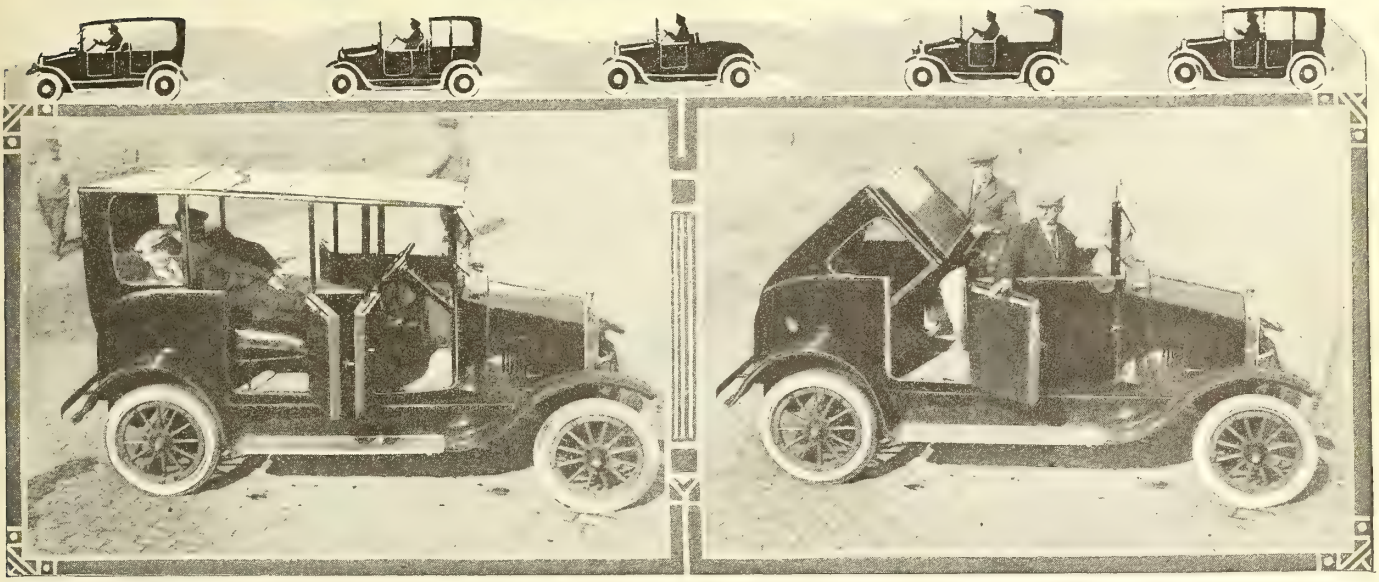
The manner in which they transport eggs to their burrows is most surprising. Rodwell, in his book, "The Rat," gives a case in which a number of eggs were carried from the top of a house to the bottom by two rats devoting themselves to each egg, and alternately passing it down to each other at every step of the staircase. Rats will not only convey eggs from the top of the house to the bottom, but also from bottom to top. The male rat places himself on his fore paws, with his head downward, and raising up his hind legs and catching the egg between them pushes it up to the female, who stands on the step above, and secures it with her fore paws till he jumps up to her, and this process is repeated from step to step till the top is reached.

A writer in *The Quarterly Review* describes an instance aboard ship wherein eggs were continually being stolen from the storeroom. Having laid in a fresh stock of eggs, the Captain sat down in a location that commanded a view of the eggs and waited. Before long, to his great astonishment, he saw a number of rats approach, form a line from his egg baskets to their hole and hand the eggs from one to another in their fore paws.

To many people, their long, narrow tails may seem of no use, but they have proved very valuable in procuring food. Rats have been known to help themselves to oil by holding on to some convenient support by the side of the bottle and then dipping their tails into the oil and thus extracting it.



Four Automobiles in One



We Have Often Entertained an Idea in Our Minds of a "Perfect" Automobile Which Can Be Changed by Pushing a Button or Two into Almost Any Type of Car We Might Happen to Desire—a Fully Closed Car for Rainy or Cold Weather; a Semi-Closed Car for the Spring and Fall and an Open Car for Summer Motoring. Mr. John J. McGuire Has Beat Us to It, However, and the Accompanying Photographs Show But Two of the Many Possibilities Available to the Owner of a Car Constructed Along the Lines of His Design. He Even Has a Folding Bed as Shown at the Left, While Some of the Other Possibilities Are Shown in the Miniature Machines at the Top of the Photographs.

JOHN J. McGUIRE is the inventor of a convertible type of body that is the limit of versatility; for less than a minute is required to change it to a limousine, an open touring car with victoria top, a coupe, and an open runabout.

In addition to this, a hinge on the back of the front seat can be let down and with the front and rear seats forms a snug bed. Its owner when touring need never worry about a shortage of hotel accommodations for he carries with him quite comfortable sleeping quarters.

Mr. McGuire is in business in New York City and the evolution of his idea arose from the apparent necessity of keeping two automobiles, one as a family touring car and one to get him and his brother, Mr. Bernard McGuire, back and forth from their place of business. He began to ask himself why it would not be possible to combine the two uses by having a body which would serve his business requirements and yet be available on occasions for family use also. His present design is the result of about two years of planning and work along this line.

Mr. McGuire is a practical coach builder by occupation, having learned his trade thirty-five years ago in the town of Longford, Ireland, in the days when coach building was an art, requiring the most careful and skilled hand-work. His present model naturally enough reflects the influence of the custom coach builder.

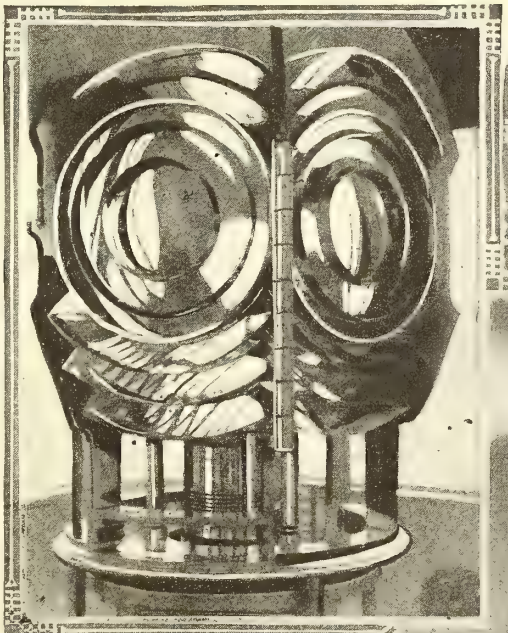
In this connection it is worthy of note that the construction of the windows comprises a separate and entirely new invention and differs from the type now in use in that the windows cannot be opened from the outside.

Mr. McGuire's car, which is mounted on a Ford chassis, took about eighteen months to complete from the day the first plans were drawn, being done in spare moments.

Mr. McGuire points out that no rack for spare tires is necessary, as they may be kept concealed under the rear seat, locked and secure from theft. He claims that his invention may be used on any chassis.

Giant Lighthouse Lenses

THE accompanying two photographs show interesting views of the famous "Robbins Reef" Lighthouse and the powerful glass lenses which throw the giant pencils of light thru the inky blackness of night. The life of a lighthouse keeper or his family, if he happens to be a married man, is one of the lonesomest in the world, as sufficient food and fuel supplies are usually kept on hand to last a month or so. Most of the big lighthouses thruout the world today are illuminated by powerful electric lamps, either of the arc or incandescent type. Some of the lighthouse electric lighting plants comprise a gasoline or other engine driving a dynamo and this is operated thru the night when the lamps are in use, the current being taken directly from the dynamo.



The Famous "Robbins Reef" Lighthouse at Right. The Small Boat, by Means of Which the Lighthouse Keeper and His Crew Visit the Mainland, Is Shown Hanging from Its Davits. The Life of a Lighthouse Keeper Is a Lonesome One as It Frequently Occurs That They Do Not Visit the Mainland for Perhaps One to Three Months or More.

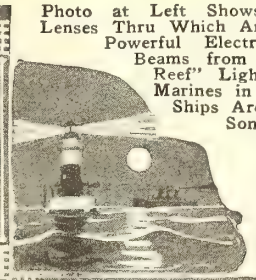
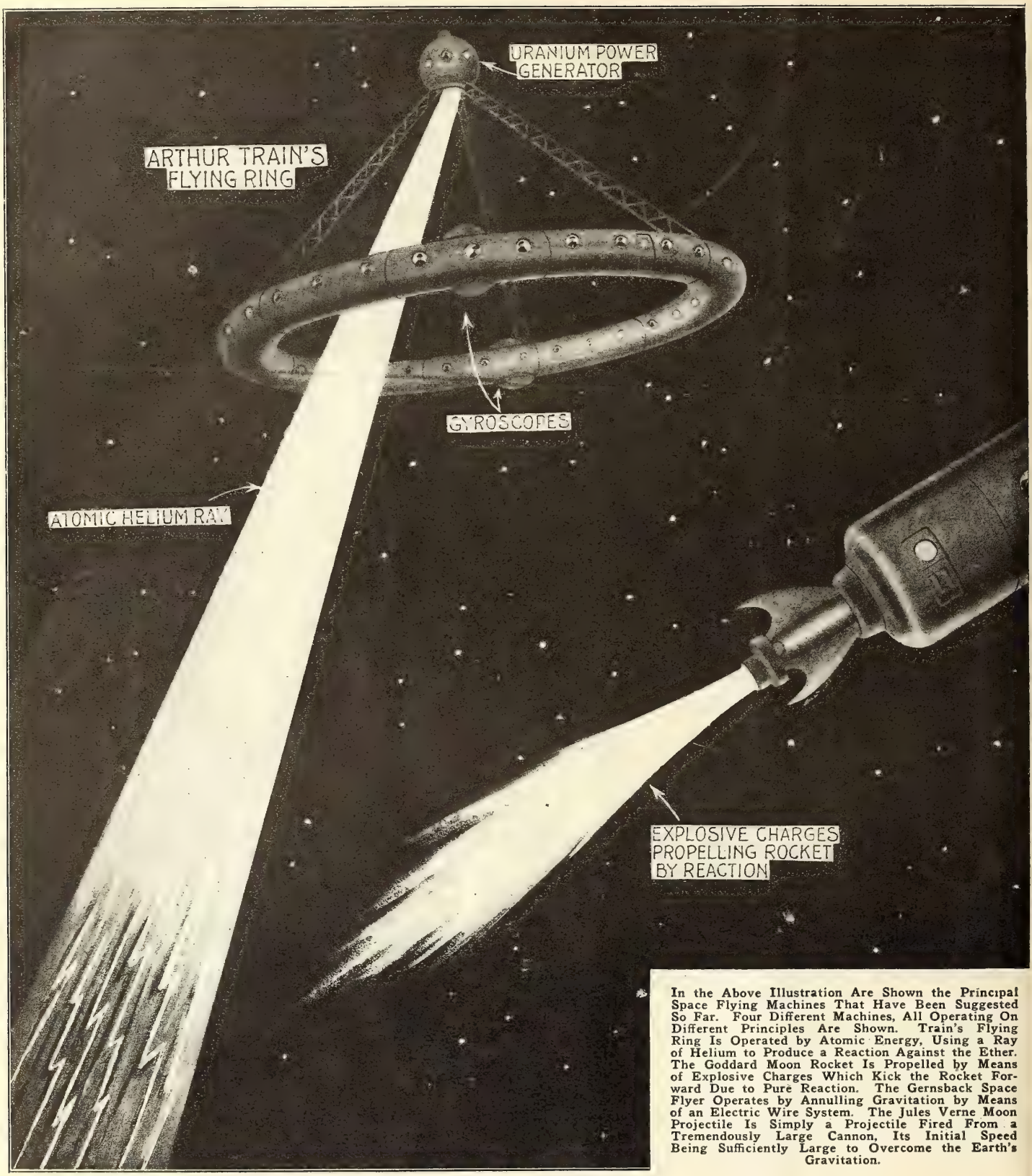


Photo at Left Shows the Fresnel Lenses Thru Which Are Flashed the Powerful Electric Searchlight Beams from the "Robbins Reef" Lighthouse to Aid Marines in Guiding Their Ships Around the Reef. Some Lighthouse Lamps Are Operated with Acetylene Gas, But Most of Them Are Electrically Operated at the Present Time.



There are lighthouses having more elaborate electric plants equipt with a storage battery which can be charged one or more times a week as the occasion may require, and the lamps then derive their current from the storage battery at night, the engine and dynamo being operated during the daylight hours to charge the battery. Those who live near seaports and have ever seen lighthouses in action at night have probably noted the different ways in which the light beams are used to signal which particular lighthouse one is looking at. There are several novel ways in which these code signals are arranged. Sometimes the light swings around in a complete circle, while in other cases it only shows its flashes in an angle or half circle, when it is situated on the shore of a harbor.



In the Above Illustration Are Shown the Principal Space Flying Machines That Have Been Suggested So Far. Four Different Machines, All Operating On Different Principles Are Shown. Train's Flying Ring Is Operated by Atomic Energy, Using a Ray of Helium to Produce a Reaction Against the Ether. The Goddard Moon Rocket Is Propelled by Means of Explosive Charges Which Kick the Rocket Forward Due to Pure Reaction. The Gernsback Space Flyer Operates by Annulling Gravitation by Means of an Electric Wire System. The Jules Verne Moon Projectile Is Simply a Projectile Fired From a Tremendously Large Cannon, Its Initial Speed Being Sufficiently Large to Overcome the Earth's Gravitation.

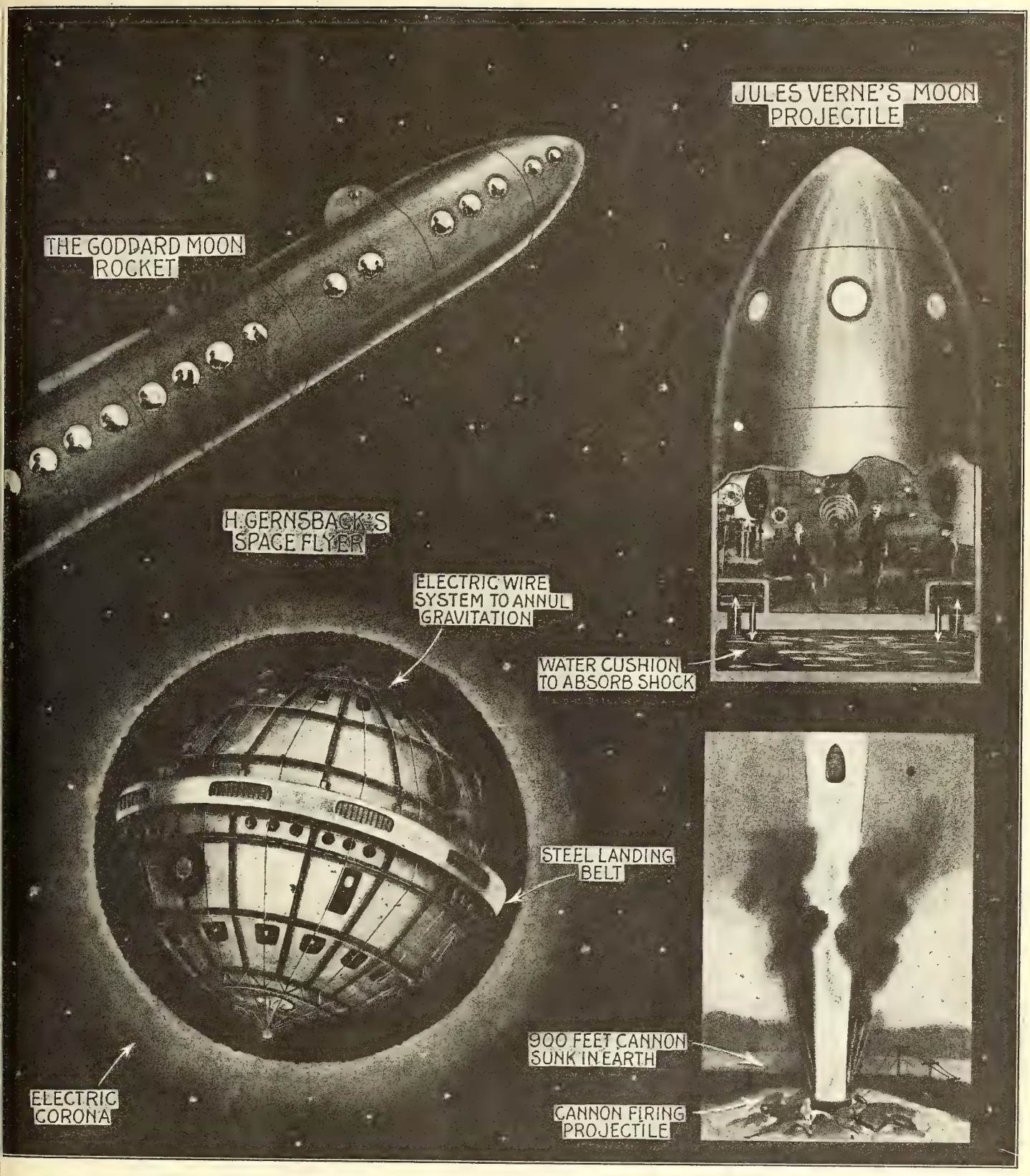
Flying In Space

By H. GERNSBACK

TWENTY-FIVE years ago mechanical flight was discussed seriously by scientists all over the world. Many scientists of great authority demonstrated mathematically that it was absolutely impossible for a man to fly a machine heavier than air. Eminent men of science sustained this view. Notwithstanding all this, we are flying today at will and we are building airplanes that can rise thousands of feet aloft and transport one hundred people over great distances. As usual our scientists were not correct as to what can or cannot be done.

The next step will be flying not only in the atmosphere, but flying in space where there is nothing to sustain a machine and where propellers and planes are no longer of use, because where there is no air there can be no mechanical flight as we know it today.

The full thickness of the earth's atmosphere is roughly speaking about 500 miles. This takes in the densest layer from the earth's surface to the outer space where there is an absolute vacuum, but our atmosphere proper is probably not thicker than

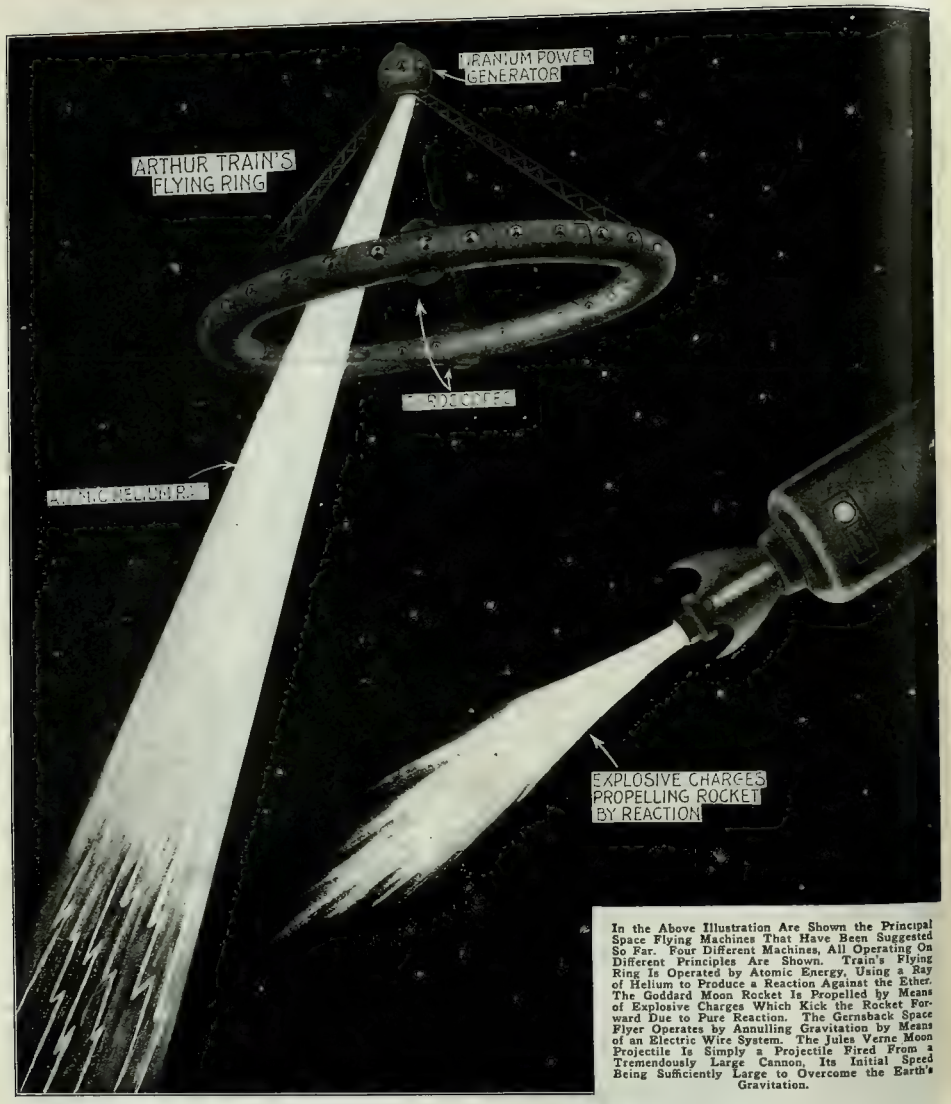


30 miles. After this distance the rarification becomes extreme. All of this, however, should not deter us from attempting to fly in space. To those who say it is impossible for a body to float in space and in vacuum, let them look at the moon or at any of the stellar bodies, and he will find that these bodies indeed float very nicely without any support whatsoever. This is, of course, due to universal gravitation, but for the moment this need not concern us.

How then can we fly in space? There are several vital points that must be considered. The main point is the earth's gravitation that holds all bodies chained to it. Take a balloon for instance. As soon as the gas gives out, the balloon must come down due to the earth's gravitation; the same thing is true of an airplane which falls or must glide down as soon as the propeller stops. If directional flight at will in space ever becomes assured, it will be absolutely necessary that we first master gravitation, or otherwise annul its effects in some way. Just how this can be accomplisht we of course do not know exactly today, altho there have been several attempts made to conquer the baffling forces that hold all objects to the earth.

The writer has stated many times in his past writings that gravitation is conceded to be an electrical effect today. If this is so, then sooner or later we will find a way to counteract gravitational force by electrical reaction, and when this happens, it will be a simple thing for us to build a machine that by means of electricity overcomes gravitation in a similar manner to a railroad engine overcoming friction by furnishing enough power to dispose of the latter. This is what makes a train move.

One of the earliest and now historical methods proposed for a machine to travel into space was the well-known moon projectile invented by the fertile brain of Jules Verne. He imagined a huge cannon sunk 900 feet into the earth. It required 400,000 pounds of gun cotton to fire the 20,000 lb. aluminum projectile which contained three travelers. The details of this invention were described in his well-known book



In the Above Illustration Are Shown the Principal Space Flying Machines That Have Been Suggested So Far. Four Different Machines, All Operating On Different Principles Are Shown. Train's Flying Ring Is Operated by Atomic Energy, Using a Ray of Helium to Produce a Reaction Against the Ether. The Goddard Moon Rocket Is Propelled by Means of Explosive Charges Which Kick the Rocket Forward Due to Pure Reaction. The Gernsback Space Flyer Operates by Annulling Gravitation by Means of an Electric Wire System. The Jules Verne Moon Projectile Is Simply a Projectile Fired From a Tremendously Large Cannon, Its Initial Speed Being Sufficiently Large to Overcome the Earth's Gravitation.

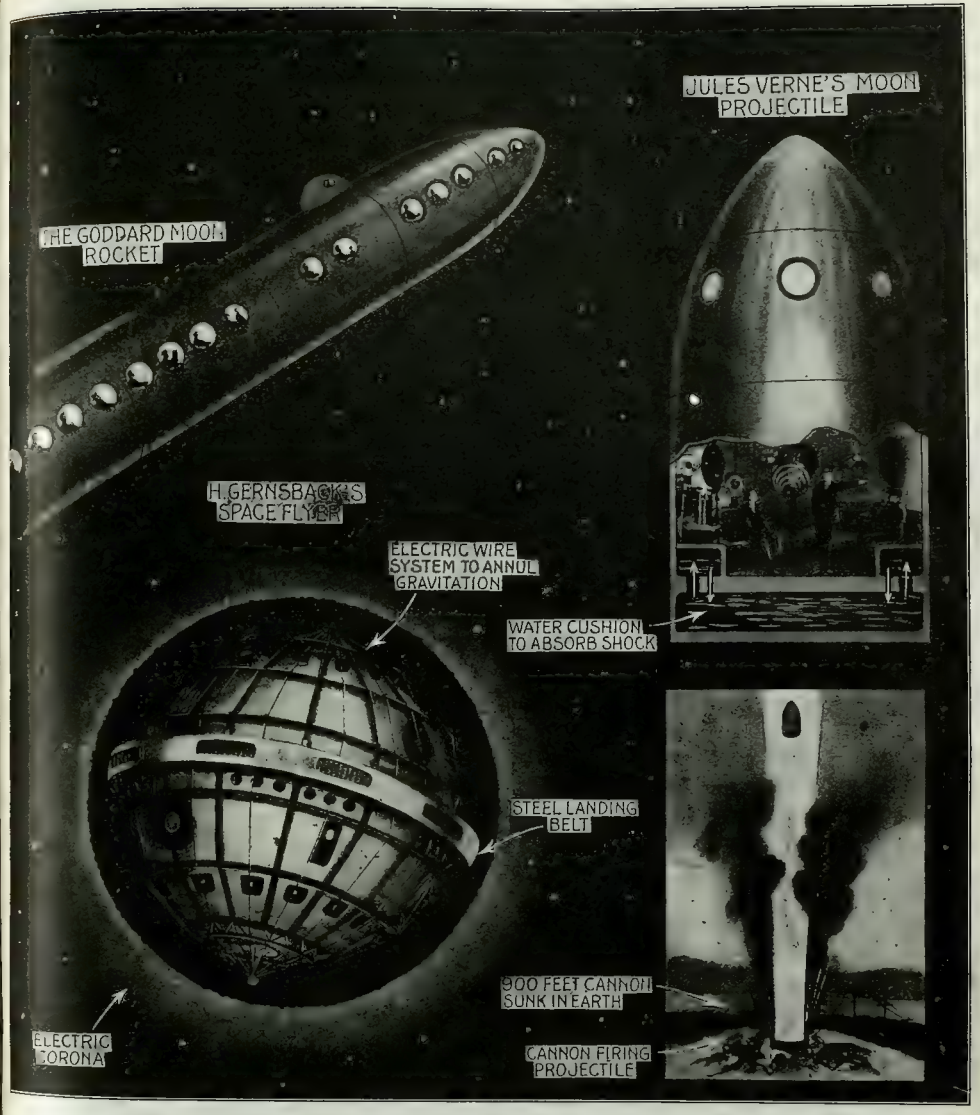
Flying In Space

By H. GERNSBACK

TWENTY-FIVE years ago mechanical flight was discussed seriously by scientists all over the world. Many scientists of great authority demonstrated mathematically that it was absolutely impossible for a man to fly a machine heavier than air. Eminent men of science sustained this view. Notwithstanding all this, we are flying today at will and we are building airplanes that can rise thousands of feet aloft and transport one hundred people over great distances. As usual our scientists were not correct as to what can or cannot be done.

The next step will be flying not only in the atmosphere, but flying in space where there is nothing to sustain a machine and where propellers and planes are no longer of use, because where there is no air there can be no mechanical flight as we know it today.

The full thickness of the earth's atmosphere is roughly speaking about 500 miles. This takes in the densest layer from the earth's surface to the outer space where there is an absolute vacuum, but our atmosphere proper is probably not thicker than



30 miles. After this distance the rarification becomes extreme. All of this, however, should not deter us from attempting to fly in space. To those who say it is impossible for a body to float in space and in vacuum, let them look at the moon or at any of the stellar bodies, and he will find that these bodies indeed float very nicely without any support whatsoever. This is, of course, due to universal gravitation, but for the moment this need not concern us.

How then can we fly in space? There are several vital points that must be considered. The main point is the earth's gravitation that holds all bodies chained to it. Take a balloon for instance. As soon as the gas gives out, the balloon must come down due to the earth's gravitation; the same thing is true of an airplane which fails or must glide down as soon as the propeller stops. If directional flight at will in space ever becomes assured, it will be absolutely necessary that we first master gravitation, or otherwise annul its effects in some way. Just how this can be accomplisht we of course do not know exactly today, altho there have been several attempts made to conquer the baffling forces that hold all objects to the earth.

The writer has stated many times in his past writings that gravitation is conceded to be an electrical effect today. If this is so, then sooner or later we will find a way to counteract gravitational force by electrical reaction, and when this happens, it will be a simple thing for us to build a machine that by means of electricity overcomes gravitation in a similar manner to a railroad engine overcoming friction by furnishing enough power to dispose of the latter. This is what makes a train move.

One of the earliest and now historical methods proposed for a machine to travel into space was the well-known moon projectile invented by the fertile brain of Jules Verne. He imagined a huge cannon sunk 900 feet into the earth. It required 400,000 pounds of gun cotton to fire the 20,000 lb. aluminum projectile which contained three travelers. The details of this invention were described in his well-known book

"From the Earth to the Moon." Scientifically this idea is absolutely sound, and if we actually would build a cannon as imagined by Jules Verne, and firing a projectile such as he described, the initial force given the projectile would be sufficient to overcome the gravitational pull of the earth and the projectile would leave the earth never to return. This is a condition fully realized by all artillerists. Given a cannon which fires a projectile whose initial speed is 12,000 yards a second, this projectile will fly out into space never to return. The passengers probably would not survive the shock, but that need not concern us here. Of course this idea was purely fanciful, and the great trouble with it is that there is no means of "navigating" such a projectile. Once out in space it becomes subject to various gravitational effects. If it came within the direct influence of the moon, for instance, it would be drawn toward the surface where it would be smashed to pieces in an instant. If, on the other hand, it would not come under the direct influence of a stellar body, it would roam around the universe for all time until finally struck by meteors or some other body.

In 1915 the writer publisht in the June issue of the "Electrical Experimenter" a machine to fly in space and he gave it the name of "Space Flyer," under which name machines of this kind have now become known. The writer's idea was to use a sphere some 75 feet in diameter which contained all the different machinery and apparatus to navigate and operate the flyer. The underlying idea was to have the whole exterior of the machine criss-crost with an electric wire system, similar to a radio station. These wires radiate over the surface of the machine from the two "poles"; the wires are insulated from the metallic shell of the flyer. The proposal was to use an electric current of a peculiar wave action, which was to annul gravitation electrically. The machine was steered very simply by switching in or out various sections of the wire system. For instance, if the machine was to leave the ground all that was necessary was to switch on the wires facing the ground, while the part pointing towards the sky was not to be electrified. A reaction would immediately set in and the machine would naturally rise as there was no gravitation to hold it back. If the machine approached the moon or a planet, the same electric current was brought into play again, and the retarding motion set up so that the flyer would not smash itself against the face of the heavenly body. There was a steel landing belt provided on which the machine was to roll upon landing. This was necessary otherwise the wire system would be destroyed.

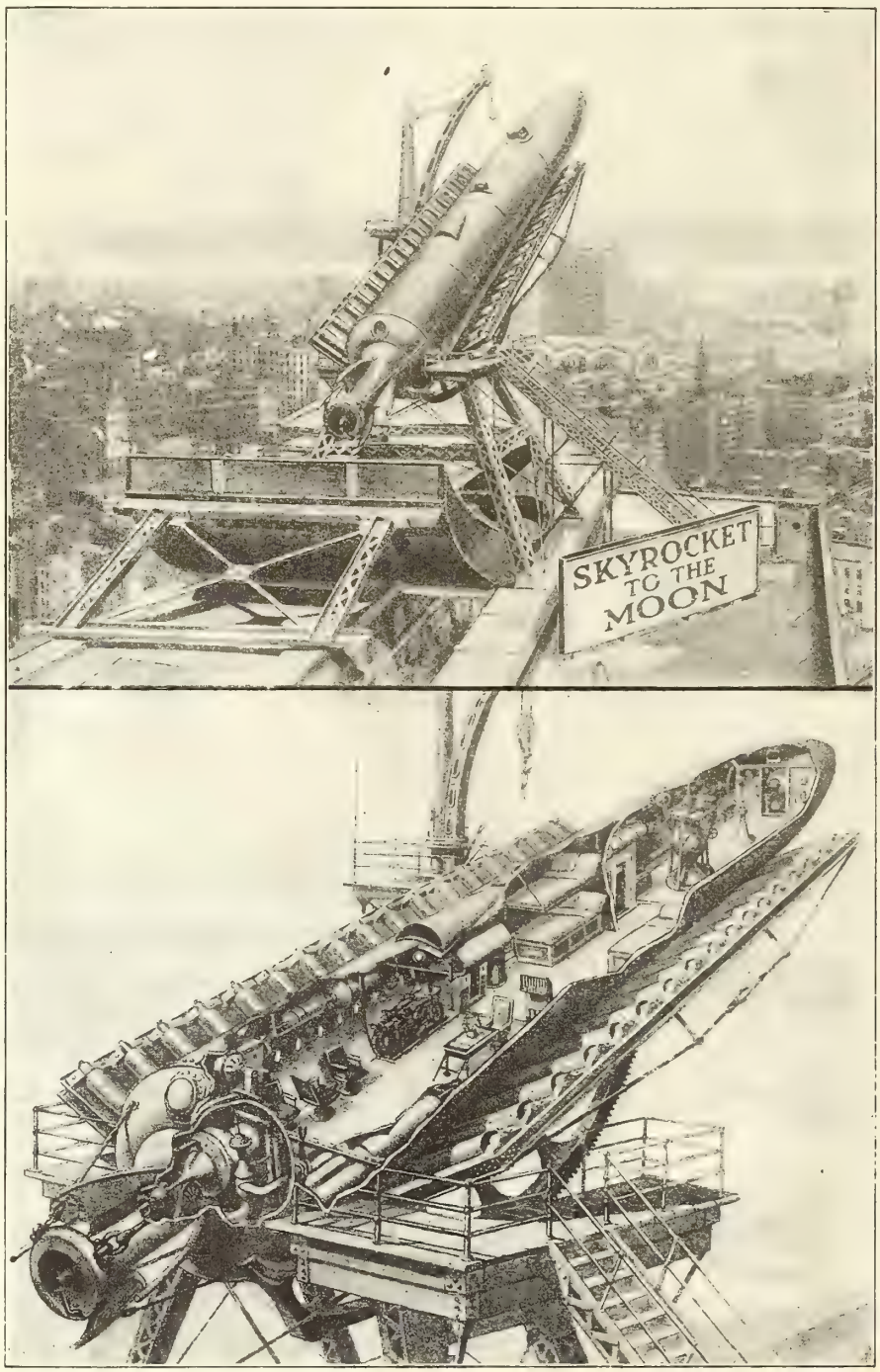
Another idea is shown in Arthur Train's "Flying Ring" publisht in 1917 in his book "The Man Who Rocked the Earth." This also was a fanciful machine and was propelled by atomic energy. The flying ring had a sort of tripod mounted upon it and at the top there was a uranium power generator which gave forth a disintegration ray of great power. This ray striking either the earth, atmosphere or the ether in space would naturally set up a reaction, lifting the ring. The direction of the machine was of course controlled by this ray. The flying ring also could be steered sideways by means of gyroscopes contained in the interior. This idea is perfectly feasible if we ever can make use of atomic energy.

The latest newcomer in space flying machines is Dr. Goddard with his now famous moon rocket. We have already described Dr. Goddard's rocket in our Feb. 1920 issue of the "Electrical Experimenter," where the detailed description of the principles can be found. Dr. Goddard's idea is sound and there is no question that it is possible to send such a rocket out into space. If we take the experimental rocket of Dr. Goddard and magnify it so that it can carry a number of people we will get a machine similar to the one shown in our illustration.

The Goddard rocket operates by explosive charges which emerge from the end of the rocket and the propulsion is accomplisht merely by reaction. It makes no difference whether these explosive charges occur in the atmosphere or in free space; the action is always the same. As a matter of fact, in free space and in a vacuum the kicking reaction of the explosive charges will propel such a machine much faster than thru an atmosphere where the air resistance tends to retard it. Not only this, but once the rocket leaves the gravitational influence of the earth, a much smaller explosive charge will propel the rocket at prodigious speed.

The matter of steering such a rocket is not a simple one and must be worked out very carefully. It would be necessary to have outlets for the explosive charges directed away from the machine at right angles, preferably at the lower end and at the bow of the machine. These explosive charges would be imperative whenever it became necessary to steer the machine to the right or to the left, to turn it about, or for landing purposes. It would not be a simple task to control such a machine by means of these charges, and it would be a ticklish business for instance to affect a smooth landing upon the surface of the moon. While of course it is not impossible to accomplish this, the matter of firing the

(*Continued on Page* 1355)



© Photos Courtesy Bray Studios

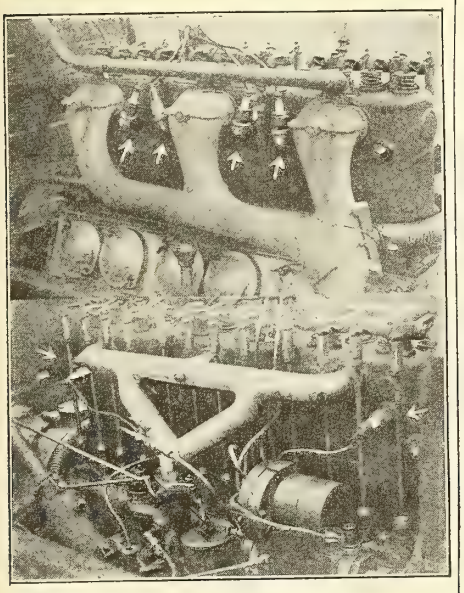
"All Aboard for the Moon"—May Not Sound So Strange to Our Ears, Fifty Years Hence. Perhaps Even Sooner the Goddard Rocket Will Have Been Perfected and Made Safe Enough to Carry Passengers Across the Intervening Chasm of Interstellar Space to Our Neighbor the Moon. The Interior Arrangement of the Passenger-Carrying Rocket Is Here Illustrated.

MOTOR HINTS

FIRST PRIZE $25.00.

"A REMEDY FOR DIRTY SPARK PLUGS."

On some of the older models of cars great trouble is often experienced due to the continuous fouling of the spark plugs.



Improving Operation of Engine When Spark Plugs Foul and Oil Up Badly by the Simple Expedient of Placing the Plugs in Male-Female Elbows. These Can Be Purchased At Any Plumbing Shop.

The main cause of this difficulty is their position. On a great many cars the plugs sit horizontal instead of vertical, allowing the oil and carbon to collect very readily.

Obtain as many male-female pipe "ells" as there are spark plugs. Next remove the plugs from the cylinders and replace them with the ells, turning them so the mouth of the ell will face up. Now screw the plugs into the ells and connect up.

As will be seen from the photo, it was only necessary to change the middle four, as the first and sixth never fouled.

I found the plugs were perfectly clean a year from the time I changed them.

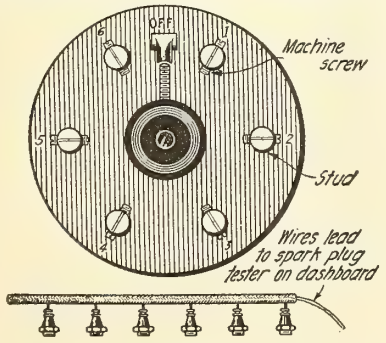
Contributed by

ORAN T. McILVAINE.

SPARK PLUG TESTING DEVICE.

This spark plug testing device is used on the dash-board when the engine is running. In the event that one, two or more of your spark plugs are not firing properly, simply turn the knob on the spark plug tester while the engine is running, and it will show you by the numbering of the studs, which one is out of order, without getting any shocks.

Contributed by WILLIAM NEBLICK.



Spark Plug Tester Suited to Mounting on the Dash-board.

$50.00 IN PRIZES

Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

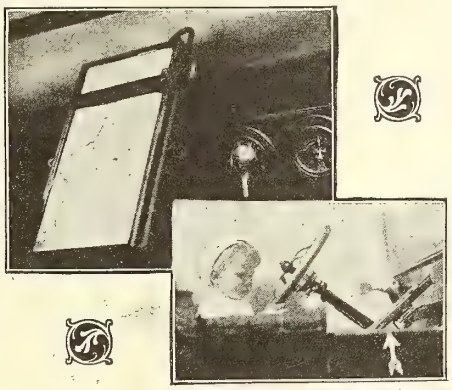
FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

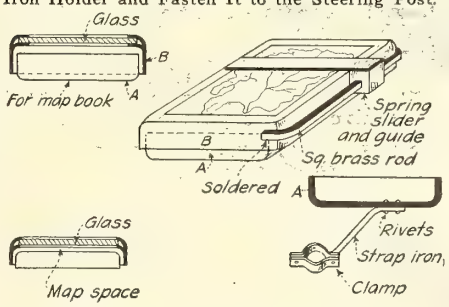
SECOND PRIZE $15.00.

INDEX ROAD GUIDE AND MAP HOLDER.

The accompanying photo and diagram show my index road guide and map holder as applied to my "flivver," and on which I am endeavoring to obtain a patent. This device brackets to dash or steering column or may be read from the hand.



Don't Hold the Road Map on Your Lap or Keep It in Your Pocket—Make This Sheet Iron Holder and Fasten It to the Steering Post.



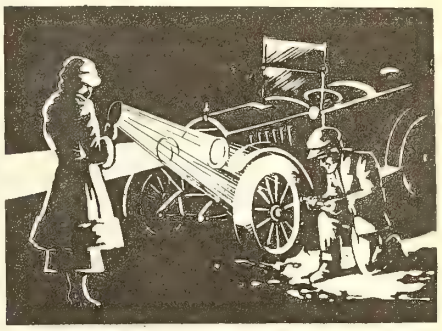
The index finger is movable and is spring clamped to guide rod, remaining in position where set. Read above the finger going from bottom to top of face—read below finger going from top to bottom. It will hold a single sheet map or an open book 1½" thick (practically all commercial maps publisht for road guide purposes). It consists of two telescoping pans, one glass bottomed, suitably clamped together as desired.

Contributed by P. C. FISH.

THIRD PRIZE $10.00.

MIRROR SERVES AS "TROUBLE LAMP."

I wish to enter your "Motor Hints" contest and I enclose sketch showing the way I have repaired my car at night on the road, with a mirror to reflect the beam from the headlight under the car. By turning the headlight to one side I could



The Simplest Trouble Light—Simply a Hand or Other Mirror Used to Reflect the Headlight Beam Rearward.

reflect the light on the rear wheels. The mirror on the car can be used with good results.

Contributed by

HARRY E. CONRAD

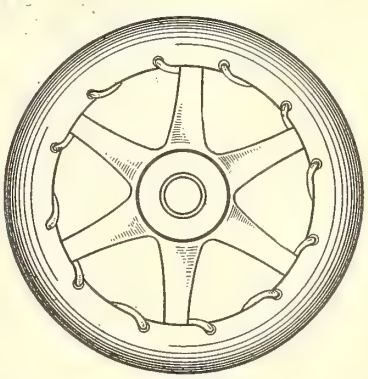
A SPARE TIRE FOR EMERGENCIES.

Many motorists have met conditions where it seemed absolutely necessary to "limp in on a flat," as the saying goes. When the spare tire has been used and there is no time to bother taking the tube out and making repairs the idea described here will be of service.

In addition to the regular spare, carry an old shoe, somewhat smaller than the regular equipment. The sides of this shoe should be perforated with holes as shown in the sketch and several old treads slipt inside it. When all the spares are used and a tire goes flat simply remove the flat tire, slip the old shoe over the wheel rim, lace it in place and go ahead. The rim will not be damaged, the going is not bad and it will prevent rim cuts on a good tire were you to run on it flat. The old shoe can be carried without difficulty and will be found mighty handy at times.

Contributed by

THOMAS W. BENSON.



In Addition to the Regular Spare Shoe, Carry An Old Shoe Along. This Shoe Should Be Perforated With Lacing Holes As Shown.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

of U. S. Naval Observatory

The Origin of the Earth

THE earth is inconceivably old. The most reliable method of determining its age—that of computing from the present amount of radium and lead in the older rocks the time necessary for the disintegration of the original uranium content of the rocks into these elements—indicates that a period of nearly two billion years has elapsed since these rocks were formed. How long a time the earth was in existence as an individual member of the solar system prior to that date is not known, but it is believed to have been fully as long as the interval that has elapsed since the formation of these earlier rocks.

More recent knowledge of the condition of the earth's interior has altered radically our earlier ideas on the subject. Instead of an intensely hot, liquid interior encased in a cooled, hardened and contracting surface crust we now know that the earth has a highly elastic and rigid metallic core of great density, largely magnetic iron in composition.

The original earth-mass has more likely been increased by the addition of adjacent masses than decreased in size by contraction under gravity from a nebulous mass of great volume and low density.

All of the inherent heat of the earth originates, it is now believed, in a comparatively shallow shell of radio-active rocks less than one hundred miles in thickness instead of within its central core which probably has a temperature approaching the absolute zero of space.

We cannot consider the question of the origin of the earth without reference to the origin of the solar system. That all the planets as well as the planetoids originated from a common parent-mass is not seriously questioned. All of these bodies revolve about the sun and rotate upon their axes in the same direction—from west to east. Moreover, all of the planetary orbits lie very nearly in the same plane and are nearly circular in form.

The orbits of the planetoids are more elliptical and more highly inclined to one another than are the orbits of the planets, but on the *average* they are neither very elliptical nor very highly inclined to the planetary orbits.

The sun rotates upon its axis in the same direction in which the planets rotate and perform their revolutions and the orbits of the planets are inclined at small angles *to the plane of the sun's equator.*



Fig. 1. Illustrating the Theory of Ejection of Streams of Matter from the Sun Under the Attraction of a Passing Sun. The Dotted Lines Show the Paths Taken by Ejected Particles (Planetesimals) After the Secondary Sun, Has Past By. The Continual Ejection of a Number of Streams Would Produce Formations Similar to the Great Spiral Nebulae, tho Much Less Extensive. This Illustration Shows Clearly How the Planets Might Have Been Formed by the Whirls of Planetesimal Particles; These Concentrated Groups of Particles Which Form, Gradually Becoming More Dense Until They Contracted Sufficiently to Form a Solid Sphere Such As Our Earth.

These facts are all significant and cannot be overlooked in formulating a theory to explain the origin of the planetary system in general and of the earth in particular. Presumably the planets and planetoids formed at one time a part of a central body which rotated on its axis in the direction in which they now revolve about the sun.

When and by the operation of what force, external or internal, they were separated from this central body is the question.

THE LA PLACE "NEBULAR HYPOTHESIS" THEORY.

In 1796 La Place advanced his celebrated *nebular hypothesis* to explain the origin of the solar system. It was received with favor both by scientists and laymen and in a short time was almost universally accepted as closely approximating to the truth.

According to the nebular hypothesis the solar nebula from which the planetary system was formed, originally extended at least as far as the orbit of Neptune and rotated slowly in the direction in which the planets now revolve. As it lost heat by radiation and contracted under the gravitation of its parts its rate of rotation necessarily increased. When the centrifugal force at the equator equalled the central gravitational force a ring was left behind by the contracting nebula. Such a ring would not be absolutely uniform and would break at some point and gather into a planetary mass under the gravitation of its parts. This planetary mass would abandon rings in turn and these would break up to form satellites. Successive rings were abandoned at intervals by the solar nebula at the present distances of the planets from the sun in the manner described above until the original solar nebula had contracted to its present size.

The rings of Saturn were supposed to be the single example remaining of this process of forming planets and satellites from a *contracting nebulous mass.*

The La Placian hypothesis attempted to explain why all the planets and their satellites revolve in the same direction in which the sun turns on its axis, in nearly circular orbits and nearly in the same plane. At the time it was advanced it appeared to be in accord with all the facts then known regarding the solar system.

The planetoids with their interlacing and in some instances highly inclined and elliptical orbits were then undiscovered. It would have been impossible for them to have been formed by the abandonment of successive rings.

The constitution of Saturn's rings was unknown at this time; also the fact that the moonlets of the inner ring revolve about Saturn in *half* the time required for the planet to turn on its axis—another impossibility under the nebular hypothesis.

The satellites of Mars were not discovered until many years later, as well as the retrograding satellites of Jupiter and Saturn, all presenting difficulties in the way of accepting the nebular hypothesis without radical changes. Attempts, mostly unsuccessful, have been made from time to time to make these exceptional cases fit in with the requirements of the nebular hypothesis.

The theory of the origin of the sun's heat through contraction advanced by Helmholtz, appeared to give considerable support to the theory of La Place but the mathematicians got to work and showed that the amount of heat that would be furnished by the contraction of the sun from beyond the orbit of Neptune to its present dimensions would be sufficient to supply

heat to the earth at the present rate for only twenty-five million years, a period far too brief, the geologists and biologists found, to cover all the vast cyclical changes that are known to have taken place upon the surface of this planet since its surface crust was formed. Evidently gravitational contraction is by no means the only or even the chief source of the solar energy.

The mathematicians, moreover, did some more figuring and showed that under the suppositions of the nebular hypothesis the hypothetical solar nebula, at the time it extended beyond the orbit of Neptune, must have had a moment of momentum *two hundred times* as great as that of the present system, though owing to the principle of the conservation of moment of momentum the two should be *equal*.

They also showed, indisputably, that it would have been impossible for successive rings to have been abandoned at certain definite intervals by a contracting nebula and granted that if a ring *could* have been abandoned it would have been impossible for it to condense into a planet, since tidal forces due to the sun would offset the gravitation of its parts.

When La Place advanced his famous theory it was, "with that distrust which everything ought to inspire that is not a result of observation or of calculation."

Were La Place living today he would be, we believe, the first to abandon a theory that is now known to be in accord neither with observation nor calculation.

Being deprived of a theory that has served to explain the outstanding features of the solar system more or less adequately for one hundred and twenty-five years, astronomers are seeking in the light of recent observations and discoveries to formulate a satisfactory theory of the origin of the solar system.

THE PLANETESIMAL THEORY

In the planetesimal theory of Chamberlin and Moulton and the recently suggested theory of the well-known English mathematician Jeans, *a second sun passing close to our own sun is assumed to have been the cause of the origin of the planetary system.*

The effect of the close approach of such a sun would be the ejection of a stream of matter from our sun as we may term it, in the direction of the passing body and also in a diametrically opposite direction, according to the *planetesimal theory* (see Fig. 1.) This ejection would be continuous as long as the stars remained near one another, the height attained by the ejected stream decreasing as the passing star receded. The result would be the formation of a *spiral nebula* in which the motion of the ejected particles, — planetesimals — would be across the spiral arms, toward and away from the passing star. After the sun had receded so far as to have no further effect upon these ejected particles they would revolve about the sun in more or less elliptical orbits which would gradually be reduced to nearly circular forms by repeated collisions between planetesimals. *Larger nuclei* would be formed and these would gradually sweep up smaller fragments and become the planets of the present system. Smaller nuclei in the vicinity of larger ones would become their satellites and in the course of many millions of years all of the larger fragments would be swept up by the planetary nuclei and their satellites—leaving only the asteriods, comets and meteors as survivors of the original spiral system.

It must be borne in mind that a spiral nebula formed by the close approach of two suns would resemble in *form only* the great spiral nebulae that are known to exist by hundreds of thousands in the heavens. These are far too extensive to form anything so small as a single solar system but would condense into systems composed of many suns,—either galaxies or star clusters.

Jean's suggested theory of the origin of the planetary system differs in its details from the above, though a passing sun is assumed to be the disturbing force that causes the ejection of a stream of matter which condenses to form the planets and their satellites. The origin of the inner planets is left greatly in doubt, however, and it is stated that the system which interests us chiefly—the earth-moon system, is the one about which it is most difficult to arrive at any definite conclusion. Our own sun, it is assumed, was dark and cold, of low density and with a diameter about equal to that of Neptune's orbit at the time of the catastrophe which is placed at some 300,000,000 years ago. In Jean's words, " . . . The time for arriving at conclusions in cosmogony has not yet come—(and it must be left)—to future investigators armed with more mathematical and observational knowledge than we at present possess to pronounce a final decision."

However, since La Place advanced his celebrated nebular hypothesis, great advances in astronomy have been made, and man is in a better position to theorize on this fascinating problem today than he was one hundred and twenty-five years ago.

All such theories must necessarily be regarded as working hypotheses only, to be discarded or modified as our knowledge and understanding of the laws of the universe increase. No theory can ever be regarded as final or perfect.

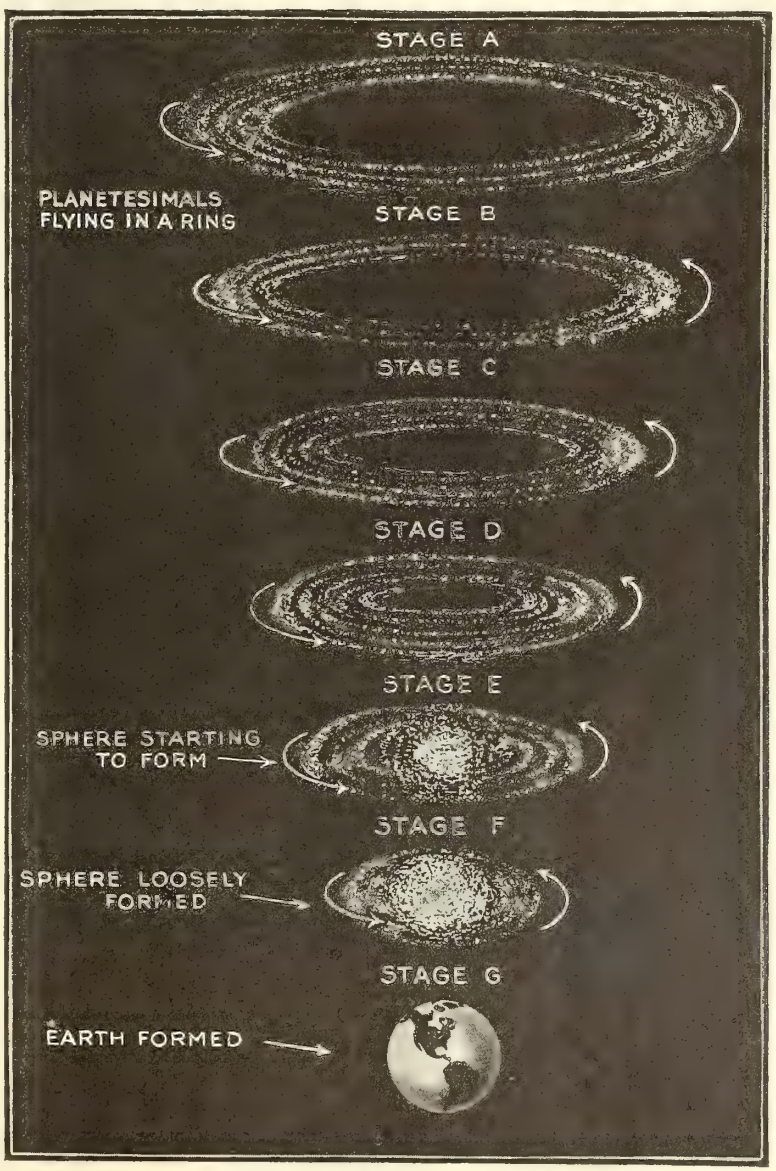
The discovery of radio-activity furnishes us with new material for new theories. The sun and the planets may be and probably are far older than we ever dreamed was possible. It is no longer necessary or reasonable to assume that a greatly extended solar nebula once existed and supplied the planets with heat through gravitational contraction or to place a time limit upon the period required for the formation of the planets and their satellites, that is not in accord with the requirements of other sciences.

We also know today that there exists within the sun powerful repulsive forces, which even under present conditions eject gaseous matter to heights of five hundred thousand miles or more with a velocity of over two hundred miles per second. Small changes in the velocity of ejection produce great differences in the height of the ejected columns.

With an initial velocity of three hundred and eighty miles per second, matter would be thrown from the solar surface to a height of fifty million miles. Were the velocity of ejection three hundred and eighty-three miles per second the height of the column would be five hundred million miles, while a further increase in the initial velocity would send matter away from the sun never to return.

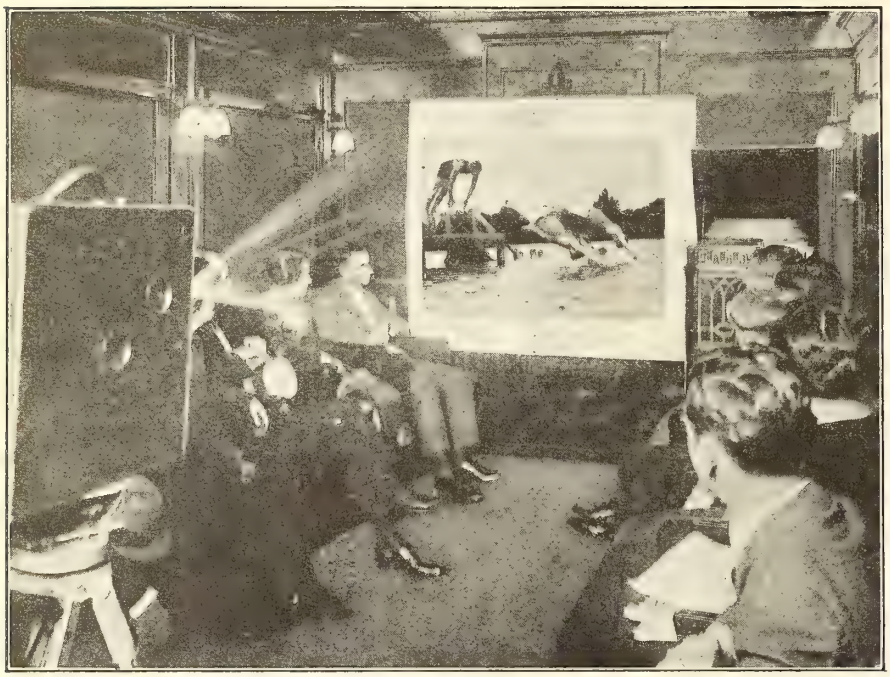
Novas, or temporary stars are not considered such rare phenomena today, as they were even twenty or thirty years ago. By the aid

(*Con. on page* 1326)



This Illustration Shows Vividly How a Planet Such as Our Earth Might Have Been Formed, Under La Place's Theory from the Whirlings of Planetesimal Particles. The Ring of Particles Acted Upon by the Gravitational Pull of Each Individual Particle, Gradually Contracts Until the Ring Itself Becomes of Smaller Diameter and More Dense, Breaking and Culminating Into a Semi-Dense Ellipsoid and Finally Into an Approximate Sphere Resembling the Present Form of Our Earth.

Movies Shown on Moving Train



A few weeks ago, the passengers aboard a southern railway train were pleasantly surprised when a phonograph was started, a screen rolled down and a movie show given.

Movie shows on trains running at a speed of 60 miles an hour, are quite a novelty, and an innovation which will add greatly to the comfort and amusement of the passengers. In conjunction with the photoplay given, a phonograph furnisht the music; and every hour, the performance of the show was repeated.

Moving Pictures "en route" While Speeding Along on a Moving Train Is One of the Latest Novelties and Pleasures Provided for Railroad Travelers. This Train Is the New Orleans Limited, and Music for the Show Is Provided by a Phonograph.

The pictures were made possible by the utilization of a specially designed generator, and in the opinion of the persons present, the show was an entire success.

Those witnessing the demonstration on the southern railway train were greatly pleased with the show, and exprest a fervent desire for the universal adaptation of this splendid idea, especially on long trips.

Many railway officials are now contemplating the installation of apparatus for furnishing movies en route.

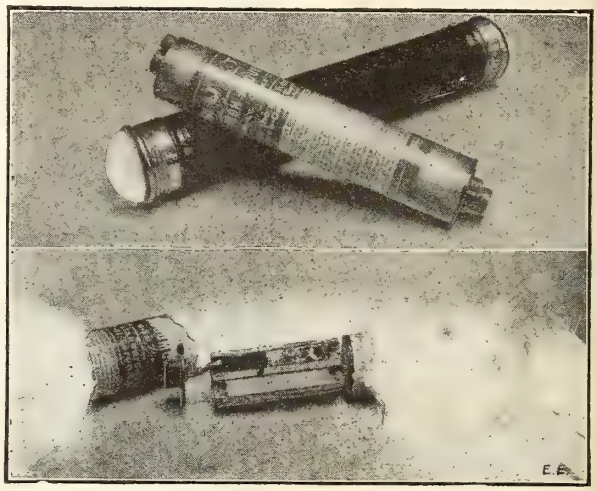
A Storage Battery Flashlight

A new so-called torch accumulator which has recently been placed on the English market promises to take the place of the dry-cell type flashlight battery. It is made to fit the standard two and three cell cases, is equally as light as those fillers, and has the distinct advantage of allowing for a complete recharge within from eight to ten hours after a complete "run down."

The photograph depicts this storage cell in its compact closed position. Cut open and dissected, it discloses great ingenuity and cleverness. A *grooved wooden separator* is filled with the red lead and litharge compounds for the positive and negative plates instead of the usual lead grid; this makes for its extreme lightness. Very little lead, except for the connections, enters into the construction of the battery. One cell is connected in series with the other thru the intercell separator.

When charging, a very small amount of sulfuric acid electrolyte is poured into each end of the battery, it is then connected to the charging circuit with the necessary resistance in series, for about eight hours. Upon removal, the acid is poured out if there should be any in the case or container, and the battery closed up and wiped dry.

This battery does not corrode the case because it is absolutely tight and acid proof.





Making Your Own Records

The new phonograph disc type recorder, here illustrated, is the invention of Mr. C. E. Sanders, and consists of a recorder and reproducer operating on a wax disc, which is placed on any standard phonograph. The recording and reproducing elements are fed across the disc by a feed arm traveling in a metal spiral lying in the center of the disc.

New Disc Phonograph Attachment Enabling Any One to Record and Reproduce Their Own Voice.

Mr. Sanders has succeeded in producing a fluid cleaner, or erasing compound, which softens the surface of the wax and smooths it so that it may be used over and over again from fifty to one hundred times without the usual shaving operation. The record on the wax is of the hill and dale variety, one hundred lines to the inch and runs for about two and one-half minutes. The natural timbre of a voice is perfectly retained, it is said. The records can be played about fifty times from the wax, or they can be made permanent by sending them to headquarters for a small charge to be plated with copper, nickeled and stampt in conventional stock.

How Rocks Grow

By WILLIAM M. BUTTERFIELD

RECENTLY a motion picture of a mountain being blown apart by explosives was shown in various metropolitan theaters, probably causing most of those witnessing this thrilling exhibition of gigantic human "destruction" to think that the masses thus separated could never again form any part of solid rock, much less a mountain.

Those not familiar with the development of the stony foundations of the earth often believe rocks are unalterable masses which were created in their present shape at the birth of our globe, a very natural notion that is persistent and not easy to correct.

Rocks have changed in past ages, and have been disintegrated in a slower, less spectacular manner than was shown in the moving-picture display. Rock changes are so slow, in fact, that successive races of men often live their brief lives amid rocks, which as far as tradition and ordinary surface observation go, have never changed their contours.

The "destruction" of rock, as the breaking process shown at the movies, may under the usual understanding be called, —nevertheless is an essential part of the history of many of the common rocks. All rocks exposed to the atmosphere, to common water, to snow, ice, glacial action and the heat of the sun, and of subterranean temperatures are subject to change; uneven expansion and contraction in the rock mass, or chemical actions may also affect them. Thus mountains may be reduced in part, to boulders, the boulders to pebbles, the pebbles to sand, and the sand to silt. Glaciers do much of this work.

Mountain streams, rivers, glaciers and even the waters of the ocean, convey this detritus and distribute it over large areas, —often thousands of square miles in extent, first as a loose soil of various degrees of fineness from boulders to the finest silt,—the mineral constituents of such soil is supplemented by vegetable and animal life and detritus. In course of time, other deposits are laid down at the bottom of the valleys, lakes and bays, one deposit on top of the other in layers of different kinds. These deposits may then be converted by cosmic force and cosmic time—lapse into rock strata, which often vary largely in composition.

Rocks are composed of various constituents that are practically indestructible, but which admit of many combinations and changes, the most important of their constituents are: oxygen, silicon, aluminum, magnesium, calcium, potassium, sodium, iron, carbon, sulfur and hydrogen. Oxygen in combination with the metal calcium and with carbon forms calcium carbonate or limestone, and this calcium with sulfur and oxygen forms calcium sulfate—gypsum.

Heat, such as is now exhibited by volcanoes, produces a typical variety of rock (the igneous rocks) and sometimes changes the character of the sedimentary and crystalline varieties. There is still an important element of rock growth and decay very rarely spoken of by geologists, but which could we think be mentioned here; it is the combined work performed unconsciously by the members of the other great kingdoms (animal and vegetable), mankind in this instance included.

Man tears the solid hills apart for building materials or minerals, he levels them to perform engineering feats, to construct water ways, dams, traction lines, or for various other purposes. Over the entire habitable globe farmers spread on the soil some prepared constituent of rock as fertilizer, and dig up and level the soil in such a state, that water and air can more readily combine these fertilizing elements with the so-called unfertile ones.

So everywhere animals and plants are performing some such work, all of it essentially a part of rock transformation.

Lime in solution in oceans, rivers, lakes and drinking waters is made by animals into shells, corals or bones.



Glacial Action Grinding Rocks to Powder and Forming Boulders. The Streams Issuing from Their Lower Moraines are Opaque and Discolored by Suspended Mineral Matter Produced by the Grinding of the Rocks Under the Mass of Slowly Moving Ice.

An Active Volcano, Showing the Agency Which Has a Part in Forming Plutonic Rocks. What Goes on in the Interior of the Earth Can be Surmised from These Exhibitions of Cosmic Power.

A Mountain Cascade Playing Its Part in Rock Disintegration. Its Action Is Usually Mildness Itself Compared to the Slow Intensive Glacial Processes, but the Action Is Progressive and Noticeable to the Student of Geology.



Level Strata of Rock Undisturbed by Any Changes. As the Strata are Supposed to Have Been Deposited from Suspension in Water, They are Normally Level.

The Bending and Deformation of Originally Parallel Strata. Here We See the Normally Level Strata Thrown Out of Line and Upheaved and Deprest by Various Causes.

The Erosion and Upheaval of Rocks Forming Mountains and Making the Strata Totally Irregular. Here Volcanic and Igneous Action May Come into Play with Accompanying Metamorphosis.

Man's Mining Operations, Where He Performs the Functions of the Mole, Working Formerly Almost in Darkness, Altho at Present the Electric Light Has Enabled the Mine to be Brilliantly Lighted.

Mining Animal Rock (Coral Rock) that Forms Nearly all of the Island of Bermuda. Some Rock Can be Easily Worked Without Using High Explosives, But Other Rocks Again, Such as Granite, Are Extremely Hard to Quarry.

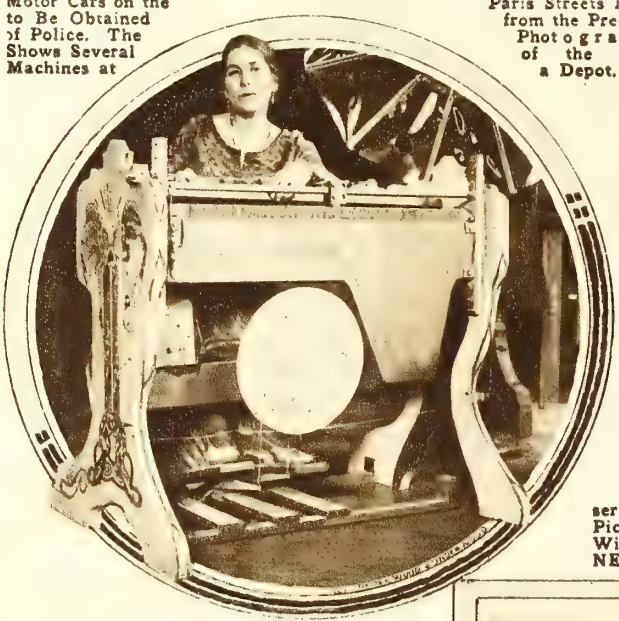
Science



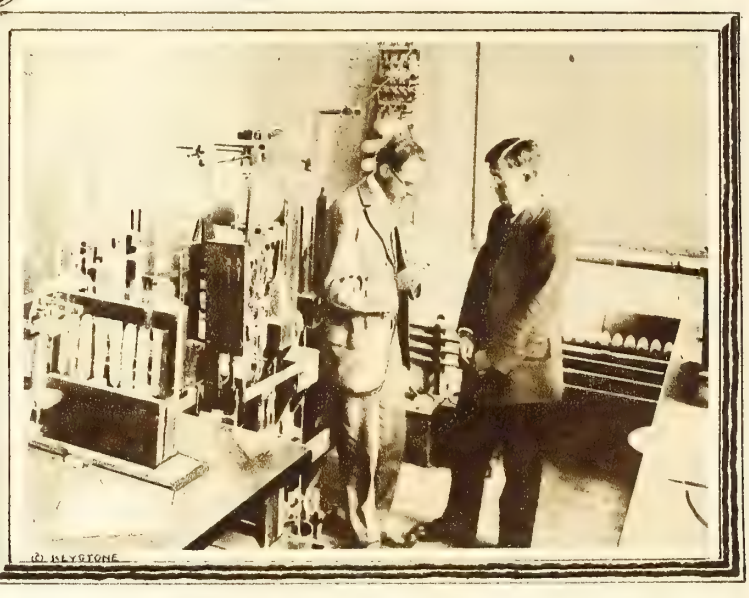
Six-Wheel Motor Bus, Recently Placed in Operation by a Paris Transportation Company. A Fleet of These Machines Has Been Placed in Commission. A Special Permit to Use the Six-Wheel Motor Cars on the Paris Streets Had to Be Obtained from the Prefect of Police. The Photograph Shows Several of the Big Machines at Machines at the Depot.



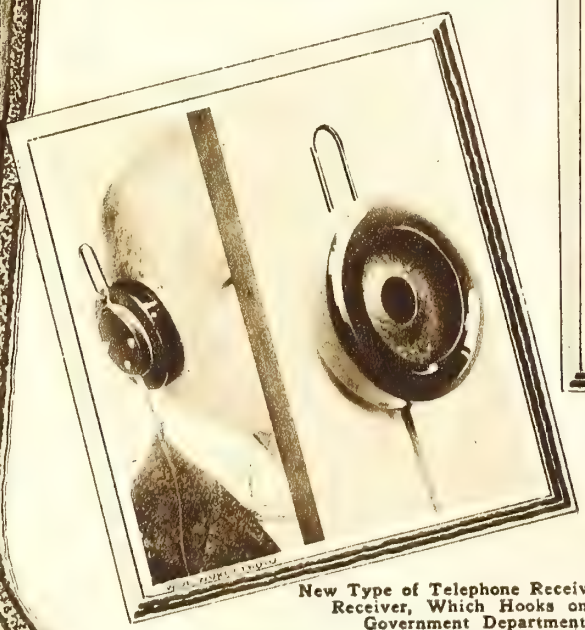
"Movies" of the Moon Were Made Recently Thru the Great Refractor Telescope at the Yerkes Observatory at Williams Bay, Lake Geneva, Wisconsin. The Pictures Were Made by the International Film Service and Will Be Shown Exclusively in the INTERNATIONAL NEWS WEEKLY.



Mrs. Mary Hallock Greenwalt of Philadelphia, With Her "Nourathar" or Instrument by Which, as One Would Play a Piano or Organ, Lights in the Theater May Be Controlled in an Amazing Number of Ways to Permit Any Expression Desired by the Orchestra Leader, So as to Make the Acting and Singing More Realistic.



Dr. Willis R. Whitney and Dr. Irving Langmuir, Who Were Awarded Distinguished Honors for Important Scientific Research by the Society for Chemical Industry. Dr. Whitney (at Left) Is the Director of the General Electric Company's Research Laboratory and Dr. Langmuir Is Assistant Director.



New Type of Telephone Receiver for Long Distance Calling. This Type of Receiver, Which Hooks on to the Ear, Has Been in Use by All the Government Departments of Germany and Found Highly Successful. No Sound but That of the Human Voice Over the Wire Can Creep in Thru the Sides of the Receiver While the 'Phone Is in Operation.

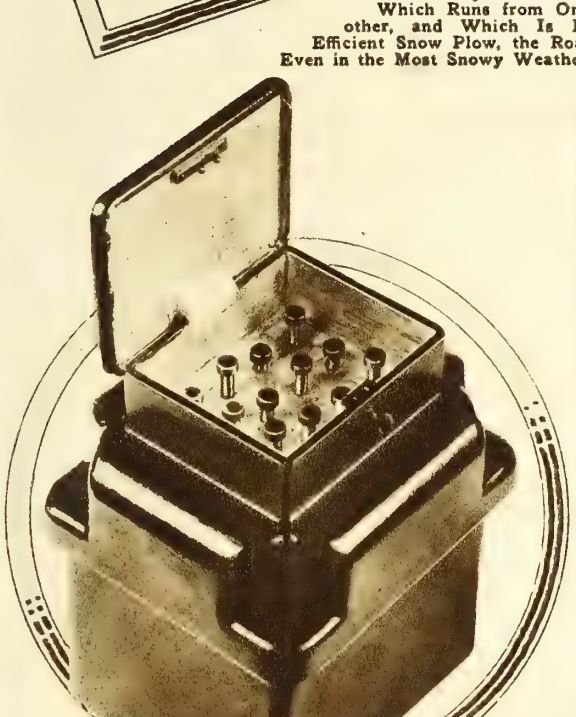
in Pictures



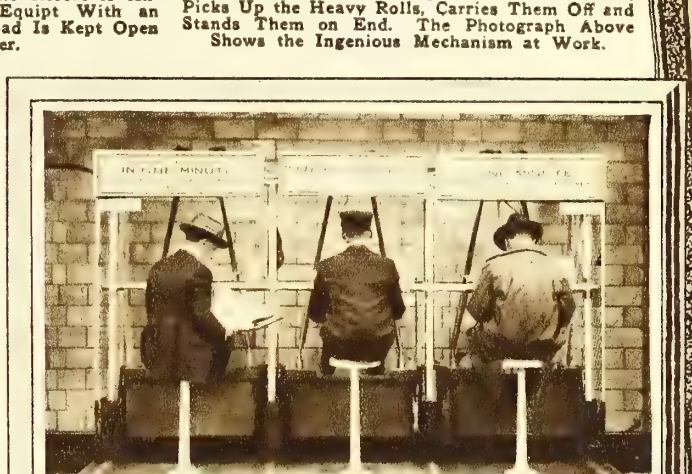
Before the Towns in This Swedish Locality Become Famous as Winter Resorts, These Places Were Utterly Snowed in. By Means of This Trolley Which Runs from One Resort to Another, and Which Is Equipt With an Efficient Snow Plow, the Road Is Kept Open Even in the Most Snowy Weather.



An Ingenious "Apron" Attachment to the Foreend of an Ordinary Electric Truck Has Eliminated the Heretofore Tremendous Labor Necessary to Handle the 800-Pound Rolls of Newsprint Paper. The Truck, or Apron as It Is Called, Picks Up the Heavy Rolls, Carries Them Off and Stands Them on End. The Photograph Above Shows the Ingenious Mechanism at Work.



A New Auto-thief Alarm Device Exhibited at the Chicago Auto Show Attracted Much Favorable Comment. The Alarm Is Enclosed In an Iron Box. No Part of the Machine Can Be Touched Without Starting This Alarm to Ringing. This Prevents the Stealing of Autos. Over 100,000 Combinations of the Locking Mechanism Are Possible by Means of the Keys.



The Machine Shown Above Shines Your Shoes While You Wait Without Extra Tips. The Machine Here Illustrated Is Fitted with Three Seats and These Three Patrons Can Be Accommodated at One Time. The Electric Motor Driven Brushes First Remove the Dust and Dirt from the Shoes, and After the Polish Is Applied, the Shoes Are Given a High Gloss by the Attendant. One Minute Completes the Process.

This "Telegraphone" Perfected by Mr. Seelan Newman of Berlin, Consists of a Combined Recording and Reproducing Phonograph. It Is Intended for Office and Home Use, and Is Attached to Telephones, Recording Messages During One's Absence.

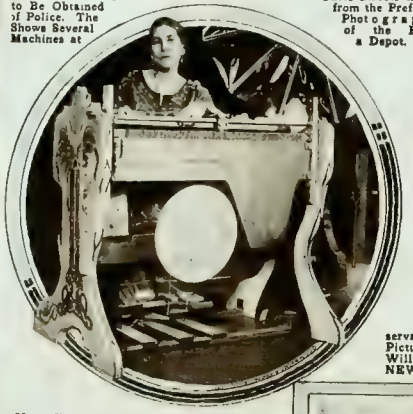


Science in Pictures



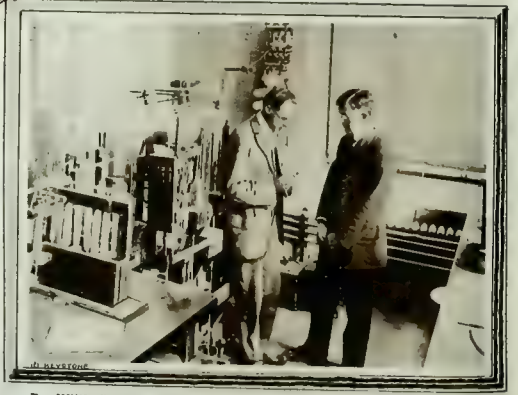
Six-Wheel Motor Bus, Recently Placed in Operation by a Paris Transportation Company. A Fleet of These Machines Has Been Placed in Commission. A Special Permit to Use the Six-Wheel Motor Cars on the Paris Streets Had to Be Obtained from the Prefect of Police. The Photograph Shows Several Machines at Photograph of the Big Depot.

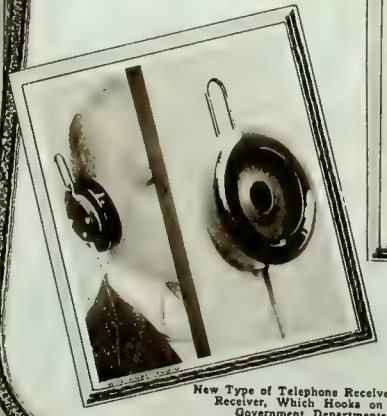




"Movies" of the Moon Were Made Recently Thru the Great Refractor Telescope at the Yerkes Observatory at Williams Bay, Lake Geneva, Wisconsin. The Pictures Were Made by the International Film Service and Will Be Shown Exclusively in the INTERNATIONAL NEWS WEEKLY.

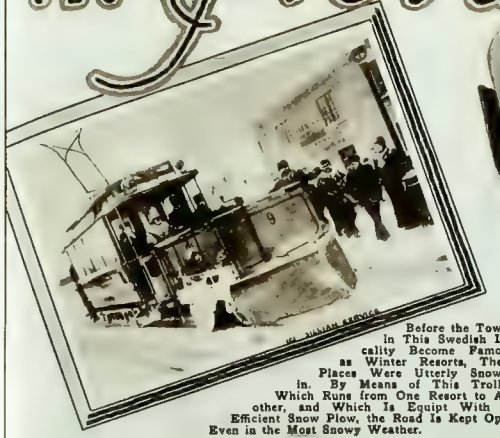
Mrs. Mary Hallock Greenwalt of Philadelphia, With Her "Nourathar" or Instrument by Which, as One Would Play a Piano or Organ, Lights in the Theater May Be Controlled in an Amazing Number of Ways to Permit Any Expression Desired by the Orchestra Leader, So as to Make the Acting and Singing More Realistic.





Dr. Willis R. Whitney and Dr. Irving Langmuir, Who Were Awarded Distinguished Honors for Important Scientific Research by the Society for Chemical Industry. Dr. Whitney (at Left) Is the Director of the General Electric Company's Research Laboratory and Dr. Langmuir Is Assistant Director.

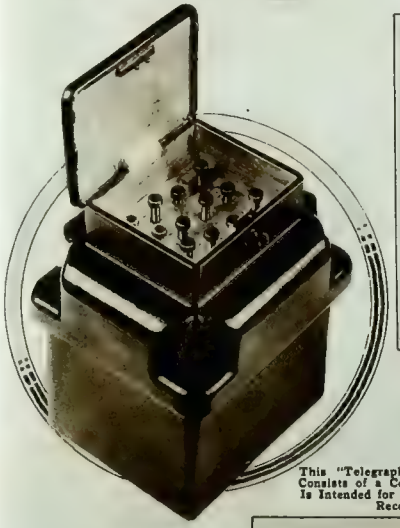
New Type of Telephone Receiver for Long Distance Calling. This Type of Receiver, Which Hooks on to the Ear, Has Been in Use by All the Government Departments of Germany and Found Highly Successful. No Sound but That of the Human Voice Over the Wire Can Creep in Thru the Sides of the Receiver While the 'Phone Is in Operation.



Before the Towns in This Swedish Locality Become Famous as Winter Resorts, These Places Were Utterly Snowed in. By Means of This Trolley Which Runs from One Resort to Another, and Which Is Equipt With an Efficient Snow Plow, the Road Is Kept Open Even in the Most Snowy Weather.



An Ingenious "Apron" Attachment to the Fore-end of an Ordinary Electric Truck Has Eliminated the Heretofore Tremendous Labor Necessary to Handle the 800-Pound Rolls of Newsprint Paper. The Truck, or Apron as It Is Called, Picks Up the Heavy Rolls, Carries Them Off and Stands Them on End. The Photograph Above Shows the Ingenious Mechanism at Work.

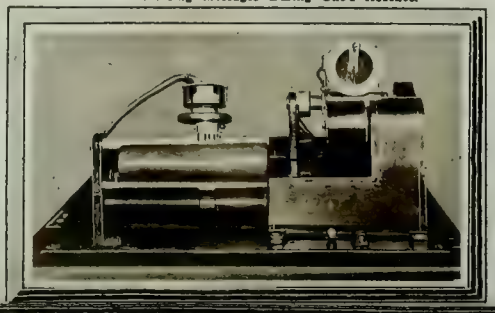




The Machine Shown Above Shines Your Shoes While You Wait Without Extra Tips. The Machine Here Illustrated Is Fitted with Three Seats and These Three Patrons Can Be Accommodated at One Time. The Electric Motor Driven Brushes First Remove the Dust and Dirt from the Shoes, and After the Polish Is Applied, the Shoes Are Given a High Gloss by the Attendant. One Minute Completes the Process.

This "Telegraphone" Perfected by Mr. Seelan Newman of Berlin, Consists of a Combined Recording and Reproducing Phonograph. It Is Intended for Office and Home Use, and Is Attached to Telephones, Recording Messages During One's Absence.

A New Auto-thief Alarm Device Exhibited at the Chicago Auto Show Attracted Much Favorable Comment. The Alarm Is Enclosed In an Iron Box. No Part of the Machine Can Be Touched Without Starting This Alarm to Ringing. This Prevents the Stealing of Autos. Over 100,000 Combinations of the Locking Mechanism Are Possible by Means of the Keys.



The Love Machine

By CHARLES S. WOLFE

FENNIMORE ript out a surprised oath, and hurled the morning paper to the floor with such vehemence that the sad faced man who stood patiently behind his chair involuntarily bounded backward a foot or two. Such outbreaks on his master's part were unusual.

Muttering unintelligibly, Fennimore addrest himself to his coffee and rolls vigorously. This farce lasted only a few minutes, however, for the young man was past the eating stage. In spite of himself he soon gave over, reluctantly picking up the paper and turning again to the advertisement that had engendered the outburst.

He found the "Personal" column again, and located the offending ad. He read and re-read it, carefully, moodily.

"I offer my personal services to any person who finds his or her love unrequited. Success of your suit is certain if I handle it. George Parsons, 1938 M—— Street."

The words stared mockingly up at him from the printed sheet. For be it known that Fennimore, scion of wealth, accustomed to having his desires speedily realized, no matter what bizarre turn they took, was head over heels in love. Very unfortunately, the object of his affections could not, by any stretch of the imagination, be said to be in the same condition.

Fennimore, paper in hand, rose slowly to his feet, leaving his neglected breakfast to the care of the servant.

"His personal services, eh?" he muttered, "Well, we'll see what they amount to."

So it was that a half hour later, while his chauffeur loafed in the car outside, Fennimore sat in conversation with George Parsons in the M street house.

Parsons, a jovial faced, middle aged man of short stature, honestly privileged to prefix his name with "Professor" and suffixt with Heaven knows how many formidable combinations of letters, leaned back in his chair and regarded his fidgetting visitor genially.

"So you are in love?" he mused. Fennimore glared without replying, a fact which disturbed the placid professor not a jot.

"Does the lady give you no encouragement whatsoever? Have you made no progress at all on your own hook?"

Fennimore's fists clenched and unclenched in the violence of his rage. Just enough to keep me hanging around the stage door like the rest of the fools in this town," he flung out bitterly, "I'd give a million dollars to see one symptom of real affection in her whole body."

Parson looked pleased. "Oh, we won't be that steep," he said, assuringly, "Ten thousand will see you out easily."

If looks could kill, Parson's hour had struck then and there. "You're damned mercenary about it," snarled Fennimore, "That detail could have waited 'till later."

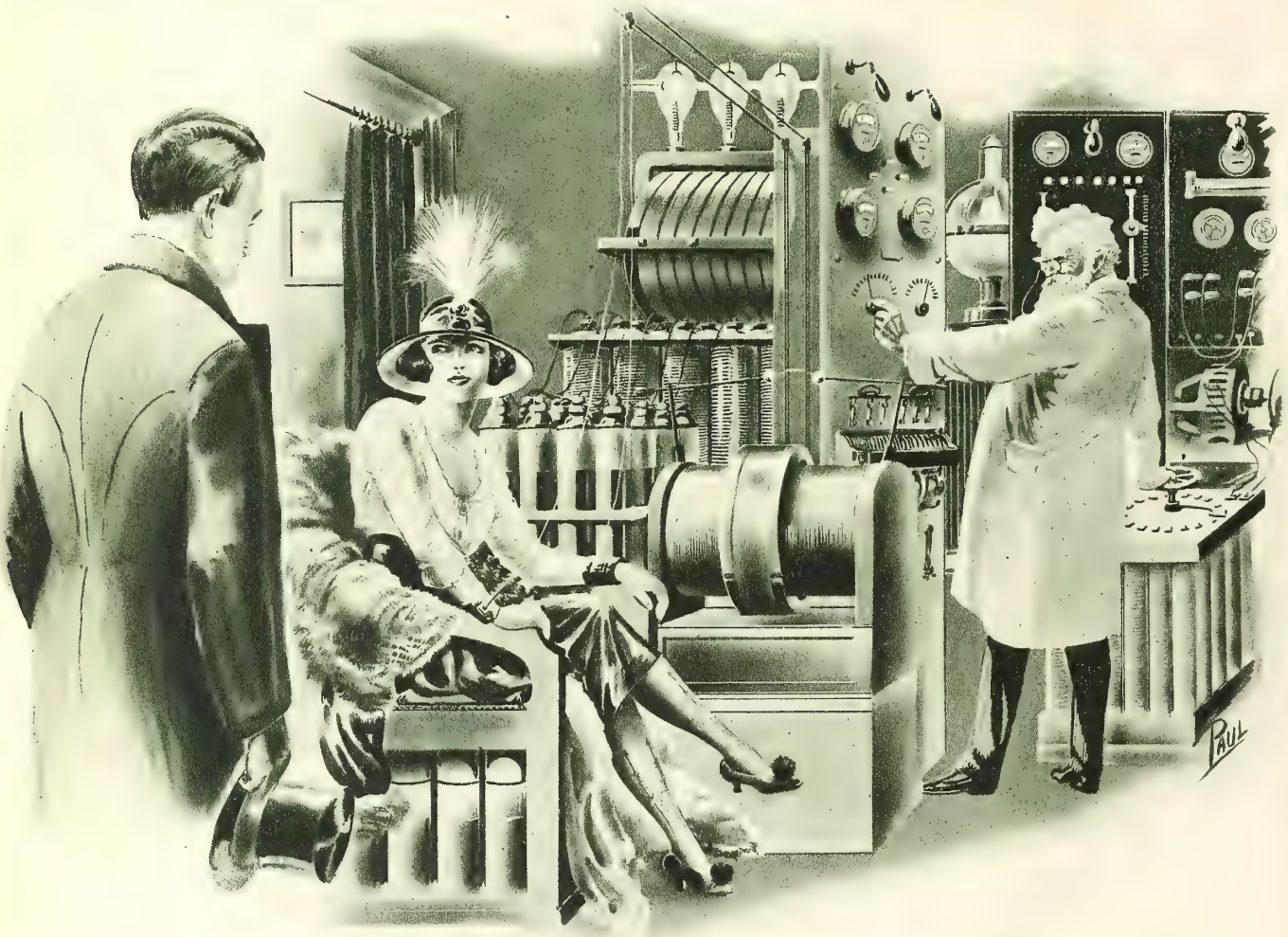
"Just enough to keep me coming thru with the supper parties after the show.

Parsons was quite unmoved. "It is best that we understand this part of the matter right from the start," he demurred, firmly, "I'm a scientist, young man, but I am not wedded to my studies. The Almighty Dollar is no revolting spectacle to me."

"And what do you propose to do to earn this sum?" challenged Fennimore, sulkily.

"I propose to make this——er—— actress of yours the most docile, obedient, adorable and loving young bride that you ever laid eyes on."

(*Continued on page* 1357)



© 1921 by Science and Invention.

"'.....and If You Were a Hundred Times Better Looking Than You Are, I Would Not Marry You If You Were the Last Man on Earth....' Prof. Parsons snapt on a Switch and Grinned At the Disheartened Millionaire. 'You Young People Think That Love Is a Question of Good Looks, Circumstances and Mutual Attraction,' Said Prof. Parsons. 'You Have Fallen Into the Common Error of Mistaking the Effect for the Cause. No two People Will Be Attracted to Each Other to Any Degree,—Far From Sufficient to Love,—If Their Natures Are Not Tuned Properly for the Occurrence of the Phenomenon'....."

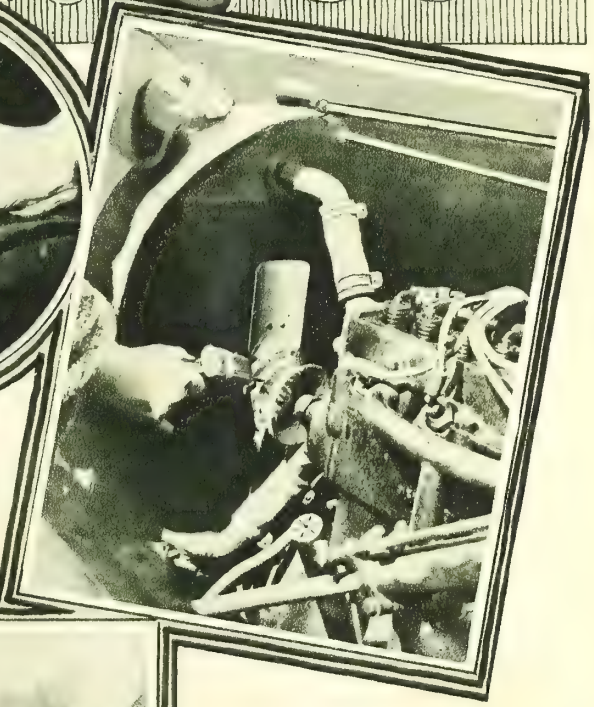
Auto Wrinkles



A Stubborn Lamp Rim Will Come Off Easily Without the Damage Done by Tools If Friction Tape Is Wound Around the Rim and Given a Quick Jerk.



One Way of Quickly Mending Loose Cap on a Country Road,—by Inserting a Small Piece of Match-Stick in the Center, Preventing Further "Skidding."





Two Scrub Brushes Fastened to a Mop Stick Make a Quick and Ideal Way of Cleaning Springs Without Getting Under the Car.



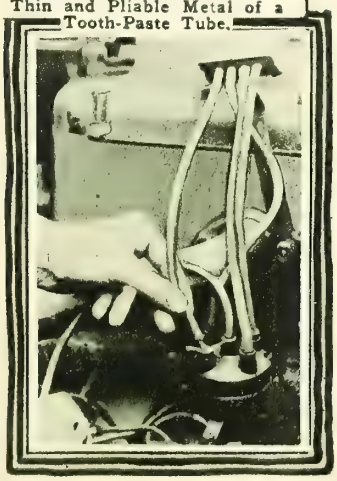
A Flashlight Attached to a Screw Driver by Means of Adhesive Tape, Throws the Light Just Where the Work on the Motor Is Being Done.



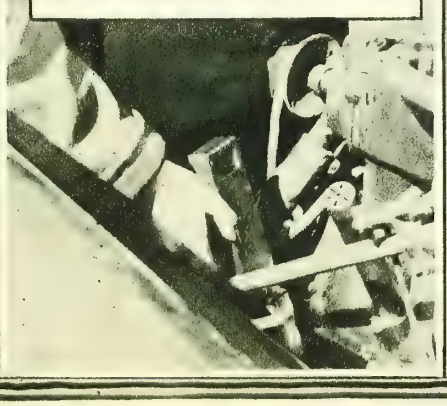
Stalled on a Country Road on Account of a Dying Battery! Don't Give Up! Stop a Passing Car. If You Have With You Two Wires, Connect the Positive Wires of the Passing Car's Battery to Your Own, Also the "Negatives." This Aid Will Enable the Car to Start and Will Give the Dying Battery a "Transfusion."

When "Near Mechanics" Try to Adjust Your Carburetor, It Is Often Hard to Get It Back Again Into Proper Adjustment. One Way of Preventing This Meddlesome Practise Is to Cover the Adjusting Screws of the Carburetor With Sealing Wax.

When the Distributor Holes Become Worn an Excellent Tightener May Be Made by Wedging Into the Holes the Thin and Pliable Metal of a Tooth-Paste Tube.



A Toy Periscope, to Which Is Attached a Small Flash-Light, Will Quickly Locate Lost Bolts and Nuts Which Have Dropt Into the Cavernous Drip Pan. Such an Electric Periscope Is Useful in Numerous Other Ways.





Take a Nail File on Your Auto Tour. It Is Available for Polishing Off the Corroded Contact Points of the Distributor When It Fails to Carry the "Juice" to the Plugs. It Is Better Practise However to Purchase a Thin Knife File Especially Made for Such Purposes, Procurable at Tool Supply and Auto Shops.

"In 1999"

"Scientific Progress in the Last Century. Presidential Address Before the American Academy of Science, September, 1999."

By FRANKLIN RUTH

Gentlemen of the Academy:

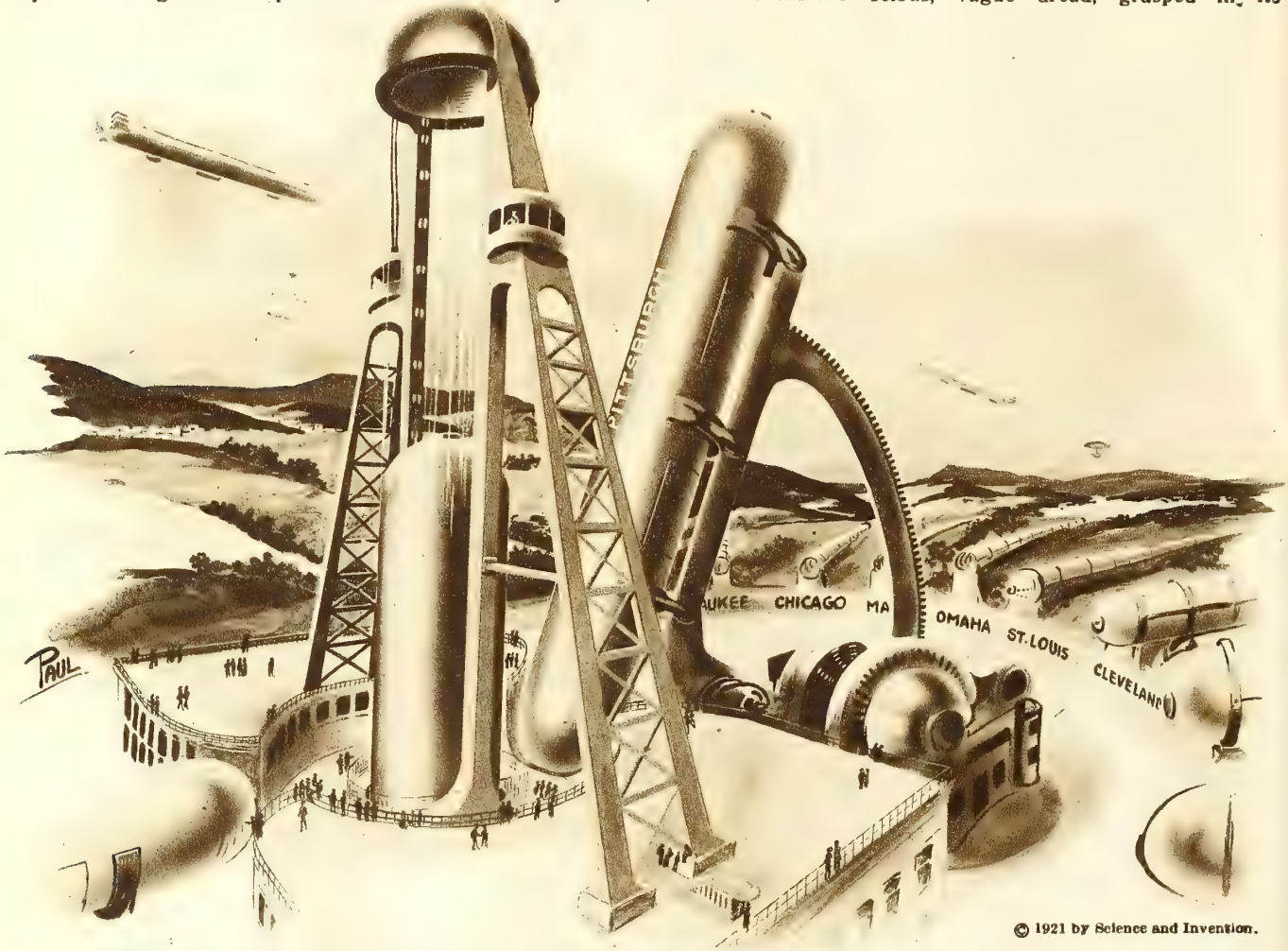
AT the close of this twentieth century we look back upon a more brilliant array of scientific achievements than man has ever been privileged to see, or imagine. within the last few decades our earth has entered upon an era that surpasses the greatest expectations of the nineteenth century philosophers. Civilization has advanced at a rate comparable to a geometric progression, and today we are living in the Golden Age of Science. In looking back upon this century, we should review some of the most significant achievements of the past, and note their bearing upon progress and their relevance to the science of today.

The dawn of modern science occurred in 1898, when the discovery of radium and its radioactive properties was made by the Curie's. The importance of this discovery can never be too greatly emphasized, for it marks the actual conception and birth of the principles upon which today's science is founded. The untiring investigations of those great pioneers of modern science, Rutherford and Soddy, in the field of radioactivity, soon caused them to announce the hypotheses of atomic disintegration and evolution of the elements. Altho these theories were at first discredited and regarded in the same light as Perpetual Motion, the undeniable existence of enormous reservoirs of energy in the minute atom, as evidenced by radium, soon attracted the attention not only of scientific circles, but of the whole world. Discovery followed discovery. Research became busy with the momentous question whether artificial means could accelerate or retard the processes of spontaneous disintegration. Civilized nations became excited and expectant. Vivid fiction, exploiting the imaginary results of the discovery of atomic disintegration, was widely read, and increased the credulity of the people.

It was at about this period that the Great War occurred. Altho this world disaster took a great toll of life, it proved to be an impetus to scientific advancement. At the close of the War the United States found itself the creditor of almost the entire European continent, whose nations were on the verge of bankruptcy and revolution. Unrest was widespread. Crises between labor and capital were imminent. Numerous strikes occurred, and Bolshevik uprisings in Russia threatened to undermine all governmental control and order. The air seemed charged with something that stifled all thoughts of resuming prewar existence. Over all hung unconscious, vague dread, grasped in its entirety by only a few minds of scientific preeminence. Prophets and religious fanatics preached the end of the world and the arrival of the Millennium. The world was ripe for some cataclysm that would overwhelm civilization and possibly sweep all life from the planet.

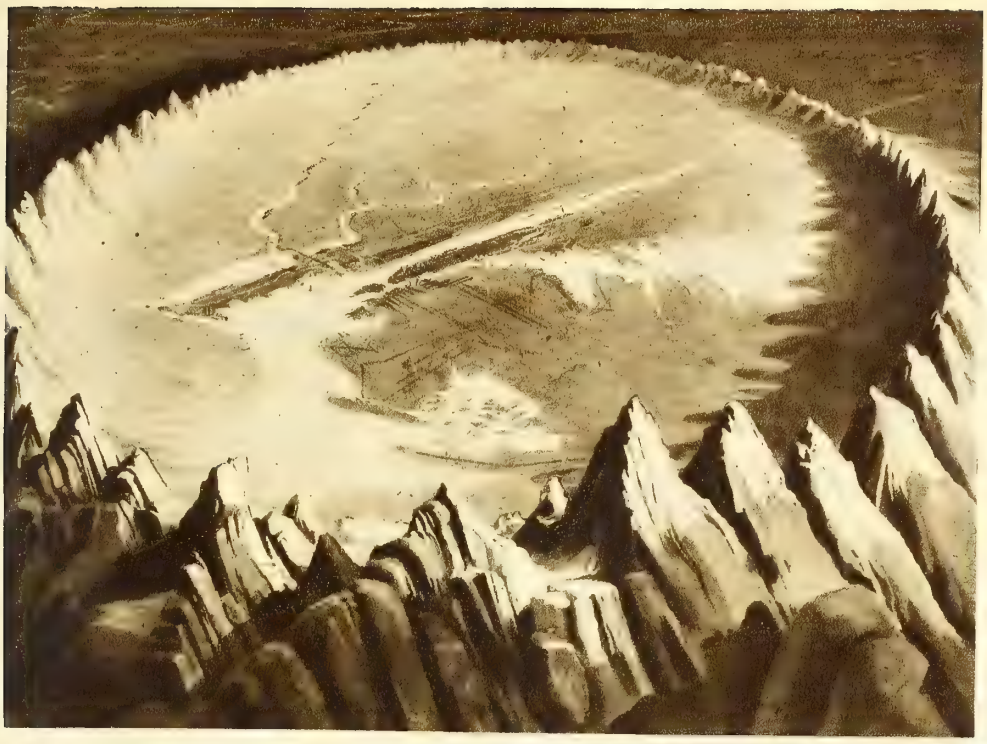
Suddenly, in 1924, occurred the first phenomenon of a series, which created physical disturbances sufficiently powerful to attract general attention. Scientific investigators, however, with the aid of their delicate instruments, had detected weaker but similar disturbances at previous periodic intervals. The world waited anxiously for words that might come from scientific men, identifying the cause of the mysterious phenomena. Scientists knew that the

(*Continued on page* 1361)



© 1921 by Science and Invention.

".....Thirty-Foot Tubes Were Excavated Thru the Earth's Diameter, Reaching From a Large Industrial Center on One Side to Some Extensive Agricultural Area Upon the Other. Africa, China, Australia and Parts of South America Were Touched. As These Tubes Were Sunk, They Were Lined With Browning's Electro-Heat Converting Apparatus, Which Turned the Intense Heat of the Bowels of the Earth Into An Immense Voltage, Giving An Electric Current, But Left the Interiors of the Tubes Relatively Cool and Insulated From the Fiery Medium Thru Which They Past. Food and Other Commodities Were Then Quickly Hauled Over Extensive Railroad Systems to the Mouths of the Tubes and the Elevator-Like Carriers Were Dropt Thru the Center of the Earth. The Momentum Gained in the 4000-Mile Drop Carried the Cars Past the Center of the Earth and Up to Within a Few Feet of the Opposite Surface. At This Point They Were Caught by Automatic Catches and Giant Electric Hoists Hauled Them to the Surface....."



One of the Giant Craters on the Moon's Surface Can Easily Contain the Whole of Greater New York City, as the Illustration Above Shows.

Trip to the Moon

WE know perhaps more of the configuration and physical make-up of the moon's surface than of any other heavenly body, due to our industrious and untiring astronomers. There are few regions of the moon's side facing the earth that have not been carefully explored and charted. Altho the moon is over 238,000 miles distant, our large telescopes bring the lunar landscape sufficiently into range so that all of the larger mountains with their ranges and craters are readily explored. The two illustrations on this page represent lunar scenes as we would see them, if we actually were to visit the moon.

In the first place, the moon, having no atmosphere, the sky as it would be seen from our satellite, is inky black with the stars shining forth in a brilliancy never viewed from the earth. A brilliant sun shines out of a black sky, while the sun itself is surrounded by a wonderful corona with its magnificient streamers only partly seen on earth at the time of an eclipse. Some of the lunar mountain ranges are tremendous, and we have nothing like them on earth. The craters of some of these huge extinct volcanos are of tremendous size; some of them measured across the bottom are more than 150 miles in extent, and you could readily place the state of Rhode Island in one of these huge depressions.

Our top illustration shows only a moderately large size crater, and it will be seen that New York City and environs would readily fit into such a baby crater, having a diameter of some 50 miles. As for height the lunar mountains are truly titanic. Some of these mountains are over 28,000 feet in height. Standing at the foot of one of these giants they seem to topple over on one due to the perspective, the same as when you stand at the foot of a skyscraper and look upwards. It seems to be bending over on you. When the sun shines on these huge mountains, it is of course possible to see all the way up as there is no atmosphere and no clouds to impair the vision. Such a sight must be overpowering and grandiose.

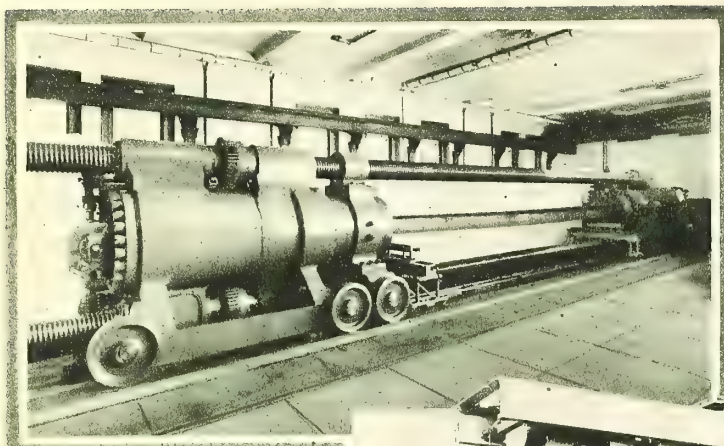
At the foot of these mountains we see huge cracks running in all directions, and these cracks are vast canyons in themselves, much deeper than we know of on earth. They extend for miles down into the bowels of the moon, and a fall into one of them would, of course, mean instant death to the traveler.

But the most impressive and terrorizing experience to the future moon traveler will undoubtedly be the vast death which is on evidence at every hand. The moon is a dead world as we all know, and there are no animals and there is probably no vegetation; only barren rocks greet the eye. Everywhere is silence; everything is dead and lifeless, and the future traveler must be encased in a sort of diver's costume with a glass-windowed helmet as he must bring with him his own air if he wishes to stay alive. And, he does not wish to stay long on the moon unless he walks around the foot of the mountains because there are possibly few places as unsafe as the moon itself. Huge meteors are crashing down almost continuously, and there is no atmosphere as on earth to act as a buffer. These

(*Continued on page* 1355)

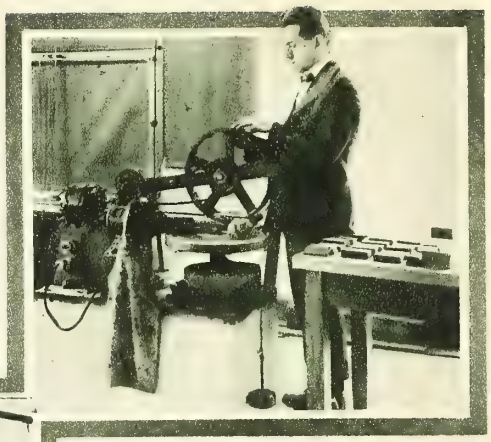


Close-up View of the Mountains of the Moon Showing Their Precipitous Sides. The Moon Has No Atmosphere and So Even If an Adventurous Earthly Being Should Make the Trip Some Day, to Our Neighbor the Moon, He Would Not Find It a Very Salubrious or Pleasant Place on Which to Take up His Habitation, for the Only Way He Could Live on the Surface of the Moon Would Be by Providing Himself With an Outfit Similar to that of a Diver's Suit, Equipt With an Oxygen Tank and Artificial Air Device.



This Giant Testing Machine at the Bureau of Standards Laboratory, Washington, D. C., Can Register With Equal Accuracy, the Power Required to Crush an Egg Shell or That Required to Crumple Up the Strongest Steel Girder. Its pulling Strength Is 1,150,000 Pounds and the Maximum Crushing Power Is 2,300,000 Pounds.

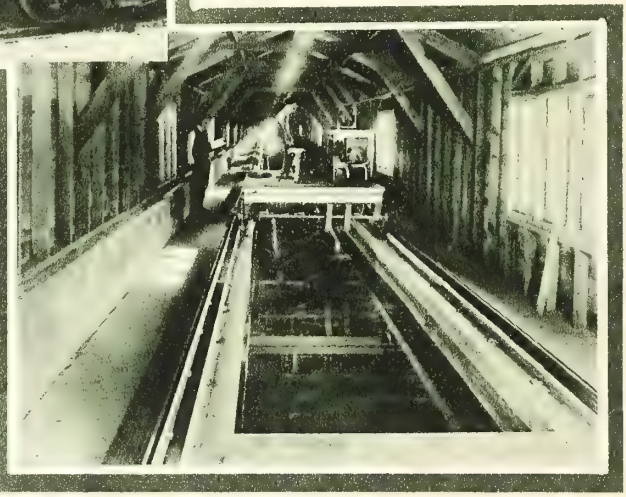
Photo at Right Shows But One of the Thousands of Activities Carried on in the Bureau of Standards Laboratories, That of Testing the Wearing Quality of Sole Leather. Pieces of Leather Are Placed on a Wheel Which Turns Against an Emery Disc, Carrying the Weight of a Man.

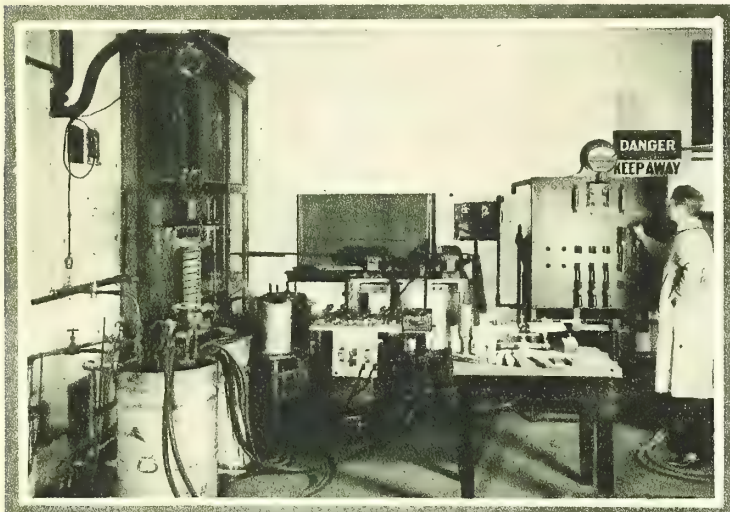




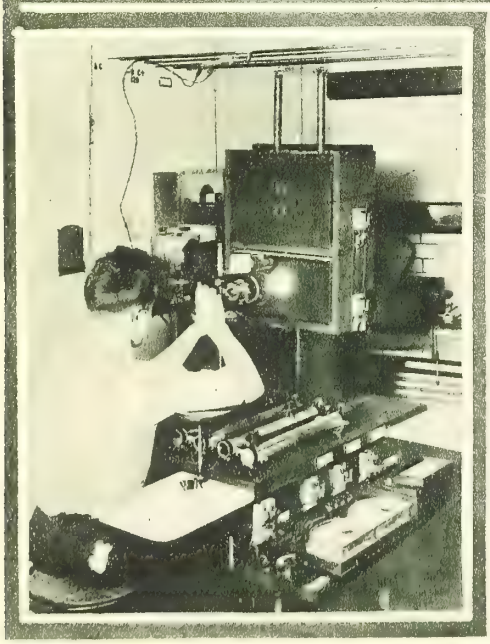
Railroad "Track Scale" Testing Car, Built By the Bureau of Standards Experts. Each Weight Has a Value of 10,000 Pounds or 5 Tons, and the Car Is Sent About the Country to Test Railroad Track Scales, and Also to Serve as a Standard By Which the Scale Testing Cars of the Various Railroad Companies Are Calibrated.

The Preparation of Pure Iron Alloys Is Carried on in the Special Laboratory Shown Below, Where Electrolytic Iron 99.97 Per Cent Pure Has Been Obtained. Two Vacuum Electric Furnaces With the Necessary Transformers and Control Switchboards Are Here Shown.





The Photograph Above Shows the Long Tank of Water Used in Calibrating Water Meters. A Miniature Control Car Runs Along the Rails at Either Side of the Tank While the Operating Mechanism of the Water Meter Being Tested Is Carried Thru the Water at Any Desired Speed and the Reading Checked With a Standard Meter Carried on the Car. The Speed of the Car Is Controlled by a Rheostat.



The Photo at the Left Shows One of the Hundred of Different Technical Departments of the Bureau of Standards Laboratories. Here We See One of the Bureau's Engineers Making Researches Into the Heat Liberated by Different Types and Makes of Electric Light Bulbs.



At a Temperature of 573 Degrees Crystalline Quartz Changes Into Another Crystal With a Transfer of Energy During the Process. Remarkable Results Regarding the Temperature Changes Occurring in Crystalline Quartz Have Been Carried Out by Means of the Extremely Powerful Electro-Magnet and Auxiliary Apparatus Shown in the Photo Above.

Recent Work of the Bureau of Standards

ALTHO you and I, as citizens of a great and progressive nation, perhaps do not realize the fact, yet every time we purchase a pound of butter or a sirloin steak at the grocers or butchers, these food products are weighed out on a scale, which has been checked with the standards provided by the National Bureau of Standards Laboratories located at Washington, D. C.

One of the accompanying photographs shows a most interesting sight,—that of a railroad track scale testing car built and calibrated by the Bureau of Standards scientists. This car is fitted with weights of 10,000 pounds or 5 tons each; it is sent about the country to test the railroad track scales and it also serves to set the standard by which the test cars of the various railroad companies are evaluated.

Altho we are prone to think that the average weighing scale is accurate in the majority of cases, it has sometimes been found that as high as 50 per cent. of the larger scales inspected have been quite incorrect,—due simply to the fact that no proper facilities had been available heretofore for testing the scales.

Another photograph shows one of the thousands of activities carried on at the laboratories of the Bureau of Standards, —that of testing the wearing quality of sole leather. In the machine here illustrated, pieces of leather are placed on a wheel which turns on an emery disc carrying the weight of an average man. After carrying on this test for a definite period of time, a careful record of which is kept of course by the engineer in charge of the work, the exact wearing quality of the leather by this simple test can be determined with exactitude.

TESTING WATER METERS WITH MINIATURE ELECTRIC TROLLEY CAR AND TANK.

One of the accompanying photographs shows the long tank of water used in making accurate standardization tests on water meters,—not the ordinary variety used for integrating the number of cubic feet or gallons of water passing thru your kitchen and bathroom spigots,—but for accurately testing the large motors employed to determine the force and quantity of water used to operate mills and factories. In this case, instead of having the water flow thru a pipe or channel and also thru the meter in order to make the necessary test on it, the water simply remains stationary in the tank shown, while the meter under test is secured on an arm projecting down into the water, which arm is securely fastened to the small electrically controlled car, shown. Many of us probably envy the man who makes these tests, for most of us in our maturity, still manifest, secretly, a great deal of the juvenile love of the trolley motorman's job.

By means of the electric controller box on the trolley car, the meter can be moved at any definite speed desired, thru the still water and the readings of the meter being tested are accurately checked with those indicated by the standard meter. The standard meter used for checking such measurements in any case, is of course calibrated previously by some other means than the one usually employed in checking up the meters sent in by patrons of the Bureau. In the case of water meters, this is often done by weighing and measuring the amount of water passing thru the meter in a given time.

Another one of this interesting Bureau's tests is illustrated in the photo showing one of the engineers making researches into the heat liberated by different types and makes of electric light bulbs. Contrary to popular opinion, the services of the Bureau of Standards are intended not only for governmental work, but it is maintained and stands ready to make any test, within its functions, for private citizens, companies or corporations, at a reasonable charge.

It is a mark of distinction and of the highest order for any new invention or device, to have bona fide tests made in the Bureau of Standards' laboratories.

A Few "May" Articles

Salvaging Ships in 24 Hours with the DeVido Salvaging Apparatus.

How the Size of Betelgeuse Was Measured by the Interference of Light Waves—By Prof. T. O'Conor Sloane, Ph.D. LL.D. Popularly explained with diagrams and photos of the actual apparatus.

What a Drop of Water Looks Like —With startling microphotographs showing some of the strange organisms existing in an ordinary drop of water.

What Causes Insects to Fly Towards a Light? With photographs. An exceptionally interesting article giving the latest discoveries of science concerning this phenomenon. By Dr. E. Bade.

How Radium is Used to Cure Cancer. Clearly illustrated with exceptional pictures. By Joseph H. Kraus.

Colloidal Fuel—How the Very Essence of Coal can be Extracted and Piped for Hundred of Miles. Interestingly explained in picture and story.

Dr. Pringle discusses Ether, the Sun and the Earth. A brilliant yet popularly written scientific discourse which everyone can enjoy. Related by our learned friend—John De Quer.

Chinese Pigeon Whistles—With Actual photos.

Instruments that Measure the Stars —Illustrated.

Optical Lenses Colored by Electricity. By Harry Rosenthal, Cons. Engineer.

Simple Substitute for the Photostat—Explaining how to copy pictures and text from books, magazines, etc., directly without a camera or other apparatus. By D. P. W. Maunsell.

Monsters of Long Ago—Wonderfully Illustrated. By Dr. E. Bade.

GIANT TESTING MACHINE MEASURES POWER TO CRUSH AN EGG.

One of the accompanying photos shows a giant testing machine operating with screw-shafts, and which machine can register with equal accuracy, the power necessary to crush an egg shell, or that required to break down the strongest steel sky-scraper girder. The machine here illustrated is suitable for testing any piece of steel, iron or other metal from a few inches in length up to 30 feet. It can exert a pulling strength up to 1,150,000 pounds and a crushing power of 2,300,000 pounds. The great screw-shafts are 40 feet long and one foot in diameter. Instead of water being used in the cylinders to furnish the necessary hydraulic power, oil is utilized.

Several of these machines are in use by the Bureau of Standards, for testing steel beams and other structural members. In the Pittsburgh branch of the Bureau of Standards' Laboratories, one of the most powerful testing machines, if not the most powerful in the world, has been installed; this is the great 10,000,000 pound Olsen testing machine. These machines are used in a series of investigations jointly conducted by the Bureau of Standards and the American Society of Civil Engineers for the purpose of quickly calibrating and checking the formulae for computing the strength of steel columns, beams and other members upon which formulas the efficiency and safety of our present day offices and industrial buildings depend.

The huge Olsen testing machine stands four stories high and somewhat resembles the horizontal type of testing machine shown in the accompanying photo if the latter were changed to the vertical position. It is often used for determining the crushing or compressive strength of such materials as a section of a brick or concrete wall, etc. It is capable of exerting a pressure as high as 10,000,000 pounds or 5,000 tons,—sufficient to break the steel propeller shaft of the greatest war vessel afloat.

A specimen brick pier made up for test to ascertain the qualities of a particular brick, measured 16 feet high by 48 inches square. Some idea of the tremendous crushing power of this machine can be gained by imagining what force must be exerted to cause this solid brick column 4 feet square and 16 feet high to crumble.

SPECIAL EQUIPMENT FOR PREPARING PURE IRON ALLOYS.

The preparation of pure iron alloys calls for special laboratory equipment, which demand has been met by the National Bureau of Standards, where electrolytic iron 99.97 per cent. pure is obtained. The illustration shows the apparatus in use, consisting of two electrical vacuum furnaces, together with transformers and switch boards for the electrical control. On the table, included in the photograph, are special crucibles, finished ingots, together with rolled bars from these ingots, and tensile test specimens.

By way of insuring a reliable foundation for the scientific study of the effects of the small portions of impurities always present in iron and steel it is essential to have accurate knowledge of the properties of really pure iron and alloys of pure iron with known amounts of single impurities, intentionally added. Such iron, in the absence of impurities, is being obtained by the Bureau of Standards. It is melted in a vacuum to

(*Continued on page* 1326.)

Home Electrics

By G. L. HOADLEY, M. E.

When the Fuse Burns Out

IT usually happens that the fuse blows, putting the lights out at the worst possible time; for instance, when the housewife is nicely started on the big family wash with the electric washer, putting it out of commission Exasperating, isn't it? The head of the house is away at work too, else he could worry about it. The Electric Power Co., will send a troubleman out to make repairs—and charge you for his time and three or four fuses, when only one was needed. You will need to wait anywhere from one to two hours for him to arrive and that will delay your washing so you can't get started again till after lunch. If you only knew how to locate the blown fuse and put in a new one, you could get the washer going again in five minutes and have the wash finished by 12 o'clock. Why not learn how? The thing is very simple and if directions are followed, you can't possibly receive a shock.

First, let us consider the purpose of the fuse. Why must fuses be put in the circuit? They are a nuisance when the fuse blows we all agree, but suppose your washer had not been protected by fuses. You get something caught in the ringer that stalls the motor. It is not built to withstand so heavy an overload—for more than a few seconds before it burns out. A new motor costs $25 or $30. Repairing the motor may cost $15 or $20. A new fuse costs 8 to 10 cents. For the protection of your motor then, you need fuses from the standpoint of cost. Fire risk is much greater also without fuse protection. Any person foolishly using pennies, a nail or wire, etc., to replace blown fuses courts fire disaster, besides trouble with the Power Company if their transformer or expensive apparatus is burnt out as a resu t.

Fig. 1 shows the ordinary 6 to 10 ampere plug fuse used on lighting circuits. It consists of an alloy of lead and zinc principally, in the form of a wire or ribbon. In all cases it is enclosed completely in order that the heated metal will not be thrown onto material that will easily catch fire when the fuse blows.

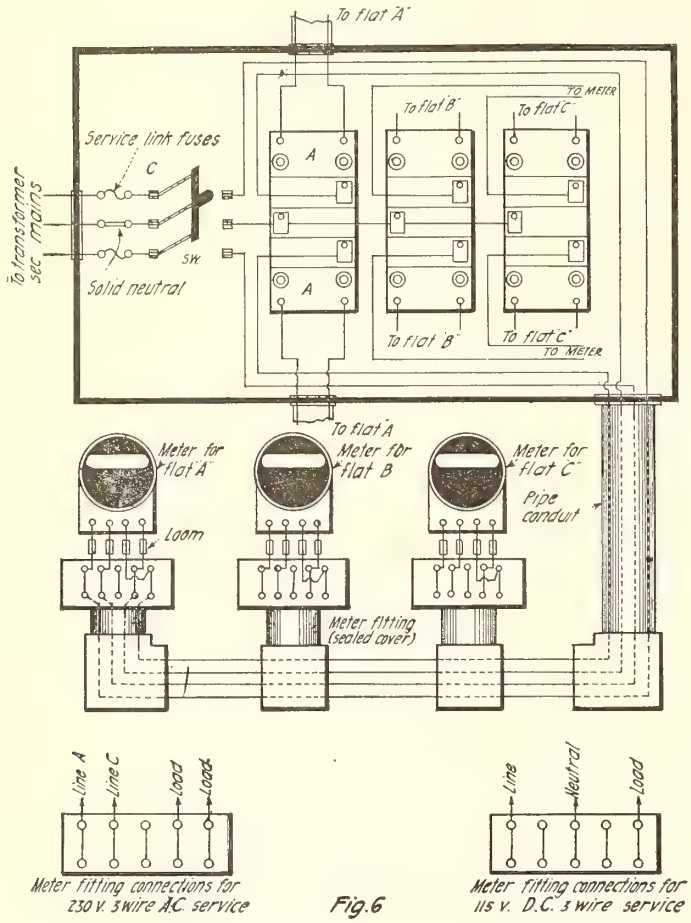


Fig. 6

How the Fuse Blocks and Electric Light Meters Are Often Arranged In an Apartment House In the Large Cities, Where Two to Three Circuits for Each Family Are Brought Down to the Cabinet Box. In Trying to Locate a Blown Fuse In Such an Installation It Is First Necessary to Determine Which Fuses Control the Circuit Leading to Your Apartment, or Else You Will Have to Test Out Each Circuit in the Cabinet, Either by Examining the Fuses or by Testing with a lamp. Once You Have Located a Blown Fuse It Is the Safest Plan to Open the Main Switch When Replacing the Fuse or Fuses.

Do not replace that 6-ampere fuse with a 20-ampere fuse for house lighting circuits, because that means NO FUSE protection for any motors, lamps or other things on the circuit which take less than 20 amperes, and you will run the risk of burning out your motors, etc. Furthermore, No. 14 B. & S. gage wire, which is ordinarily used for wiring houses, will only carry safely 15 amperes; if a heavier current is carried continuously, the wire overheats and the insulation is gradually destroyed causing trouble later or else fire results.

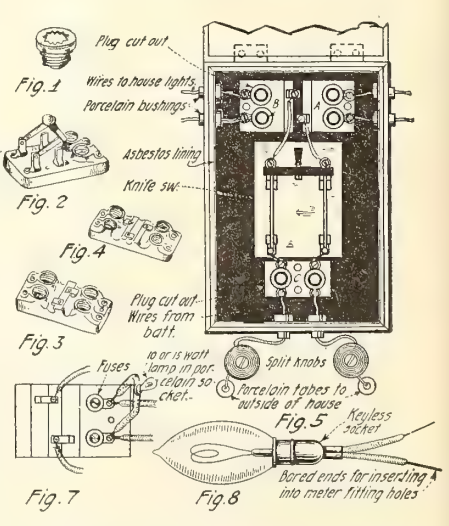
When a fuse blows it is generally caused by too big a load. It might, of course, be a *short-circuit* or *ground;* but in the majority of cases it is due to either a sudden heavy overload or else a steady heavier load than the fuses are intended to carry. This causes them to gradually heat up and melt. Getting something stuck in the ringer is an example of a sudden heavy overload; while operating the washer, the vacuum sweeper, the coffee percolator, and the toaster or some similar combination ALL at one time off of one circuit, is an example of a steady overload that will melt an ordinary 6-ampere fuse shortly.

Generally, an ordinary house will have at least two branch circuits and quite often more. Sixteen lights is all that is supposed to be put on one branch circuit. Fig. 2 shows an ordinary single branch fuse cut-out block with switch suitable for one two-wire circuit. Fig. 3 shows a double-branch fuse cut-out block used for two two-wire circuits. Fig 4 shows a fuse cut-out block for two two-wire circuits with 3-wire service. Fig. 5 illustrates a typical two-wire installation with a double branch fuse cut-out block for two separate house circuits.

The cabinet-box is usually located in the basement and has a switch inside as shown. After opening the self-closing hinged door of the cabinet-box, pull this switch open the first thing, then replace both fuses of one circuit at A, with new fuses, and close the switch. If this does not remedy the trouble, OPEN the switch and replace fuses in B with new ones. Then close the switch. If the trouble was merely an overload, following these simple directions will restore service as a rule. Once in a hundred times the service fuses C are blown. You can easily observe whether or not this is the case. There is absolutely no danger of your receiving a shock if you OPEN the switch before replacing the fuse. Do not attempt to replace the service fuses C, if they are blown, unless either you or the man of the house knows considerable about electricity, as those contacts are alive and dangerous. Better call up the power company and have them replace them.

In large cities, the procedure for flat buildings where two or three circuits for each family are brought down to the cabinet-box, shown in Fig. 6, is slightly different. It now becomes necessary to either first determine which cut-outs control the circuits leading to your own particular flat or else test out each circuit in the cabinet-box. The first way is safer to follow for one unfamiliar with electricity. Adopting this plan then make it the first duty

(*Continued on page* 1346)



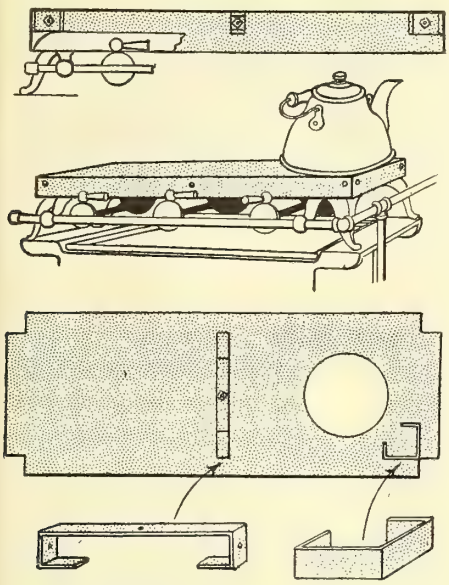
Several Styles of Fuse Blocks Are Shown In the Illustration Above, as Well as a Typical Testing Socket and Lamp.

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

HOME-MADE GAS SAVER.

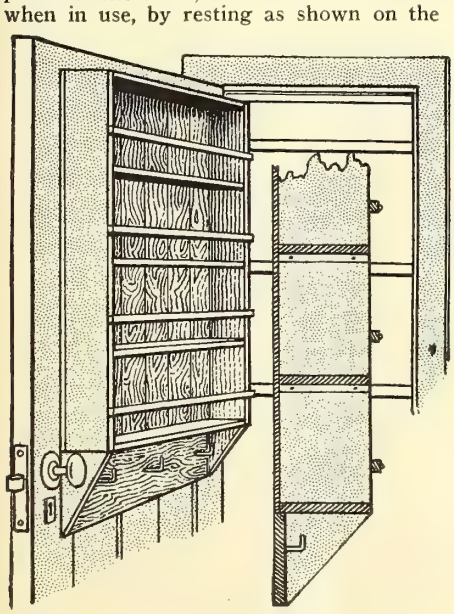
A HOME-MADE gas saver that has the value of saving that household necessity is shown in an accompanying illustration. It consists of a sheet iron, box-like cover that is made by the home mechanic to fit



This Home-Made Gas Conserver Is Constructed from a Piece of Sheet Iron Cut and Bent to the Shape Shown, or to Fit the Particular Stove at Hand. The Heat Ordinarily Wasted by the Gas Flames Shooting Up All Around the Tea Kettle or Other Vessel, for Example, Are Caused to Heat the Sheet Iron Top in the Manner Apparent—a Real Economical Idea!

closely over the top of any sized gas stove or range. It has but one hole thru which the heat from a single lighted burner may come in direct contact with any cooking utensil. The sides of the cover are held by strap iron pieces, bent into the shapes shown (3/16″ x 1″ iron), and 3/16″ bolts. These retaining pieces also serve as supports for the cover, and its load of utensils when in use, by resting as shown on the top of the stove. The cover can be attached or removed as quickly and as easily as placing a kettle on the stove.

The idea is that with one burner lighted, and a kettle over the hole above that burner, heat is confined and distributed over the area of the cover to such a degree that other utensils are heated and food cooked without any of the other burners being used, and with no loss of heat applied to the kettle over the lighted burner. In this way one burner does the work of the entire group of burners.



Housewives Are Always Wishing for More Shelves on Which to Place Their Dishes and Cooking Utensils, Especially in and About the Kitchen (Which Is Not Always So Large Nowadays). This Idea Provides Extra Shelf Room Right on the Inside of the Closet Door, Suitable for Dishes and Utensils.

CABINET FOR KITCHEN DISH-CLOSET.

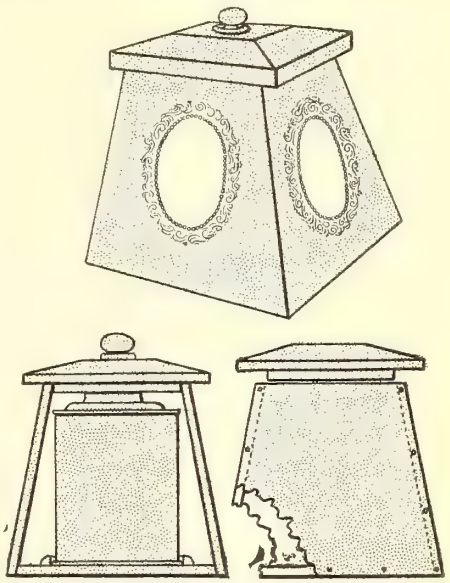
There is usually about nine inches of waste space between the inside of a closet door and the front edge of its shelves which can be used to good advantage, in these days of housing shortage. The suggestion is for the dish closet in the kitchen, and consists of a four-shelved cabinet, with its supporting brackets made useful by a connecting board with hooks for hanging up pots or frying-pans. This idea we imagine will meet with wide approval, for it has advantages which are apparent to every orderly house wife, yet for some reason such an arrangement has never been utilized. As the cabinet is swung more or less quickly on the moving door it should be secured firmly thereto with screws or nails.

LEATHER TOBACCO BOX.

Herewith is shown a leather covered and metal trimmed tobacco box that the home mechanic can make during his spare moments. The design is of that flexible kind provided to fit any special brand of tobacco can which the maker is in the habit of using, and consists of a wooden frame, with wooden cover, upon which the leather or leatherette is glued. No attempt is made to bevel the corners of the box, this part being nailed together as shown. The top consists of two pieces of wood, joined to form a lip and lid, and a brass knob—screwed on when the leather is in place. Brass oval frames, for the portraits of favorite lady friends, are also nailed over the leather in the places illustrated on the sides of the box. Frames of this sort are commonly sold for similar uses. To prevent the tobacco can from shifting about in the box a moulding is tacked to the box bottom to fit the can and hold it in place before putting in that part.

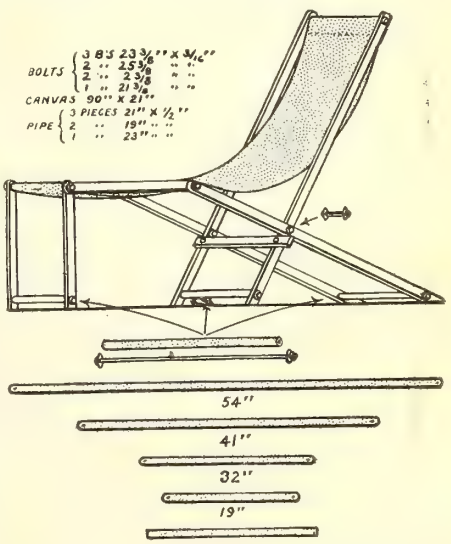
HOME-MADE STEAMER CHAIR.

One of the most comfortable lounging chairs for out-of-door use is the old home-made folding chair with foot rest, constructed somewhat along the lines of the steamer-chair. The canvas seat and rest being in one piece, and suspended at its ends, just fits somehow and makes the chair cool and "comfy." The cut herewith shows a method of constructing a chair of this sort. The lumber is 1¾″ x 1″ hardwood, say ash or oak, and should be straight-grained and extra tough. As small bolts as possible (¼″) should be used so as not to make the holes in the wood so large as to weaken it. Iron gas pipe, fitting the ¼″ bolts, is used to keep the wood pieces spaced apart and in place as shown. A stop for holding the back in position is also made of wood and screwed in the place illustrated. Heavy canvas, such as is used for tents, is provided in the rough 21″ x 90″, when a 1″ hem is then formed on each side making the piece 19″ wide. This is looped, and fastened by stitching, so that when placed over the pipe when the chair is put together the seat will hang about as shown in drawing. The bolts may be slightly riveted, once the chair is put together, to prevent nuts from working loose. Dimensions of bolts, pipe and lumber are given in the illustration.



There Is Nothing That Is More Available for the Requirements of the Man in the Household Than an Attractive Container for His Tobacco Can or Humidor, and the Author Here Describes and Illustrates a Design for Such a Container Which Should Be Finished in Leather or Burnt Wood.

When complete, this steamer chair can be placed on the porch or in the shady back yard. As no chair in the house can compare with it when it comes to comfort, this steamer chair may be desired for parlor use; and to remove any trace of its "home-made" appearance, besides adding greatly to its attractiveness, it would be advisable to have it covered with flowered cretonne or other material, so as to match the summer coverings of the other furniture.

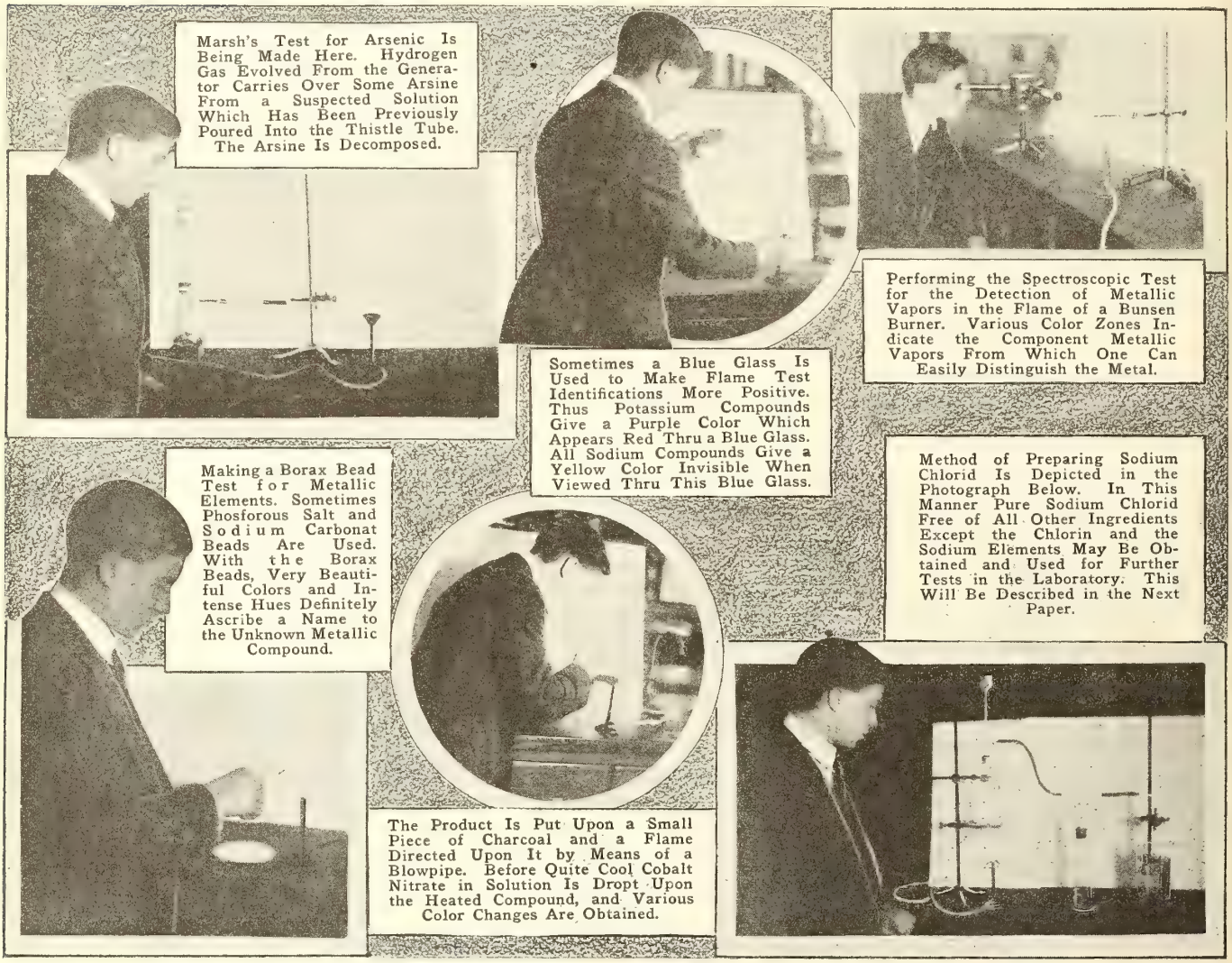


Now That Vacation Days Are Approaching, This Home-Made Steamer Chair, Which Is Simplicity in Itself, Will Appeal to Many. Contrary to General Opinion, This Type of Chair Is Much More Comfortable Than Might Be Supposed. The Canvas Forms Itself to the Contour of the Body Nicely.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

SOME SIMPLE CHEMICAL TESTS



Marsh's Test for Arsenic Is Being Made Here. Hydrogen Gas Evolved From the Generator Carries Over Some Arsine From a Suspected Solution Which Has Been Previously Poured Into the Thistle Tube. The Arsine Is Decomposed.

Sometimes a Blue Glass Is Used to Make Flame Test Identifications More Positive. Thus Potassium Compounds Give a Purple Color Which Appears Red Thru a Blue Glass. All Sodium Compounds Give a Yellow Color Invisible When Viewed Thru This Blue Glass.

Performing the Spectroscopic Test for the Detection of Metallic Vapors in the Flame of a Bunsen Burner. Various Color Zones Indicate the Component Metallic Vapors From Which One Can Easily Distinguish the Metal.

Making a Borax Bead Test for Metallic Elements. Sometimes Phosforous Salt and Sodium Carbonat Beads Are Used. With the Borax Beads, Very Beautiful Colors and Intense Hues Definitely Ascribe a Name to the Unknown Metallic Compound.

Method of Preparing Sodium Chlorid Is Depicted in the Photograph Below. In This Manner Pure Sodium Chlorid Free of All Other Ingredients Except the Chlorin and the Sodium Elements May Be Obtained and Used for Further Tests in the Laboratory. This Will Be Described in the Next Paper.

The Product Is Put Upon a Small Piece of Charcoal and a Flame Directed Upon It by Means of a Blowpipe. Before Quite Cool Cobalt Nitrate in Solution Is Dropt Upon the Heated Compound, and Various Color Changes Are Obtained.

THERE is nothing that gives the Amateur Chemist more genuine satisfaction than to be able actually to make *tests for chemical substances.* The whole subject of Qualitative Analysis, one of the chief branches of the science of chemistry, consists in doing in a systematic way this very thing. A little later I propose to take up in this series of articles an elementary course in qualitative analysis, but in the present number I shall deal only with a number of isolated sets of chemical tests which are much used in particular cases.

Flame Tests: There are a number of the metals which give to the Bunsen flame characteristic colors. In order to do this some compound of the metallic element must be present in the flame in the form of incandescent vapor. The metal which gives the most striking and persistent color to the flame is sodium. It gives a brilliant yellow and only the faintest trace of the metal is necessary to color the flame. Indeed with the aid of the *spectroscope,* a very delicate instrument for the detection of elements in the form of incandescent vapor, so small a quantity as one-hundred-thousandth of a grain of sodium may be identified with perfect certainty.

For use in making flame tests a mounted platinum wire will be necessary. Of course platinum is very expensive but the cost of a 4-inch length of about No. 22 wire will not be prohibitive. To mount it fuse one end securely into the end of a short length of small glass tubing. Clean the wire by dipping it into a solution of concentrated hydrochloric acid and then heating to incandescence in the outer, or oxidizing flame, of the Bunsen burner. Never place it in the inner, or reducing flame, and always have a colorless flame, i.e., a non-luminous flame. If not you will injure the platinum.

Draw the clean platinum wire thru your fingers and then place it in the flame. Immediately you will notice the yellow color of sodium, for this element in the form of its compounds is everywhere present, even on your hands, and, as already stated, the minutest quantities will reveal themselves in the flame.

Now dip the wire into each of a number of solutions of sodium salts and in each case place the wire in the flame. In all of them the brilliant yellow of sodium will flash out and persist for several minutes. Before using with any other salt solution, the wire must be cleaned by dipping it into concentrated hydrochloric acid and reheating in the flame. Always repeat this operation until there is no color left. Figure 1 shows the proper position for the wire in the flame.

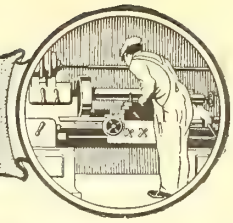
Hold a short piece of glass tubing in the flame until it has softened. You will note that the flame becomes yellow, showing the presence of sodium, for sodium is always present in glass.

Obtain three small squares of cobalt-blue glass and, having dipt the platinum wire in the solution of some sodium salt, hold the three thicknesses of glass between your eye and the sodium flame. You will observe, however, that the yellow sodium flame is entirely cut off, because blue glass will not permit the passage of yellow light. This fact as we shall see is of fundamental importance in the detection of the potassium flame.

(*Continued on page* 1349)



THE CONSTRUCTOR



A Model Electric Railway De Luxe

By Earl Christmas

UP on the third floor of their home in St. Paul, Allan and James E. Trask, youthful engineers, have built a complete electric railroad, perhaps the only one of its kind in the entire country. Its miniature locomotive is modelled after the big electric locomotive used in pulling the Chicago, Milwaukee and St. Paul trains over the Rocky Mountain division; the miniature electric type embodies practically all the features of its big prototype. In fact, the builders of the model, with just the ordinary tools and a few pictures of the big locomotive, had to work out in miniature problems similar to those which the General Electric engineers had to master in constructing the big engine.

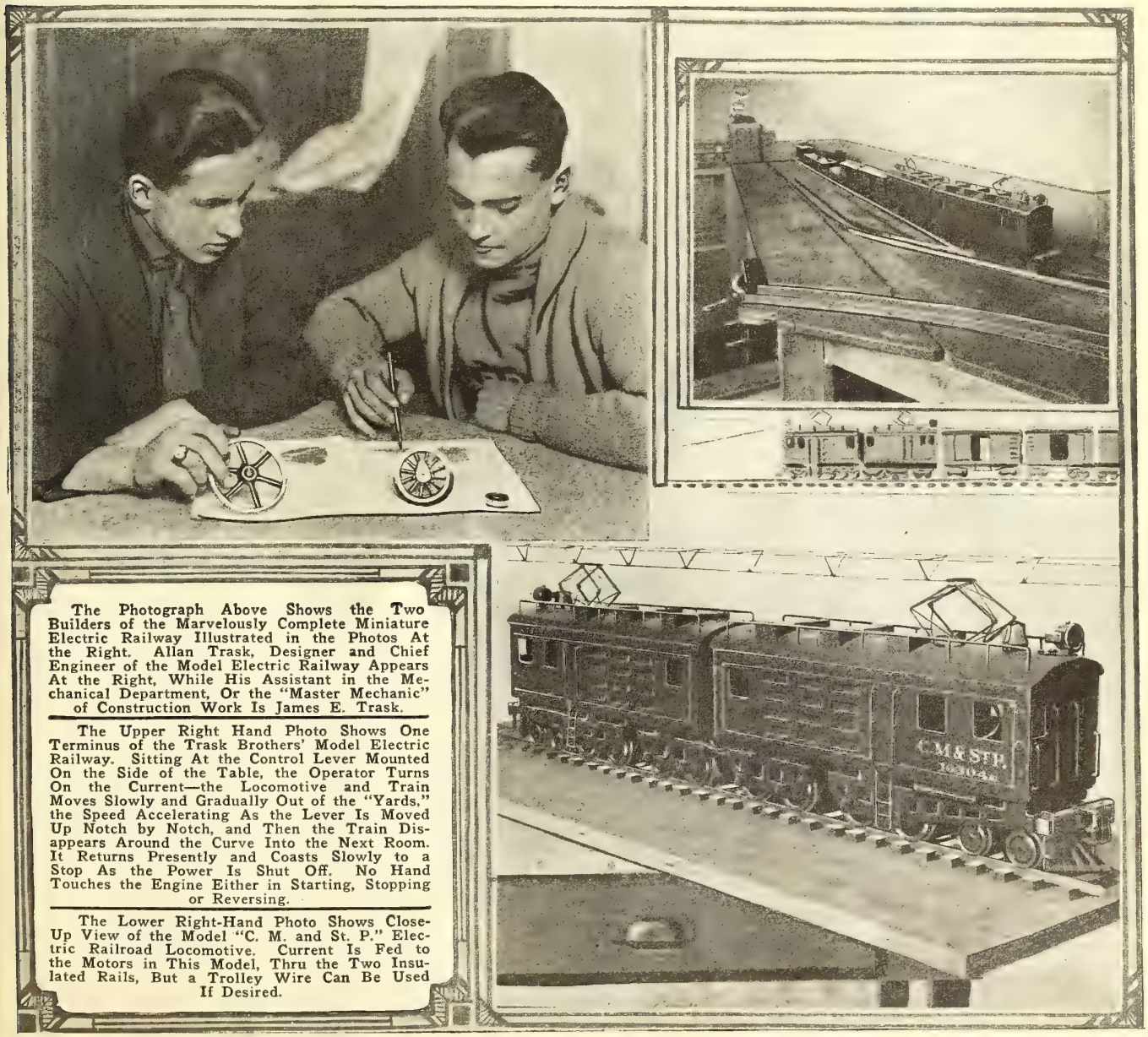
In addition, their problem was complicated to some extent by the very smallness of the model. For instance, a system of remote control had to be developed. A 300-watt generator set provides the power from the lighting current.

Sitting at the control levers, the operator turns on the current. The locomotive moves slowly and gradually out of the yards, the speed accelerating as the lever is moved up notch by notch, and the engine disappears around a curve into the next room, returning presently and coasting slowly to a stop as the power is shut off. Not a hand touches the engine in starting or stopping.

Twenty feet away, in another room, where it can't be seen by the operator, the train may be speeding along. The operator changes the levers, and back the train goes in the other direction, reversing its course electrically without the touch of a hand to the engine, so perfect has the system of control been developed.

Allan, now 22 years old, designed the miniature railroad and worked out the electrical problems. James, aged 17 years, did the necessary machine work, such as turning up the wheels and shaping the truck frames, in the shop at the local High School.

The engine is 38 inches long and weighs 48 pounds. It will exert a 10-pound pull at the draw-bar, which is sufficient to pull 250 pounds of smooth running cars on a level track. With a 100-pound train, it



The Photograph Above Shows the Two Builders of the Marvelously Complete Miniature Electric Railway Illustrated in the Photos At the Right. Allan Trask, Designer and Chief Engineer of the Model Electric Railway Appears At the Right, While His Assistant in the Mechanical Department, Or the "Master Mechanic" of Construction Work Is James E. Trask.

The Upper Right Hand Photo Shows One Terminus of the Trask Brothers' Model Electric Railway. Sitting At the Control Lever Mounted On the Side of the Table, the Operator Turns On the Current—the Locomotive and Train Moves Slowly and Gradually Out of the "Yards," the Speed Accelerating As the Lever Is Moved Up Notch by Notch, and Then the Train Disappears Around the Curve Into the Next Room. It Returns Presently and Coasts Slowly to a Stop As the Power Is Shut Off. No Hand Touches the Engine Either in Starting, Stopping or Reversing.

The Lower Right-Hand Photo Shows Close-Up View of the Model "C. M. and St. P." Electric Railroad Locomotive. Current Is Fed to the Motors in This Model, Thru the Two Insulated Rails, But a Trolley Wire Can Be Used If Desired.

will run full speed, which is proportionately 60 miles an hour.

The entire locomotive, except the motors and the gears, was built by the two boys from raw stock. The 16 driver and 8 pilot wheels were turned from solid brass castings. The wheels on one side of the locomotive have fibre bushings between the wheel and axle. As the current is carried by both rails of the track, the wheels have to be insulated one from the other.

The truck frames were cut from pieces of flat steel, drills being used to make the latticed part.

There are two motors, geared to eight drive wheels. The motors are wound for twelve volts. The drive wheels are worm driven thru a reduction of eighteen to one.

Since it would not be practical to use the current from storage batteries or to use alternating current, the builders have made a 300-watt motor generator set, composed of a one-fourth horse-power induction motor on the 110-volt lighting circuit and a small 12-volt D. C. automobile generator.

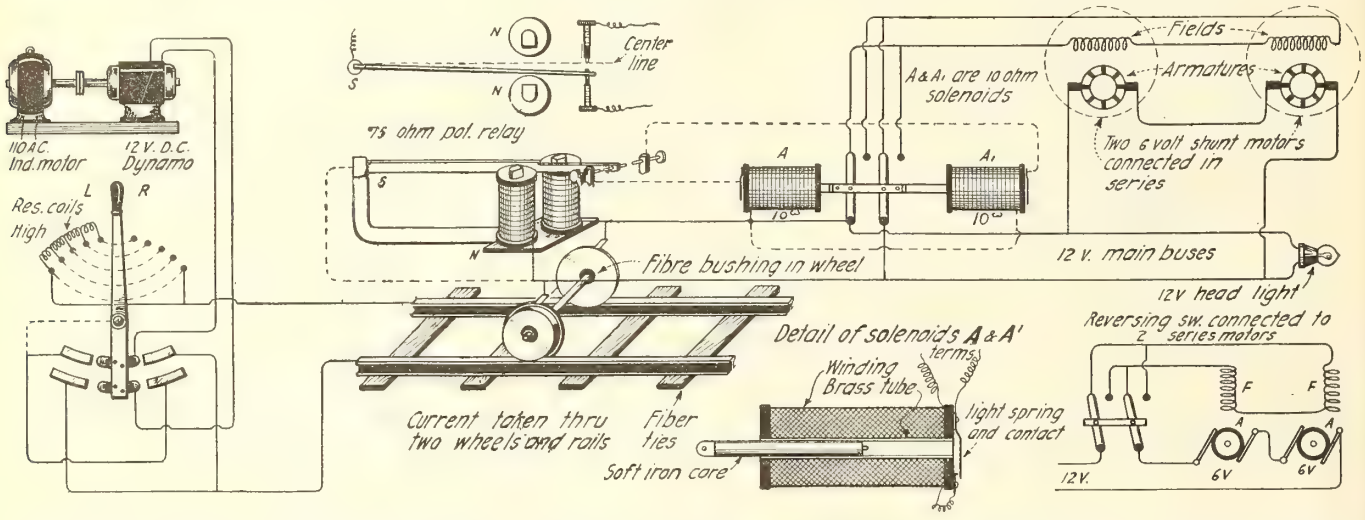
The two motors are connected in parallel to a relay reverser, which enables the locomotive to be reversed by changing the polarity of the current. This device is a combination of a permanent and an electro-magnet wound with fine wire, and shunted across the circuit in the engine. The movement of the electro-magnet mechanism on changing the polarity of the current throws a switch, which reverses the locomotive. (*A polarized relay is shown in the diagram appearing herewith.—Editor.*)

An unusual feature is a two-pound fly-wheel of solid brass mounted on the motor shaft just above the truck frame. By the use of the fly-wheel, the performance of the model is made strikingly similar to that of its monster prototype.

The body of the engine is made of heavy leaded iron such as used for automobile fenders. The bells were turned from a brass bar, and the cowcatchers were cast at a foundry from a pattern made by the youthful builders.

Railroad engineers who have called at the Trask home in St. Paul, to see the model have marveled at the correctness of the reproduction, and the ingenious manner in which the control has been adapted to the small locomotive. The C. M. and St. P. Railroad has started negotiations to borrow the miniature railroad for exhibition purposes, so much have the officials been imprest with it.

In addition to the locomotive, these two geniuses have built coal cars, box cars and a caboose, all faithful reproductions of the larger types. They have built a track some fifty feet in length, tunneling around thru the walls of three rooms and one closet, which happened to get in the way. Tunneling thru those walls almost aroused serious displeasure on the part of James E. Trask, Sr., but the desire of the builders prevailed, and with such success that Papa Trask was as much elated as the youths themselves.



One Method of Controlling Model Electric Trains Like That Shown On Page 1309, As Indicated in the Accompanying Diagram. The Necessary Direct Current for Operating the Motors Driving the Engine Can Be Taken Either From Storage Batteries, From a Step-Down Rheostat Connected to 110 Volt D.C. Circuit or Else From a Small D.C. Dynamo Direct-Connected to a 110 Volt A.C. Motor. A Combination Rheostat and Reversing Switch Is Suggested, Which Resembles Quite Faithfully the Large Controllers Used On Electric Locomotives and Trains. The Main "Trick" Embryo Electrical Engineers Would Be Interested in Probably Is How the Locomotive Is Reversed While Running Along the Rails Without Having Recourse to Trip Switches Placed On the Track. One Way in Which to Reverse the Engine From the Single Control Switch and Rheostat, Is by Means of a Polarized Relay or Similar Mechanism. A Polarized Relay, Which May Be Constructed From a Polarized Bell Ringer Having a Permanent Magnet Field, Is Illustrated Above—Also Its Connections to Two Small Solenoid—Magnets Employed for Operating the "Current Reverse" Switch Connected to the Field Windings of the Two Motors. The Action of the Polarized Relay Is Based On the Fact That a Current Passing Thru It in One Direction Will Not Move the Armature Away From the Lower Contact, for Example; While a Current Passing Thru the Relay Magnets in the Opposite Direction Will Produce a Polarity Opposite to the Normal Field of the Relay, and Cause the Armature to Fly Over to the Upper Contact.

GARAGE TURN-TABLES AND BURGLAR ALARMS.

WE have under preparation an elaborate article for the Constructor Department in the May number which will appeal to all of our readers who own and operate an automobile, and that means almost everybody today. The automobile is hardly a luxury now,—it is considered a necessity and it is not by any means a cheap necessity for most of us, so that we are always on the *qui vive* as the French say, or on watch for new ideas which will help to protect our automobile from theft. The article on an electric turn-table for private garages also contains a lot of valuable information on various forms of burglar alarm circuits for garages, some of which operate on current obtainable from the lighting circuit, while others operate by means of closed and in some cases open-circuit batteries. Do not miss this valuable article in the next issue. Complete details for building and installing these various devices are given in detail.

HOW THE ELECTRIC LOCOMOTIVE IS REVERSED AND CONTROLLED.

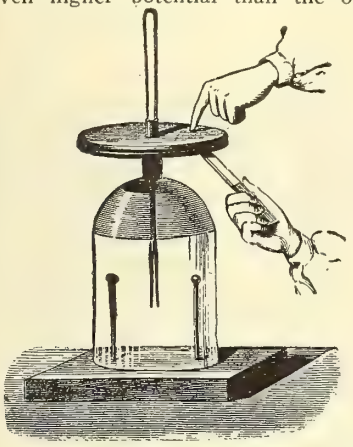
The diagram appended herewith shows how the direct current supplied by the twelve volt potential motor generator set is reversed as well as varied in strength as it is applied to the two insulated rails of the track system. These rails may be made of brass, iron or copper strip about 1/16" thick, ⅜" to ½" in width, fitted into slots cut by means of a hack-saw into fibre or wooden ties. The speed regulator or rheostat can be arranged as shown, so that when the handle is in the center or zero position, no current is supplied to the rails. When the handle is moved to right, or left, current is fed to the rails thru ment mounted on an insulated fibre bar at the base of the controller switch and moved by it.

A polarized relay, which may be a home-made one, constructed from a polarized telephone ringer having about 50 to 75 ohms resistance is connected across the wheels of the train and on the locomotive, so as to receive current in one direction or the other according to the polarity of current supplied thru the speed control and reversing switch. If the armature of the polarized relay is set just past the center line, as shown in the detailed diagram, then with the current passing thru the coils in one direction, it will produce north and south polarity in the coils, and if the polarities on the lower pole piece agree, then the armature will remain attracted as shown. Now if the current thru the rails is reversed, a south pole will be set up by the coil in the lower pole-piece, which will neutralize the magnetism of this pole, and cause the upper pole-piece to attract the armature, thus forcing its platinum point against the upper contact screw, permitting current to pass thru the opposite solenoid A_1, which will throw over the reversing switch connected to the field windings of the motors, thus in turn causing the motors to reverse their direction of rotation.

The solenoids actuating the pole-changing switch for the field windings of the motors, may be small ones about 2" in length, and 1" in diameter, with ⅜" soft iron cores. It will be noted in the scheme shown herewith, and as the detailed drawing further elucidates, that when the iron solenoid plunger is sucked all the way into the coils, it causes the light spring contact at the outer end to be opened; thus after the coil has done its work in shifting the pole-changing switch over to one side or the other, as the case may be, the current thru the solenoid is cut off; this eliminates any further waste of energy thru these members.

The Contact Theory of Electricity

THE contact theory of electricity is one of the older theories, and states that if two dissimilar conductors, such as plates of copper and zinc are brought in contact with one another, a difference of potential will result, one conductor showing a fraction of a volt or even higher potential than the other.



Electroscope Showng Potential Due to Contact of Dissimilar Metals.

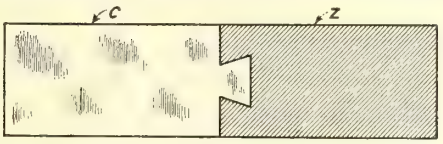
This is the simplest case. To make it more complicated, a chain or succession of various conductors such as plates of different metals, may be placed in series, in contact with each other, so that each of the plates will touch only its neighbor or neighbors. If this is done, the potential difference between the terminal plates will be the same *as if they only* were in the set and were in contact, the others being eliminated.

An electroscope comprising a pair of gold-leaf strips has a circular metallic plate horizontally secured above it, in metallic contact with the gold-leaf strips. A second plate of metal with a glass handle and with its lower surface thickly varnisht, when placed as shown on the lower one, establishes a capacity, and the pair form a condenser. The upper plate is earthed, preferably by a metal conductor. The lower one is toucht with one of the constituent metals of a compound bar of copper and zinc.

By the contact theory, each metal has its own potential, and when one of them touches the lower plate, it charges the condenser. This has practically no effect on the gold-leaf, because of the large capacity of the two discs, but if the upper plate is removed, the capacity of the condenser is reduced to almost zero, the potential rises and the gold-leaf strips diverge.

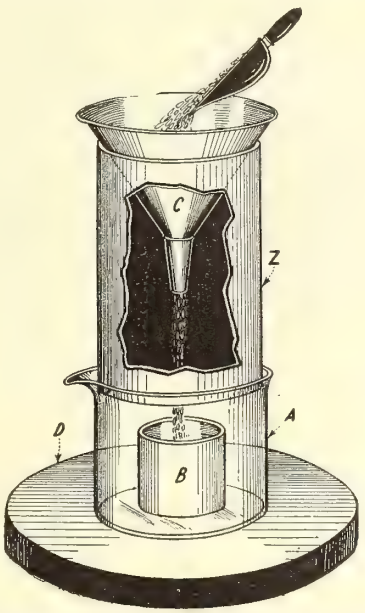
Another demonstration of the principle of the apparatus is based on a variation on the torsion electrometer. Referring to the second illustration, C and Z, are two plates, one (C) of copper, and the other (Z) of zinc. Above them is suspended by an insulating thread an index coated with metal foil shaped as shown, one end flat and expanded, the other end counterpoised. The whole is enclosed in a glass bell-jar. A movable brass rod passes thru a hole in the bell-jar so that it can be brought into contact with the index and removed from contact, as desired. It is caused to touch the index and by touching the protruding portion of the rod with a Leyden jar or other source of excitation, a charge is imparted to the index. The rod is then turned so as to be out of contact with the index. If now, the copper and zinc plates are brought into electrical contact by connecting the ends of the wires shown in the cut, each assumes a polarity and the index is deflected.

As many readers interested in this experiment have failed to obtain results, the matter was referred to Dr. T. O'Conor Sloane, and he explained that usually the instruments employed were not sufficiently



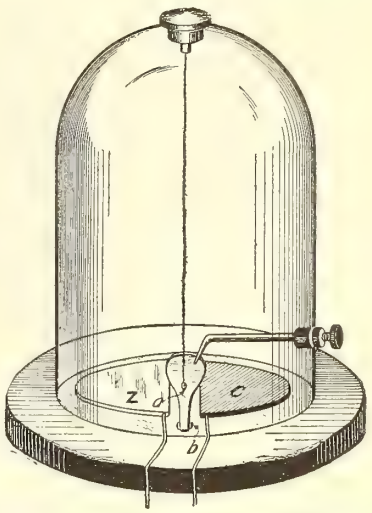
Compound Bar for Showing Contact Action.

sensitive, as the contact electricity produced was mostly potential or voltage and the current or amperage was of infinitesimal value.



Apparatus for Producing Electric Potential Difference by Contact Action.

Carrying this idea still further, Lord Kelvin constructed the apparatus shown in the last illustration. A cylinder (Z), of zinc contains a copper funnel. Below the funnel is a cup of copper. The whole apparatus stands on a glass insulating base, and the copper cup is insulated from the rest of the apparatus. On pouring copper filings into the funnel, they stream down



Torsion Electroscope for Showing Contact Action.

into the cup below, and as zinc is in contact with copper, they carry a charge so that the insulated cup acquires a potential.

What has been described, is designed to show the *contact potential* of solid and dry conductors. The experiments can be developt to include liquid electrolytes—the whole gist of the matter being purely theoretical, to give a basis to establish the rationale of the action of the galvanic cell. There is nothing of practical value in it, and it is not even certain that the potential difference is due to the solid conductors alone.

The following table gives the differences of potential between some of the more common metals and carbon.

Difference of Potential (Volts)

Zinc	
Lead	0.210
Tin	0.069
Iron	0.313
Copper	0.146
Platinum	0.238
Carbon	0.113

If we add the six potentials together, the result is the potential difference between zinc, the first of the metals, and carbon at the foot of the list. It is 1.089 volts. The difference of potential between any two metals is equal to the sum of the differences of potentials between the intervening metals in the contact series.

Mending Cracks in Glassware

A VERY novel way of mending cracks in glassware has been recently introduced. By means of this plan it is possible to make the articles just as they were when they were new. The work is very interesting and it is not at all difficult to carry out.

For the purpose a small amount of sodium silicate or waterglass is needed. This material can be secured from any chemist and, as is well known, it is largely employed in the preserving of eggs.

Where the cracked object is a decanter, a bottle, or anything that has a stopper, or can be provided with a cork, proceed in this way: Take out the stopper and hold the bottle in front of a stove until it is quite warm. Then replace the stopper and, without delay, get to work with the waterglass. This is painted all along the crack with a brush, care being taken to put it on rather thickly. After a little while the air in the bottle begins to cool down and then a very singular thing happens. The pressure of the atmosphere outside forces the water glass into the crack and the ugly line disappears as if by magic. Leave the bottle for a few hours so that the waterglass may set hard and then wipe away any surplus where the crack has been with a sponge and very hot water. The bottle will then be just as good as ever it was and will hold liquids.

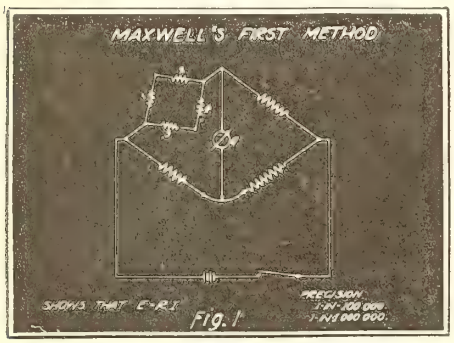
Where the article is a wide-mouthed jar or bowl a somewhat different line of procedure is needful. Take a basin and, in the center of this, put a lighted candle end. Now pour about an inch of water into the basin and place the cracked jar in an inverted position over the light. As soon as the air is exhausted inside the light will naturally go out. Without any delay paint on a thick layer of the waterglass all down the crack. Exactly the same thing happens as was noticed previously. The pressure of the atmosphere outside forces the waterglass into the crack and the line disappears. Thus the jar is perfectly mended and no sign of damage can be discerned. Drinking tumblers which have been cracked can be treated in just the same way only in these cases a short piece of candle should be used such as will conveniently go under the tumbler.

Contributed by S. LEONARD BASTIN.

Is Ohm's Law Valid?

By C. A. B. RIGGS

NINETY-THREE years ago, Professor Ohm, as the result of experimenting with the primitive facilities then available, announced the relations existing in a conductor carrying an electrical current,—be-



The First Method of Maxwell, Used in Checking Up the Validity of "Ohm's Law." Four Equal Resistances Are Measured Separately In a Wheatstone Bridge, and Are Then Connected in Series-Parallel, as Shown, Giving the Same Resistance as One of the Elements Separately. No Error in the Law Was Found.

tween the *current, electro-motive force,* and *resistance;* thereby formulating the law which now bears his name. Ohm's law now comes first in the ritual of things electrical, and to the novice it presents, usually for the first time, a glimpse of the fact that all electrical phenomena obey fixt rules,—laws that are embodied in exact mathematical expressions.

Ohm's law states, that in a metallic conductor of a given physical state, i. e., *where the temperature and dimensions remain constant, the electrical current flowing will be directly proportional to the electromotive force imposed.* In terms of the units of electrical measurement which are now in use, it can be stated, that, in a conductor, the current flowing in amperes is equal to the e.m.f. or potential in volts, divided by the resistance in ohms. This is really an experimental law and is not deduced as the inevitable consequence of a theory. It is a simple law. Moreover, it is of fundamental importance to the electrical engineer, the electrical experimenter, and the physicist.

How exactly does this law hold? With the great refinement of the facilities of investigation of the present day, is it not possible that Ohm's law may be found to vary ever so slightly from the exactitude of the mathematical form in which it is presented? In other words, may it not be found possible that the resistance may change just a little in a conductor, in varying the current from a small value to one of greater magnitude?

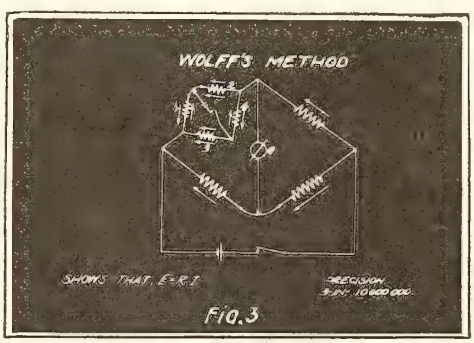
Recent experiments indicate that Ohm's law holds to a high degree of exactitude, no departure being observed in employing the refined methods of testing now available. This subject was discust by Dr. Frank Wenner of the Bureau of Standards, in a paper before the American Physical Society this spring. The statements of Dr. Wenner are of especial interest on the subject, as he is a high-priest in the Temple of Standards, at Washington—the Keeper and Dispenser of the Sacred "Ohm." He has charge of the work of standardizing electrical resistances, and is specially qualified to discuss the subject.

According to the speaker, about fifty years ago a committee of the British Association was appointed to investigate the accuracy of Ohm's law. Maxwell was chairman of this committee, and he devised two methods for making the tests, both of which were capable of giving high precision. No departure from the law was then found.

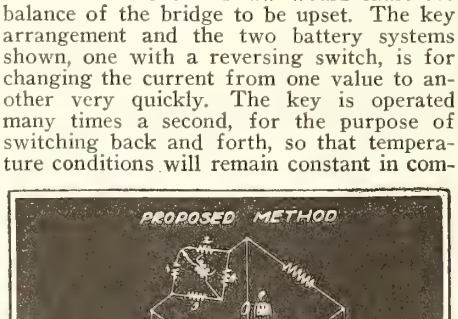
The first method was thought to give a precision of one part in 100,000, and the second was supposed to be good to one part in 1,000,000,000,000 or one part in a million million. On account of the relatively higher accuracy of the second method, little weight was given to the results of the first. However, it now appears, according to Dr. Wenner, that the first method was more fundamental in character than the second, and this was discust in connection with figures which appear with this article.

In Figure 1 is shown the first method of Maxwell. In this method four substantially equal resistances are measured separately in a Wheatstone bridge; and are then connected in series-parallel, as shown, giving the same resistance as one of the elements separately. If a departure from Ohm's law, perceptible by this method, existed, it would become apparent by a discrepancy between the resistance of the four, measured in series-parallel, and as computed from the resistance as determined separately. This was not found.

The second method is shown in Figure 2. Here the bridge is so arranged so that in each branch there is provided one long thick conductor and one short thin conductor, with the result that the current density in each conductor of a branch will be different. In this experiment it is assumed that if the current applied to the bridge is changed then a variation from Ohm's law would cause the balance of the bridge to be upset. The key arrangement and the two battery systems shown, one with a reversing switch, is for changing the current from one value to another very quickly. The key is operated many times a second, for the purpose of switching back and forth, so that temperature conditions will remain constant in comparing the effects of the two currents.

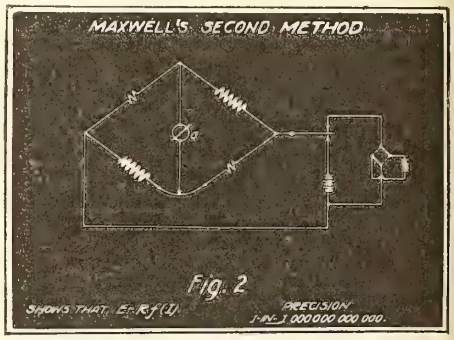


Not Being Satisfied with Maxwell's Method, Dr. Wolff of the Bureau of Standards, Devised a Special Circuit Like That Shown in Figure 3, Giving an Accuracy of One Part in 3,000,000. This Precision Test Once Again Demonstrated the Exactness of Ohm's Law.



Proposed Method for Checking the Validity of Ohm's Law Suggested by Dr. Wenner of the Bureau of Standards. In This Case, Both Direct and Alternating Currents Are Used, in Connection with a Special Wheatstone Bridge. The Precision Attained Would Be One in 100,000,000.

This method in Maxwell's hands showed no departure from Ohm's law. The speaker stated, however, that this method was not an absolutely conclusive one, in that the resistance could vary according to certain special mathematical laws, and the balance of the bridge would be maintained with different current densities.



Maxwell's Second Method of Checking the Validity of Ohm's Law Is Here Shown with a Wheatstone Bridge Arrangement, Prepared to Show That E Equals R I (I).

Maxwell's first method was used by Dr. Wenner with modern apparatus, giving an accuracy of one part in 1,000,000, and no departure from Ohm's law was found.

Another method, proposed by Dr. Wolff, of the Bureau of Standards, was also tried. This was capable of giving an accuracy of one part in 3,000,000. The connections are shown in the diagram of Fig. 3. In this a Wheatstone bridge equipt with a battery in the position ordinarily used for the galvanometer, is placed in one of the arms of another Wheatstone bridge. By a suitable balancing of resistances, the galvanometer of the large bridge was so arranged that when either of the two battery keys, shown, controlling the battery circuits, were closed separately, the galvanometer did not deflect. Both keys were then closed at the same time, and the fact that no deflection was produced indicated that Ohm's law held.

Dr. Wenner then showed the diagram for a new method devised by him which was yet more sensitive. This is indicated in Fig. 4. In this case direct and alternating currents are used. As before, one Wheatstone bridge was arranged to form an arm in another bridge. An alternating current is arranged to be supplied to the cross connection of the little supplementary bridge, and another alternating current of just twice this frequency is used to excite the field coils of an alternating current galvanometer, placed across the arms of the large bridge. A direct current battery with a contact key is arranged at the terminals of the large bridge. By a suitable adjustment of the resistances, the bridges are balanced when either the alternating current or battery current is applied separately. The direct current and the alternating current are then to be applied simultaneously, and if there is any variation from Ohm's law detectable it will be shown by a deflection of the galvanometer. With this arrangement a sensitiveness of one part in 100,000,000 is predicted.

Dr. Wenner, with conventional scientific caution, stated that from his experiment Ohm's law was found to hold for the conductors which were used in the investigation, but he was not making any assumptions respecting what might be found with other conductors.

In the course of the next year it is planned to obtain results with the last-mentioned method and with other materials.

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

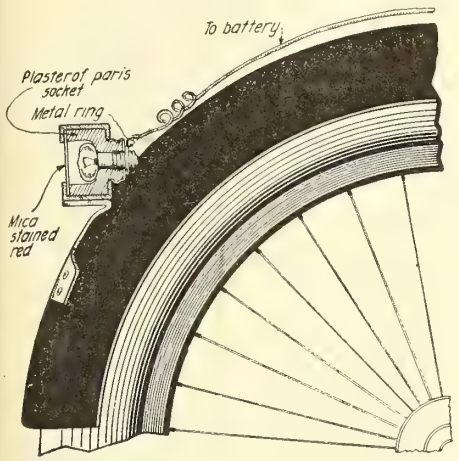
ELECTRIC BICYCLE TAIL LAMP.

Very few people have thought that an old fuse plug would make a very good bicycle tail lamp, but nevertheless, it does. First it will be necessary to remove the mica shield from the fuse plug. In some of the separable plugs this is rather easy; the mica shield is painted red and constitutes the "lens."

The bottom contact of the fuse plug will then have to be removed and scraped larger whereupon a tiny bulb is put into position and locked from the outside by a washer. A wire can be soldered to the washer and led to the battery and the other contact takes place thru the bottom of the bulb where it will touch the mudguard of the bicycle.

The fuse plug is then fastened to a piece of fiber and locked in place on the mudguard as shown in the illustration. A battery is suspended from the frame of the bicycle.

FRANCIS DONNELL.



Here Is the Way to Construct a Real Tail Lamp for Your Bicycle or Motorcycle,—the Lamp May be Lighted from a Battery or Dynamo.

PAPER BUTTERFLIES THAT FLY.

Here is a charming little experiment that can be carried out by means of a Seidlitz powder, one of the last things in the world from which one would expect any amusement. Secure an empty jam jar and get a good-sized cork to act as a stopper to this. In the centre of the cork bore a hole thru which opening a funnel is pusht. The way in which this is done can be seen from the sketch. Next, from brightly colored tissue paper, cut the shapes of three or four butterflies. In the middle of each of these, just between the wings, fasten with glue a thin strip of cork. This serves to act as a body for the paper insect and also helps in the balance of the butterflies when they are in the air.

Fill the jar about half full with water. Then, into it, tip the contents of the packets forming the Seidlitz powder. Quickly replace the cork in the jar and put the paper butterflies into the funnel. Soon the gas generated by the effervescence rises and this causes the butterflies to fly up and down in a most life-like manner. The effect continues for quite a good while seeing that the comparative smallness of the opening of the funnel only allows a little of the gas to pass out at a time. This is all sufficient to keep the butterflies flitting up and down in a most fascinating manner.

Contributed by S. LEONARD BASTIN.

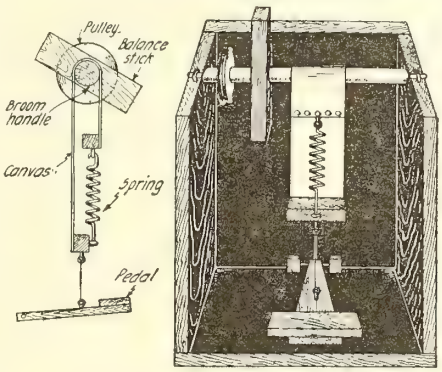


The Paper Butterflies Seen in the Accompanying Illustration Are Caused to Flit About By the Action of a Seidlitz Powder Dissolving in Water.

SECOND PRIZE, $3.00

A MECHANICAL WHIP MOTOR.

In the diagram shown here, we see the constructional details of a mechanical whip motor. A shaft is made from a broom handle to which the balance stick and pulley are attached. A strip of canvas belting, whose ends are now nailed to two blocks of wood, is passed over the broom handle, and one end is connected to a spring and the other end and the spring are connected to a pedal.



One of the Latest Discoveries in Mechanical Science Is the So-called "Whip" Motor. The Author Shows Above How to Construct a Simple Whip Motor Which May be of Considerable Size, Depending Upon the Strength of the Parts and the Power Available to Operate the Pedal.

When the pedal is moved up and down rapidly, a speedy little motor is the result which does not, however, give much power. This same principle will work on a much smaller scale by using rubber bands and thin tape instead of the canvas, in which event the motor may be actuated by hand.

Contributed by
ARMARD MOTSINGER.

THIRD PRIZE, $2.00

A "TWO CENT" HYDROMETER.

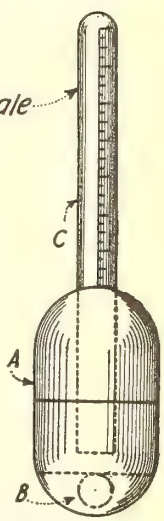
This is a very simple, easily made hydrometer and accurate enough for all ordinary purposes. Two bottle corks, ¼ inch in diameter and an inch long, are glued together as shown at A. Then a hole is drilled in the bottom, a lead bullet, B, inserted, about 38 caliber answers the purpose nicely. Now push a piece of steel, C, an old corset steel is suitable enough, about 7 inches long, into the top. Paint the whole thing with a good coat of asphaltum thinned with turpentine.

To make the scale. Take a standard hydrometer and immerse it in a test solution made up so that it sinks until it registers O, then insert the two-cent homemade hydrometer into the same solution and mark it with white enamel just at the line. Then add more salt to the solution and continue graduating it until the scale is complete.

I have a set made for acid, oil, gasoline, alkali, etc., twelve in all, and the actual cost of making the twelve was only ten cents, while if I had purchased them they would have cost $13.00.

You can undoubtedly borrow hydrometers for the purpose of making the scale on these homemade ones from your local pharmacist or garage owner.

Contributed by
EVERHART TURNER



Who Would Not have a Hydrometer When One Can be Constructed as Simply as This One,—Which Consists of Two Corks and a Piece of Corset Steel? Do Not Use It in Your Storage Battery!

Many amateurs have often desired to join pieces of glass or glass tubing together, but as they are not skillful enough at glass blowing and in handling glass, they have hesitated to try various experiments.

A solder for glass can be made by first melting 95 parts of tin and then adding to it, 5 parts of copper. Zinc in the proportion of ½ to 1 per cent. makes this solder harder, whereas lead in the same proportion, makes it softer.

Glass tubing, united by this means, will separate at any other point sooner than at the point of junction.

Contributed by J. H. K.



Fascinating Experiments in Chemistry

By O. IVAN LEE

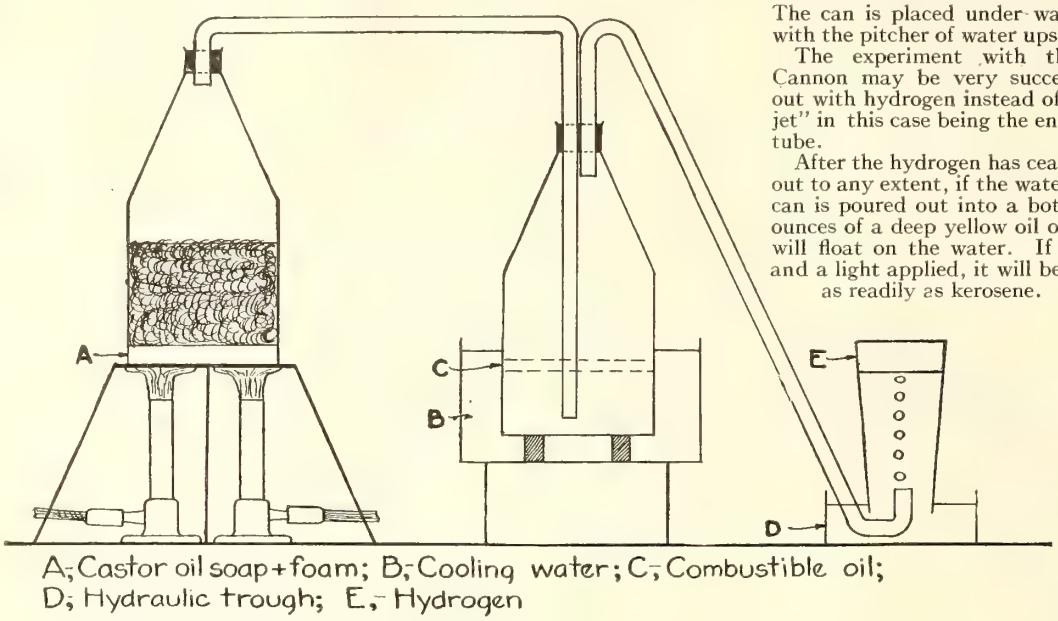
How to Make a Burning Gas (Hydrogen) and a Burning Oil from Castor Oil.

CASTOR oil, of unpleasant memory to many of us, is an extremely complicated substance chemically, and a great variety of interesting and useful things may be made from it, depending upon how it is treated. Among these is the wonderful gas hydrogen with which balloons are inflated.

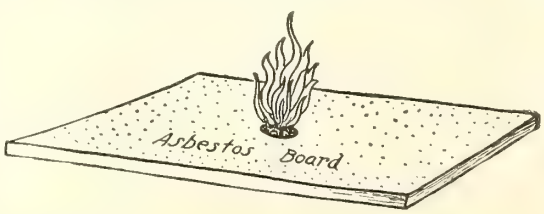
The apparatus required is a couple of quart tin cans, a fire to heat one of them, another larger tin can with the top cut out, a water basin, a glass pitcher (or large olive bottle), and three glass or metal "L" tubes with some rubber tubing for making connections. One of the "L" tubes has one long arm, the other, two. Connect the two tin cans as indicated in the drawing, making one of the long arms of the second "L" tube extend nearly to the bottom of the second can which is half filled with water. An outlet connected to a couple of feet of rubber tubing is made with the third "L" tube and leads from the second can to the water basin. This is partly filled with water. Drill the corks used carefully, and make all the connections air-tight.

Set the second can in the larger can and pour water into the space between. This is for cooling purposes.

Into the first can put one and a quarter ounces of water and two ounces of soda-lye, warming the mixture till the lye is dissolved. Then add half a pound of castor-oil. (The prevailing price for this is 21c a pound, but this will vary with the place of purchase), connect up the apparatus again and light the fire under the first tin can. To avoid direct contact of the flame with the bottom of the can, put a piece of sheet iron or common tin under it. Soon after the fire is lighted, bubbles will be noticed coming from the end of the rubber tubing in the water. These are bubbles of air driven out by expansion, due to the heating. A little later, some white smoke may appear with a peculiar sweetish odor. When the bubbles begin to come at a more rapid rate, fill a long slender vial or bottle with water. Cover the end with your finger and turn it upside down with the mouth under the water in the basin. Now catch some of the bubbles coming from the end of the rubber tube. The water in the bottle will rapidly be driven out. When this has occurred, place your finger over the mouth of the bottle again, strike a match, and holding the vial pointed away from you, apply the flame of the match as soon as you remove your finger. Very likely you will hear a sharp "pop" and you may see a little flame flash down inside the bottle. On the other hand, if nothing happens, only air is coming out and not air and hydrogen, which *together* are explosive. Hydrogen alone burns but will not explode, so when the air has been all pushed out by the hydrogen, a sample of gas caught and burned as described will burn quietly. If you watch closely you may see the hydrogen flame as it sinks down into the bottle forming perhaps a ring.



Apparatus Set Up for Making a Burning Gas (Hydrogen) and a Burning Oil from Castor Oil.



Apparatus Used in Performing "Spontaneous Combustion" Experiment.

No attention need be paid to any white smoke which may accompany the hydrogen gas as it will disappear on letting the gas stand over water. A larger volume of hydrogen may be trapt and stored in the water pitcher, which is to be supported by an inverted tin can with a small hole cut in the bottom, and another near the rim of one side for the insertion of the gas-tube. The can is placed under water, of course, with the pitcher of water upside down on it.

The experiment with the Powderless Cannon may be very successfully carried out with hydrogen instead of gas, the "gas-jet" in this case being the end of the rubber tube.

After the hydrogen has ceased to be given out to any extent, if the water in the second can is poured out into a bottle, about two ounces of a deep yellow oil of peculiar odor will float on the water. If it is removed, and a light applied, it will be found to burn as readily as kerosene.

"Spontaneous" Combustion.

In the first place, there is no such thing as "spontaneous" combustion. If a fire starts, there is always a perfectly good reason for its starting, altho it may be very puzzling if all the facts are not known. What is meant then, is that the mysterious fire starts apparently without any direct human aid, but since nature is always "on the job," there is no magic about the matter. The whole term is based on popular ignorance of natural laws, of the kind which leads some to waste their time and money trying to discover "perpetual motion."

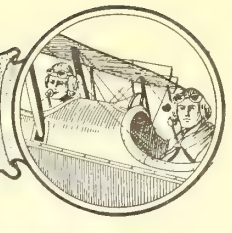
A striking demonstration of the kind of combustion whose origin would be conveniently described by the newspapers as "spontaneous" may be made with ten cents worth of chemicals obtainable at any drug store—five cents worth of glycerine and the same amount of permanganate of potash. This last is a dark violet crystalline substance of which a minute particle will color a glass of water a beautiful purple.

Rub a half teaspoonful at a time between two flatirons until it is a fine powder. Collect a couple of spoonfuls into a little heap on a slab of stone or iron, and make a slight depression in the top of the heap. Now quickly drop about a dozen drops of the thick, sweet and harmless looking glycerine into the little hole in the heap of powdered permanganate. For a moment you'll be disappointed—nothing seems to happen. Then—signs of action!

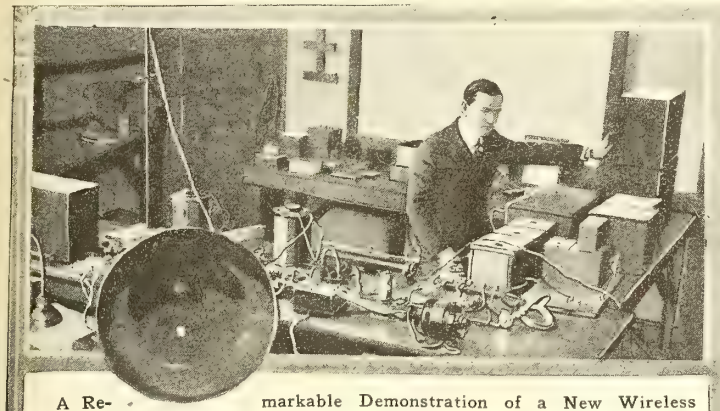
(*Continued on page* 1328)

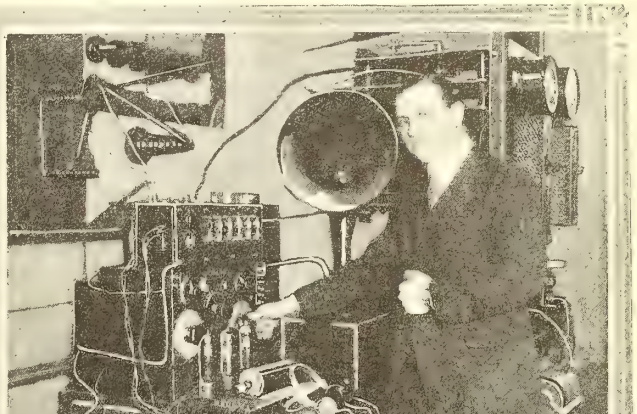


RADIO DEPARTMENT



Radio "Talk" Relayed to Land Lines





A Remarkable Demonstration of a New Wireless Stunt Perfected At the City College of New York, Was Given Recently by Professor Alfred N. Goldsmith, Here Shown in His Laboratory At the College. Through a Megaphone Attachment the Wireless Gossip of the World Was Heard by Those Who Witnest the Demonstration.

RECENTLY there was carried out at the radio laboratory of the College of the City of New York some extremely interesting tests in which radio-telephone "talk" was transferred to land lines and vice versa, at will. When interviewed at the Radio Laboratories of the College of the City of New York, concerning these tests, which were under his supervision, Professor Alfred N. Goldsmith, in charge of Electrical Engineering, said:

It is natural that the recent remarkable achievement of the American Telephone and Telegraph Company in enabling persons on board a ship on the Atlantic Ocean to talk by wire and by telephone to persons or individuals on the Catalina Islands in the Pacific Ocean should have aroused such widespread public interest.

This transmission of the human voice over thousands of miles of wire and thru many miles of air has been made possible by the development of a new type of vacuum tube frequently known as the *audion*. It resembles in appearance a large lamp and contains a glowing filament and special forms of metallic grids and plates. This tube can take the extremely feeble speech and raise its loudness by electrical means until tremendously loud speech is produced. When it works in this way, it is known as an *amplifier*, and as such is widely used in wire telephony and in radio communication. It can also be used in a number of other special ways for radio telegraph and telephone transmission and reception, and is largely employed for these purposes today.

Radio-telephony has long been a subject for special investigation in the Radio Laboratories of the College of the City of New York. The first experiments were carried out more than twelve years ago with what is known as the *Poulsen Arc* apparatus and covered only short distances. However, by 1916, a powerful vacuum tube radio-telephone set had been installed in our Laboratories at the College and gave excellent results. It was much the same type of apparatus as is used today for the same purpose.

There was stretched over the buildings of the College a great aerial wire system for transmitting, with more than three-quarters of a mile of heavy bronze wire in it. Thousands of feet of broad copper band were buried in trenches under the College lawns to afford a proper connection to the earth.

The results that were obtained at the College more than five years ago justified the trouble taken. We telephoned from a downtown residence more than seven miles from the Laboratory over the wire lines and then *automatically transferred* or *relayed* the received speech out by radio-telephone. That is, the wire telephone was automatically linked with the wireless telephone and every word spoken downtown went out by radio from our transmitter.

This speech was heard as far away as North Dakota, over 1,300 miles from New York. At shorter distances the loudness of the speech was so considerable that some amusing incidents occurred. For example, a radio amateur some 50 miles from the College happened to "tune in" our speech signals one evening. He afterwards explained that he thought his aerial wires had either fallen across an electric power line or been struck by lightning, judging from the tremendous volume of the speech received.

This pioneer work of five years ago has been carried forward steadily in the Radio Laboratories of the College and about ten different types of radio-telephone transmitters of various sizes have since been produced and successfully tested here.

The American Telephone & Telegraph Company has been interested in radio-telephony as a useful adjunct to its highly successful wire service under special conditions for a number of years.

In 1915 elaborate experiments were carried out by that Company and the Western Electric Company, with the co-operation of the United States Navy, at the Arlington, Virginia, radio station of the Navy. The great aerial wire system at Arlington supported on 600-foot steel towers was placed at the service of the Companies for experimental purposes. A radio transmitter was installed in which as many as 550 of the transmitting tubes were used at a time. Speech from various points was carried by wire to Arlington and then sent out by radio automatically. The voice of the speaker was heard at points as widely separated as Paris, France; Mare Island in the Pacific Coast; and Honolulu.

The promise shown by these experiments encouraged the Telephone Companies to carry the work further and they determined to try out thoroly radiophone communication between ships and shore, and between islands and the main land. Accordingly, the steamship *Gloucester* was equipt with an efficient radiophone set. Furthermore, two land stations were established, one at Green Bay near Boston and one at Foxhurst, N. J., near

Articles to Appear in April Issue of "Radio News"

Aeroplanes and Radiogoniometers by Armstrong Perry.

Simple Measurements and Calculations for the Radio Station Owner by P. F. Geagan.

A Long Range Receiver by Joseph G. Read.

A Honeycomb Coil Tuner by Paul Watson.

Short Wave Radio Vacuum Tube Transmitter and Regenerative Receiver With Two-Step Amplifier by Walter Hyndman.

A Two-step Audiotron Amplifier by Frederick J. Rumford.

Tug or Spirit—a Fascinating Story by Julian K. Henney.

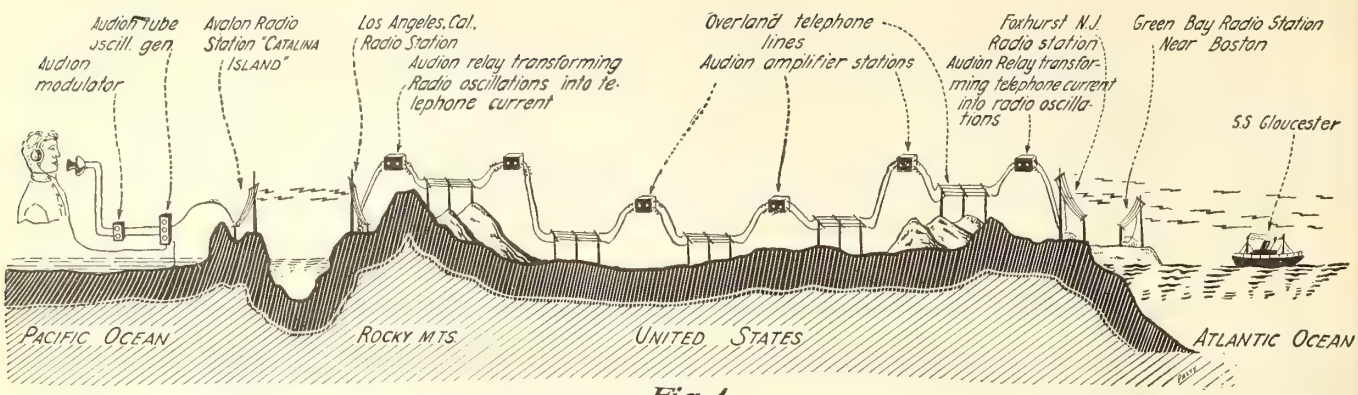


Fig. 1

Fig. 1. Physical Diagram Showing the Combined Wireless and Wire Telephone Conversation Recently Carried Out Between a Radio Station At Avalon, Catalina Islands, Off the California Coast, and the Steamship "Gloucester" Off the Atlantic Coast. This Diagram Shows How a Person At Avalon, Off the Pacific Coast, Talked First by Telephone Then by Radio and Then Again by Telephone, Over the Famous Transcontinental Telephone Circuit Equipt With Audion Amplifiers As Shown At Successive Stages of the Journey and Finally the Telephone Currents Corresponding to the Human Voice Were Converted Into Radio Oscillations and Ether Waves At the Atlantic Coast Stations, Whence the Messages Were Wafted Thru the Ether to the S. S. "Gloucester."

Elberon; these points being near the terminals of the coastwise trips of the *Gloucester*. These sets were all transmitting tube sets and were *duplex* sets. That is, it was possible to send and receive at the same time and the users of these sets could therefore *talk and listen simultaneously,* just as on an ordinary telephone wire line. The Foxhurst and Green Bay radiophone stations were then connected to the wire line systems of the Telephone Company.

About the same time, radio telephone sets were installed at Los Angeles, California and Avalon, Catalina Islands. The stretch of the Pacific Ocean lying between Avalon and Los Angeles was very successfully bridged, and many thousands of calls have been handled without trouble.

Recently, the operator on the *Gloucester* established communication with Foxhurst. There his speech was automatically transferred to the transcontinental line terminating in Los Angeles, where it was again transferred to the radio-telephone and carried to Avalon. So that the operator at Avalon and the operator on the *Gloucester* were in direct personal touch.

While the radio-telephone is not regarded as a competitor of the wire telephone for ordinary overland communication, it is, nevertheless, a useful adjunct in such special cases as those just described and forms an excellent element in the system of any effective public service wire communication company.

The *Gloucester-Avalon* transmission is interesting from another point of view. For the first time in the history the voice of man has been carried across portions of two oceans and an entire continent!

In view of the ease with which the wire service and the radio-telephone can be linked to each other, it is clear that every telephone subscriber in the United States automatically becomes a subscriber to such special radiophone service as may be established by the wire companies and their associated companies.

Clearly, the time is not far distant when, by asking for "radio long distance" or possibly radio marine service any telephone subscriber will be able to reach ships at sea or possibly even telephone subscribers on the other side of the ocean.

The work done in radio research at the College of the City of New York enabled its staff to render valuable service to the Army and Navy during the war. Many hundreds of men were trained for the Navy in a special school established at the College, under the general direction of Professor Frederick B. Robinson, Dean of the School of Business and Civic Administration, and under the engineering charge of myself. The purpose of this School was to teach the Navy's operators how to handle radio direction finders or "radio compasses," as they were called. This interesting device enabled stations equipped with it to find the direction of any station which they heard. Not only

(*Continued on page* 1349)

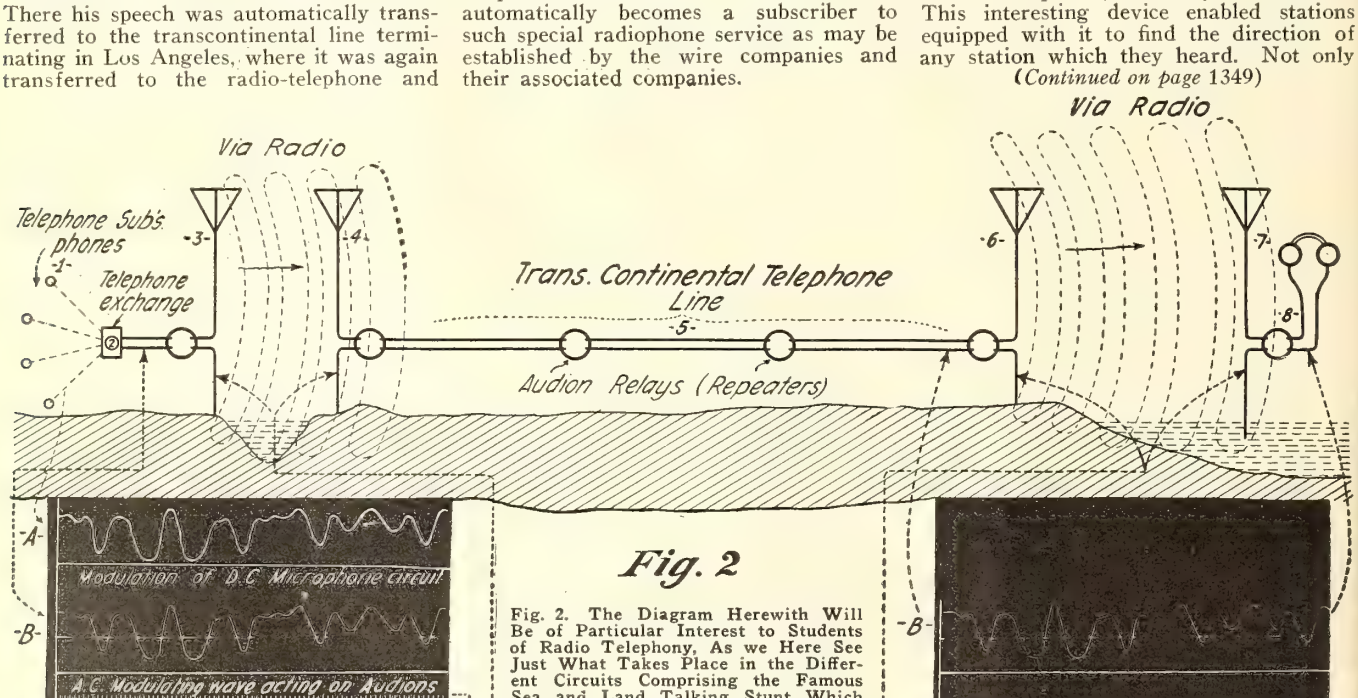


Fig. 2

Fig. 2. The Diagram Herewith Will Be of Particular Interest to Students of Radio Telephony, As we Here See Just What Takes Place in the Different Circuits Comprising the Famous Sea and Land Talking Stunt Which Joined the Two Oceans. Referring to the Chart of Current Variations, We See At "A" the Modulated D.C. Microphone Current Which Acts Upon An Audion Set in the Radio Station. These Audions Normally Produce a Radio Frequency Undampt Current in the Antenna Circuit Shown At "C." When the A.C. Modulating Wave "B" Acts On These Audions, Thru a Suitable Modulating Circuit, the Radio Frequency Oscillations in the Antenna Are Molded to Resemble Those at "D." The Antenna Current Received At the Antenna 4, for Example, Resembles the Groups of Oscillations "D," Which Are Transformed Thru An Audion Receiving Set, Into Telephone Currents Similar to Those At "B." At the Atlantic Coast Radio Station, 6, for Instance, These Telephone Currents "B," Are Again Changed Into Modulated Radio Frequency Currents "D." The Electro-Magnetic Waves From Antenna 6, Reach the Antenna of the Ship Station At 7, Where Radio Frequency Currents Are Set Up in the Antenna Resembling "D." The Currents in the Antenna 7 Pass Down Thru An Audion Receiving Set and Into the Telephone Receiver Circuit, Where An Audio-Frequency Current As At "B" Is Heard by the Operator. It Was Possible for Conversation to Be Carried on Both Ways Without Switching From Transmitting to Receiving, in the Recent Telephone Tests—the Person Both Talking and Listening in the Same Natural Manner As When Using a Common Bell Telephone.

The Audio-Frequency Amplifier in France

By ROBERT E. LACAULT

Late Lieutenant in the French Army Signal Corps

VERY little has been sai ' about the researches made in France on the subject of Radio and especially on the apparatus using V. T. (vacuum tubes), for most of the experiments were carried out during the war

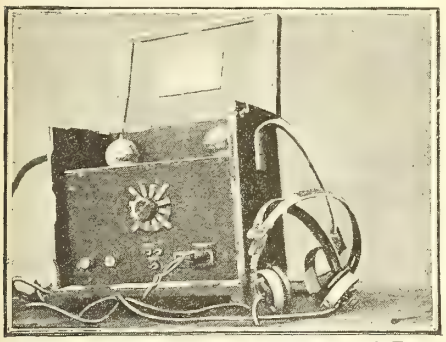


Fig. 1. This Shows the First Model of Two-Stage Audio-Frequency Amplifier Developed for Use by the French Army.

in the laboratory of the Signal Corps, and until peace was signed, nothing could be divulged to the public.

The writer, who has carried out several experiments in this laboratory, is pleased to present to the readers of SCIENCE AND INVENTION some new facts on the birth and growth of the amplifier in France.

It was in 1915 that the need for a sensitive and practical amplifier was felt in the army for until that time spark transmission was used, and the reception was effected on a crystal detector. At this time, some officers who were sent to this country, brought back a few models of V. T.'s, which were practically unknown in France. Immediately experiments were made by the most prominent French radio engineers and a few months later a standard type of V. T. was adapted and manufactured by two firms which produced *5000 tubes a day;* it must be added that a great number were broken at the front every day owing to the bombardments, which explains why this number was only just sufficient.

This standard type of V. T. was so designed that it could give equally good results when used as a detector or an amplifier as well as an oscillator. At the same time research was made to find the best characteristics of an amplifying transformer which was to be used in conjunction with the standard V. T. The result of this work was a two-stage audio-frequency amplifier especially designed for field work. This amplifier is shown in Fig. 1.

Catching the German Conversations

As soon as amplifiers were brought to the front the officers of the Signal Corps tried to use them to catch the conversations carried on over the telephones in

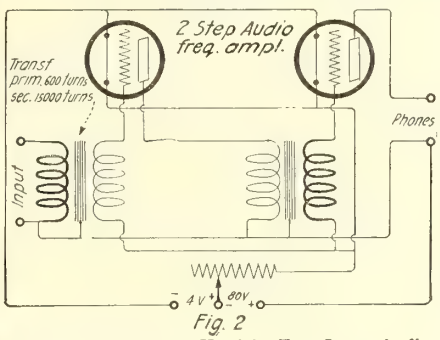


Fig. 2. Connections Used in Two-Stage Audio-Frequency Amplifier Used Considerably in Trench Radio Sets by the French Army.

the German trenches. These attempts were quite successful and it was found that by running two wires parallel to the German 'phone lines along the ground, it was possible to hear every conversation of the enemy, and thanks to the ultra-sensitive amplifier the inductance was sufficient even at a great distance from the lines to accomplish this successfully. It is needless to add that very important information was obtained by this system.

When no telephone was used by the enemy, a microphone (like that used in a dictagraph) connected to an amplifier was brought near the German trenches during the night and some useful and interesting data for the Allies was gleaned from the overheard conversations.

The amplifiers have also been extensively used in the ground telegraphy system. This ground radio merely effects the transmission of waves in the earth and is very simple. The transmitter is a powerful buzzer operating on 10 volts and the receiver is an audio-frequency amplifier; the radiating system is made of two wires grounded at the ends. This ground telegraphy was especially useful where it was impossible to erect an aerial, and a range of about three miles was obtained with a power of only 20 watts. Fig. 8 illustrates this system.

After this short review of these generally unknown uses of the amplifier we will speak of its use in Radio-telegraphy. With the new warfare it was often impossible to use in the trenches the heavy powerful spark sets which were supplied to the Signal Corps. It was therefore, decided that small portable sending sets should be built which could be carried by one or two men and which could be erected or dismantled in a few minutes. But owing to the small power of these stations it was necessary to use very sensitive receivers.

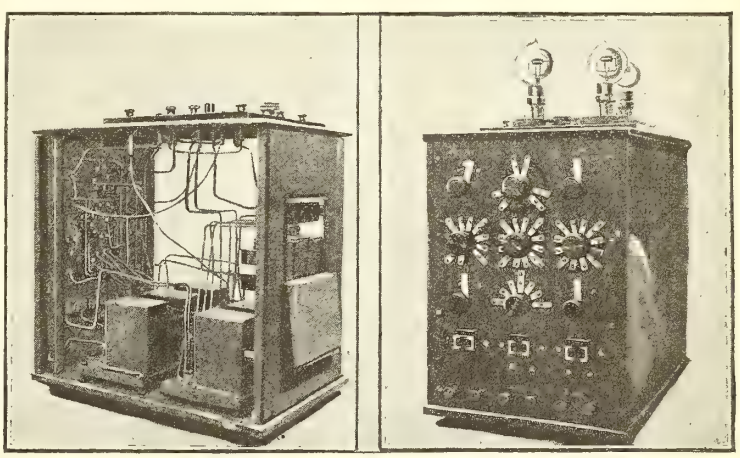


Fig. 3. Regular Model Three-Stage Audio-Frequency Amplifier Which Can Be Used When Desired As a Detector and Two-Stage Amplifier. The Photo Shows the Front View of Switch Panel with Three Jacks for Telephone Receiver Plugs As Well As Interior View of the Cabinet with Wiring, Self-Inductance Coils and Transformers.

The amplifier shown in Fig. 1, was at first used with the receiver of the portable sets and has made long distance communication with low powered transmitters and low aerials possible; the question of Trench sets was therefore solved. As can be seen in the diagram Fig. 2, this apparatus was rather simple. Later a new model fitted with the latest improvements came out of the laboratory. It was a three-step amplifier equipt with a switch, whereby the first tube could be used as a detector for Radio reception. With this apparatus wonderful results were obtained and a great number of these amplifiers have been manufactured for the Signal Corps. This instrument is shown in Fig. 3 and the diagram of the same in Fig. 4.

Altho this model of amplifier was the best ever designed it was found that owing to its size, it was not very practical for trench work, so the former apparatus was modified again and a new model known as the "3-ter" type was produced which was much simpler, but with which the same value of amplification was obtained. Fig. 5 is a photograph of the Standard amplifier now used in France, and as can be seen only one rheostat is used to control the current in the filament

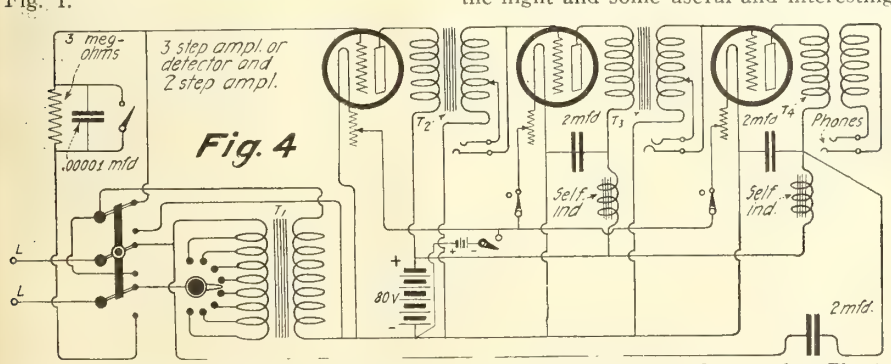


Fig. 4. Wiring Diagram for the Three-Stage Audio-Frequency Amplifier Illustrated at Fig. 3. As Will Be Seen, the Switches Permit the Operator to Employ the First Bulb As a Detector and the Remaining Two Bulbs As Amplifiers in Conjunction with a Crystal or Other Detector.

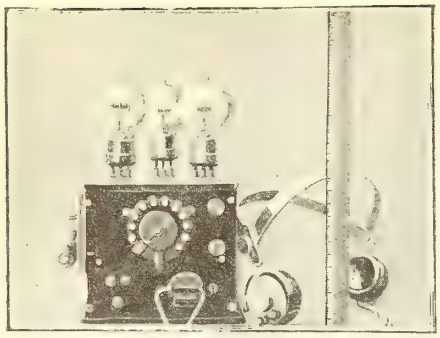


Fig. 7. This Shows One of the Smallest Three-Stage Audio-Frequency Amplifiers Ever Constructed, Possibly. It Was Built by the Writer of This Artilce, and All of the Apparatus Is Combined in a Wonderfully Compact Manner, So As Not to Waste a Bit of Space. The Cabinet Containing This Set Measures But 6"x6"x 6". The Switches Permit the Use of the First Vacuum Tube As a Detector with Two Stages of Amplification, or of Three Bulbs, to Be Used As Amplifiers. The Author States That He Has Accomplisht Just As Good Work with This Set As with the Large One Illustrated at Fig. 3, Which Measures About Four Times Its Size.

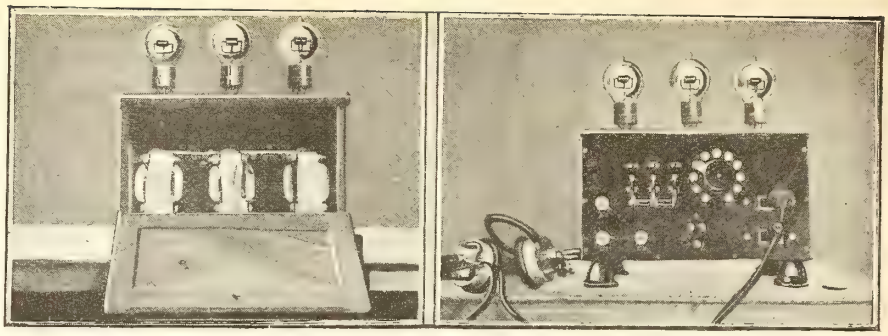


Fig. 5. These Two Photos Show One of the Later Models of Three-Stage Audio-Frequency Vacuum Tube Amplifiers Perfected and Used in the French Army Signal Corps. This Set Has Proven Extremely Efficient and Is Far Smaller in Size and Less in Weight Than the Large Set Shown in Fig. 3, and Is Used Aboard Ships As Well As in Commercial Stations. The Switch at the Left Permits of Using the First Bulb As a Detector When Desired. These Photos Show the Front View As Well As the Interior View of the Set.

of the three tubes. The switch allowing the use of the first tube as a detector is mounted on the front panel, while the cabinet contains only the three audio-frequency transformers and the grid condenser.

The writer has designed and built for a portable set, an amplifier embodying the same characteristics as the model just described but much smaller in size which is represented in Fig. 7. This is to give an idea of what can be done in this line when an apparatus is properly designed to meet a special requirement.

A great number of radio-frequency *amplifiers* have also been built, and at the present time these apparatus make possible the reception of radio signals with very small indoor aerials, including loop or coil aerials no longer than a cigar box. But as this line of apparatus is quite different, it will be described in a future article.

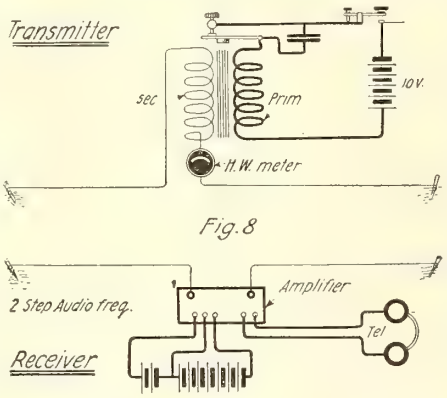


Fig. 8. Hookup and Arrangement of Buzzer Transmitter, Together with Two Step Audio-Frequency V. T. Amplifier Used in Carrying on Telegraphic Communication in the Front Line Trenches of the French Army, During the War. This Set Worked Over Surprisingly Long Distances Considering the Small Wattage Used in the Buzzer Transmitter, and by Changing the Code Used Every Day or So, There Was Little Chance of the Enemy Interpreting the Words Sent by This Method. This System Is Known As the T. P. S. System, Which Is the French Abbreviation for Telegraphie Par Sol, Meaning "Telegraphy Thru the Earth."

Miscellaneous

The American amateur radio man often experiments with other circuits than those here shown, for example: Method of using one or two audion bulbs to amplify the signals rectified by a crystal detector. Where expense is an item or for other reasons, this system can be used, but the most reliable, all - around outfit, of course, is that employing a vacuum bulb as a detector, in addition to the one or more bulbs employed as amplifiers. There are several vacuum tubes on the American market available to amateurs which operate on as low a plate potential as 20 to 22 volts, the voltage rating of the usual "B" block battery now on the market. There are many wrinkles which will help to improve the operation of audion amplifier sets, particularly when two or more steps of amplification are utilized, and which often cause supersensitive electrical conditions about the various instruments, particularly the bulbs themselves. One of the leading American manufacturers has found it advisable to enclose the audion coupling transformers in a metal case and the experimenter can try out different stunts such as this, so as to eliminate the freak conditions which sometimes bother one considerably in endeavoring to amplify thru several stages. One American radio manufacturer encloses the coupling transformer in a brass shell, while in a German set which was examined the audion transformers were enclosed in sheet steel shells. One of the mistakes amateurs make is supposing that the apparatus can be operated at high efficiency by simply mounting the various audion receptacles, switches, etc., on a wooden panel, but this is not so at all, and for best results the switches and other metal current carrying members really must be mounted on either fiber, hard rubber or Bakelite. If wood must be used, it should be thoroly soaked in hot paraffin or beeswax, or a mixture of the two.

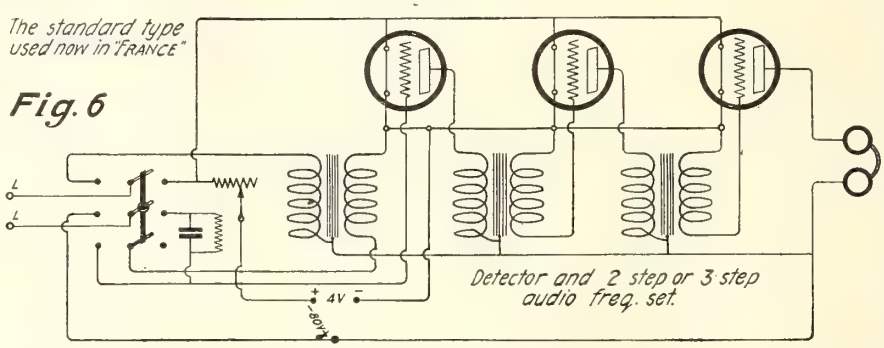


Fig. 6. Connections of Three Bulb Standard Audio-Frequency Amplifier Used Latterly by the French Army Signal Corps and Providing for Quick Change from Detector and Two Step Amplifier to Three-Stage A. F. Amplifier.

U. S. Bureau of Standards News

Observations of Radio Transmission Phenomena by Amateur Radio Operators.

It has been observed by radio amateurs generally that the strength of signals received from a given transmitting station varies rapidly during very short intervals of time, probably depending upon the weather and various meteorological conditions. The Bureau of Standards has desired to collect as much data as possible on the nature and causes of this fading of radio signals. In order to secure simultaneous observations of signals, arrangements have been made for a number of well-equipt amateur radio stations, including 6 transmitting stations and about 40 receiving stations, to begin such a series of tests. The 6 transmitting stations will send out a broadcast message, each of which will last about 3 minutes, on Tuesday, Thursday, and Saturday evenings, beginning just after the time signals from the Arlington Naval Radio Station. The 6 above-mentioned stations will transmit for their different regions 10 minutes apart and 3 or 4 of them will be within the receiving range of each receiving station.

The Bureau of Standards has supplied forms on which the operators will record the strength of the signals they receive and other information, such as weather conditions, presence of strays or atmospheric disturbances, and the general character of radio transmission at the time of each observation. It is hoped that as a result of this program of careful observations some valuable conclusions regarding radio transmission will be reached. If the present plan, which covers only the northeastern part of the United States, is successful, a more extensive program may be undertaken at a later date.

Lecture Explaining the Phenomena of Radio Telegraphy and Telephony

Communication by means of electricity without wires has progressed very rapidly during the last few years, and has probably been given more consideration by the general public than almost any other scientific subject. It is, nevertheless, a fact that due to the somewhat inaccurate and misleading newspaper accounts which have appeared from time to time dealing with

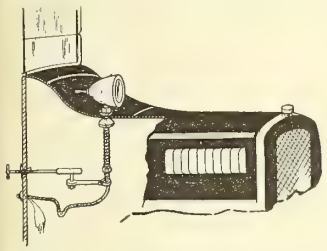
(*Continued on page* 1348.)

LATEST PATENTS

Spot-Light Mounting.

(No. 1,363,426. Issued to Charles Mee.)

This invention relates to a method of mounting spot-lights on the automobile engine hood, so that the spot-light

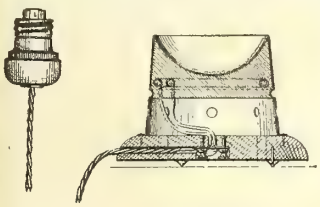


may be operated by the driver of the car thru the agency of rods. When it is desired to tilt the lamp down, the operator draws the rod and handle toward him. When he wishes to tilt the lamp up he pushes the handle away from him. When he wishes to turn the lamp from side to side he moves the handle to the right or left, swinging the rod on the dash board as a center and this in turn swings the arm and turns the stem of the lamp and the lamp as well.

Evaporizer.

(No. 1,359,000. Issued to Carl. L. Stottmeister.)

This invention has for its main object to provide an evaporizer, in which various substances in liquid, powder or solid form are subjected directly to the effects of heat within an integral of the heating apparatus. It is portable and has a relatively cool base when in

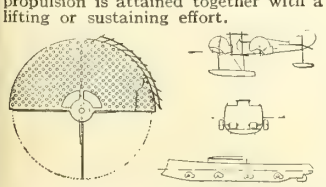


operation and there is a cup-like metallic receptacle in its upper part, so that when current is turned on, certain resistance wires are heated and evaporize the medicant. This is particularly adaptable for treating such diseases of the respiratory organs and such affections as sore throat, hay-fever, catarrh and asthma.

Propulsion Means.

(No. 1,360,182. Issued to Salustio Valdés Cortés.)

This is indeed a very clever method of arrangement for a paddle wheel or rotating propulsion mechanism, mounted on a vertical, horizontal or inclined shaft, whereby the inventor realizes some possibilities, which were heretofore overlooked. He adapts the invention for airplane, submarine or seagoing vessels with but slight modification. Essentially it consists of a new casing made to fit over one-half or more of the paddle wheel, which casing is constructed with permeable or perforated lateral sides, and with holes or openings and deflecting vanes in its perifery whereby greater efficiency of propulsion is attained together with a lifting or sustaining effort.

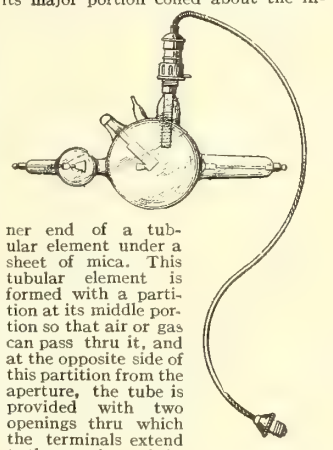


This box or casing which is fitted around the propeller utilizes the centrifugal force of the revolving medium, air or water, confined in the casing by converting it into propulsive or lifting effort.

X-Ray Tube

(No. 1,359,300. Issued to Edmund Wandner.)

This invention aims to provide for an improved X-ray device including a manually controlled regulator by means of which a very steady or uniform vacuum can be maintained in the X-ray tube, and by means of which the vacuum can be lowered so as to prevent the tube from being punctured. It also affords an easy method of controlling the current. It will be seen by referring to the diagram that a screw-plug is formed so as to be adapted to fit an ordinary electric lamp socket, which likewise fits a regulator or rheostat-socket, whereby the resistance and current strength may be regulated. A wire of relatively high resistance has its major portion coiled about the in-

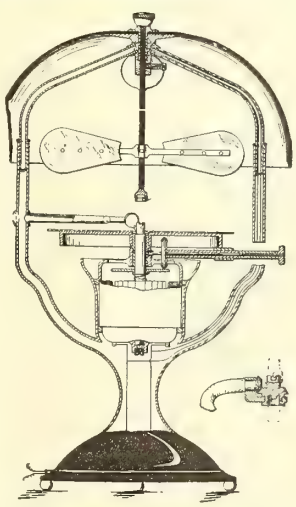


ner end of a tubular element under a sheet of mica. This tubular element is formed with a partition at its middle portion so that air or gas can pass thru it, and at the opposite side of this partition from the aperture, the tube is provided with two openings thru which the terminals extend to the exterior and thence connect to the current line.

Combined Light, Fan and Phonograph.

(No. 1,359,053. Issued to Peter R. Gonsky.)

This rather simple, yet clever device, comprises a phonograph, fan and a table lamp, all within the same con-

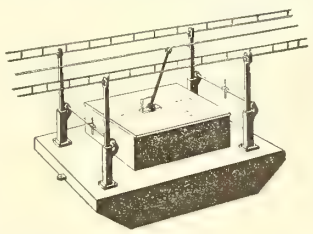


struction. An important feature is that the shaft for the rotating table of the phonograph also rotates or drives the fan and there is an additional interposed flexible shaft connection employed so that a record can be changed without interfering with the driving of the fan. The lamp-motor base is further used as a sound amplifier. The entire device is made in compact form and has a very pretty effect when placed upon the table. A bevel gear is provided so that the device can be used to drive small household appliances such as massage vibrators, which gears may be thrown into or out of operating position.

Electrically-Propelled Boat.

(No. 1,355,156. Issued to Maria Rodrigues Loija.)

Altho this invention will require considerable expenditure in order to make it operate properly, when once

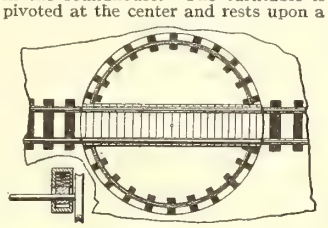


installed, it promises to be very successful, in that not alone is a ship propelled by electric current operating a motor, but it requires no steering control. There are two horizontal members which engage four wheels serving to guide the vessel over the waterway. These wheels are on standards automatically or manually adjustable for changes in tide and current, which also serve to act as one conductor, whereby the power will be conducted from any suitable source to the motor on the boat.

Turntable.

(No. 1,355,722. Issued to Byron E. Viele.)

The invention relates to an improved method of operating a turntable in roundhouses, etcetera, so as to dispatch locomotives to different points in the roundhouse. The turntable is pivoted at the center and rests upon a

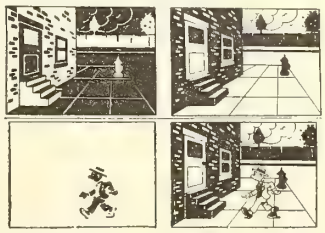


circular track. An electric motor or steam engine is housed at the center point, and thru the agency of bevel gears, power is transmitted to friction wheels which serve to drive the table around on the circular track.

Animated Cartoons.

(No. 1,355,648. Issued to Leslie Elton Brownley.)

This invention provides for an improvement in making animated comic characters or cartoons and photographic backgrounds, or so-called "real life action" upon motion picture films, or also in making real life action in combination with animated silhouette figures. The inventor first takes a photograph of real life action and produces a positive print therefrom, but does not develop this positive print. Then he makes a cartoon character in detail upon a black background by projecting the negative of the real life image on to a ground glass and sketching the character therefrom. Now a black silhouette of the cartoon is made, omitting all detail; a print of this silhouette is also made, when this latter negative print is placed upon the undeveloped positive print made in the

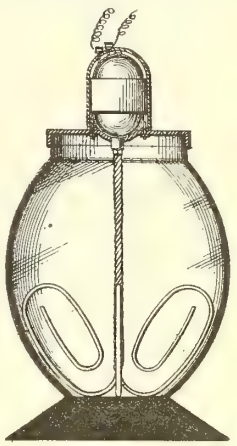


second stage, and both are subjected to light. Upon viewing the same in its developed state we will find a real life background with a black silhouette figure. The cartoon that has been drawn is then photographed and superimposed in the position occupied by the black silhouette figure, giving us a cartoon figure acting with real life objects on real life backgrounds.

Electrically-Operated Egg-Beater.

(No. 1,359,208. Issued to Burr D. Viers.)

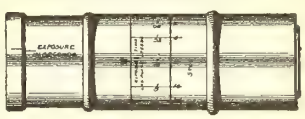
This little device is so arranged that it is readily adapted for disposition on the top of an ordinary glass or tumbler and is constructed on novel lines. It can be taken apart for cleaning and re-

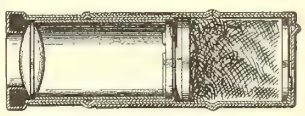


pairing. There is a dome-shaped casing covering the motor and openings are formed in the sides of the casing to facilitate the introduction of oil. It will thus be seen that when the cover is removed from the receptacle, the motor will also be removed, while the dasher shaft will remain in the receptacle. Thus the dasher can be changed or cleaned without taking the motor apart or removing the motor from the cover.

Photographers' Light-Meter.

(No. 1,361,999. Issued to Charles Clinton Howenstine.)





This meter is intended for determining the strength of light, particularly in taking photographs so as to give the correct exposure for any diafram opening and any speed of exposure of plate or film. Enclosed within the meter is a self-luminous body or compound which constitutes the standard. A light coming from the subject is compared with this self-luminous body and by adjusting the shutter so as to cut out or allow for a greater proportion of incident light, a point is reached where both lights will match exactly, by means of a suitable scale, the correct exposure for any stop or speed of film or plate, etc., is easily determined without calculation. Before the light enters from the subject it passes thru the uncovered portion of the shutter opening, then thru a diffusing body and a color screen. This color screen may be a gelatin film, stained a bluish-green color and therefore only transmits light of the same color.

What To Invent

By JAY G. HOBSON

PRACTICALLY all modern player pianos have automatic tracking devices for the purpose of keeping the music rolls in proper alignment with the holes in the tracker-bar, which represents the eighty-



For Years Railroad Travelers, Especially Those Having to Make Journeys Between Cities Early in the Morning, Have Had to Go Without Anything to Eat Until the Dining Car Was Ready to Serve Breakfast. What a Boon It Would Be to Travelers If Some Progressive Railroad Manager Would See Fit to Have Developed and Installed, a Suitable Coin-in-the-Slot Sandwich Machine As Well As a Coffee Dispensing Device.

eight keys, the number on all standard pianos.

If the perforation in the paper music roll does not pass over the hole in the tracker-bar there can be no playing of music. The reason for this fact is, that player pianos are in reality another form of the vacuum cleaner, adopted to make the piano play. Therefore if the note hole in the music roll fails to effect a proper conjunction with the hole in the tracker-bar, the piano keys cannot operate because of insufficient vacuum and air pressure—hence no music.

There are several semi-successful tracking devices for player pianos on the market, but all have their faults, causing no little dissatisfaction and trouble in operation, by tearing the paper music rolls or causing discords in playing when the rolls are not tracking properly as required for good music.

In view of the present unsatisfactory tracking devices installed on player pianos, and because of the great need for a practical and simple improvement upon same, there now exists a splendid opportunity for the inventive public to exercise their ability of creation by perfecting a new design for this important purpose.

I would suggest that the reader procure catalogues of the different player mechanisms, which will explain the player action and automatic tracking device in detail. The present tracker construction is made to operate from the vacuum or suction that also produces the music in the player piano. But, the pneumatic tracker soon becomes clogged with dust and lint from the paper roll, thereby making it ineffective in keeping the roll properly aligned.

In my opinion, what is needed is a mechanical tracking device of simple construction, so arranged that it can be quickly attached by the average piano tuner, and made to operate from the mechanism that runs the music roll. If the problem is worked out along this line and solved, I am confident the invention will sell promptly to some large piano company who will gladly pay a good sum or royalty for the improvement.

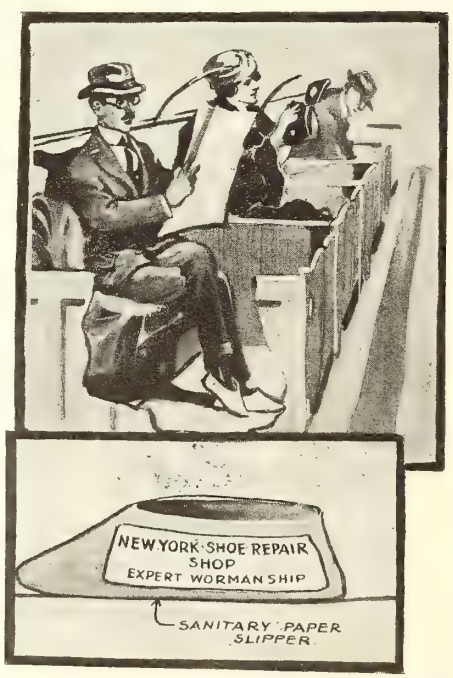
SANITARY FOOT WARMERS.

The other day I had an occasion to get myself shod in one of these up-to-date, "While-U-Wait" electric shoe repair joints, (And truly—many are only joints, being so small, and built in to make a patron feel out of joint to find a place to wait) where the head man grunts out his gruff interrogation of what is wanted; and when you tell him you are all run down at the heel—needing a new pair, he pushes you, (figuratively speaking) into one of his lame chairs with a remark:—"Put on theese hare slippers," or: "Jus use theese hare paper t'put yourn feet on!"

Dejectedly you slip on an old, dirty pair of carpet slippers about ten sizes too large for you; or else choose the other alternative of assuming an unconcerned air about sitting in your sock feet, secretly thinking everyone around you is looking at your big feet. But the horror of it all is the inner fear you contain, lest in your walking one of your suffocating toes has bitten a hole in your sock which now shows up like an automobile headlight during an eclipse.

Its pesky hard to maintain one's equipoise of appearance when finally you gather enough nerve to let your eyes fall floorward, and to your painful surprise find your fears exactly realized, making you wish your father had been of a darker hue.

But granting that all the above did not happen to you, the need still remains for improved and sanitary foot warmers. While I was waiting for my "heels" the idea came to me picturing individual paper slippers of average size, printed on either side with the advertisement of the repair shop, etc., paper



An Idea Which Has Often Appealed to the Author, Takes the Form of a Paper Slipper Carrying the Advertisement of a Shoe Repair Shop Like That Shown Above. This Paper Slipper Could Be Given to Each Customer After His Shoes Had Been Repaired, and He Can Use Them at Home for Some Time;—Thus Providing Excellent and Cheap Advertising.



A Simple Water-Purifying Filter, Modeled Somewhat After the Arrangement Here Illustrated, Should Prove Valuable As a Part of Equipment for Life-Boats and in Fact All Vessels Which Make Trips Out to Sea—the Filter After Proper Chemical Treatment of the Salt Water Giving Pure Drinking Water.

slippers that would certainly be comfortable and warm, as well as, splendid advertising for each shop, because their customers could take them home; they would serve in the place of the frequently misplaced, regular slippers.

SANDWICH SLOT MACHINE.

As I write these jiggles while slowly creeping on the S. & U. R. R. thru the "Tar Heel" state, my liver is having a heated argument with my stomach about the fuel supply. You see these family arguments happen with the best regulated livers and stomachs, when the question of "eats" is a point to be considered.

Whoever figures up the train schedules certainly has some enemy traveling, and takes this early means of revenge by setting the time of departure in the wee-sma-hours, when the first cock crows—or to be more exact somewhere around five A. M. Now, I am sure you will agree that no decent person likes to catch a train before the Sun gets out of bed; for when he does, it surely means an empty stomach and angry liver until the destination is reached.

Of course, if the "Slow & Uncomfortable R. R." provided us early birds with some movable means of obtaining coffee and rolls, even tho it be of the tin can variety, we could hold out and appear a little more peaceful when reaching our destination. However, and sad as it may be, such is not the case. NO, in this case the early bird doesn't get the worm. He gets the grouch instead. So as I sit here on the S. & U. R. R. this hungry morning, weaving our empty way among the fat and juicy morsels that we know these country folks are now enjoying, my mouth begins to water for some good, old fashioned ham and—with flapjacks for the finish.

(*Continued on page* 1342)

Scientific Humor

Like an Echo!—"Pa, why do they have repeating rifles?"

"I guess, son, to make every shot tell."

—William Tuman.

Couldn't "Bear" It.—Pulley: "Why did you get so hot-headed yesterday?"

Motor: "The oil ran out of my bearing."—*E. W. Vahle.*

The Origin of Brainstorms.—College Prof: "What is mind?"

Student: "No matter, sir."

College Prof.: "What is matter?"

Student: "Never mind, sir."

H. C. Bearden.

Heard in the Criminal Court.—House: "I've been framed by a bunch of low wood-butchers."

Street: "That's nothing; these crooked car tracks have double-crossed me."

—F. J. Schwab.



A Hint for Bores.—"Am I boring you?" said the auger to the plank.

"You are boring me to death," groaned the plank.

"I'm sorry," said the auger. "I'll soon be thru."—*F. J. Schwab.*

Depends What He Hits.—"Just think of it, Pat," said the auto salesman to his prospective purchaser, "this car will go sixty miles an hour."

"Foine!" said the Irishman. "And, now, how fast will it stop?"

—Dick Dickinson.

Eggsactly.—Tompkins: "Bently has received a million dollars for his patent egg-dating machine. It's absolutely interference proof, and dates correctly and indelibly as the egg is being laid."

Dewley: "Is the machine on the market yet?"

Tompkins: "Oh, my no! and it won't be either. The patent was bought by the Cold Storage Trust!"—*H. S. Johnson.*



+ And − Is O.—Student of Electricity: "Can anything be both positive and negative at the same time?"

Electrician: "Sure. When I proposed to my girl last night she gave me a negative answer which was very positive."

—Walter Luire McDonald.

A Black and White Artist.—"Well Rastus, I hear you are working again. What business are you engaged in now?"

"I'se done be in de mining business, sah."

"What kind of mining are you doing: gold, silver or diamond?"

"I'se doing calsomining, sah."

—Henry Sorenson.

But the Juice Ain't "Lower" There.—First Student of Electricity: "Why are the lights in lower New York brighter than those in the upper section?"

Second Student: "Because they are nearer the Battery, I guess."

—No Name.

FIRST PRIZE $3.00



Or Feeding "Hootch" to the Radiator!—Teacher: (in physiology class) "Who can tell me what is auto-intoxication?"

A pause—then little Johnny volunteers.

Teacher: "Yes, what is it, Johnny?"

Johnny: "Riding around in an auto till you're dizzy."—*Paul Abramson.*

Little Songs of Safety First.—

Lies slumbering here
One William Lake;
He heard the bell
But had no brake.
—Detroit News.

At fifty miles
Drove Ollie Pidd,
He thought he wouldn't
Skid, but did.
—Rome, (N. Y.) Times.

At ninety miles
Drove Edward Shawn;
The motor stopt.
But Ed kept on.
Little Falls, (N. Y.) Times.

We receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

This monument's
For Jackson Druck;
His Lizzie was lighter
Than the truck.
—Scrantonian.

Down in the creek
Sleeps Jerry Bass;
The bridge was narrow,
He tried to pass.
—Wilkes-Barre Times-Leader.

In peace here rests,
Poor Jerry Fitch
He put his hand
Upon the switch.

In state here lies
Old Archy Hale,
He put one foot,
On the third rail.

The Stomach Contains Indigestion.—The physiology instructor had asked Johnny to name the parts of the body and the organs contained therein.

Johnny answered, "The body consists of the head which contains the brains, if any, the chest, which contains the heart and lungs and the abdomen which contains the bowels which are A, E, I, O, U, and sometimes Y and W."

—Carl Wm. Timm.

No Wonder the Joke Editor Is Blue.—He: "Why does a black cow give white milk that makes yellow butter?"

She: "For the same reason that a blackberry is red when it is "green."

—Dwight L. Parham.

(We heard always that the white cow gave milk and the brown cow gave coffee.—*Printer's Devil.*)

Wasted Science.—Jim: "I see a certain doctor has cured insanity by pulling out infected teeth."



Jam: "It won't do any good; they'll go crazy again when they see the bill."

—Victor C. Heubner.

Heard in Biology.—Teacher: "Johnny, can you tell me what a tissue is?"

Johnny: "Sure, a tissue is a collection of cells, all of which are similar."

Teacher: "Correct. Now give me an example."

Johnny: "The Penitentiary."

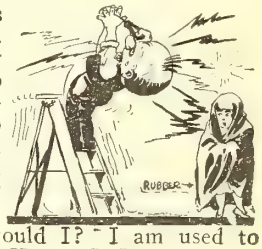
—Chas. E. Harrison.

Scientific Facts.—Sound travels 400 yards per second, but there are some exceptions to the rule.

Scandal—2,000 yards per second.
Flattery—1,500 yards per second.
Truth—2½ yards per second.

—Melvin Greene.

He Was "Charged" Too.—He: (screwing electric fixture to the ceiling) "Better not stand so close Mary, you might be shocked if this thing slips."



Her: "Why would I? I am used to your language."—*Henry S. Johnson.*

Squaring the "Circle."—She: "What shape is a kiss?"

He: "Give me one and we will call it square."—*Albert E. Snyder.*

A Good "Find."—He: "They are a wise couple."

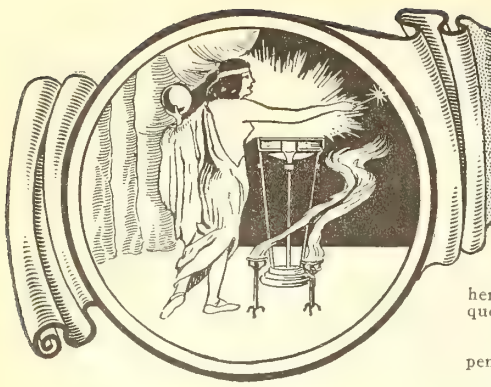
She: "Why?"

He: "They feed their baby garlic so they can find it in the dark."

—Evarest Ryan.

We'll Be Switched.—Trans: "Nellie's hair used to be light, but now it's dark."

Former: "Perhaps she turned off the switch."—*Earl. A. Keiser.*



THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.

2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.

3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.

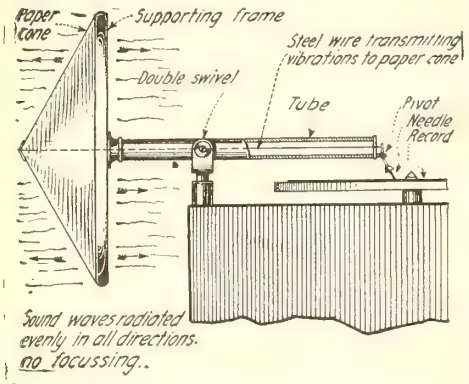
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Hornless Phonograph

(1086) Oscar W. Hartung, Detroit, Mich., asks:

Q. 1. How does the Pathé *Actuelle* phonograph operate?

A. 1. Relative to the two articles "Building Your Own Phonograph" which appeared in the September and October issues of this journal, it would probably be a welcome idea, as you suggest, to publish the details of the Pathé *Actuelle* hornless phonograph, but we have to state that it would hardly be compatible with ethical principles to publish details of a specific machine of this new type.



The Diagram Above Shows the Principal Features of the Hornless Phonograph In Which a Paper Diafram, Taking the Shape of a Cone, Vibrates So As to Radiate Sound Waves In All Directions with Equal Intensity. This Eliminates the Undesirable Focusing Effect of the Usual Phonograph Horn or Sound Chamber.

The details which we did publish were practically all based on common knowledge of phonographs, and we did not feel that we were giving away any great trade secrets in explaining the details there given. The *Actuelle* or hornless phonograph, like all simple things, must be built carefully and very exactly to obtain anything like satisfactory results. The diagram herewith shows its general make-up. The paper cone is a good piece of parchment paper stretched or supported in such a manner as to form a rigid cone, and the center of this cone is attached by a stiff metal wire to the stylus at the inner end of the moving arm supporting the cone.

The secret of the *Actuelle* lies in the fact that the paper cone or diafram vibrates in a particularly free manner, and this causes sound waves to be set up practically all around and thus eliminates the disagreeable focusing effect due to the usual horn—which produces sounds only in one direction, *i. e.*, from inside the horn and outward. Thus it is that with the *Actuelle* a person hears the sound equally well in any part of the room and not in a certain corner of the room as is the case with practically all other machines having a horn-shaped amplifying chamber.

Motor-Bus Versus the Trolley

(1087) H. P. P., L.——, Canada, writes the Oracle:

Q. 1. I am writing you to learn if you can put me in touch with places where I can get information in regard to the comparative cost of operating electric railway and motor-buses.

Some business men are of the opinion that the motor-bus cannot compete in a city which has only a population of about 70,000.

A. 1. We would refer you to an article by Mr. L. H. Rosenberg, an engineer of the General Electric Co., which appeared in our May, 1920, issue. In this article are discust some of the merits and demerits of the one-man trolley and their relation to the motor-bus.

To our mind, and providing your city board were faced with the consideration of building a new electric railway, then by all means it would seem the most economical to purchase the necessary number of motor-buses and establish a regular and specific operating schedule, etc. Of course, it is a question not so easily answered, when it comes to the consideration of substituting motor-buses for an already established electric railway.

It would seem to the editor of this column that one of the important factors bearing on this particular matter would be whether or not the electrical energy for operating the present railway is derived from coal or from a hydro-electric system. As you undoubtedly know, the gross efficiency obtainable from small or medium size steam-driven electric power plants is very low, and does not usually rise above 7 to 8 per cent.; while if the electrical energy required is secured from a hydro-electric system, particularly if it is owned by the operating company, this may show a gross efficiency as high as 40 to 50 per cent.

Finally, we would suggest that you write to the American Institute of Electrical Engineers, 29 W. 39th St., New York City, N. Y., and to the American Railway Engineering Institute, 431 Dearborn St., Chicago, Ill., who may have in their files copies of papers presented before these respective bodies that you can procure.

The railless trolley, an omnibus taking power from an overhead wire, has been used more in Europe than in America, and is worthy of careful consideration. There is a very great saving in capitalization, but the passenger-carrying capacity is more limited than in the case of a regular electric railway.

We described and illustrated the railless trolley in our issue of July, 1916, to which we refer you.

Electric Motorcycles

(1088) Fred Post, Auburn, Ill., asks the Oracle:

Q. 1. In the article by Mr. Secor in the January issue, on building a small automobile, it is stated that the electric type requires 300 to 600 amperes. At this rate and figuring on 15 amperes per battery, 25 starting type batteries would be required weighing 1,500 pounds, and costing about $750. Is this right?

A. 1. Concerning the number of storage batteries required for operating the small automobile as outlined in the article in the January number of SCIENCE AND INVENTION, would say that the figures you give are right, but in actual practice those who have built electric motorcycles have done either of two things, it seems:

1. They operate the batteries at a higher discharge rate and use a smaller number of them than that theoretically required, or;

2. They do not operate the motor with the full load current required, or in other words, the motor is operated at a lower horse-power output.

There is a photograph and description of an electric storage battery motorcycle in the February number.

Water Motor Query

(1089) Roy E. Dukette, Hoboken, N. J., asks:

Q. 1. Several queries about water motors.

A. 1. Small water motors can be procured from several manufacturers of these devices.

With a ¼-inch pipe and 25 pounds pressure, we do not believe that you can develop much over 1/6 to 1/5 horse-power, altho if you can procure a very efficient turbine, you might develop as much as ¼ horse-power.

Operating 32 Volt Lamps on 110 Volt A. C.

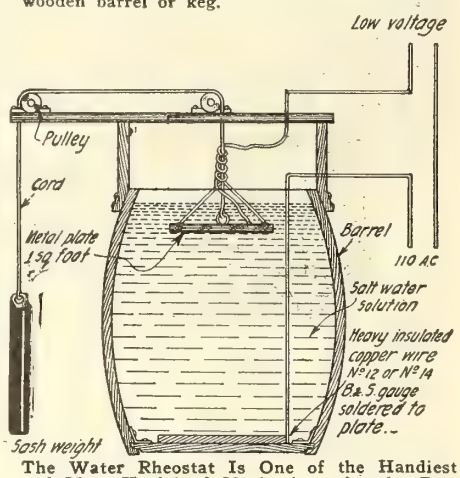
(1090) R. M. Ayers, Detroit, Mich., writes:

Q. 1. What is the simplest way to operate 32 volt lamps from 110 volt A. C. mains?

A. 1. In reply to your query asking for the easiest way to reduce 110 volts A. C. to 32 volts, for operating lamps rated at this potential, we would advise as follows:

The usual method of doing this and the one in commercial use for operating the lamps at 32 volts from a 110 volt circuit is by means of a step-down transformer. Four lamps might also be burned in series on 110 volts.

You did not state in your letter how many watts you will need. But as you mentioned therein that your particular requirements are of an experimental nature, we would suggest that you reduce the voltage in the same way as that followed in shop and field work, by means of a water rheostat. A diagram is given below showing a water rheostat made from a small wooden barrel or keg.



The Water Rheostat Is One of the Handiest and Most Useful of Mechanisms for the Purpose of Controlling the Amount of Current Supplied to Any Certain Piece of Electrical Apparatus. A Very Serviceable One May be Made from a Barrel, the Larger the Barrel the Greater the Current Capacity, and Vice Versa.

Of course the rheostat will have to be proportional in size to the amount of energy or watts you require. With a saturated salt water solution in a beer keg and using iron or other plates in the solution having about one square foot area each, you can take care of 500 to 600 watts, and somewhat more than this for shorter periods.

How Many Miles of Wollaston Wire per Cu. In. Platinum

(1091) William A. Romans, Baltimore, Md., asks:

Q. 1. Several questions as to the ductility of platinum wire.

A. 1. Regarding the ductility of platinum, we have calculated the length to which this wire can be drawn.

The very common form of Wollaston wire is that used in ordinary delicate electrical instruments which has a thickness of .0004 inch. The cross-sectional area of this wire is .000,000,125,664 sq. in. by the formula, area is equal to $\frac{\pi d^2}{4}$ dividing this into 1 square inch we obtain the figure 7,957,730. In other words, there will be exactly 7,957,730 inches of wire in 1 cubic inch of platinum.

This will give us 663,144 feet or 125.6 miles of wire obtainable from 1 cubic inch of platinum. Inasmuch as 1 cubic inch of platinum weighs .7758 pounds, we obtain a figure of 162 miles for one pound of wire. This wire is however, not the finest platinum wire obtainable. We have on record, wire whose diameter is .00004 inch. This will mean that a wire of the above thickness could be drawn out just 100 times as long as the first mentioned wire or 16,200 miles.

This light wire is by no means the smallest wire obtainable; it is a commercial product and can be obtained on the market.

Was $100 Before the War

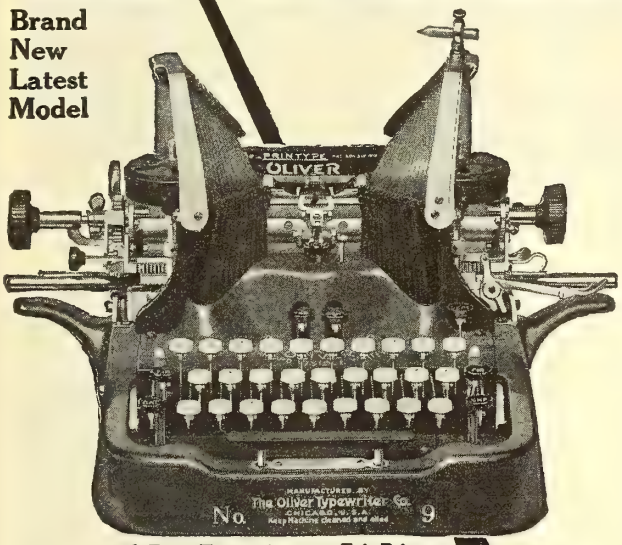
Now $64

SAVE $36

Buy Direct From The Factory

Try the Oliver for Five Days at Our Expense

Brand New Latest Model



A Finer Typewriter at a Fair Price

Only $4.00 Per Month

Do not buy or rent any typewriter until you know the Oliver. A five days' trial will help you decide. Besides saving you $36, we make the payments easy. We ask no advance payment. But merely $4 per month until the $64 is paid.

Do not confuse this offer with those for second-hand or rebuilt typewriters. Our $64 Oliver is our brand new identical Model 9, formerly priced at $100. It has not been changed in the slightest.

Over 900,000 Sold

Olivers are in use all over the world. Some of the large concerns in the United States using Olivers are: U. S. Steel Corporation, Nat'l City Bank of N. Y., Diamond Match Company, Pennsylvania Railroad, Hart, Schaffner & Marx, American Bridge Company, Encyclopedia Britannica, Otis Elevator Company, Bethlehem Steel Company, Boston Elevated Railway, N. Y. Edison Company, and a host of others of equal importance.

And thousands of Olivers are used by individuals—every business is represented among our users. And every profession.

You can depend on this wide use of the Oliver as a guarantee of its worth.

No Finer Built

Examine the Oliver carefully. It is built in a model factory with a heritage of ideals. Only the finest materials are used. And this accounts for the prolonged life of the Oliver, its durability, its inbuilt service. It is simplified in construction and built to withstand the hardest usage. The Oliver in war service proved its fine design and construction.

You can't buy a better typewriter at any price.

Mail the coupon now, for either a Free Trial Oliver or further information.

This Simple Plan Makes It Easy to Own an Oliver

This sales plan is a legacy of the war, which taught us all new economies—ones we won't forget.

By reorganizing our method of distribution, we were able to make a radical reduction in price.

We did not change the famous Oliver an iota. The machine we now sell for $64 is the identical one formerly priced at $100—our latest and best model.

During the war we learned that it was unnecessary to have great numbers of traveling salesmen and numerous, expensive branch houses throughout the country. We were also able to discontinue many other superfluous, costly sales methods. You benefit by these savings.

Pre-war extravagances were ended. And our plan of selling made simpler. We send the Oliver to you for free trial, so that you may judge it, in solitude, without being influenced.

Send No Money

Merely send us the coupon. We ship an Oliver to you. Try it for five days. Then if you agree that it is the finest typewriter at any price, merely send us $4 per month, until the $64 is paid.

If you do not believe that this is the greatest typewriter opportunity, return the Oliver to us, express collect. We even refund the outgoing transportation charges. You have not placed yourself under any obligation to buy.

When the Oliver comes to you, you will admire its many advancements—all the refinements made possible during 24 years of typewriter-making. A finer typewriter is impossible. The coupon below gives you the opportunity to be your own salesman and save yourself $36.

Note that it brings EITHER an Oliver for Free Trial, or further information. Check it accordingly.

Canadian Price, $82

The OLIVER Typewriter Company

674 Oliver Typewriter Building, Chicago, Illinois

THE OLIVER TYPEWRITER COMPANY,
674 Oliver Typewriter Building, Chicago, Illinois

☐ Ship me a new Oliver Nine for five days' free inspection. If I keep it, I will pay $64 at the rate of $4 per month. The title to remain in you until fully paid for.

My shipping point is.....

This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name .....

Street Address.....

City..... State.....

Occupation or Business.....

Auto Owners WANTED!



To introduce the best automobile tires in the world. Made under our new and exclusive Internal Hydraulic Expansion Process that eliminates **Blow-Out—Stone-Bruise—Rim Cut** and enables us to sell our tires under a

10,000 MILE GUARANTEE

We want **an agent** in every community to use and introduce these wonderful tires at our astonishingly low prices to all motor car owners.

FREE TIRES for YOUR OWN CAR

to a representative in each community. Write for booklet fully describing this new process and explaining our amazing introductory offer to owner agents.

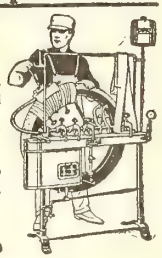
Hydro-United Tire Co.
DEPT. 217 PHILADELPHIA, PA.

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2203 Fourth St. Waupun, Wisconsin

MEN WANTED



Mechanically Inclined—to send for my big illustrated 72-PAGE BOOK—**FREE!**

It tells how in a few weeks you can earn from $150 to $400 a month in the **Auto** and **Tractor** business. ***Be Your Own Boss.*** At small cost learn to be an expert mechanic by the **Sweeney System** of working on real cars. ***Use tools not books.*** Simply send your name and address today, a post card will do, for our **Free** book and 27 photographic reproductions of machine shop work, etc. **Let's Go---Write Now!**

EMORY J. SWEENEY, President

LEARN A TRADE—
Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
138 SWEENEY BLDG. KANSAS CITY, MO



$100 A WEEK AND MORE FOR YOU!

Chas. Evans, carpenter, of Ind., earned $100 weekly last year. Gibbard of Mich. did $60,000 business in 1920. Others had sensational records. All did it with **Haywood's Tire Surgery.** Twelve years ago I began with $1000 and new tire repair idea. Now own $400,000 business. I've started hundreds of men from all walks of life — without experience — with very little capital—on same road to financial success. Let me start YOU. Write today. M. Haywood, Pres.

HAYWOOD TIRE & EQUIPMENT CO.
1209 Capitol Avenue Indianapolis, Indiana

How Big Are Molecules?

By ROGERS D. RUSK, M.A.

(*Continued from page 1286*)

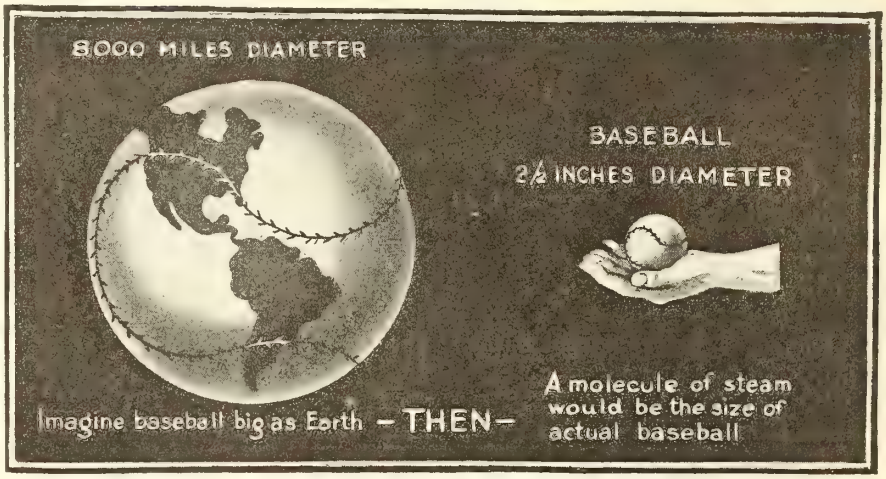
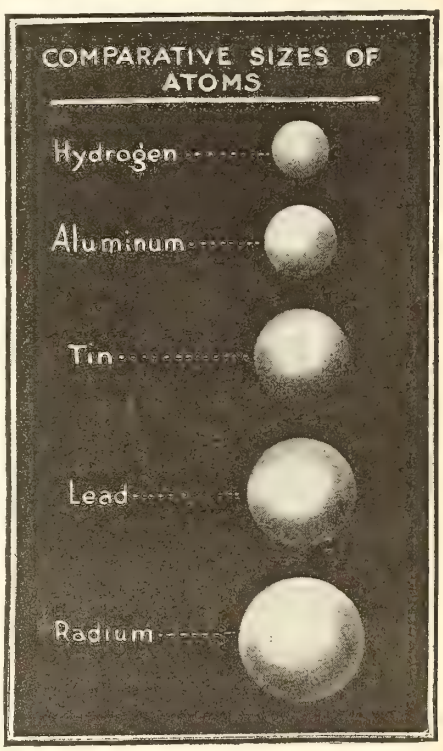


Fig. 4. The Illustration Above Shows That if a Baseball and a Molecule of Steam Were Magnified Until the Baseball Was as Large as the Earth, Then the Molecule of Steam Would Be About as Large as the Baseball Was. Fig. 1 Below Shows Comparative Size of Atoms.

Prof. Millikan, the American investigator, in his wonderful laboratory at the University of Chicago, has carefully measured and determined the electrical charge of the electron under very elaborate laboratory conditions.

An article describing how the electron was measured and even weighed, appeared some time ago in this journal, and those interested in the electron theory and the precise mathematical measurements of this basic quantity of matter, according to the present-day hypothesis, will find Prof. Millikan's book entitled "The Electron" extremely interesting and valuable.

The illustration at Fig. 5, brings out in a clear manner, the extremely small mass of the electron of which the human body and all other matter is now supposedly constructed. Imagine a powerful ray of light focust on to a spot on the man's chest down to a point no larger than the head of a pin, and that in turn, the reflected light ray is magnified or enlarged to the size of the earth, or a circle 8,000 miles in diameter. The whirling electrons would only then be visible as shown to the left of the illustration, Fig. 5. The continents of North and South America are superimposed on the illustration at the left of Fig. 5, to emphasize the idea that this enlarged view of the area the size of a pin-head, on the man's body, is of the same size as the earth or 8,000 miles in diameter.



Blasting Pole Holes

By E. H. Dana, Missouri.

I had an opportunity, late last fall, to try a new method of digging pole holes for the Cairo Light & Power Co., of Cairo, Mo.

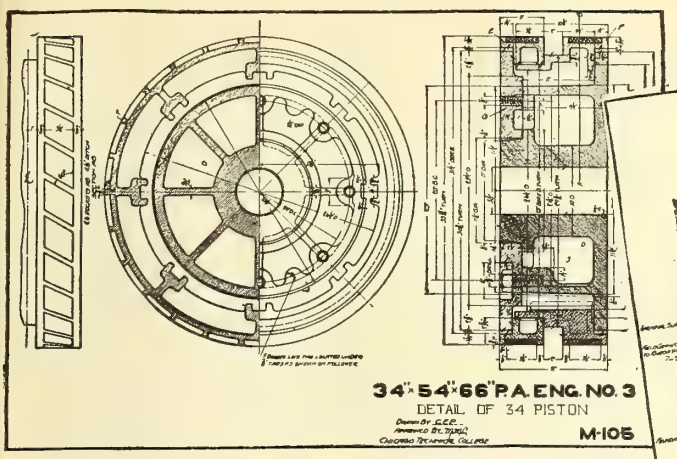
There were 155 holes needed, 20 in hard rock, the balance in clay soil. The holes were wanted in a hurry and labor was scarce. I have seen the use of dynamite advocated for this purpose and had read a description of the proper way to do it.

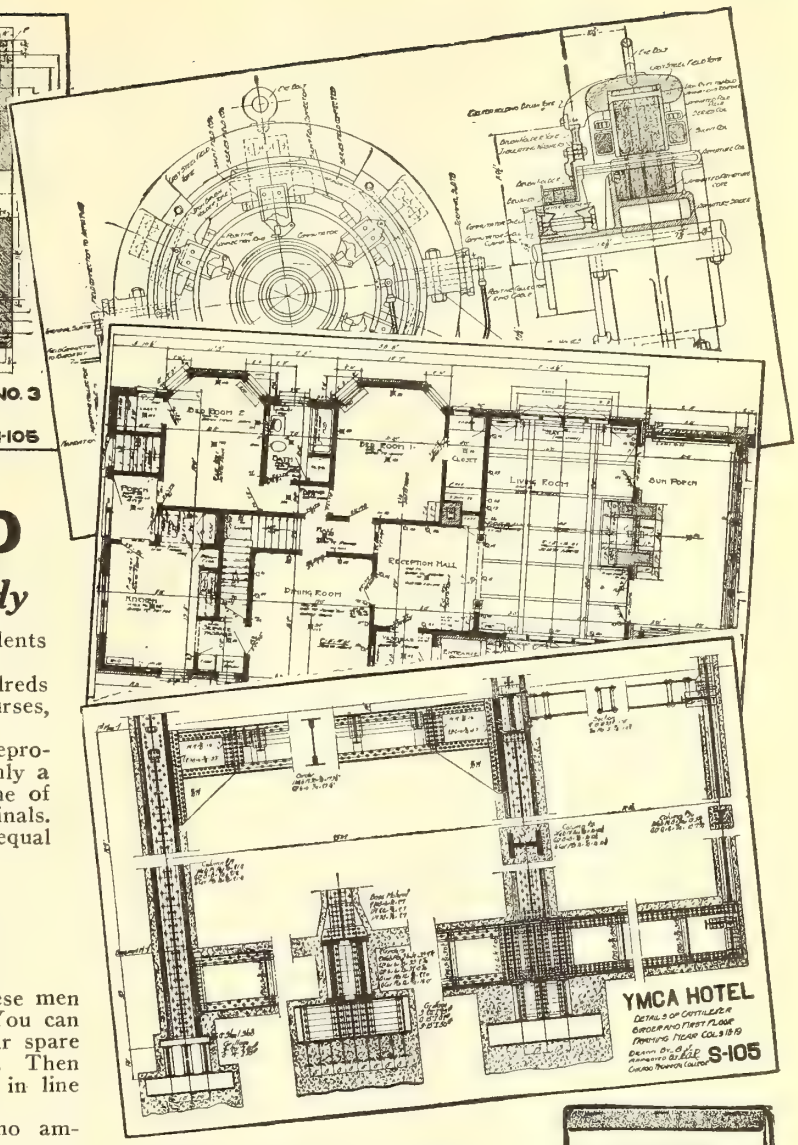
Bore holes were put down to a depth of five feet. Two cartridges of 40% dynamite were cut in halves. The four half sticks were tied to a thin strip of wood spaced about six inches apart. A cap and fuse were inserted in the top piece of dynamite. The holes were not tampt, as we desired a hole of only large enough diameter to take the pole. The less the surrounding soil was disturbed and broken up, the better.

The shots made a clean, well shaped hole, just right for planting a pole.

The work consumed thirty hours' time. The total cost for labor and explosives was $80, or a trifle over 50 cents per hole. The engineer in charge was entirely satisfied with this cost.

Of course, the method described applies only to the holes in clay. The holes in the rock were blasted in a way well understood by engineers, so will not be described here. However, the rock work added materially to the labor cost of the job. Had all the holes been in earth the expense would have been somewhat less.





Draftsmanship

Become an Expert by Home Study

The illustrations show the work of some of the students of Chicago Technical College.

These drawings were picked at random from hundreds equally good made by men who, before taking the courses, had had no training as draftsmen.

Naturally the large reduction made necessary to reproduce the drawings in the space of this page gives only a partial idea of the high excellence of the work—some of the lines losing the strength they show in the originals. But even so, it will be seen that these drawings are equal in merit to the work of men of long experience.

Make Yourself Worth $60 to $150 a Week

You, too, can master draftsmanship as easily as these men did under the Chicago "Tech" method of training. You can soon become proficient simply by giving some of your spare time to home study under the direction of our experts. Then you will be ready to step into a paying job and be in line for promotion to important managing positions.

Draftsmanship today offers opportunities which no ambitious man should overlook. American industries are constantly looking for experts—and none are more eagerly sought than the draftsman.

No need for you to settle down in any humdrum occupation or to accept an outlook without promise of large success when great manufacturing organizations, railroads, architects—all classes of concerns engaged in technical work—are searching everywhere for trained men. At least look into this profession today.

Train Under Practical Men

From the day you enroll with Chicago "Tech" you are under the direction of practical engineers who teach you thoroughly the methods which they use in their own work and which you will use when you practice the profession yourself. Lessons, exercises and special texts deal with conditions as they exist, so when you graduate you are perfectly familiar with the actual work of the drafting room.

You are carefully instructed on every point, taken upward step by step, everything being made so clear that your advancement is sure and constant. No time is put in on unnecessary studies—you concentrate on the work that will make your services in demand.

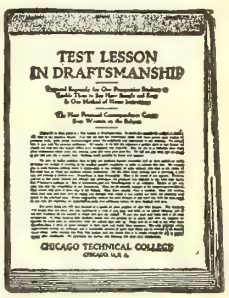
You get the same instruction by mail that you would get if you came to Chicago to attend the College. Therefore if now employed you can hold your present position until you are ready to enter the field of expert Draftsmanship.

Moderate Fees, Easy Terms

Chicago "Tech" offers this practical instruction at a price and on terms which place any of the courses within the reach even of the man of moderate means. And payment can be made on easy monthly terms. No man who wants such training can give himself an excuse for not grasping the opportunity now.

CHICAGO TECHNICAL COLLEGE
445 Chicago "Tech" Bldg. CHICAGO, ILL.

FREE TEST LESSON



This free test lesson will show you how well qualified you are for Draftsmanship and how practical the Chicago "Tech" courses are. While other schools ask you to enroll and send money first, we send the free lesson first. The only offer of its kind. Read the lesson, practice the exercises and then decide for yourself whether to take the course or not. No obligation on you for asking for this.

Drawing Outfit—No Extra Charge

FREE outfit is included with our Home Study Course or credit given if you already have an outfit. These are high grade instruments, drawing board, T square, etc.—same as used by leading draftsmen.

Other Chicago "Tech" Courses

Chicago "Tech" opens the field of specialized training not only in Draftsmanship but in other paying lines also. If you want information on any of these, mark the coupon with X to show which subject interests you and full information will come by return mail.

SEND THE COUPON

No obligation upon you is implied when you ask for the facts about Chicago "Tech" instruction. We gladly send catalogs and information telling you about the opportunities offered in any line of work we teach. Then you can decide what the field offers for you. Big jobs are waiting now for men like you—WITH TRAINING. Send the coupon—today.

CHICAGO TECHNICAL COLLEGE, 445 Chicago "Tech" Bldg., Chicago, Ill.

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below:

[ ] Architectural Drafting	[ ] Auto. Engineering
[ ] Machine Drafting	[ ] Aero. Engineering
[ ] Electrical Drafting	[ ] Gas Engines
[ ] Structural Drafting	[ ] Plan Reading—Buildings
[ ] Sheet Metal Drafting	[ ] Estimating—Buildings
[ ] Topographic Drafting	[ ] Plan Reading—Machinery
[ ] Surveying	[ ] Plumbing—Estimating
[ ] Designing	[ ] Heating and Ventilating
[ ] Contracting—Buildings	[ ] Steam Engineering

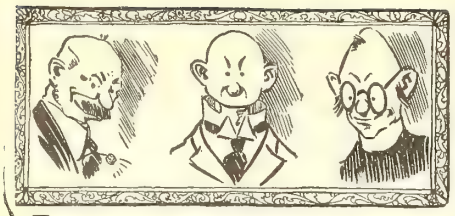
Name.....

Address.....

Post Office..... State.....

Free Trial Lesson included when inquiry is for Draftsmanship or Plan Reading.

College or Home Study, state which.....



Learn to Draw at Home

Illustrators, Cartoonists, Commercial Artists earn big money. $25 to $100 a week and more. Learn at home in spare time under personal direction of Will H. Chandlee, famous newspaper, magazine, advertising artist of 35 years' successful experience.

BE AN ARTIST

Delightful, fascinating profession. Wonderful new home-study method makes drawing easy! Send coupon or postal today for special offer of complete Artist's Outfit FREE to new students. Write for handsome book, "How to Become an Artist." Don't delay—write or send coupon at once. Address

Washington School of Art, Inc.
Room 1612 Marden Bldg., Washington, D. C.

FREE COUPON

Washington School of Art, Inc.
Room 1612 Marden Bldg., Washington, D. C.

Send me particulars of FREE ARTIST'S OUTFIT offer and Free Book, "How to Become an Artist."

Name .....
(State whether Mr., Miss or Mrs.)
Address .....
City ..... State .....

Here's a Tool You've Waited For

HAN-D Hammer

Four Tools in One

Send No Money

Send only your name and address—no money—and we will send you this clever handy, practical tool. It's the real tool of a thousand uses and at a price far below what it would ordinarily sell for. No automobile kit should be without it—it should be in every home—every workshop—every garage—every farm—every office. Every part of the tool is fully guaranteed. The three screw-drivers nested in the hammer handle are of high grade tool steel and all parts are nickel-plated and highly polished.

$1.79 and postage **ON ARRIVAL**

For Garage, Shop, Home and Office

The HAN-D HAMMER is 7½ inches long and weighs but 10 ounces. It is a tool for long and reliable service. We are so sure that you will be more than satisfied with it that we send it to you without one single penny in advance.

Order NOW!

The Handiest, Most Useful Tool Ever Invented

Remember—don't send one penny with your order. Just your name and address on a post card and we will send you this wonderful HAN-D HAMMER. All you need do is pay postman the specially low price of $1.79, and postage, on arrival at your door.

Order Now Don't delay in puttingthis most useful of all tools to work for you. Send your name and address today. Don't pay one cent until delivered. You take no risk—satisfaction guaranteed or money back.

MOTORIST SHOP
21 W. Jackson Blvd. Dept. 210, Chicago, Ill.

You Can KNOW

all about AUTOS, TRACTORS, AEROPLANES, STARTING and LIGHTING SYSTEMS, STORAGE BATTERIES, VULCANIZING, etc.

Valuable Book FREE

"How to Succeed in the Automobile, Tractor and Aeroplane Business," gives much new and very useful information; also tells all about the many splendid advantages and practical training you can get at this college in a few weeks. Tear this out and write for a copy, FREE, today.

GREER COLLEGE OF AUTOMOTIVE ENGINEERING
Dept. 124 1519 S. Wabash Ave.
CHICAGO

Recent Work of the Bureau of Standards

(*Continued from page* 1305)

avoid absorption of gases and in special refractories. The latter treatment guards against solution by the molten iron of small amounts of impurities which occur when the former comes in contact with any ordinary refractory materials. With vacuum fused electrolytic iron as a starting point alloys have been prepared containing the elements commonly present in steel. Mechanical, thermal, microscopic and magnetic tests on these alloys reflect the relation between these properties of steels and its chemical composition.

NEW TEMPERATURE CHANGE THEORY OF CRYSTALLINE QUARTZ.

Strange enough, it would seem, that the Sugar Section of the United States Bureau of Standards, engaged as it is in the study of sugars, both common and rare, should stumble upon a new theory relating to the properties of quartz. The latter, however, is employed extensively in the construction of polarimeters, a device common to the sugar industry, and while analyzing the natural rotation of light by crystalline quartz the research led to other fields of science.

At a temperature of 573 degrees Centigrade crystalline quartz changes into another crystal, with a transformation of energy during the process. Here a scientist of the government, by employing special equipment consisting of a large electromagnet for studying the effect of magnetism upon light evolved the theory that the temperature at which the transformation starts when the crystal is being heated is sharply defined; namely, that of 573°.3 C. The change of energy at this temperature seems to be more clearly marked and more easily determined than that utilized in revealing the ordinary points on the high-temperature scale. A thermocouple close to but not in actual contact with the specimen of quartz will register this point with fine precision. Preferably, the thermocouple should be inserted in a small opening in the crystal, which method standardizes it at a fixed and accurately known temperature.

A study of quartz assembled from widely distributed areas of the United States reveals cumulative evidence that this phenomenon is characteristic of all crystalline quartz. According to the Bureau of Standards, the temperature of 573°.3 C. is a fortunate one inasmuch as there has been heretofore no known method of conveniently calibrating temperature-measuring devices in this region. As the temperature of a crystal of quartz approaches 573° Centigrade a change is exerted in all the physical properties of the substance. The change is particularly abrupt in the optical properties. When light, vibrating in a single plane, penetrates the specimen, the rotation of the plane of vibration which usually occurs in quartz is found to suffer a jarring change as the temperature of 573° is neared. The magnitude of the transformation is, of course, influenced by the wave length or color of light employed. The measurements of polarimeters, as negotiated by the Bureau of Standards, is said to be the first precision determinations ever made at high temperatures.

(*Continued on page* 1328)

Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page* 1295)

of photography as many novas have been discovered in the past thirty years as have been recorded through all the centuries that elapsed up to that time. A nova a year is about the rate at which they are now being discovered, and how brief a period is a year in the life of a stellar system!

Instead of suns and solar systems evolved from nebulae we are now more familiar with the idea of nebulae evolved from stars through some terrific cataclysm.

It is now known that there exists in certain parts of space a number of sharply-defined stars surrounded by extensive nebulous envelopes. Are these suns that are going thru the process of forming their planetary systems?

The fact is now recognized that pressure of light and electrical repulsion are forces to be reckoned with in the evolution of stars and nebulae as well as gravitational contraction. It has long been felt that the peculiar formations existing among the extended gaseous nebulae could not be explained as gravitational effects alone.

Light-pressure and *electrical repulsion*, as well as *gravitation* are at work within the solar system and the sun is the seat of powerful disturbances which produce periodic outbursts of exceptional activity and which may have produced in the distant past more startling effects than any with which we are familiar at present.

The earth and moon form a system that is in a way unique. No satellite in the solar system is so large in proportion to its primary as is our own moon. Seen from the distance of Venus or Mars, the two bodies would apparently form a *double star*. The diameter of the moon is one-fourth that of the earth. Satellite III of Jupiter far exceeds our own moon in actual size but its diameter is only about four-hundredths of the diameter of the planet its orbit encircles. The diameter of Titan the largest satellite of the Saturnian system, bears the same ratio to the diameter of Saturn. Moreover, all the nearer satellites of Jupiter and Saturn lie nearly in the equatorial planes of these planets, but the orbit of the moon is inclined at a high angle to the plane of the earth's equator.

It is not difficult to believe that the satellites of Jupiter or Saturn were at some time thrown off from the equatorial belts of their primaries, just as the planets themselves may have been ejected from the equatorial belt of the sun, but we cannot so readily believe that our own satellite was formed from the earth in a similar manner.

The moon's orbit lies nearly in the plane of the *sun's* equator however, and it is conceivable that both earth and moon were *simultaneously ejected* from the equatorial zone of the sun, the two nuclei being so close together that the smaller one remained under the gravitational control of the larger.

The difficulties in the way of believing that the moon once formed a part of the earth are very great. It has been shown mathematically that if the two bodies at one time formed a single mass it would have been impossible for the moon to break away from the earth, unless the force that caused the separation were sufficient to hurl the moon to a greater distance than two and a half times the earth's radius. Roche found out by computation that a satellite could not remain intact within this distance (2.44 radii, to be exact) of its primary, but could be broken up into small fragments

(*Continued on page* 1356)

NOTICE TO ELECTRICAL MEN

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Type Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information Regarding Wire Used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

The book, called the "Burgess Blue Book," is published and sold by the Burgess Company for one dollar ($1.00) per copy, postpaid. If you wish one of the books, send me your order with a dollar bill, check or money order. I know the value of the book and can guarantee its satisfaction to you by returning your money if you decide not to keep it after having had it for five days.

Yorke Burgess, Pres. **THE BURGESS CO.** 750 East 42nd St., Chicago, Illinois

Consulting Electrical Engineering. Power Plants, R. R. Signals, Electric Railroads, Industrial Problems a Specialty. Information furnished on electrical subjects. Inventions perfected.

$90 TO $125 EARNED PER WEEK by Burgess-Trained Men

MY POLICY

My policy is TRUTHFULNESS in advertising and to give an HONEST and RELIABLE SERVICE. I offer NO FREE INDUCEMENTS but I promise to give you INSTRUCTION, HELP and ADVICE, the kind that is helping hundreds of men and boys to succeed.

YORKE BURGESS, Supt.
Burgess Electrical School

Burgess-Trained Men are not only getting $90.00 to $125.00 per week, but they are earning it. We do NOT promise you will do it, because a good bit depends upon you alone, but the opportunity is there and it is up to you to make the best of it. Burgess Service is so planned that it fits the needs of anyone desiring to succeed in electricity—whether he is a beginner or an experienced man. It gives you the benefit of a lifetime of practical electrical experience.

Send for the Burgess Catalog for complete information.

ELECTRICITY TAUGHT BY A PRACTICAL MAN

A FAIR AND SQUARE STATEMENT

I have been training ambitious men, both young and old, in practical electricity for a number of years by my Home Instruction Method, and would like to send you my catalog, which tells exactly what I do and **HOW I DO IT.** It also tells why, when and where my students succeed and **HOW THEY DO IT.** The catalog costs you nothing—it obligates you in no way whatever, but, for your own good, send for it, as it contains things you should know.

YORKE BURGESS, Supt.

BURGESS ELECTRICAL SCHOOL
Dept. F. 745 East 42nd St., Chicago, Ill.

A Practical Home Study Course

INSTRUCTION
The instruction is no cut and dried book plan, but is actually prepared with a view of fitting the individual. In this way one who is slow has the same advantage as others.

COMPLETE ELECTRICAL OUTFIT
Including Apparatus, Tools and Material, is supplied with the course without extra charge.

ELECTRICAL DRAFTING
This is a part of the regular work and certain drafting implements and materials are furnished students without any additional charge.

ELECTRICAL SLIDE RULE
I have written 30 lessons on this subject which are now included as part of the regular course in addition to the lessons on Electricity and Drafting. I am also supplying a Slide Rule and leather case to each student without charge.

Send Coupon For Catalog and Full Information

YORKE BURGESS, Supt.
Burgess Electrical School, Dept. F, 745 East 42nd Street, Chicago, Illinois.

DEAR SIR:—
Please send me your catalog, which explains your Home Instruction Course and the Burgess Service Method.

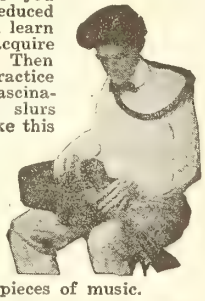
Name .....

Address .....

Play the Hawaiian Guitar

Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs and other effects that make this instrument so delightful. The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Your tuition fee includes a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 complete lessons and pieces of music.



Special arrangements for lessons if you have your own guitar.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK

I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc., etc.

Name .....
Address .....
Town..... State.....E. E.
Write Name and Address Clearly



A Valuable Book FREE BRINGS BIG PAY

Do you want to increase your income by home study in your spare time? Our new catalog of **home self-helps** will show you how. No matter what your line of work, you will find in our FREE CATALOG of self-help books many valuable suggestions as to how you can **easily** increase your income. Especially valuable to all interested in **Electricity, the Automobile, Machine Shop, Carpentry, Painting, Farm Mechanics and Machinery, Gas and Steam Engineering, Railroading or Modern Languages.**

Sent ABSOLUTELY FREE. A postal will bring it. Send for your copy now.

Frederick J. Drake & Co.
1009 Michigan Ave. Chicago

Free Book
Containing complete story of the origin and history of that wonderful instrument—the

SAXOPHONE

Easy to Play
Easy to Pay

(4)



This book tells you when to use Saxophone—singly, in quartettes, in sextettes, or in regular band; how to transpose cello parts in orchestra and many other things you would like to know.

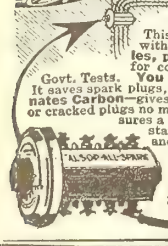
You can learn to play the scale in one hour's practice, and soon be playing popular airs. You can double your income, your pleasure, and your popularity. **Easy to pay by our easy payment plan.**

MAKES AN IDEAL PRESENT

Send for free Saxophone book and catalog of everything in True-Tone band and orchestra instruments.

BUESCHER BAND INSTRUMENT CO.
604 Buescher Block, Elkhart, Ind.

THE ALSOP-ALL-SPARK

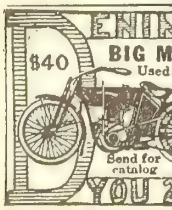


BEST BY GOVERNMENT TESTS

This simple little device does away with **Spark Plug and Carbon Troubles,** pays its owner big dividends. Ask for copy of report showing severe U. S. Govt. Tests. **You Cannot Afford to Be Without It.** It saves spark plugs, gasoline battery and starter—**Eliminates Carbon**—gives your car greater power—will fire old or cracked plugs no matter how full of oil or grease. Insures a hot spark. Prevents misfires. Makes starting easy. Send your order today and put an end to your engine troubles. Cost complete, with Money-Back Guarantee, **$7.50**

ALL-SPARK IGNITION CO.
Mail Order Dept.
13 Water St., N.Y. City

ENINGER WILL SAVE



$40 BIG MONEY SAVINGS FOR YOU

Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog **Deninger Cycle Co., Rochester, N.Y.**

YOU 25 TO 50 DOLLARS

Recent Work of the Bureau of Standards

(*Continued from page* 1326)

LARGE ELECTROMAGNET FOR MAGNETO-OPTICS.

This electromagnet is used for studying the effect of magnetism upon light. It takes 100 amperes at 240 volts and is water cooled. It is perforated along the axis to allow a beam of light to pass thru. A polariscope is shown set up on the end pillars—the polarizer at the far end and the analyzer at the other. The strength of the magnetic field is measured by means of a Bismuth Spiral or a test coil (both shown on the small table) in conjunction with the accessory apparatus (shown on the left), mutual inductance galvanometer, milliammeters, sliding resistance, etc. The apparatus as shown is arranged for studying the effect of temperature on the rotation of crystal quartz, a crystal of quartz being placed in the small cylindrical furnace between the poles of the magnet.

Fascinating Experiments in Chemistry

By O. IVAN LEE

(*Continued from page* 1314)

The glycerine is uneasy and begins to bubble—then smokes and fumes. In a flash, the whole mass bursts into a hot and dazzling violet flame resembling a miniature volcano, for sparks and clouds of smoke are not lacking to complete the illusion. It will need little imagination to conjure the possibilities of such chemicals starting trouble if broken cases should get them to rubbing elbows in transit. Fortunately, there are not a great many combinations which are so energetic, but the moral is: No matter how mysterious the fire—there's always a reason!

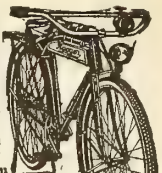
HOW "RED CROSS" KEPT LIGHTS GOING.

Along with keeping "the home fires burning," the Transportation Department of the "American Red Cross" considers it also essential to keep its office lights shining. To this end, by providing its own electric light by means of a rather novel agency, it has given Paris its latest American sensation, the one preceding it, being the afternoon when Major George H. Robertson, head of the department, stood at the junction of two of the city's most congested thorofares giving Paris policemen his ideas on how to regulate traffic.

Recently the city authorities notified the headquarters of the Department at No. 4, Avenue Gabriel, that there would be no "juice" for the electric lights between the hours of 9 a.m. and 3 p.m. Fuel is scarce in Paris and must be used sparingly. Now this particular day happened to be dark and foggy with much work to be done in the department. Some had visions of a holiday, for without light it was practically impossible to figure up long columns of gas consumption, finance, or play on a typewriter. That idea, however, was rudely dispelled, for a telephone message to the Red Cross garage brought out a big Crochat repair car, equipt with powerful generators and heavy cables.

Within a few minutes after its arrival, the motor was snorting away in the street, and the generators were sparkling and sending out over the cables into the building sufficient current to furnish the light for every lamp there. Standing as it did on a much frequented thorofare, the big car attracted considerable attention.

Ride a Ranger



the finest bicycle ever built anywhere at any price. Select from **44 Styles,** colors and sizes made in our three big model factories.

SAVE $10 to $25 on your bicycle. Pay cash or take advantage of the **12 months to pay plan.** Many parents advance first small deposit and energetic boys and girls easily earn the small monthly payments.

30 DAYS FREE TRIAL on the Ranger you select. Costs nothing unless you are satisfied. Delivered free on approval.

Tires lamps, horns, wheels, parts, all equipment for bicycles below usual prices. **WRITE TODAY** for full information. Big, Free illustrated catalog, factory prices and terms as well as **Rider Agent** offer. Don't delay. Do it now.

Mead Cycle Company Dept. D-107 **Chicago**



ADD TO YOUR INCOME
$5 TO $10 A DAY MADE EASY

The New Improved Am. Jr. No. 2 Is A Wonder

Sharpens and strops ordinary razors. Sharpens razor blades, scissors, etc.

Complete outfit for only $85

AM. SHARPENING MACHINE CO.,
184 Washington St., Chicago

EASIEST SHORTHAND

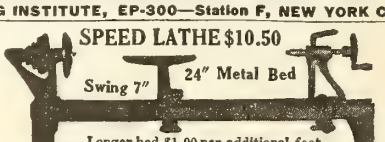


Learn in 5 evenings home study then acquire speed with K. I. Shorthand. **Amazingly simple, easy. Approved by experts. Write dictation, messages, etc., rapidly as spoken,** after brief pleasant practice. Favorite method for personal use; make notes at lectures, meetings; keep confidential diary. Big help in any profession or business; aid in your career. Used in Army, Navy, courts, commercial schools; by public and private stenographers, teachers. Slight cost. **K. I. Shorthand**—for busy people, including YOU. **Proof Lessons,** Guarantee and Brochure with Testimonials **free,** postpaid. Address:



KING INSTITUTE, EP-300—Station F, NEW YORK CITY

SPEED LATHE $10.50



Longer bed $1.00 per additional foot

Head has 3-speed cone No. 1 Morse Taper Shank Centers, 3-8 in. hole thru spindle. Tail Stock has screw feed spindle and No. 1 Morse Taper Shank Center. 3 1-2 in. Face Plate $1.25. Spur Center for Wood Turning $1.00.

CENTRAL MANUFACTURING CO. FAIRFIELD, IOWA

INVENTORS
MODELS EXPERIMENTAL WORK

Are you looking for a reliable concern to assist you in developing that idea that you just can't work out? Consult us. With our staff of expert engineers and thoroughly equipped experimental machine shop, we can develop any proposition for you, mechanical or electrical, and *make it work.*

We develop, simplify and perfect inventions, make them commercially possible, and build working models. We design and build special automatic labor saving machinery.

All business strictly confidential and protection guaranteed.

ELK MFG. CO., INC. 1926 Broadway, New York

DO YOU WANT ?
Prosperity! Power! Happiness!

Positive Wonderful Results by Our System. "Success" Lesson and Personality Sketch for 10c and birth date.

THOMSON-HEYWOOD CO.
Dept. 350 Chronicle Bldg. San Francisco



"BOW LEGS and KNOCK-KNEES" UNSIGHTLY

Send for booklet showing photos of men with and without **THE PERFECT LEG FORMS.**

PERFECT SALES CO.
140 N. Mayfield Ave., Dept. 50, Chicago, Ill.



STAMMER

If you stammer attend no stammering school till you get my large FREE book entitled "STAMMERING, Its Origin and the Advanced Natural Method of Cure." Ask for special tuition rate and a FREE copy of "The Natural Speech Magazine." Largest and best school for stammerers in the world. Write today.

The North-Western School, 2331 Grand Ave. Milwaukee, Wis.

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write **American School of Criminology, Dept. B, Detroit, Mich.**

BOUND VOLUME No. VI
Of ELECTRICAL EXPERIMENTER

(*Issues of May, 1918, to April, 1919, inclusive*)

Contains hundreds of interesting articles and illustrations. The material contained would cost thousands of dollars to assemble in any other form

Do not delay a single day. The best volumes will be mailed out first. Mail your order at once, and you will receive your volume by return mail.

Special Price, $1.75
Plus Postage for 8 Pounds

This is less than the actual subscription price. Mail your remittance today.

Book Department Ezperimenter Publishing Co.,
233 Fulton Street, New York City

DETROIT

The Auto Center is the Logical Place To

LEARN AUTOMOTIVE ELECTRICS



Training for Head and Hand

A few weeks of M. S. A. S. factory outlined training has put thousands of men into big money jobs or started them in business for themselves. It can do the same for you. Previous experience is not necessary. At the M. S. A. S. you learn automobiles and tractors from A to Z. You learn the way the men who built the machines say you should learn. The leading manufacturers, their engineers and service managers know their business, and they endorse our methods. Our courses were planned and are given as outlined by these leaders of the industry.

Unlimited Opportunities

The big rush of repair and service work is on; there is no limit to the opportunities for trained men. You can start a garage, repair shop or service station of your own. Production is again increasing and trained men are moving forward. Trained men are needed to operate, repair and sell tractors and automotive equipment used on the farm. Experts are needed to install and do service work on lighting systems. Salesmen who understand mechanics and electrics are winning big success. More brazing and welding shops, more tire repair shops are needed. There is no other line of business where a man can go out and do what our graduates do in such a short time. Many of our graduates who had no experience before training now

Make $500 to $1000 a Month



H. A. BRADLEY was working for $12.00 a week. Says he didn't know a carburetor from a magneto. He trained at the M. S. A. S. and now has a garage business of his own in Cleveland, paying a profit of over $500 a month.



J. S. STECKLE, of Coplay, Pa., was working for small pay. He trained at the M. S. A. S., increased his income to $100 a week. Mr. Steckle also made a good record in the army, due to M. S. A. S. training.



ELDRIDGE BROOKS, of Meadville, Pa., is just 18 years old and has a garage business of his own with sales agency for Oakland and Nash cars. This is a splendid record for a young man just 18.



OSCAR PETERSON, of Denmark, came to the U. S. A. to learn the auto business. M. S. A. S. training has done much for him. He has a thriving business of his own in Denmark and says he owes his success entirely to M. S. A. S. training.



C. F. SWANSON, of Sioux City, Ia. Before training at the M. S. A. S., Mr. Swanson was working by the day. He now has a business of his own and makes over $500 a month. He attributes his success absolutely to M. S. A. S. training.



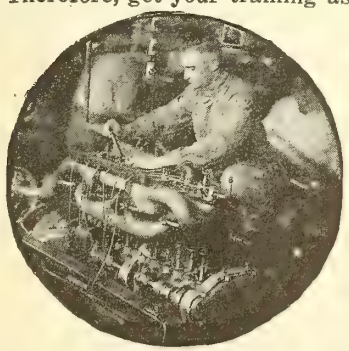
CHAS. CHAMBERS, of Oakton, Ky., is farming 3,000 acres of land. Says he would find it impossible to farm without tractors and other motor equipment and that his M. S. A. S. training saves him many hundreds of dollars each season.



This is 20-year-old **BEN KOEHLER**, M. S. A. S. graduate, at Pulaski, Wis. He has done $93,810 worth of business with $10,000 profits in six months.

Leading Manufacturers Say

Train at the M. S. A. S.—the manufacturers know from experience that M. S. A. S. trained men know their business. In fact many of the leading manufacturers, their service managers, engineers and officials assisted in outlining M. S. A. S. courses. They know M. S. A. S. courses are right. They recommend M. S. A. S. training because of its factory outlined system. Nowhere else can this factory outlined, factory endorsed course be found. Therefore, get your training as recommended by leaders of the industry.

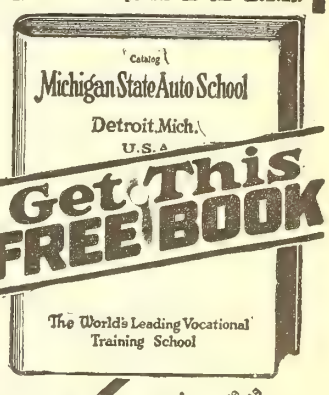


Showing individual work on motor in M. S. A. S. block test

Now Is The Time To Start

This is the very best time to get your training. All the latest automobiles and tractors are now in our equipment. Hundreds of men are coming every week from all parts of the country and are going back in ten weeks with a training that will enable them to get the best job and to start businesses for themselves.

There is nothing ahead but success for the man with an M. S. A. S. training and an ambition to get ahead. If you have this ambition, write today for our free 124-page catalog and information on the auto industry. Or, better still, take the first train to Detroit, look over the M. S. A. S. and then decide.



MICHIGAN STATE AUTO SCHOOL
"The Detroit Auto School"
Endorsed by all Leading Automotive Manufacturers
664 Auto Building, 3729 Woodward Avenue
DETROIT, MICHIGAN, U. S. A.

MICHIGAN STATE AUTO SCHOOL
664 Auto Building, DETROIT, MICH. 3729 Woodward Ave.,

Gentlemen: Please send me absolutely FREE New 124-page illustrated Catalog, "Auto School News" and information as checked below.

[ ] Auto and Tractor Course
[ ] Tire Repairing
[ ] Brazing and Welding

(Mark each course you are interested in.)

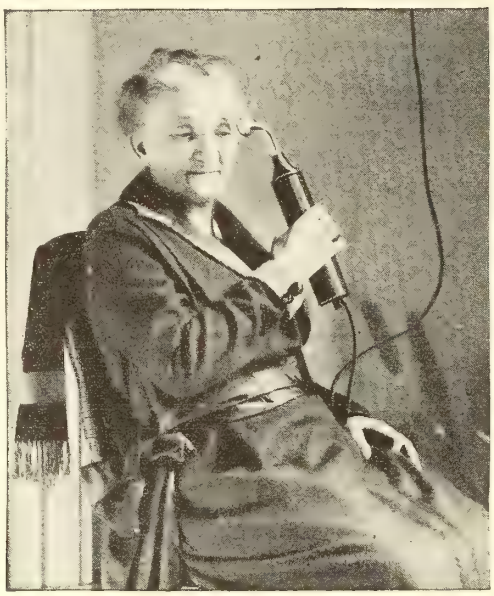
Name.....

Street.....

City..... State.....

The VIRAZONE

in its functions and accomplishments, is science's medicine chest in combination with a miniature beauty parlor.



Mechanically, it is a self-contained high-frequency instrument with all the current efficiency of the more elaborate and costly professional apparatus. Attached to any electric-light fixture it transforms the current (direct or alternating) into Violet Rays and Ozone in all their purity. Though highly technical in design and assembly it is as simple, safe and economical in operation as a light-bulb.

The VIRAZONE responds with reliable constancy to all the varying demands for volume and intensity. Whether the subject under treatment be a delicate infant with "every nerve on fire" or an aged paralytic, devoid of sensory reaction, the simple turning of a knob calls into immediate action the gently soothing or the intensely stimulating rays. All bodily ailments, ranging in gravity from pimples to paralysis, are effectually cured or greatly benefited by the tremendous energizing impulses of the Violet Rays and the peculiar oxidizing and cleansing property of Ozone.

The VIRAZONE "gets under the skin" and deep into the underlying tissues without the stretching and sagging that follow the use of the prevailing type of vibrator.

Whether suffering from some serious malady or embarrassed by some annoying affection or condition of the skin or scalp, the VIRAZONE is your confident hope.

The VIRAZONE is a marvel of compact efficiency, extremely moderate in price and guaranteed for all time against mechanical deficiencies of every nature and kind. Regardless of what it is doing for others, you want to know what it will do for you.

Apply to your favorite drug or electrical dealer today for a ten-day free trial. If he cannot supply you promptly, write us, and we will.

THE VIRAZONE COMPANY

1300-5 Absopure Bldg.,
DETROIT, MICH., U. S. A.

JUNIORPHONE



A THERMO TELEPHONE
—WITH—
COMPLETE TALKING AND SIGNALLING SYSTEM
A PRACTICAL SCIENTIFIC TELEPHONE OPERATING ON A NEW PRINCIPLE.
EASILY ASSEMBLED FOR INSTANT USE
CAN NOT BE EQUALLED AS A DISTINCTIVE, INSTRUCTIVE AND INTERESTING NOVELTY.
APPEALS TO ALL UP-TO-THE-MINUTE YOUNGSTERS AS WELL AS TO THE GROWN UPS.



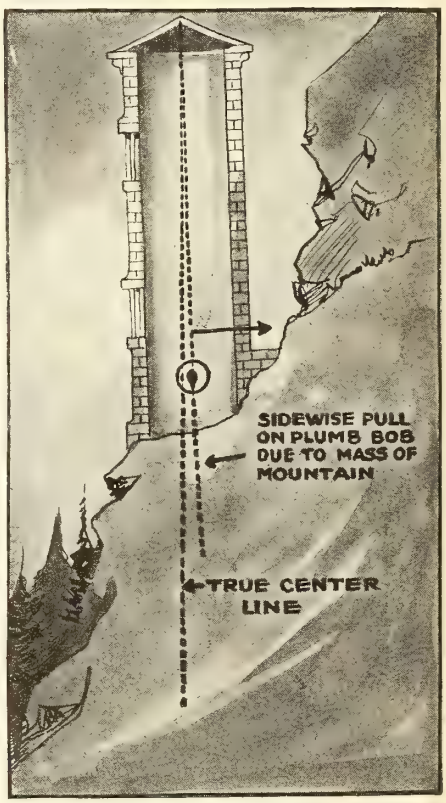
MANUFACTURED BY
AMERICAN THERMOPHONE COMPANY
114-116 BEDFORD ST. BOSTON, MASS.

Oddities of Physics

By H. WINFIELD SECOR

(*Continued from page* 1285)

building a wall one mile long, the difference between the actual wall as constructed by leveling with spirit levels, and a dead straight line (sighted across the top of the wall by using a leveling telescope or surveyors instrument) is one-half foot. In other words, if the wall was constructed two miles long by leveling, the top of it would curve upward in the center, so that if a perfectly straight line or chord were drawn across the top of the wall, there would be one-half foot difference between the line and the top of the wall at either end. For longer walls this difference increases of course, and decreases as the wall becomes shorter.



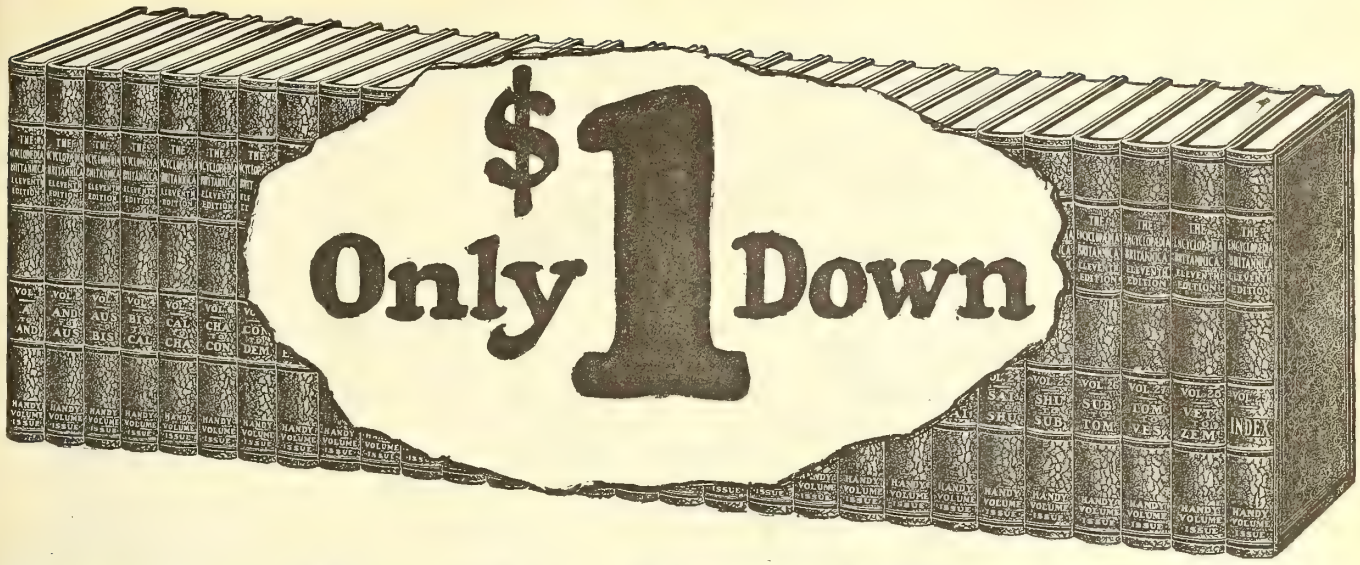
The Illustration Above Shows, Greatly Exaggerated of Course, How a Mountain or Hill Exerts a Sidewise Gravitational Pull on a Suspended Plum Bob, for Example. That Is, If a Tower Were Built by Means of a Plumb Bob on the Side of the Mountain in the Position Here Shown, the Tower Would Not Be Straight But Would Lean Away from the Mountain, (Unless Precautions Were Taken to Allow for the Sidewise Pull of the Mass of the Mountain, of Course). This Difference Would Not Be Very Much,—But the Higher the Tower, the Greater Its Magnitude.

HOW MOUNTAINS ATTRACT MASSES.

It is a well known fact in physics that if we suspend a mass, such as a leaden sphere, whether small or large with a cord by the side of a mountain or hill, this promontory will exert an attraction for the suspended mass, and which varies with the respective sizes of the mass and of the mountain.

The particular consideration we are interested in here is that if we were to construct a tall chimney or tower on the side of a mountain and line this up presumably vertically with a plumb line and bob, then as the diagram, Fig. 4 shows, the tower would not be exactly vertical, but would lean outward from its base, owing to the attraction between the plumb bob and the mass of the mountain which, altho

(*Continued on page* 1332)



Surely, You Can Now Afford to Own This Great Library of Knowledge

Sets of the Encyclopaedia Britannica in the Popular Handy Volume Issue, Printed on the Famous India Paper, Are Offered at Prices Within the Reach of Everybody

ARE you one of those who do not own a set of the wonderful Encyclopaedia Britannica because you THOUGHT you couldn't afford it?

Have you wanted this splendid library of facts ever since you first heard about it but NEVER INQUIRED how easily it could be purchased?

This book will give you a tremendous advantage.

Think, too, what it will mean to you, to your children, to have in your home—to have constant access to the SUM and SUBSTANCE of ALL HUMAN KNOWLEDGE.

Consider what a satisfaction it will be to have at hand THE ANSWER TO EVERY QUESTION which comes to an active mind.

The Britannica covers the whole range of man's thought and activity and achievement—it contains more than 41,000 special articles, more than 500,000 indexed facts.

Both for profit and pleasure

THE ENCYCLOPÆDIA BRITANNICA

Is one of the best investments any ambitious man or woman can make. To briefly describe its scope is impossible. It contains hundreds upon hundreds of articles on religion, philosophy, history, art, science, literature, manufacturing, engineering, law, physics, commerce and scores of other subjects—41,000 articles in all. It abounds in everyday useful facts that satisfy the inquisitiveness of the child mind, that enlighten the housewife, the farmer, the business man, the investigator, the educator and the lawyer.

Men and women in all walks of life are among the 200,000 owners of the Eleventh Edition.

IF YOU DO NOT OWN THE BRITANNICA, WHY NOT?

This is your opportunity to own an India paper set.

These sets are printed on the beautiful, genuine India paper.

As you know, this very thin but strong India paper makes this great work more convenient to handle, more inviting to read.

These sets are offered at prices and terms which make the Britannica a bargain to anyone who does not yet own a set.

$1 As First Payment Brings You This Complete Set of 29 Volumes Containing 44,000,000 Words, 30,000 Pages, 15,000 Maps and Illustrations. The Balance Is in Small Monthly Payments.

Remember, this is an unusual offer of the complete Britannica printed on genuine India paper. Act today—NOW—by clipping the coupon and sending for the beautifully illustrated book, which is sent without charge, telling all about the Britannica.

If you are ready to subscribe now, write an order on a piece of paper and mail with a dollar bill and we will give your order prompt attention.

Sears, Roebuck and Co.
CHICAGO

Sign and Send This Coupon Today.

Sears, Roebuck and Co., Chicago, Ill. 26U

Gentlemen: Please send me your illustrated Book, giving full information about the Encyclopaedia Britannica. Also tell me what I will have to pay for a set of the Handy Volume issue of the Britannica printed on genuine India paper.

Name .....

Postoffice .....

R. F. D. No..... Box No..... State.....

Street and No.....

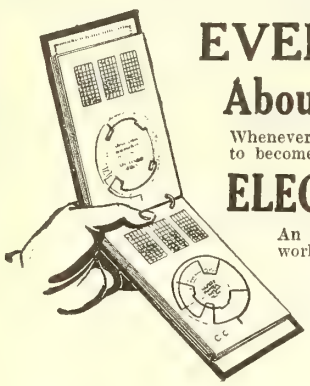
ONLY
$8.45
Sent on Approval



for actual $18 value—
Tenor Banjo, Banjo or Banjo-Mandolin—

Sensational. direct-from-the-factory price. PROFESSIONAL TONE instruments, guaranteed 10 years. No. 2 Tenor-Banjo, No. 3 Banjo and No. 4 Banjo Mandolin have 11 in. heads; nickel-plated brackets and tail pieces; Champion pegs; fine Calfskin heads, nickel-plated shell, both edges spun over steel wire. Artistic scroll heads. Worth $18.00. Our rock-bottom, direct-from-the-factory price only $8.45 each; No. 5 Banjo-Ukelele, 7 in. head, same style, only $6.45. Also have beautiful laminated Bird's eye Maple shell, 3 piece neck, elaborate pearl inlay, Banjo, Tenor-Banjo, Banjo-Mandolin; $65.00 value. Our factory price, $18.85. Violin and Bow, $25.00 value, $11.95. Make big money. We want customer agents everywhere. Select your instrument and in evidence of good faith, send $1.00 today. Will ship C.O.D. balance with privilege of examination. You will get an instrument you will be proud to own. If not worth 2 or 3 times amount we ask, do not accept it, and we will refund your dollar. Hurry! This offer may not appear again.

Chicago Musical Instrument Mfg. Co., Desk 802. 602 W. North Ave., Chicago



EVERYTHING You want to know About A. C. Motors and Repairing

Whenever any question arises regarding motors, or if you are anxious to become a specialist on electrical motor work, you need the

ELECTRICAL WORKERS FRIEND

An invaluable collection of diagrams and instructions for electrical workers, students, amateurs, etc.

This book contains 66 motor diagrams with complete instructions for rewinding and reconnecting A. C. Motors. Shows how to put each coil in the slots, giving all internal and external connections. For reconnecting they cover all practical changes showing which diagram to use for the change wanted. Bound in loose leaf form for handy reference. The only complete book of its kind on the market. So simple anyone can understand. It is helping thousands of other workers—it will help you too, as hundreds of testimonials prove.

SPECIAL PRICE, COMPLETE $4.00. Order today. If desired we will ship C. O. D. by Parcel Post. U. S. only.

YOU CAN EARN YOUR COPY FREE

We offer all owners of the Electrical Workers Friend a commission of 50c on every book they help us sell. All you have to do is show your book and recommend it. You can earn the full price of one of these books in a few days. Write immediately for full particulars—this offer is limited.

SMITH & SMITH PUB. CO. 1524 Lowrie St., N. S. Dept. B, Pittsburgh, Pa.

ELECTRIC LIGHT IN YOUR HOME $1.00

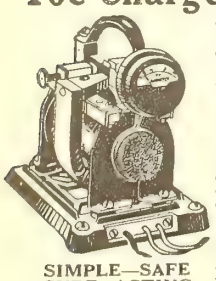


The latest electric light, no batteries to buy or electric bills to pay. Anyone can install and maintain this midget electric light. Safe, simple and inexpensive. No more smoke and smell, no wicks or oil, no chimneys to clean or break, just as safe in the barn, garage and clothes closet as in any open room, always ready for use, day or night. A touch on the switch and you instantly have a **bright electric light.** No matter where you live this light can be installed. It is not affected by heat or cold. Many homes have installed this electric light in their halls, closets, pantries, barns, sheds, cellars, garages, etc., with good results. It is an extremely useful light which no household should be without. The reason for this bright electric light is that the lighting bulb is fitted with a drawn Tungsten filament wire which is much more efficient and durable, besides giving a **300% increase in light** as compared with the ordinary carbon lamp. The power system furnished with this lighting outfit is somewhat similar to the electric power battery described. Each electric light outfit includes the following: Complete directions and plans, copper wire, insulated wire holders, knife switch, drop light fixture with socket, friction tape, battery protector, maroon shade, national mazda globe. Our dry battery compound, which assists in renewing and supplying the current and our current renewing system with which you can **renew the current at home without expense.** With every day use one recharge usually lasts two to three weeks. This electric lighting outfit is undoubtedly the most practical and durable electric light of low cost and long service ever devised. **Special price to introduce these electric lighting outfits $1.00, prepaid.** Outside the U. S. $1.25.

ADAMS BROS. Peoria and 13th Streets, CHICAGO

Auto Owners—Battery Users—Wireless Operators—Experimenters

10c Charges Your Battery AT HOME WITH AN F-F Battery Booster



SIMPLE—SAFE SURE ACTING

or Magnetic Rectifier for 105-125 Volt 60 Cycle Alternating Current at a 1914 Price. F-F Battery Boosters are entirely automatic and operate unattended. Adjustable Carbon Electrodes rectify the current and operate for thousands of hours.

Screw the plug in lamp socket in your garage, snap charging clips on battery terminals without disconnecting or removing battery from car, turn switch and lock garage door, knowing your battery will be charged in the morning. Keeping your Starting Storage Battery in charged condition makes it delightfully responsive and lasts so much longer, requiring fewer expensive battery renewals, that it actually costs you less to buy a Booster than to be without one.

Bantam type 6-6 ampere for 6 volt battery . . . **$15**
Type 16-8 ampere for 6 volt battery **$24**
Type 166-12 ampere for 6 volt battery **$32**
Bantam type 12-5 ampere for 12 volt battery **$15**
Type 112-6 ampere for 12 volt battery **$24**
Type 1612-7 ampere for 12 volt battery **$32**
Type 1626-12 amperes or 7 amperes in combination for both 6 volt and 12 volt batteries **$48**

High ampere charging rates are best for large batteries, or where time is limited. Shipping weight complete with **AMMETER** and **BATTERY CLIPS**, 11 to 15 lbs. Include postage and insurance with remittance for parcel post shipment. Other F-F Battery Boosters for Farm Lighting Plants and Direct Current. Battery Stations and Garages Use the F-F Rotary Rectifier for Group Charging.

WRITE FOR BULLETINS 12 AND 12-A, OR MAIL CHECK WITH ORDER

THE FRANCE MANUFACTURING CO., Offices and Works, Cleveland, Ohio

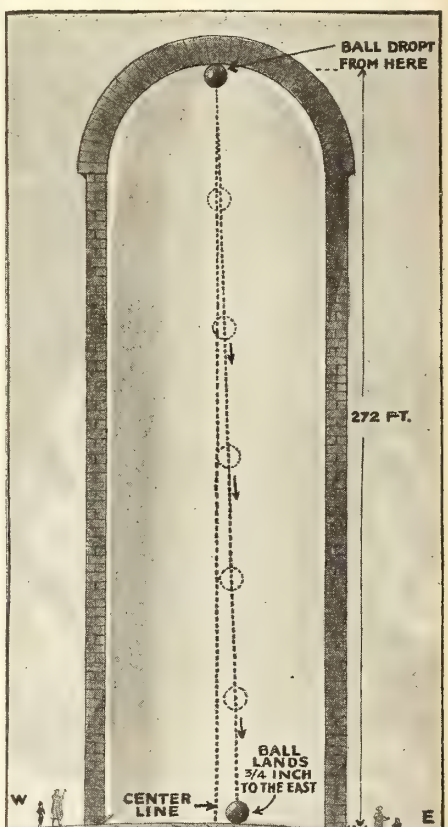
Oddities of Physics

(*Continued from page* 1330)

extremely slight, might become quite an appreciable factor to reckon with in a tall structure. About the simplest way to check up the perpendicularity of the tower or other structure would be by means of a surveyor's theodolite.

DOES AN OBJECT WEIGH THE MOST ON THE EARTH'S SURFACE?

If you want to start a good "rainy day" argument at the club or in the smoking car, just ask the question, "Where does a cannon ball weigh the most,—at the surface of the earth, below the surface, or above the surface?" Due to two well defined laws of Nature, we come to the conclusion, that the object, whatever it may be, weighs its greatest at the earth's surface. The law of weight with respect to distance which concerns the present problem has



An Iron Ball or Other Weight Dropt from an Elevation Such As the Top of a 272-Foot Tower Here Shown, Will Land to the East of the Point Directly Under the Central Point from Which It Was Dropt, the Ball Landing on the Average ¾" to the East. Fig. 6.

been formulated as follows: "The weight of a body varies directly as the mass, and inversely as the square of the distance between its center of gravity and that of the earth."

This is shown in the accompanying illustration, Fig. 5. A 100 pound ball, that is, one weighing 100 pounds at the surface of the earth, will weigh but 25 pounds when four thousand miles above the earth's surface. Since the weights of objects above the earth are inversely proportional to the squares of their distances from the center of the earth, we find that w, the weight at any elevation is to W, the weight at the surface, as D^2—the distance in miles from the surface to the center of

(*Continued on page* 1334)



"Good Bye, Boys!"

"Today I dropped in for a last word with the boys at the office. And as I saw Tom and Dave there at the same old desk it came to me suddenly that they had been there just so the day I came with the firm four years ago.

"When I started here I was put at a desk and given certain routine things to do. It was my first job and I took it as a matter of course. But after a few months I began to realize that I was nothing but a human machine, doing things that anyone could do, and that I couldn't expect to advance that way.

"So I had a talk with the manager and I'll never forget what he said. 'If you want to get ahead, put in some of your spare time getting special training along the line of your work. We want men who care enough about their future not only to do their work well but to devote part of their spare time to preparation for advancement.'

"That very night I wrote to Scranton and a few days later had started studying evenings at home. Why, do you know, it gave me a whole new interest in our business? In a few months I was given more important work and more money. Since then I've had three increases, six months ago I was put in charge of my department, and now my big chance has come—I'm to be manager of our Western branch at $5,000 a year!

"Tom and Dave could never see any sense in my studying nights—they said eight hours a day was enough for any man to be bothered with business. They had the same chance I had—they could have been big men in the firm today. But they stood while I went up to one of the best jobs in our business. It just shows what spare time training will do."

Every day men who have let the International Correspondence Schools help them are moving up to more responsible positions and bigger salaries. Clerks have become advertising, sales and business managers; mechanics have become foremen, superintendents and engineers; carpenters have become architects and contractors; men and boys have risen from nothing at all to splendid positions of responsibility—because in spare hours at noon and at night they have learned to do some one thing well. If *you* want to make more money, show your employer you're trying to be *worth* more money. If you want a bigger job, show him you're willing to *prepare* for it.

There's a simple easy way to do it. For 29 years the International Correspondence Schools have been training men and women right in their own homes whenever they had a little time to spare. More than two million have stepped up in just this way. More than 130,000 are studying now. Ten thousand are starting every month.

Can you afford to let another priceless hour pass without finding out what the I. C. S. can do for you? Here is all we ask—without cost, without obligating yourself in any way, mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6186-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electrician
- ☐ Electric Wiring
- ☐ Electric Lighting
- ☐ Electric Car Running
- ☐ Heavy Electric Traction
- ☐ Electrical Draftsman
- ☐ Electric Machine Designer
- ☐ Telegraph Expert
- ☐ Practical Telephony
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Toolmaker
- ☐ Machine Shop Practice
- ☐ Gas Engineer
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREMAN OR ENGINEER
- ☐ ARCHITECT
- ☐ Architectural Draftsman
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Ship Draftsman
- ☐ Traffic Management
- ☐ CHEMICAL ENGINEER
- ☐ Pharmacy
- ☐ SALESMANSHIP
- ☐ ADVERTISING MAN
- ☐ Show Card and Sign Painting
- ☐ RAILROAD POSITIONS
- ☐ ILLUSTRATOR
- ☐ DESIGNER
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ Business Correspondent
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Public Accountant
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ Common School Subjects
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ STATIONARY ENGINEER
- ☐ Textile Overseer or Supt.
- ☐ AGRICULTURE ☐ Spanish
- ☐ Navigator ☐ Autos
- ☐ Poultry Raising ☐ Banking

Name_____

Present Occupation_____ Business Address_____

Street and No._____

City_____ State_____

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada 1-1-21

ON CREDIT DIAMONDS WATCHES



Send For Catalog

DIAMONDS WIN HEARTS

Special Bargains in Diamond Engagement Rings and Solid Gold and Platinum Wedding Rings, Diamond-Set

Also a splendid assortment of the new engraved, pierced Rings, White and Green Solid Gold, fine brilliant Diamonds; Diamond La Vallieres, Bar Pins, Ear Screws, Scarf Pins, Cuff Links, Watches, Wrist Watches, etc. Send today for Catalog and make your selections. We pay all shipping charges.



Credit Terms on purchases of $5 or over, one-fifth down, balance in eight equal amounts, payable monthly. **LIBERTY BONDS ACCEPTED.**

LOFTIS BROS & CO. ESTD 1858 — **The National Credit Jewelers** Dept. M-22 108 N. State St. CHICAGO, ILL. STORES IN LEADING CITIES

ROTH PROTRACTOR DRILL LEVELS



$2.00

Will make your drill "STAY ON THE LEVEL"

When you know that you can drill holes accurately at any angle, you will want a Roth Protractor Drill Level. Easily attached to any kind of drill. Hand-Chain or Electric. It saves time and assures better work.

You know what this Level will do for you. Mention type of drill you are using. Postage prepaid.

PROTRACTOR LEVEL CO.
620 Arctic Avenue Atlantic City, N. J.



From factory to you—FREE Easiest riding, most comfortable wheel built We'll ship to you on approval. You'll surely want it when you see the **18 exclusive features** of the wonderful 1921 model electrically equipped

BLACK BEAUTY

There's a large variety of models to choose from. Pick the one you like best. We'll ship it to you express prepaid on approval. A small deposit and a

DOLLAR A WEEK

makes you the owner. Our direct factory price saves you money. You get a **liberal 5-year guarantee** and **6 months' accident policy** with every wheel.

HAVERFORD CYCLE COMPANY
Dept. 624 Established 25 years Philadelphia, Pa.
Be a Black Beauty Owner Agent.

Big new catalog in colors—FREE Something every boy needs. It shows everything a bicycle rider wants at remarkably low prices. Send for it —NOW!

HB This HB Battery Charger is My Biggest Money-Maker!



You Can Make $1500 to $3000 a Year Charging Batteries

Others are doing it—you can, also. It costs 4c to 12c to charge batteries, customer pays 75c to $2.00. *Clear cash profits*—no bulbs to burn out, no repairs or expensive renewals with H. B. Chargers.

Small cash payment—almost a year to pay balance on Easy Terms.

H. B. Chargers in sizes for 10, 16, 32 or 70 batteries. Choose size you need, then write QUICK for information. Money back guarantee. Ten days free trial.

Hobart Bros. Co. Box 477E, Troy, O.

Start NOW to make BIG PROFITS!

Oddities of Physics

(*Continued from page* 1332)

the earth squared, $4{,}000^2$ is to d^2—the distance from the center of the earth to the level at which the object is placed. Algebraically we have:

$$w : W = D^2 : d^2$$

or $w : 100 = 4{,}000^2 : (4{,}000 + 4{,}000)^2$

and $$w = \frac{100 \times 16{,}000{,}000}{64{,}000{,}000} = \frac{100 \times 16}{64} = 25$$

When we go *below* the surface of the earth we find that objects *weigh less as we progress towards the center.* In this case the decrease of weights follows a different law than that for bodies placed above the earth's surface. This last law states that *the weight of a body placed below the surface decreases as the distance to the center decreases.* That is, if the body is only one-half as far from the center as the surface is, it will weigh but one-half as much as on the surface. This is due to the fact that the mass between us and the center of the earth becomes less and secondly, the force of direction is less. Thus the weight of a 180 pound ball or mass, 2,000 miles below the surface is but 90 pounds, or our 100 pound ball in the illustration, Fig. 5, would weigh but 50 pounds at a depth of 2,000 miles below the surface.

"FALLING EAST."

One of the most interesting and not so well known of physical phenomena is that known as "falling east." Dr. Daniel W. Hering in his work, "Essentials of Physics" states that inertia has been employed to demonstrate the rotation of the earth upon its axis; and furthermore, if the earth rotates, the top of a tower or mast moves faster than the bottom, which we perceive as being true upon consideration of the facts in the case.

The apex of Dome of the Pantheon in Paris is 272 feet above the floor, and the latitude of this structure is 48+ degrees; and for the earth to rotate once in 24 hours, the top of the dome or structure moves to the east faster than does the bottom of the tower, by .18 inch per second. A body requires 4.1 seconds to fall from the top of the dome to the floor; theoretically, therefore, the body should strike .75 inch to the east of a point directly under the plummet when dropt. This was born out by actual experiments, repeated many times, when an iron ball thus dropt, always fell to the east one-half inch to one inch away.

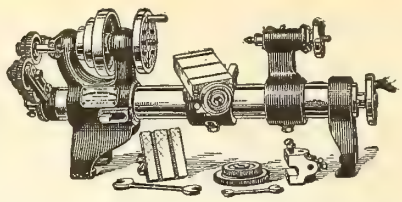
As Dr. Hering states, "This experiment may be interpreted either way, for if we regard the rotation of the earth sufficiently well proved, we may regard this experiment as confirming the principle of inertia."

WHICH IS THE MOST EFFECTIVE—A SHORT OR LONG HITCH?

When it comes to a good argument in "applied physics,' one that will shake up the whole bunch and rattle the kitchen stove as well as the oil paintings in the parlor, and when you really feel like starting something, just spring this one: "Which is the most effective, —a short or long hitch when pulling a load?"

Fig. 7 illustrates what is meant more clearly. Usually of course it is the farmers' argument, or one frequently heard among those having to do with horses, that it is a well-known fact that

(*Continued on page* 1336)



Model-Makers—Inventors Mechanics—Repair Men ARE *YOU*

Looking for a Lathe that will do Turning, Boring, Drilling, Screw-cutting, Milling and Keyway-cutting, and *low* in price?

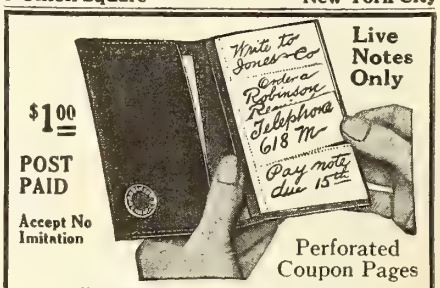
The "DRUMMOND" 8 inch Lathe

With Circular Bed

is the one you want!

Send for particulars

PRODUCTION EQUIPMENT CO., Inc.
Dept. 6
5 Union Square New York City



$1.00 POST PAID

Accept No Imitation

Live Notes Only

Perforated Coupon Pages

ROBINSON REMINDER
Tear Out When Attended To

Each memo a perforated coupon, which when attended to, is torn out, **Leaving Live Notes Only.** No searching thru obsolete notes. Everything ready for instant reference. Pocket in cover.

	Size B	Size A
Reminder with extra filler	3x5 in.	3½x7 in.
Black Leather	$1.00	$1.75
Cross Grain Leather	1.50	2.50
India Calf	2.50	3.25
Cowhide	2.25	3.00
Genuine Morocco	2.75	3.75
Imitation Leather	.75	1.00
Cloth (without extra filler)	.25	.50

	Size L
Ladies' Shopping Reminder With Pencil and Extra Filler	2¾x3¾
Black Leather	$1.25
Cross Grain	1.50
Patent Leather or Cowhide	1.75
Calf	2.00
Morocco	2.25

Extra Fillers---Per dozen: Size B, 75c; Size A, $1; Size L, 70c. Gold name on cover 25c extra. Prices changed without notice. If not at your stationer's, order from us. (Stationers write.)
Robinson Mfg. Co., 131 Elm St., Westfield, Mass.



No. 1 No. 2

Just Send Your Name

We want you to wear one of our sparkling oriental gems **10 days free.** These wonderful new **perfect cut gems** have all the **dazzling fire and brilliancy of a real diamond.** The luxurious, blue white gems—**each a carat in size**—are perfect diamond cut, and absolutely flawless. Mounted in beautiful **heavy high-grade 12K. gold** s. ring, men's or women's style as illustrated.

No Money Simply tell us which of the rings you want. We will send the ring you choose **without one penny in advance.** When ring arrives, simply deposit $3.65 with postman. After 10 days' wear, **if you can tell it from a costly diamond,** we will refund every cent of your money. (To determine proper ring size, send narrow strip of paper that meets around finger where it is to be worn.)

GEM IMPORTING CO., 664 N. Carpenter St., Dept. 42 Chicago, Ill.

THE MIDGET "FIVE-IN-ONE" SLIDE RULE



is a combination Mannheim, Log-Log Add and Subtract, Polyphase and Binary Slide Rule. It will instantly add, subtract, multiply and divide any combination involving whole numbers, fractions, decimals and mixed numbers. Gives every possible root and power of every quantity. The graduations are printed on metal, coated with white celluloid and are grease and waterproof. While it is the most versatile calculator ever invented, its operation is simple and easily understood. Diameter 4 inches.

Price with 16 page Instruction Book, $1.50. Leatherette carrying case 60c extra. Catalogue Free. Your money back if you are not satisfied.

GILSON SLIDE RULE CO. Niles, Mich.

MEN

Intensely interesting booklet free.
Wonderful results.
H. Gyde Co., Washington, D. C.

Make Electricity Your Goal

Electricity holds brilliant opportunities for the man who is trained. Specialists are in demand everywhere at high salaries. Make electricity your life work and enjoy the rich rewards.





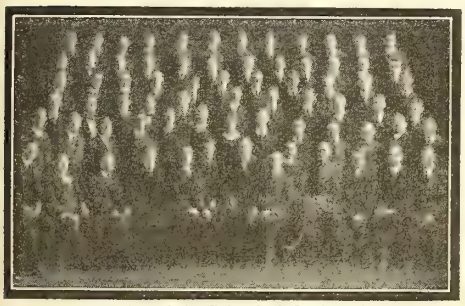
Steinmetz, the world famous electrical engineer, is a member of our advisory board.



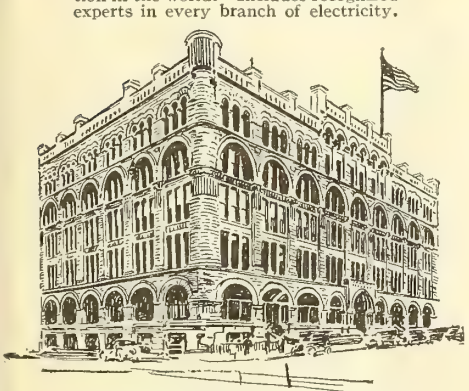
Edison, the electrical wizard, began his electrical career as a telegraph operator. He specialized.



A view in one of the School of Engineering laboratories. Students receive practical instruction on laboratory units as well as class room work.



Faculty of the School of Engineering. The largest staff of any similar institution in the world. Includes recognized experts in every branch of electricity.



Fifteen years ago the S. of E. began in a little store of 500 sq. ft. Today it occupies the greater part of four modern buildings; 2300 students were enrolled in 1920. Modern study rooms, fraternity house, sports, athletics and other student activities.

How This Great Institution Trains You for the Master Job

You can develop your talent so that you, too, can be prepared for the big electrical job at handsome pay. Ninety leading electrical experts and instructors—the largest faculty of any similar institution, are here ready to personally direct you to SURE success. Every minute of your time here is made to pay you. We SPECIALIZE IN ELECTRICITY ONLY. You receive thorough theoretical knowledge as well as practical training in our well equipped laboratories. Fifteen years of specialization has taught us what non-essentials to eliminate. Instruction here is more thorough and personal. You learn more in a shorter time at less expense, and you can fill a definite place in industry when you graduate!

A PLACE FOR EVERY STUDENT

Whatever your age, your past education or present ability, there is a proper starting place for you here in this big electrical school. The chief requirement is ambition to succeed. We will place you where you belong and advance you as rapidly as your work permits.

EARN WHILE YOU LEARN

In addition you may be employed part time and study at school part time. Thus you may obtain actual practical experience and the salary earned helps pay your way through school.

JOIN OUR BIG STUDENT BODY

Over 2300 ambitious young men studied electricity here in 1920. In over 15 years we have trained thousands of electrical experts who have made their mark in every country of the world. If you want to make your mark in the great big world of electricity with its unlimited, high pay opportunities, don't experiment with untried, unsound methods of instruction. Investigate all that this world famous school offers you. Let it help you to make your dreams come true. Get the full particulars. Fill out and mail the coupon now and be that far ahead in the climb to your success.

MAIL THE COUPON, TODAY, FOR FULL INFORMATION ON THE COURSE YOU WOULD LIKE TO FOLLOW. SEE LIST OF COURSES.

School of Engineering
of Milwaukee

"Leading Electrical School of America"
Established 1905
MILWAUKEE, WISCONSIN

SELECT YOUR OWN FUTURE

Practical Electricity.—A six-months' course in installation and maintenance work. Eighth grade education desirable. Entrance any time.

Electrotechnics.—Two and three year courses. Diploma admits without examination to College of Electrical Engineering. Common school and some high school credits required. Entrance any time.

Electrical Engineering.—Thirty-six months study. Degree of B. S. in E. E. granted. Open to men with full high school education or equivalent. Entrance every three months.

Armature Winding.—Three months full time. Common school education desirable. Entrance any time.

Drafting.—One year course. Common school education desirable. Entrance any time.

Automotive Electricity.—Three months' course on starting, lighting, ignition, storage batteries, farm lighting plants. Entrance any time.



MAIL the Coupon To-day for FREE Illustrated Booklets

SCHOOL OF ENGINEERING,
Dept. SI-4—Milwaukee, Wis.

Please send me information and illustrated book on—

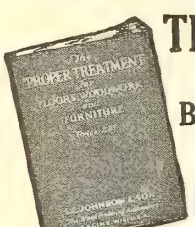
Course.....

Name.....

Address.....

Town..... State.....

Age..... Education.....



THIS BOOK ON HOME BEAUTIFYING
Sent Free

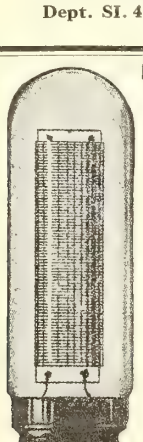
Contains practical suggestions on how to make your home artistic, cheery and inviting. Explains how you can easily and economically keep the woodwork, piano and furniture in perfect condition.

BUILDING?

This book gives complete specifications for finishing both hard and soft woods in enameled effects with **Johnson's PerfecTone Enamel**—and in stained effects with **Johnson's Wood Dye.** We will gladly send you this book free and postpaid. When writing please mention the name of your best dealer in paints.

Tell your painter and architect that you want your floors and interior trim finished with Johnson's Artistic Wood Finishes. Then you will be assured of satisfactory results—a thrill of pleasure when the work is new and yearly satisfaction at its wearing qualities.

S. C. JOHNSON & SON
"The Wood Finishing Authorities"
Dept. SI. 4. Racine, Wis.



Selenium Cells

(NEW PROCESS)

Highly Sensitive. Quick Acting. Permanent. Uniform in Quality.

Sizes and types for all uses.

OFFER A NEW FIELD FOR THE INVENTOR

Send for illustrated Catalog A describing interesting electrical behavior of this metal under varying light conditions.

Richardson, Cook & Seixas, Inc.
154 Nassau St. New York, N. Y.

BLUE PRINT READING



CARPENTERS, Shipfitters, Bricklayers, Structural, Concrete and Sheet Metal Workers, Electricians, Mechanics, Plumbers, Pipefitters, Boilermakers—can you read Blue Prints and hold a big job? If not, learn how. It will help you hold your job—it will get you a better job—it will increase your earning capacity. DON'T DELAY—it means more money! Write for Catalog Bf stating trade.

BE A DRAFTSMAN
Earn $35-$150 Week

Draftsmen are in demand. Books and tools FREE. Write for Catalog G. DO IT TODAY!
Columbia Correspondence School Est. 1904
Dept 1, Drexel Bldg., Phila, Pa.

LAW IN YOUR SPARE TIME AT HOME
FOR BUSINESS
Degree LL. B. Conferred **FOR PROFESSION**

Study law with only Institution which gives same Course by Correspondence through Lecture System as was given for years at resident classes of this College. Business today demands a knowledge of law for those who want success. Big opportunities in the legal profession. We coach you free to pass Bar Examination in any State. Special consultation privileges. Complete 24-volume library (12 books) specially prepared by leading professional and law trained business men. Organized 1910. Low enrollment fee, easy terms. Write for Free illustrated book.

HAMILTON COLLEGE of LAW, 404 Morton Bldg., Chicago

Oddities of Physics

(*Continued from page* 1334.)

when a truck is caught in the mud or ditch, a short angular hitch permitting the horse or horses to pull up and out on the load, will invariably give success; whereas a straight pull, if the traces are horizontal, would not pull the truck out of the mire or ditch.

This question, let it be said, is not as easily solved or answered as might at first seem, for there are several factors which bear on the matter, and these are considered briefly below:

In the first place, we had probably best consider what happens in the case of a short or long hitch when the pairs, traces, ropes or chain used are of different lengths for each pull, but perfectly horizontal during the act of pulling. As the scale in the two figures shown, the pull exerted in this case, 200 pounds, is the same whether the trace is long or short. This may not seem so at first, but it is a proven fact and anyone who has studied engineering calculations, especially those concerning the movement of railroad trains and the power required to move a given load (whether it be a car, wagon, automobile or sled) with a certain co-efficient of friction, and knowing the speed at which the mass is to be moved, will see this point immediately.

Regarding the short and long hitch with the horizontal or usual style of traces, it might be interesting to note that the writer before being able to convince a friend of his that the pull is practically the same in either case (disregarding any small infinitesimal loss due to any extra long traces, chains or ropes used and their consequent weight, or any swinging) had to get the opinions of five professors of mechanical engineering in leading American universities (and these letters are still on file for the benefit of any other "Doubting Thomases"), to the effect that this law is correct.

To sum up the situation in a few words then, and providing the traces are straight or horizontal, and not placed on an angle, which changes the effect of the problem at once:—it does not make any difference whether we use a short or long hitch. The same would apply to a man pulling with a rope attached to a piano or other heavy mass, and he would not pull any more—or less, whether he were five feet or twenty-five feet from the load!

Where this problem changes entirely, due to placing the traces at an angle, is shown in the two lower illustrations at Fig. 7. The illustration showing the front wheels of a wagon in a gully, and resting against a large amount of dirt, talks for itself and shows that the only successful or logical way in which to get this wagon out of the rut, is to apply two forces, one *upward* and one *forward.* Calculating the resulting forces accruing from the slanting traces and solving the parallelogram of forces as shown in the drawing, taking the pull exerted in the traces as 200 pounds, we find that the horizontal component or forward pulling force would be 199 pounds, while at the same time an upward or vertical lifting force of 20 pounds would be exerted to help raise the wagon out of the rut or gully.

(*Continued on page* 1338)



FREE for 10 Days' Wear

Send no money—just tell us which ring to send—No. 102 or 103. We will send you one of these genuine sparkling Tifnite gems mounted in solid gold—on 10 days' FREE TRIAL. Don't miss this offer. Send. **Put It Beside a Diamond** When it arrives, deposit $3.50 with postmaster. Wear it 10 days. See how beautiful it is. If anyone can tell it from a diamond, send it back and we refund deposit. If you buy, pay the balance at $3.00 per month until $12.50 is paid. Price smashed—terms lowest on record—everything on pre-war basis. Write today. Send strip of paper fitting end to end around finger joint.
The Tifnite Co. 5113 Plymouth Ct. Dept. 1347 Chicago

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP **SAVE OVER HALF**

A few hours interesting work saves over half and gives you a machine to suit your ideas. We furnish motors, tone arms, case material, blue prints and full instructions Plays any record. Make fine profit building phonographs for your friends.



Write today for our Blue print offer. **FREE**
AGENTS wanted for Choraleon King Phonographs

Choraleon Phonograph Co.
421 3rd St., Elkhart, Ind.

FREE



$20

Violin, Hawaiian Guitar, Ukulele, Guitar, Mandolin, Cornet, Tenor Banjo or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.
SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 613 CHICAGO, ILL.

SAVE 25% to 60%
on slightly used
GRAFLEX-KODAKS



Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 10 days' Free Trial. Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 36 years. Write now.
CENTRAL CAMERA CO., Dept. 114 124 S. Wabash, Chicago

Make Your Own Violin

from exact reproductions of 12 old masters. Complete plans and specifications, one dollar, postpaid.

Violin Outfits from $15 Up

JOSEF DEULIN Violin Maker and Repairer "Everything for the Fiddle"
1414 Broadway :: DETROIT, MICH.

MECHANIC'S POCKET SECRETARY **25c**

Constructed of finest steel. Just push the button and out comes the article you require. Worth $1.00. Postpaid **10 in 1**



25c Get One Today

Adjustable Pencil, pen, paper knife, ink eraser, pencil sharpener, nail file, and cleaner, mechanic's marking point, fine compass with screw attachment, foot rule.
Universal Co., Box A, Stamford, Conn.

Book on Law Free



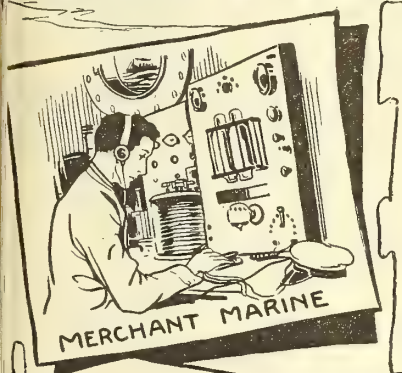
Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE.
Write Today—now while we are making a special reduced price offer.
American Correspondence School of Law
7444-3601 Michigan Ave., Chicago, Illinois

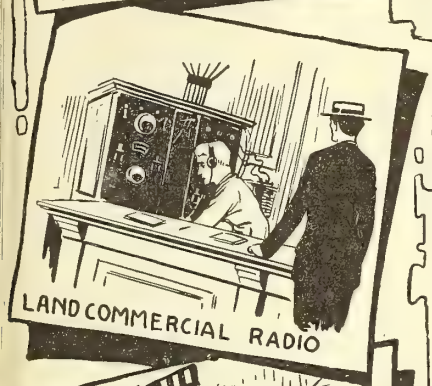
LEARN WATCH REPAIRING



You can learn by our modern and original system of instruction every part of the Watch Repairing Trade at home as good or better than at a shop. You can earn money while learning and secure a well paying position or start in business after completing our course of instruction. Good watch repairers are always in demand and earn from $30 to $65 per week. For particulars apply to the
MILWAUKEE SCHOOL OF WATCH REPAIRING. 166 Mason St., MILWAUKEE, WIS.

LEARN WIRELESS At Home By Mail











Wireless Operators Employed at Good Salaries by Merchant Marine, Commercial Land Radio Service, Radio Supply Factories, U. S. Navy, Government Service and Aerial Mail.

Salaries Up To $3,500 a Year

Exceptional opportunity for ambitious men for promotion to the higher branches of Radio. Our graduates are qualified as Senior Operators, and besides room and board, receive $125 a month to start, which altogether means more than $200. Positions to which they can promote themselves are as follows: Supercargo and Wireless Operator—$175 a month; Radio Mechanic—$1,500 to $2,000 a year; Radio Aid—$6 to $8 per day; Radio Inspector—$1,500 to $3,000 a year; Radio Engineer—$6,000 and more a year; Radio Draftsman—$7 to $10 a day. You can learn wireless the National Radio Institute way, quickly and easily, by mail right in your own home, in your spare time. No previous experience or training is necessary. With our help you can quickly qualify for first grade government license and a fine position.

U. S. Department of Commerce Recognizes N. R. I.

and allows its graduates 5 to 10 points credit when taking the examination for First Grade Government License. This school heads the printed list of reputable Wireless Schools recommended by the U. S. Shipping Board.

Travel Without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs, Wireless offers the chance of a lifetime. On shipboard you are rated as an officer. You need not travel unless you wish, but may secure a position at one of the many increasing land radio offices.

Pay As You Learn

Our plans of payment place a wireless education within the reach of anyone who desires to learn. A small payment down and the small payments made during the course make it possible for you to earn the cost of your tuition while actually learning to be a wireless operator.

New Automatic Wireless Instrument Free

In addition to all necessary text books and other equipment with which we supply you, we furnish FREE to every student our marvelous new automatic Natrometer, which transmits wireless messages in 600 different combinations, and can be regulated to operate at any speed from 1 to 30 words a minute.
It is complete with phones, etc., and is sent you in a neat carrying case. This instrument is operated entirely without the use of aerials and is used exclusively by the National Radio Institute to teach Wireless at home in the scientific way.
You receive the instrument after your enrollment; it becomes your personal property upon completion of our course.

FREE

In addition to our complete course in Radio Telegraphy, every student is given our complete course in modern Radio Telephony. These combined courses enable our students to fill positions requiring a knowledge of both Radio Telegraphy and Telephony. Send the following coupon today for our FREE BOOK containing all particulars.

NATIONAL RADIO INSTITUTE
Dept. 530, 1345 Penna. Ave., N. W.
WASHINGTON, D. C.

MAIL THIS COUPON TODAY

NATIONAL RADIO INSTITUTE,
Dept. 530, 1345 Penna. Ave., N. W.
Washington, D. C.

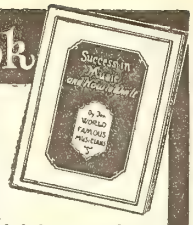
Send me your FREE book "Wireless The Opportunity of Today." Tell me about your Home Study Course in Wireless Telegraphy and Telephony—the free post-graduate course—and your special Instrument offer.

Name .....

Address .....

City .....State .....

Free Book



"Success in Music How To Win It"



LET Sousa, Pryor and eight other world-famous musicians tell you secrets of their success; how to discover and cultivate *your* musical "bump"; double your income and pleasure playing in band or orchestra.

FREE TRIAL
Any Instrument

Conn instruments are used by world-famous artists. Known everywhere as *easiest of all to play*. Try any instrument FREE. No obligation, easy payments when you buy. Send coupon for free book and details of free trial plan

C. G. CONN Ltd
456 Conn Bldg. Elkhart, Ind.
Agencies in all large cities

C. G. Conn, Ltd.
456 Conn Bldg., Elkhart, Indiana
Gentlemen:—Please send me "Success in Music" and details of your free trial plan. (Mention instrument.)
*Name*_____
*Street or Rural Route*_____
*City, County*_____
*State*_____
*Instrument*_____

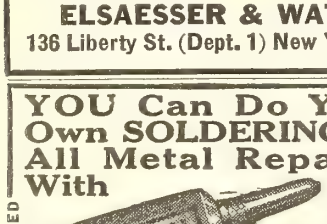
No Batteries Needed



Saves cost of batteries and will soon pay for itself. Nothing to get out of order—lasts a life-time. Only a few hundred will be sold at this price—*order at once.* Send check, money-order or cash to

ELSAESSER & WATTS
136 Liberty St. (Dept. 1) New York City

YOU Can Do YOUR Own SOLDERING and All Metal Repairing With



25c PER TUBE

A Paste That Turns Into Metal When Heated

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. E,
129 Sussex Avenue, Newark, N. J.

Dealers Send for Quantity Prices.
LOOK FOR TRADE MARK "SOLDERALL"
BEWARE OF IMITATIONS WITH SIMILAR NAMES

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR

Oddities of Physics

(*Continued from page* 1336)

The solution of the parallelogram of forces is solved by the laws of geometry, viz: the force exerted by the traces, or 200 pounds, is equal to the square root of the sum of the squares of the vertical and horizontal components. Likewise, the value of the horizontal component is equal to the square root of the trace pull, squared, minus the value of the vertical component, also squared; and the value of the vertical component is equivalent to the square root of the trace pull, squared, minus the value of the horizontal component, squared.

It might seem at first glance, after looking over this solution of the short hitch, angular trace problem—that we really obtain more power than was exerted on the traces by the horse, but this is not so, for otherwise we would have *perpetual motion.* What really happens is this:

When the trace is placed at any angle other than horizontal, the horse begins to exert on the load a lifting effect—as well as a forward pulling one, but as the vertical pressure increases, the forward pull decreases in value, until when we have the trace directly vertical, the horse would theoretically be exerting a purely vertical lifting effort, and would exert no forward pulling effect whatever.

Typewriting and Stenographic Machines for the Blind

(*Continued from page* 1282)

produced a typewriter remarkably similar to the original Remington, for making books for the blind.

Some years later, typewriters for everyday use made their appearance, and the names of the American inventors Pratt, Shoales, Soulé, Glidden and Densmore covering the periods from 1864 to 1872 appear on the roll of honor. It is curious to note that the origin was identified with machine-writing for the blind.

Today there are two types of typewriters for the blind, some writing the regular everyday letter and others the Braille alphabet.

The Hall-Braille machine which we illustrate in one of our cuts has had extensive employment in America. It has only six keys, symmetrically placed to right and left, and is arranged with a spacer to separate the words. It will be remembered that we said the Braille letter never needed more than six points, so in the Hall machine with its six keys, all the points required for a letter by one impulse of the operator's hands can be struck at once. With the Hall machine a blind person can write 20 to 30 words a minute, three times the speed of the original typewriting for the blind.

The Frenchman Lotz, the Italian Dr. Ceresota, the German Pichl and the Englishman, Stainsby, all produce machines with six keys, so that a complete Braille letter can be made with one blow.

In one of our cuts we show the Stainsby machine, which has been much used in England, like the Hall machine in America.

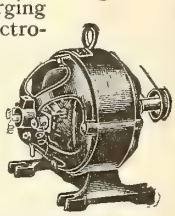
Towards 1910, M. Maurice, Constançon, head of the Asylum for the Blind in Laussanne, Switzerland, produced a distinctive machine illustrated herewith. This is so ingeniously constructed that

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

Dynamo Motor

For Boys **$9.00**

For producing current for inductance coils, recharging storage batteries, electro-plating and hundreds of other uses. Well constructed throughout, exceptionally smooth running and highly efficient. A good, strong, durable dynamo that runs as well as a motor without change.



AT ALL LIVE DEALERS

Insist on your dealer showing you the **KNAPP** line—**KNAPP** goods are best. If your dealer cannot supply you, order direct. Send for **FREE** illustrated catalogue showing a complete line of Electrical Motors and Novelties.

KNAPP ELECTRIC & NOVELTY CO.
523 West 51st Street, N. Y. City



Box like a Champion!

Do you want to outbox the best man in your crowd, no matter how big or strong he is?

You can do it all right. Marshall Stillman teaches you by mail, right in your own home. You learn how in five simple lessons. A few weeks' practice makes you lead, guard, hit, duck and feint like an expert professional. Also how to defend yourself against all sorts of violent attack.

Don't believe it? We take the risk. We send you the Course free on approval. If you like it you pay for it the 15th of next month—$5 in U. S., $6 in Canada, $7 in other countries. If you don't like it you return the Course in 10 days.

Write today. Give name and address clearly.

MARSHALL STILLMAN ASSOCIATION
Suite E204 461 Fourth Ave., New York





"Lighting Fixtures"

Ready to Hang

(Direct from Manufacturers)

Completely wired, including glassware. New designs.

Send for catalog No. 20

ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.



Learn to Dance

You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances *in your own home* by the wonderful Peak System of Mail Instruction.

New Diagram Method. Easily learned; no music needed; thousands taught successfully; success absolutely guaranteed.

Write for Special Terms. Send *today* for FREE information and surprisingly low offer.

WILLIAM CHANDLER PEAK, M. B.
Room 244 4737 Broadway, Chicago, Ill.

ALL MAKES



Underwoods, Monarchs, Remingtons, L. C. Smiths, Olivers, Royals, Coronas AT REDUCED PRICES. Prices as low as.... **$20.00**

Write for our Catalog No. 15

BERAN TYPEWRITER CO.
Dept. 21, 58 W. Washington Street, Chicago

both sides of the paper can be used. It must be remembered that the letters are read by the points in relief,—the arrangement of this machine is such, that the relief points on one side of the paper occupy the blank spaces of paper between the relief points on the other side. Of course with this machine exact registration is absolutely essential. Again we have the six keys arranged radially for making the Braille embossments. Like all the machines hitherto mentioned, this Constançon machine is deficient in speed.

We now come to a stenographic machine. M. Pierre Villey, the eminent professor of the University of Caen, France, blind from infancy, invented a stenographic machine for the blind, and in spite of the war, managed to complete its construction by October, 1916. It uses syllabic signs and adhering to the Braille embost points, the inventor developt a most ingenious phonography of his own. It is fair to say that the development of his stenographic system to be written in points, was as much an invention as the machine which executes it. Twelve points in his system can be combined in over 4,000 ways, giving an immense number of syllables; three lines are used for the development of each normal line of writing. What is called the tactile field of the finger is not called upon to go outside of the area of the six Braille points. He has even developed the embossing to such an extent that the blind person can read simultaneously with both hands.

A blind stenographer has reached the remarkable speed of 140 words a minute with this machine. It is to be noted that he was an exceptionally expert operator. Our illustration shows the general arrangement of the parts and it will be seen that it prints upon a wide band of paper.

Finally Lieut. Muller, an officer of distinction who was wounded in the war, and blinded there, has produced what he calls his stenoglyphe, also in the year 1916. He uses a phonetic stenograph alphabet in which each sign represents a syllable. He adheres to the Braille embossments. He uses ten points. One feature of his system which is favorably commented on, is that while its rapidity of execution is quite sufficient, it gives a text very easy to read. It was thought at one time that the ten points covered too much of an area, but it is found that it can be read with as great a rapidity as any other system.

FIREFLIES' LIGHT IS MOST EFFICIENT.

Fireflies which will soon be flashing in parks and gardens are called by Dr. E. Newton Harvey, professor of physiology, Princeton University, "a most extraordinary kind of lamp which is able to make its oil from the products of its own combustion." Speaking before the American Philosophical Society, he described the chemistry of the production of light by the firefly. Without going into technical details, it may be said that this light is due to the burning or oxidation of a substance called luciferin in the presence of an enzyme or catalyst called luciferase. As in other methods of burning, oxygen is necessary; unlike other methods, water is essential, and no carbon dioxid or heat is produced.

When the luciferin is oxidized, producing light, it turns to oxyluciferin and water. The strangest part of this reaction is that it reverses itself immediately, the oxyluciferin and water forming luciferin. 'Thus, while a firefly is flashing, oxyluciferin is produced, and between the flashes oxyluciferin is reduced and is now ready to be again oxidized with light production."

This reversible reaction can be produced in a test tube by any one who can collect the luciferin and luciferase.

Learn Mechanical Drawing



Men Needed

Salaries: $35 to $100 per Week

I personally stand back of the Columbia School of Drafting—founded, directed and owned by myself—and guarantee the training given by it to be absolutely as represented. The work of each one of our students has my personal supervision. We seek "Quality" students rather than "quantity," as our proposition is of the highest character in every respect.

Roy C. Claflin
President

Are you earning less than $35 a week? Can you reasonably expect your present position to pay you $35 to $100 a week in the near future? If not, this offer will interest you. We offer to qualify you for a profession which, at the very start, pays higher salaries than the average man receives. We offer you the best personal service obtainable. We offer you personal instruction in mechanical drawing and teach you expert Draftsmanship in your spare time, at your home, by mail, in the same practical way that you would learn it in any big Drafting department. We offer to qualify you for one of the many high-salaried positions in the Drafting field, and to keep you in touch with openings for Draftsman in big machine shops, industrial plants, manufacturing concerns and United States Government Departments. We guarantee to start you on real Drafting work at once qualifying you as a thoroughly trained professional Draftsman, capable of succeeding from the very start. One of the many outstanding features of our training is that it qualifies you in an unusually short time.

Become a Chief Draftsman

You cannot make a mistake by taking up mechanical drawing. The field is not crowded, nor can it be. No single profession today offers better opportunities. The great need for trained Draftsmen continues to increase. Each step forward in mechanical development creates a need for more trained Draftsmen. Promotion in this field is sure and certain. Men who start as Draftsmen are often advanced to Chief Draftsmen, Chief Engineer, Production Manager or other high-salaried positions. There is a constant demand for our graduates. We cannot supply them rapidly enough. Many of them are accepted even before they complete their training. This unusual demand for "Columbia" Trained Men is explained by the fact that our students enter upon actual drawing work the day they receive their first lesson. They spend no time with unnecessary preparation or useless theory.

The Largest Institution Specializing in the Training of Draftsmen. Teaches You Mechanical Drawing at Your Home.

This is the mechanical age in world history. The day of big opportunities for technically trained men is here. Especially is this true in the case of Draftsmen, on whom the mechanical industries of America and the entire world depend. On no one profession does the continued development of machinery so nearly center. With the training which we can give you at your home, your services will always be in demand, at a premium, in this permanent, highly paid field.

Drawing Instruments Furnished

We supply our students with complete drawing equipment. A professional outfit is furnished, together with a highest grade set of Drafting instruments for your permanent use.

No Previous Training Necessary

As our students are put into actual practice at the beginning, they grasp the essentials of drawing quickly. The lessons supplied are thorough, clear and easily understood even by those who have had no previous technical training of any kind. No previous experience or special education is necessary.

Send in the Coupon Today

It Brings to You full particulars of our proposition. Your future depends upon what you do now. We cannot begin to tell you here, in so few words, of the advantages afforded you by this unusually practical course in up-to-date mechanical drawing. If you are in earnest and desire to learn a big-paying profession, we urge you to act now by returning the following coupon. We will immediately send you our book of information, "Your Future in Drafting," which tells of our new method of teaching mechanical drawing and outlines our offer to you fully.

COLUMBIA SCHOOL of DRAFTING

Roy C. Claflin, *President*

Dept. 1406, 14th and T Streets

WASHINGTON, D. C.

SEND THIS COUPON TODAY

COLUMBIA SCHOOL of DRAFTING

Dept. 1406, 14th and T Sts., WASHINGTON, D. C.

Without obligation to me, please send me your illustrated book on Drafting, telling how I can secure your complete home study course and your help in securing a position as Draftsman.

Name.....Age.....

Address .....

City.....State.....



This Man Wouldn't Stay Down

He was putting in long hours at unskilled work. His small pay scarcely lasted from week to week.

He saw other men promoted. Then he learned the *reason.* They had special training. He made up his mind to get that kind of training.

He sent to Scranton a coupon like the one below. That was his first step upward.

The reward was not long coming—an increase in salary. Then he was made Foreman. Now he is Superintendent.

It just shows what a man with ambition can do!

What about you? You don't *have* to stay down. You *can* climb to the position you want in the work you like best.

The way to do it is easy—without obligating yourself in any way, mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6187-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ Pharmacy
☐ Electric Wiring	☐ SALESMANSHIP
☐ Electric Lighting	☐ ADVERTISING MAN
☐ Electric Car Running	☐ Window Trimmer
☐ Heavy Electric Traction	☐ Show Card and Sign Paint'g
☐ Electrical Draftsman	☐ RAILROADPOSITIONS
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ Business Correspondent
☐ Ship Draftsman	☐ BOOKKEEPER
☐ Machine Shop Practice	☐ Stenographer and Typist
☐ Toolmaker	☐ Cert. Pub. Accountant
☐ Gas Engineer	☐ Traffic Management
☐ CIVIL ENGINEER	☐ Commercial Law
☐ Surveying and Mapping	☐ GOOD ENGLISH
☐ MINE FOREM'N OR ENG'R	☐ STATIONARY ENGINEER
☐ ARCHITECT	☐ CIVIL SERVICE
☐ Architectural Draftsman	☐ Railway Mail Clerk
☐ PLUMBING AND HEATING	☐ Textile Overseer or Supt.
☐ Sheet Metal Worker	☐ AGRICULTURE
☐ Navigator	☐ Poultry Raising ☐ Spanish
	☐ Automobiles ☐ Banking

Name _____

Present Occupation _____ Business Address _____

Street and No. _____

City _____ State _____

1-1-21

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada

Make $100 a Week

GO INTO BUSINESS FOR YOURSELF

Retail Rawleigh Good Health Products. Toilet Preparations, Spices, Flavors, Cocoa, Dessert Powder, Household Medicines, etc. 130 useful items needed in every home every day. On market 30 years—used by millions. Your relatives, friends and acquaintances will buy at sight—become regular customers. Easy to build permanent, profitable, big paying business. Pleasant, healthful, outdoor work. Make $3000 to $5000 a year, or more. Experience or capital not necessary. We furnish free advertising matter and sale helps. Write for particulars.

THE W. T. RAWLEIGH CO.
361 Liberty St., Freeport, Ill.

Write Like This

Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. **Complete outline FREE.** Write C. J. Ozment, Dept. 44 St. Louis, Mo.

200 Miles per hr. Air Propelled Railway

(*Continued from page* 1279)

major part of the load or weight, the car units resting on ball-bearing wheels so as to minimize all friction.

The car units as devised by the inventor, are intended to be made up in short, inter-locking sections, the coupling between each unit being flexible to a certain degree so as to facilitate the train of several sections moving thru curved tubes at high velocity.

Mr. Barlow has called the front section, the "engine unit," and this contains the electric motors and the propellers which create the rearward thrust on the air and on the side walls of the tube, which walls are formed into annular pockets with curved tails, the air taking the course indicated by the arrows. The tube is designed to be about 9 feet in diameter, while the body of the train and the engine units are much smaller so as to provide plenty of space for the air currents and propeller action.

Mr. Barlow has had considerable experience in flying large airplanes and it was due to this experience, that he was imprest with the idea of designing a new transportation carrier embodying the principles here elucidated. The reason for using three propellers is based on the fact that a smoother action is obtained in creating such a high velocity thrust on the air. Each of the three propellers rotates at the same speed, but they are arranged with successively increasing pitch so that the air current from front to rear is smoothly but rapidly accelerated to a very high velocity.

One of the principal points covered in his patent on this railway, and as explained to the editors, is the arrangement of the inner wall of the tube or duct so as to quickly bring to rest the rapidly moving air currents set up by the propellers mounted at the forward end of the car or train. If this were not done, a powerful current of air would be created which would continue rearwardly from the train for a great distance, and would eventually interfere with the progress of any train or car units which might be following close upon the leading train.

The inventor explained that by this method of curving the rear edge of each wall pocket around toward the front, any current of air thrown into it by the propellers, would swirl around and be shot out in a forward direction eventually, so as to react against the sides of the train,—as well as forming a reaction jet or wall for a part of the rearwardly current of air from the propellers, and thus give greater speed to the onward rushing train.

By this arrangement of the operating factors, it will be seen that all which will result in the rear of the train, would be a series of air eddies or practically local swirls of air.

Another one of the important merits of this system, as compared to an airplane flying in free air, is that none of the power used in propelling the train *is required for sustaining the load,* as is the case with the former machine.

The inventor also points out that the provision of the enclosing tube insures a continuous solid and stable condition of the air on which the propeller operates, and it is interesting to note that contrary to most systems proposed along these lines, the tube does not have to be air-tight. In fact when there are conditions where ex-

Make Your Own Selenium Cells

Complete Selenium Cell Outfit

Just the Thing for the Experimenter

A complete selenium cell outfit shipped in metal carton, including fully illustrated book on selenium cells entitled, "Selenium Cells and How They Are Made," by Samuel Wein (the only book of its kind on the market), together with a piece of selenium, a slate slab and sufficient wire to make a selenium cell.

This book contains a very valued analysis of selenium, giving such information as to its discovery, its source and manufacture for commercial uses, its chemical characteristics and an instructive talk on the various cells in which it is used. Intelligently written in very plain language.

Only a limited supply of these books on hand.

$2.00 COMPLETE Postage Prepaid



Order today

The Steen-Bleyer Chemical Company
1807 Candler Building
220 West 42nd Street
New York City

The Boys' Magazine FREE!

Send us the names and addresses of 10 boys (from 10 to 16 years old) and we'll send you a copy of this splendid magazine FREE. Great stories—beautiful illustrations—handsome covers in colors. Departments devoted to Wireless, Electricity, Mechanics, Athletics and Physical Training, Moving Picture Plays and Players, Cartoons and Jokes. (Write plainly.)

Address

THE SCOTT F. REDFIELD CO.
6028 Main St., Smethport, Pa.

THE BOYS' MAGAZINE on sale at all newsstands, 15c a copy

1/4 H. P., 110 volts, A. C., 60 cycle, single phase, 1750 R. P. M.

MOTORS

LARGE QUANTITIES NEW WASHING MACHINE MOTORS

These are of standard manufacture and carry the full factory guarantee. Shipped in original boxes. Complete as cut. Suitable for operating Coffee Grinders, Cream Separators, Bottle Washers, Air Compressors, Small Lathes, Etc.

Mail $1.25 cash or Money order. We will send C.O.D. subject to full examination. Money Back Guarantee.

Bargains in Small Motors and Generators. Write for Catalogue. Special Quantity Prices-Value $22.50

$22.75 Each

MANUFACTURER'S DISTRIBUTER

GEO. B. JOHNSTON - Box 12 W. E., Pittsburgh, Pa.

LEARN ENGINEERING

Electrical and Mechanical Engineers receive fabulous salaries. Thousands wanted. 3 months to 2 years Practical-Technical training under experts. Not a trade school but a Practical-Technical College teaching electricity, steam, gas, auto-electric, armature winding, drafting. Extensive laboratory and shop equipment. Degrees awarded. Day and night sessions. Enroll any time. Don't judge us by size of ad. Write for free catalog. FINLAY ENGINEERING COLLEGE, 1003 Indiana Avenue, Kansas City, Mo.



PROTECT GOOD TOOLS

UNION Tool Chests

Good tools deserve a Union chest. Styles and sizes for all mechanics. Quartered Oak, Plain Oak and Covered. Write for catalog and prices.

UNION TOOL CHEST CO., Inc.
36 Mill St., Rochester N.Y.

You can be quickly cured, if you

STAMMER

Send 10 cents for 288-page book on Stammering and Stuttering, **"Its Cause and Cure."** It tells how I cured myself after stammering 20 years. **B. N. Bogue, 777 Bogue Bldg., 1147 N. Ill. St., Indianapolis.**

tremely high speed is not desired, it need not be covered at all.

It would seem that the high speed claimed by the inventor, as attained by this novel form of railway, propelled by air screws in contra-distinction to the usual form of railway car propelled by an engine or electric motor geared direct to the wheels,—is due to the fact that with the standard form of railway, the total tractive effort—which directly concerns the speed and power with which the car is moving,—is dependent upon the great weight of the car upon the wheels.

In other words, the steam locomotive which has the largest weight directly over the driving wheels,—other things being equal, such as good design, etc.,—will exert the maximum tractive effort. Further it seems that Mr. Barlow gets around this defect by decreasing the weight on the bearing wheels in order to realize high speed and propelling power by utilizing the air screw as employed in the airplane.

The traction of a locomotive engine depends on its weight, giving adherence to the wheels, but of course an airplane has no such requirements, the lighter it is the better, and in the Barlow air-screw engine, the weight has nothing to do with its tractive power.

At this point it might be well to mention, as a matter of actual fact, that no railway carrier in which motors or other prime movers are geared directly to the wheels, have ever attained a speed in excess of 130 miles per hour (Berlin-Zossen tests)—but, as we know, airplanes have reached a speed closely approaching 200 miles per hour in the past year, in several instances,—and a speed of 150 to 160 miles an hour has been attained several times by the standard type, medium powered, U. S. Government mail planes.

Mr. Barlow prefers to drive his propellers with a series of eight small electric motors, geared in any suitable manner, in preference to one large electric motor, for the simple reason that the small motors can operate at high speed much more efficiently and safely than a large one. All the construction and operating features of such an air-propelled railway are we believe, quite clear now, and these features present mostly details to be worked out by construction engineers.

COMMERCIAL ASPECTS OF THE AERIAL PROPELLED RAILWAY.

The commercial features of this air-propelled railway devised by Mr. Barlow, are surprising and revolutionary in the extreme. As pointed out by Mr. Barlow in an interview, the inventor's great dream is to see railways of this type built over great stretches of country so as to serve not only sections of great cities or suburban sections thereof, but to act as automatic high speed carriers of everyday mail, grain, oil, etc., between various parts of the country,—such as between the lake-ports of the North and the gulf-ports of the South.

One of the detailed drawings in the illustration herewith shows one of the unique features of the Barlow aerial railway, namely, the automatic switching arrangement and the device whereby the cars can be routed at their originating stations so as to distribute themselves to the proper destination, without the aid of any human agency. A code box with a series of levers projecting for each of the different stations along the route, which route may be several hundred miles in length or more, is fastened to the forward end of each train.

As will be evident, if the index trip is pulled out corresponding to St. Louis, for example,—and a car is started at Chicago

Quick Success in Electricity!



Get Ready to Make Big Money

Thousands of Electrical Experts Needed

Electricity is King. No other industry in the world offers the wonderful chances for big money and quick success that the Electrical Industry offers to ambitious men today. Trained Electrical Experts are needed to fill big paying jobs. This is truly the electrical age — electricity is rapidly taking the place of steam and hand power. Thomas A. Edison says Electricity is still in its infancy. So get into it now. Those who get in now are the ones who will cash in big.



A. W. WICKS
Elec. Engineer

My extensive electrical experience has been gained with such important industrial concerns as General Electric Company, Jenney Electric Co., Fairbanks, Morse & Company, also as Advisory Engineer for such mammoth companies as Corn Products Co., Quaker Oats Co., and the Corporation Steel Plants.

To $150 a Week and More

Go as high as you like. No limit to salaries in Electricity. In the Electrical Industry it is not a question of pay, it's a question of trained men — electrical experts are needed to fill big jobs as Power Plant Superintendent, Chief Electrician, Sub-station Operator, Electrical Inspector and hundreds of other positions. Electrical Contractors also make big money. There is also big money in conducting Electrical stores.

FREE

Here are some things I give and do for my students Absolutely FREE.

1.—Complete and Valuable Electrical Tools, Instruments and Equipment.
2.—Monthly Bulletin of interesting facts and news of what's doing in Electricity.
3.—Practical Training in Electrical Draftsmanship and Blue Print Reading.
4.—Prepay charges on everything I send you.
5.—An indispensable Electrical Dictionary.
6.—Full benefits of my Employment Service.
7.—Complete supply of Examination Paper, Envelopes and Stationery.

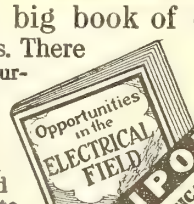
Space does not permit me to detail the scores of other things I do for my students Absolutely Free.

Learn at Home I Teach You MYSELF

I am an authorized Electrical Engineer. Every student is under my personal instruction assisted by an advisory staff of prominent Engineers and Electrical Manufacturers. The Wicks Electrical Institute is known nationally as the largest and foremost school giving home training in Electricity, and its policies and methods are highly endorsed by the Electrical Industry. Its system of instruction is positively "Best by Test," for its graduates make good.

BIG BOOK of Opportunities FREE

Let me send you this big book of opportunities with my compliments. There is no obligation. Find out for yourself what is doing in the Electrical Industry. You owe it to yourself to investigate. This book shows what other ambitious men have done in this field and what you can do. With this wonderful book I'll also send you a complete outline of my method of instruction and actual letters from my students and graduates testifying to what my training has done for them.



Save $43.00 Tuition Now

SEND COUPON TODAY—DON'T DELAY Those writing now will save $43 00

This offer is special and is made for a limited time. So mail coupon at once. This is the most unusual offer ever made to ambitious men. So hurry.

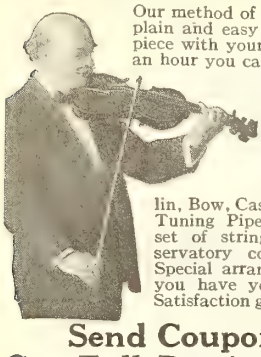
A.W. Wicks, E. E., Pres., WICKS ELECTRICAL INSTITUTE
3601 Michigan Avenue, Dept. 2994, Chicago, Ill.

FREE COUPON

A. W. Wicks, E. E., Pres., WICKS ELECTRICAL INSTITUTE,
3601 Michigan Avenue, Dept. 2994, Chicago, Ill.
Without any obligation send me your Big New Book, "Opportunities in the Electrical Field," and full particulars regarding your method of training.

Name.....
Address.....
City.....
State.....

Learn to Play the Violin IN YOUR OWN HOME



Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it. Complete course under personal direction of Prof. A. Hinchcliffe, a musical director and violin teacher of prominence for the past forty years. Low price includes Violin, Bow, Case, Chin Rest, Rosin, Tuning Pipes for all strings, extra set of strings, and complete conservatory course of instruction. Special arrangement for lessons if you have your own instrument. Satisfaction guaranteed.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK

I am interested in the VIOLIN. Please send complete information, special offer, etc.

Name.....

Address.....

S. & I.—V.

Town and State.....

Write Name and Address Clearly



6000 Mile Guarantee

Clifton Double Tread Tires are noted for their long wearing qualities. **All are standard makes** reconstructed in our own factory by experts. 6,000 mile guarantee. These wonderfully long wearing tires must go at

FREE TUBE and RELINER

SMASHED PRICES

30x3	$ 6.90	34x4	$11.10
30x3½	7.95	34x4½	12.25
32x3½	8.75	35x4½	12.75
31x4	9.85	36x4½	13.25
32x4	10.35	35x5	14.00
33x4	10.80	37x5	14.25

Free Tube & Reliner

State size wanted S. S. or Cl. Non-Skid or plain tread. Send only $2.00 deposit, balance C. O. D. subject to examination. **Satisfaction Guaranteed. Order To-day — Supply Limited.** 5% discount if cash is sent with order.

CLIFTON TIRE CO.
3536 Ogden Ave. Dept. 44A, CHICAGO, ILL.

BE A REAL MAN!

LOOK LIKE ONE AND FEEL LIKE ONE



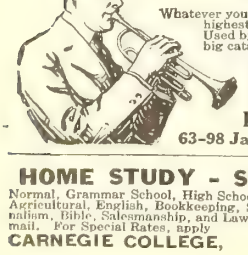
Broaden your shoulders, deepen your chest, enlarge your arms, and get a development that will attract attention. Fill yourself full of energy and be powerful.

My New Book
"Muscular Development"
Will Explain How

This book is illustrated with 25 full page photographs of myself and of some of the world's finest developed athletes I have trained. It will interest and benefit you greatly.

Send 10c (stamps or coin) for a copy NOW, today, while it is on your mind.

EARL LIEDERMAN, Dept. 204, 305 Broadway NEW YORK CITY



Big Band Catalog sent free

Whatever you need—from a drumstick to the highest priced cornets in the world. Used by the Army and Navy. Send for big catalog; liberally illustrated, fully descriptive. Mention what instrument interests you. Free trial. Easy payments. Sold by leading music stores everywhere.

LYON & HEALY
63-98 Jackson Blvd. Chicago

HOME STUDY - SPECIAL RATES

Normal, Grammar School, High School, Civil Service, Engineering, Agricultural, English, Bookkeeping, Shorthand, Typewriting, Journalism, Bible, Salesmanship, and Law Courses thoroughly taught by mail. For Special Rates, apply

CARNEGIE COLLEGE, ROGERS, OHIO

with this trip properly arranged, the car will hit the St. Louis "trip" when it reaches that city, causing the track to be switched over a considerable distance ahead of the swiftly moving car, and it will be shunted into the St. Louis tube. As seen, when the car passes into the St. Louis tube, it hits a second trip which causes the main line switch section to be quickly moved back into junction with the main line tube. A flexible section of tube can be used for this switching purpose, as one of the diagrams clearly shows. This is a detail which can be solved, of course, in several different ways.

The beauty of Mr. Barlow's idea which appeals to our minds in both a commercial and utilitarian sense, is the automatic distribution of great quantities of grain, oil, and other miscellaneous products, to shipping ports and municipal distribution centers at a heretofore undreamt of speed. The cars in this system can be operated all day and all night, and follow one another at intervals of one-half to one mile, the distance between them being regulated, if necessary, by automatic electrical block systems.

The cars need never stop,—even to discharge their cargoes, an automatic trip system being arranged at the receiving warehouse, whereby the grain for example can be dumped from the compartments as the car moves at a reduced rate thru the graineries, the grain being readily discharged thru pipes directly into the holds of steamships, which would thus distribute the grain to all parts of the world almost automatically from the time the wheat was growing until it was received by the consumer.

Undoubtedly it will be found advisable to adapt a system of signals to be placed in the master dispatcher's office of his high speed railway, which would indicate instantly at a moment's notice, just what carriers were in the tubes and their exact location, similar to the visual signal boards used at the Panama Canal, and also in the Hudson Tube Railway system which passes under the Hudson River from New York to New Jersey.

What to Invent

By JAY G. HOBSON

(*Continued from page* 1320)

Still, right now I would be mighty thankful if the S. & U. R. R. had a SANDWICH SLOT MACHINE somewhere in its anatomy, and from the look upon the faces of the other early birds stretched around me, who didn't get their worm either, I'll wager ten to one, there wouldn't be many sandwiches left, at any price, if there was only a sandwich slot machine where we unfortunates could push our coins into it. So if this condition is true with us today, why isn't the idea for a sandwich slot machine for trains, and public places as practical as chewing gum slot machines? I am sure it is, and also believe slot machines for dispensing food in such places would make lots of money for the inventor and those placing them there.

WATER PURIFIER FOR LIFE BOATS.

I have in mind a possible filter of improved design, made so sea water could be poured into it and purified for drinking purposes. A filter construction with the purifying element of silver citrate or some other substance that would decompose the saline contents of sea water, and make it suitable for drinking when wrecked at sea. One of these filters would be included as standard equipment on each life-boat.

(Copyright by Jay G. Hobson, 1921.)

Klim Mattress $10.95 and Express on Arrival



Large Size

Send No Money

Famous FELT Mattress

At a Rare Bargain

Just send your name and address—no money—and we'll send you a genuine first quality Klim Mattress. All you need to do is pay expressman the special low introductory bargain price of $10.95, and express, on arrival. You take no risk—money back promptly if not satisfied.

ENJOY REAL COMFORT

Never before has it been possible for us to offer this famous 50 pound, high quality, long wearing, all felt mattress at such an amazing price. Made of pure white layer felt covered with best quality blue and white striped ticking. This is the mattress for a lifetime of wear.

Order NOW at Bargain Price!

Send your order today—no money down. If dissatisfied, return to us and we pay charges both ways. Be sure to state whether 42, 48 or 54 inch width. Order now. Supply limited.

HOUSE OF ANTON KLIMEK & SONS
1257 Noble St., Dept. 105 Chicago

Price $1.50



Foreign $1.60

SCIENCE PRODUCED IT

The THERAPHONE Mouthpiece puts your message across CLEAR. Gets attention—holds it—makes friends. No repeating or confusion. Unequalled for privacy, range and perfect phone service. Affixed in a minute. Endorsed by users everywhere. Check or C.O.D. Satisfaction guaranteed.
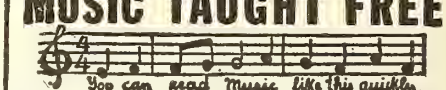
THE EVOLUTION PHONE COMPANY, Inc.
48-CM Greenwich Avenue New York City



$4 AND $5 a month WILL BUY
A Standard, Guaranteed
TYPEWRITER
With Every Modern Writing Convenience

WRITE TODAY FOR ILLUSTRATED CIRCULAR Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

MUSIC TAUGHT FREE



You can read Music like this quickly

In Your Home. Write today for our booklet. It tells how to learn to play Piano, Organ, Violin, Mandolin, Guitar, Banjo, etc. Beginners or advanced pupils.
American School of Music, 57 Lakeside Bldg., Chicago

Handwriting Tells You Secrets

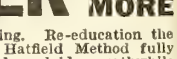
Be successful. Find out what holds you back. Send us an ink specimen of your handwriting and $1.00. Our expert Graphologists will tell you your faults, virtues, talents, etc. Your $1.00 back if you are not satisfied.

ROBERT R. ROSS, 110 West 40th St., N. Y.

STAMMER NO MORE

Kill the fear of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Order a copy today. **THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago, Illinois**

"FIBRE-LITE" LIMBS



Easy Payments—Do Nature's Work. **AGENTS WANTED** who wear leg. Good Pay. FREE Fibre Sample.
Describe Stump to
WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.



PIGEONS PAY Easy raised, any small building, very little space required. Build their own nests, feed their own young. Very profitable business. Get your start with a few good pairs. Write today for 1921 Circular.
Pigeon Supply House, Hanover, Pa.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER LONGMONT, COLO.

Electric Power from the Air

(*Continued from page* 1280)

urements obtained, in a number of works which may be consulted at the local library.

The atmospheric charge is usually gathered on a metal ball fastened to a rod, to the other end of which rod is connected an electro-static voltmeter in a suitable casing. Measurements have been made with this apparatus during the changing seasons of the year; the apparatus has been established in a laboratory on the ground as well as in a balloon which was sent aloft.

Dr. Plauson therefore proposes in his latest scheme for utilizing the electrical energy collected in the atmosphere, that we send aloft a series of inflated balloons having metal coatings, all of these balloons being connected by means of flexible copper conductors so as to discharge all of the energy they may gather thru a single large conductor to the central power station, as shown in the accompanying illustration.

Several important and extremely interesting points now come up for consideration. One of these is that it would probably be advisable in the first plants that are erected for this purpose, to place them on high elevations such as mountains or hills, as in this way it may prove possible to gather the same quantity of electrical energy with a shorter balloon cable than would be the case with plants situated in valleys. If the balloon cables were guyed, the guy wires would have to be suitably insulated the same as radio antenna masts, so as to prevent the dissipation of energy down thru the guy wires to earth.

Dr. Plauson points out that the balloons should be fitted with a multitude of sharp points in order to enhance their collecting powers for the static electricity of the atmosphere, which, as is well known, always discharges toward or from a point more rapidly than with other form of discharger. He even goes so far as to propose that we shall attempt the ionization of the air in the neighborhood of each balloon by suitably coating or painting the surfaces of the balloons with some radio-active salts,—of radium, of polonium, or of other metals.

Some interesting ideas in this direction were publisht several years ago in this journal,—where the process of producing rain by discharging huge quantities of electrical energy from metal surfaced balloons placed in a highly ionized atmosphere, was described. There the ionization was created by powerful X-rays or by ultra-violet rays.

Another very interesting question, but which does not condemn the scheme necessarily, is as to whether or not the electrical energy would be drawn off continuously (under normal weather conditions) or whether it would be discharged to the central collecting station periodically,—similar to the discharge of static electricity which most of us have probably heard in the receivers of radio telegraph stations; but in any event the main problem which all atmospheric electricity investigators have been confronted with, is the danger of being annihilated or else of having their plants destroyed when electric storms are frequent as in the summer months; when a lightning discharge is of unusual severity, it may pass down the balloon feed wire or cable and destroy the machinery of the plant.

If I Had But Two Dollars In The World I Would Pin Them to The Bottom of This Page!

Because This is Your *ONLY* Opportunity To Order Matysek's

Muscle Control Course for but $2.00

In the future the price will be higher

It is the scientific system of control of all the physical functions. You can cure yourself of any functional disorder. You will be independent of all medicines and drugs which you know cannot bring health and are always debilitating. When physicians fail in getting results they suggest Matysek—the Maker of 100% Men.

A "Body Beautiful" Maker

Thousands of men say this course is the surest and quickest "muscle bulging out" stimulant. A curative system of exercises that produce really athletic men with graceful outlines full of strong personality.

These exercises are the CHIEF SECRET of why I am growing despite my age, each day stronger and better developed as well.



ANTONE MATYSEK

the muscular phenomenon, the man who is offering to place you on the energetic strong man map. When you find your place on this map you will always be full of pep, ambition and joy. You will be a REAL MAN and then will achieve your chief aim!

Course Consists of

Two handsomely finished charts containing twenty-one beautifully produced pictures of myself, many of decidedly larger size than the above specimen, showing every detail as to how to perform the movements with absolute correctness. The instructions are in book form and "straight from the shoulder" such as only an expert who went through the mill himself could ever possibly produce.

Let My Muscle Control Exercises Mold Muscle On You Quickly and Solidly!

Only ten minutes a day, in the privacy of your own room, solves any case. I know that in less than five days your efforts will be realized to a most surprising extent. If you are already training on some good "system" these Muscle Control exercises will force your progress to be 100% faster! If, however, you do not exercise, then for your own sake and own happiness, start building yourself up into a *real man.* Do not merely drag on.

Some Subjects are

How to quickly make respond the inactive bowels, easily correct the rounded shoulders, in no time expel the bothering gas out of the stomach, promptly chase away the staleness of the body, strengthen the nerves and internal organs, easily overcome the bodily abuse, efficiently strengthen the sexual organs, control every muscle of your body, store up energy for feats of strength, also: Complete relaxation and contraction—Effective breathing—the best way to arouse your inactive nerves—creation of better blood circulation—easiest way to increase your chest circumference—the famous shoulder blade control—how to thicken the shoulders—how to learn the art of making your shoulders supple from only three days' practice—development and control of the neck muscles—spreading of the back—depression of the abdominal muscles and wall—control of the pectoralis (chest muscles), the biceps, triceps, thighs, calf and all other muscles—how to train the abdominal regions to be immune from rupture—how to master correct posture—simple yet positive cure for insomnia—how to pose for good pictures—Advantages of perfect co-ordination of muscles and mind through concentration which brings success and all the good things that go with it, and many other vital pointers you need every day, too numerous to mention.

Of Particular Interest to YOU

Every reader of Science and Invention is earnestly requested to purchase this course NOW as the truly wonderful benefits it is bringing thousands of men and women throughout the world has prompted me to sell it at practically no profit so that YOU and every one else may enjoy Life at its Best. The two-dollar price applies to this course for a limited time only. The price will surely be increased in the next advertisement. Send for your copy *today* and start reaping the benefits by return mail.

You Can Well Afford It. Costs But $2.00

I guarantee quick results and absolute satisfaction or money back. Come, Friend, let me help you! I will place you on the real road and show you the main secret that helped me to get what I longed for and now certainly possess. In addition you have the privilege to ask any questions pertaining to your physical training; to these I will gladly reply giving you personal attention. This favor alone is worth the $2.00. Better avail yourself of this splendid offer *right now*, for in the future the charges will be doubled. You will be the envy of your friends. Learn how to get the most out of yourself. It is easy and YOU CAN DO IT! GET STARTED RIGHT—RIGHT NOW! Simply tear off the coupon below, mail with but $2.00 (Canadian and Foreign orders—$2.20) and leave the rest to me.

Prof. Matysek

Muscle Control Dept. 401, 523 N. Charles St., Baltimore, Md.

Detach and mail NOW while it is on your mind.
PROF. MATYSEK, Muscle Control Dept. 401.
523 N. Charles Street, Baltimore, Md.

I want bulging muscles and yet I want them to have fine outlines. I desire to increase my strength, my internal activity, my energy, my manly powers. I want to be more than I am now and I want to achieve my "chief aim" in a short and efficient manner. For these reasons send me your wonderful Muscle Control Course, illustrated with 21 high grade pictures of yourself. If I am not completely satisfied, my money will be promptly refunded if course is returned within 48 hours.

Name.....

Address.....

City.....State.....S&I 4-21

PUBLISHER'S NOTICE—The above statements are guaranteed to be entirely truthful.

LEARN WIRELESS AT HOME

The Demand for Good Wireless Operators far Exceeds the Supply

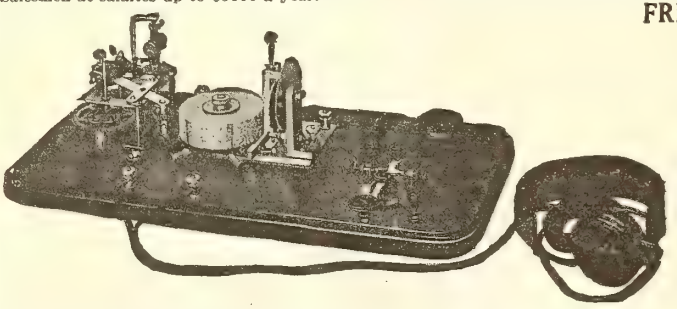
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, formerly Chief Radio Inspector, Bureau of Navigation, N. Y. He resigned last August to accept a position of still greater responsibility with one of the largest Commercial Radio Corporations in the United States. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



FREE Instruments and Text Books

We furnish free to all students, during the Course, *the wonderful receiving and sending set exactly as shown in the illustration.* **This set is not loaned, but given to all students completing the Course. One cell of dry battery all that is required. No additional wiring, aerials, etc., needed.**

This wonderful Set for learning the Code furnished free with our Course.

The Transmitter shown is the celebrated **Omnigraph** used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the **Omnigraph,** place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the **Omnigraph**—the same model **Omnigraph** as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

Wireless Telephony Course

We have incorporated in our Institute an up-to-date and complete Course in Wireless Telephony, written by our Chief Instructor, Mr. L. R. Krumm. **This Course is also furnished free.**

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire at one of the largest Wireless Schools in New York City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

The Department of Commerce of the U. S. Government

recognizing the value of the instruction furnished by us, allows all of our graduates a five-point credit in their examination for first-grade license.

THE U. S. SHIPPING BOARD will also testify as to the value of this instruction.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

AMERICA'S FASTEST GROWING WIRELESS INSTITUTE

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—**but do it today.**

NEW YORK WIRELESS INSTITUTE,
Dept. 212, 258 Broadway New York City

There Must Be a Good Reason. There Is—

The Best Course in Theory available.
The Best Instruments obtainable.
The Best Text Books and Diagrams on the market.

NEW YORK WIRELESS INSTITUTE
Dept. 212, 258 Broadway, N. Y. City.
Send me, free of charge, your booklet "How to Become an Expert Wireless Operator", containing full particulars of your Course, including your **Free Instrument offer.**

Name.....
Address.....
City or Town.....State.....

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.

Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. Guaranteed by the maker. Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness. Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.

EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.

$2.98



6 YEAR GUARANTEE

SAMPLE WATCH FREE

Genuine full standard size railroad style watch with locomotive on dial and locomotive handsomely engraved on back. Full nickel plated case, extra dust proof, Arabic numerals on dial, heavy R. R. style figures. Genuine American make, stem wind and set, fully **GUARANTEED for 5 YEARS.** To advertise our business and introduce this wonderful watch and our great catalogue of Elgin, Waltham and Hampden watches we will send this elegant watch to any address by mail postpaid for **ONLY $2.98** and if you sell two of these watches we will give you **ONE SAMPLE WATCH FREE** for your trouble. Send this advertisement with $2.98 and watch will be sent by mail postpaid, or send $5.96 for two and we will send **ONE EXTRA WATCH FREE.** Order today as this offer may not appear again. Address **CHALMERS WATCH CO., 538 So. Dearborn St., CHICAGO, ILL.**

The diagram shown in the accompanying illustration is given merely as a suggestion of what we may expect in the direction of atmospheric power plants. Needless to say, the first and foremost mechanism we will have to design will be a suitable and absolutely certain lightning protector, and which is indicated in the present diagram by the ball spark gap. Practically all radio apparatus, at least the commercial types, are fitted with suitable micrometer spark gaps, so that if lightning or extra heavy static charges may pass down the antenna to earth, this energy will be able to leap the gap and thus prevent burning out of the apparatus.

Ordinarily, the atmospheric electric currents will pass down the balloon feed cable and thence thru the transformer primary winding down to earth, at the same time energizing or inducing electric currents in the secondary of the transformer, and from which the successive quotas of electrical energy may be stored in suitable accumulators (of the condenser or other type). The energy stored in the accumulators can then be drawn off as desired and distributed thru a transformer and transmission line. At the receiving end of the line possibly 100 to 200 miles away or more, the line current can be reduced by a transformer to a suitable potential for operating motors, lights, etc.

It is well to mention a word of caution on this point with regard to experimenting with atmospheric static electricity, and it may be said at the outset that this is not a branch of science to be investigated by those untrained in such matters, as they may be electrocuted,—particularly if an electric storm happens to be in the vicinity. The writer has seen electric sparks jump a gap of several inches across the blades of an aerial switch in a radio-telegraph station, even when an electric storm was only approaching and not yet directly overhead.

To those uninitiated in handling elevated aerial conductors such as radio antennae and balloon cables, etc., it should be noted that the only safe method and the one followed in practically all cases, is to ground such free elevated conductors during electric storms.

If it comes to pass that such plants prove practical and the hopes of Dr. Plauson and other investigators who are working on this problem, are actually realized. the electric current thus obtained from the atmosphere can be utilized directly in the preparation of nitric acid and ozone from the air, thus giving us a sure means of refertilizing the soil.

By suitably transforming the current, it can be further employed on a large scale in the realms of electro-chemistry and electro-metallurgy. A French writer, M. Matignon, has stated that by means of the electrical energy collected upon the surface of six square kilometers (about 2.16 square miles) will result in producing five tons of carbid within 24 hours. This expert further points out that if we assume that we obtain 100 horse-power per square kilometer, it will be possible to develop 100,000,000 horse-power from the total surface of France.

The German writer, who describes the invention of Dr. Plauson, and whose article appeared in *Ueber Land Und Meer,* states that one of the engineer's estimates shows that 720,000,000 horse-power per day can be procured from the atmosphere with an area equivalent to that covered by the German nation.

It is claimed by Dr. Plauson that even with the considerable initial cost of erecting these atmospheric electric collecting stations over the country, the operating factor of the total production cost would be considerably less than that resulting from electric plants operating with coal.



In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Making Money from an Invention*

By JAY G. HOBSON

(Conclusion.)

WITHIN a short time everything was arranged to spread the news far and wide about the meritorious sharpener. The following month several prominent magazines carried attractive advertisements of their products. Orders began to come in almost instantly. Dealers commenced to inquire about representation, salesmen were taken on to cover more territory, jobbers were becoming interested in large orders and business began to boom.

The little factory was soon swamped, another building was added, then another, until three times the former manufacturing space was being used. Figures began to reveal the fact that the cost of production was being decreased per article. The turnover was increasing by leaps and bounds. The profits, while smaller on each article amounted to many times the former total.

Over night, it seemed, these boys were actually getting rich. They became quite a factor in the business circles of the city and were soon rated among the very prosperous.

Advertising—telling the world about their product—made the universe their market and every nationality their customer. But had their product been of little value all the money and advertising at their command would not have made success permanent. After the public starts buying a new article or invention it behooves the manufacturer to maintain efficient service in his products so that the satisfaction will continue. Profitable repeat orders result from satisfied customers.

There are several ways to make money from an invention. One is to sell it outright for a certain cash sum, another to sell it to a manufacturer on a royalty basis, and another to form a company and market it. The first plan is the one most tried, but the difficulty encountered in finding a cash buyer discourages the majority of inventors. The second way is easier and often more profitable in the long run. The third I believe is the quickest of all, and undoubtedly the best, if the inventor has some executive ability, plenty of confidence in himself and in his invention and can influence sufficient capital, with the necessary cooperation from the investors to wait until the patent has had time to prove a commercial success.

It takes hard work and considerable time to place an invention on the market. It takes some money too, but money is generally forthcoming if the improvement has merit and possibilities of success. There are people who are always interested in a money-making proposition. They can be found through advertising, through friends and acquaintances, and by giving public demonstrations of the invention.

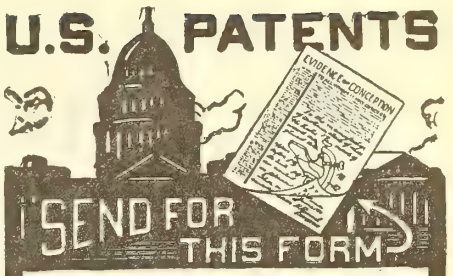
The American spirit is one of adventure; to take a chance for making big profits. A large number of people have the courage of the western pioneers handed down to them. They enjoy the thrill possible from investing in a prospect and cashing in when it becomes a large success. They understand that to make the big money from a new thing, a person must get in at the start, and sell out after the company has reached the peak of its career.

To wait until a business has become one of the seasoned investments paying the usual rate of interest, is to buy the securities at the top figure, which means paying someone else the big profit which could have been made by getting in on the ground floor in the beginning.

Everybody will lend an ear to the inventor selling an interest in a meritorious proposition where the commercial gain is in evidence. If the inventor first sells himself on the article, he will have little trouble to sell others, this day and time. The day of Bell, Fulton and Howe has gone and with it the many vexing tribulations of scorn, ridicule and abuse they

*No queries are publisht this month owing to the article by Mr. Hobson.

U.S. PATENTS



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg.
Pittsburgh Offices: 514 Empire Bldg.
Philadelphia Offices: 135 S. Broad St.
San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... *Address*.....

had to endure, in order to succeed with their inventions.

Today the inventor is encouraged, assisted and boosted along by the people if they are assured that he has ability and is sincere. Often men with money appropriate finances to further the success of some idea they learn to be of value.

So in this wonderful country of one hundred million busy people there is great opportunity for people with new ideas of improvements, to become successful inventors.

He need not be of a mechanical turn of mind. It may be an invention in fruit, clothes, shoes, painting, sculpture, chemistry and beverages. Or it can be an improvement in machinery, houses, wagons, bridges, tents, kitchen utensils, fixtures, glass and hundred of various things always needing improvements.

© 1921, by Jay G. Hobson.

Home Electrics

By G. L. HOADLEY, M. E.

(*Continued from page* 1305)

of the man of the house to have the cutouts for your flat located and marked in such a way that you will know them for certain, as you do not want to be meddling with some other family's fuses. Then open up the switch and replace the fuses as previously outlined. Opening the switch shuts off lights for the other families whose circuits lead to that cabinet-box of course, but it only takes a half minute at most to replace your fuses and the power-house quite often shuts off power for considerably longer periods. It is a perfectly safe way to replace blown fuses, however.

In some large flat buildings the switch is replaced by a fuse block with large fuses. It then becomes necessary to replace your blown fuses with others while the circuit is alive. To do this, open the self-closing hinged lid or door of the cabinet-box and insert a thin wedge-shaped piece of wood in the hinged side of the box to hold the door open. Then stand with both feet on a dry board and use one hand only for replacing one fuse at a time. Be careful not to touch any part of the metal cabinet-box with your hand or your body and replace one fuse at a time, then no shock can possibly be received.

There are several ways of locating your cutout blocks which lead to your flat. Your meter is tagged with your name and it is frequently possible to trace back from this point to the cutout blocks. Another way is to first make sure all switches in your flat are off except one. Then, let some one—your wife for instance, stand before your meter and have her tell you when the meter stops, as you replace one fuse in the various circuits. This will locate only one branch cutout. To locate the others repeat this procedure for each one of the switches in your flat.

The second way previously mentioned: namely, testing out each circuit in the cabinet-box to determine the blown fuse is nearly always preferred by the electrician or others familiar with electricity. Referring to Fig. 7, a test lamp is made by connecting two wires to an ordinary lamp socket. Use a heavy enough wire so that it will retain its shape well and bend it as shown in figure 7. Then, with one hand you can rapidly place the test lamp across the terminals of each cutout in turn. As long as the test lamp lights up the fuses are good, but when a cutout is reached where the lamp fails to light it shows that one or possibly both fuses are blown for that cutout.

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c

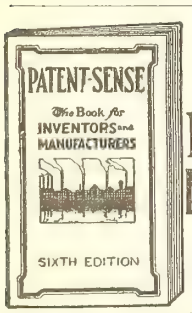
U.S. PATENTS

PROTECT YOUR RIGHTS



Write for "Record of Invention" containing forms establishing evidence of conception.
Send sketch and description for report upon patentable nature and instructions. Preliminary service without charge.
PROMPT PERSONAL - SERVICE

J·REANEY·KELLY
PATENT ATTORNEY
892 SOUTHERN BLDG.
WASHINGTON D.C.



"The Book for Inventors and Manufacturers"
SIXTH EDITION
By return mail FREE. Write LACEY & LACEY Dept K. Washington, D.C.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

PATENTS & TRADE-MARKS

SEND SKETCH AND DESCRIPTION for report on patentable nature, and instructions. Preliminary advice without charge. Full, prompt report in strict confidence. Reasonable terms, reliable service by Registered PatentAttorneys. WRITE TODAY

CLARENCE A. O'BRIEN & CO.
PATENT LAWYERS
1023 WOODWARD BLG., WASHINGTON, D.C.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

WILLIAM C. LINTON
Consulting Engineer and Patent Attorney

"Inventor's Adviser" Mailed free on request. Gives full information as to Patents, Trade Marks and Their Cost

OFFICES
364 University St., 331 National Union Bldg., Montreal, Canada. Washington, D.C.

PATENTS & TRADE-MARKS
FREE BOOKLET ON REQUEST
MY CLIENTS ARE INFORMED OF EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES
WARNER I. CUBBERLEY, PATENT ATTORNEY
22 NATIONAL UNION BUILDING
WASHINGTON D.C.

PATENTS

Write for free INVENTOR'S RECORD form for establishing the date of your Invention, and INVENTOR'S BULLETIN Confidential Service

WM. H. MULLIGAN, PATENT LAWYER
110 Woodward Bldg. Washington, D. C.

PATENTS

C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 74 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.

MUNN & CO., 618 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 625 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

PATENTS

Thirty-five years experience. Send model or sketch for opinion as to patentability. Free "Inventors' Guide." Highest references and personal attention assure best results.

FRANKLIN H. HOUGH
520 Washington Loan & Trust Bldg.
Washington, D. C.

Free Book on PATENTS



Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.

RADIOTRONS

POWER TUBES



RADIOTRONS FOR POWER WORK ARE HERE

U. V.—202 RATED AT 5 WATTS PRICE $8.00

MODEL U. V. 202	MODEL U. V. 203	MODEL U. V. 204
5 watt	50 watt	250 watt
Price $8.00	Price $30.00	Price $110.00
Filament V.—7½ volts	10 volts	12 volts
Filament current—2.35 amps.	6½ amperes	15 amperes
Plate V. 350 volts	1000 volts	2000 volts

Deliveries Begin March 10th

These Radiotrons are new types of Vacuum Tubes of improved operating characteristics, especially designed to provide long operating life.

A complete line of Radiotrons for radio detection, amplification and other power work are now available.

See your nearest dealer for full information

The Radio Corporation's tubes are covered by patents dated November 7th, 1905, January 15th, 1907, and February 18th, 1908, as well as by other patents issued and pending. Tubes licensed for amateur and experimental use only. Any other use will constitute an infringement.

Address all orders and inquiries to

SALES DIVISION, COMMERCIAL DEPARTMENT

RADIO CORPORATION OF AMERICA

233 BROADWAY

NEW YORK CITY

MODEL STEAM LOCOMOTIVE



As illustration, with *brazed* water tube copper boiler guaranteed to twice working pressure; *steel frames;* cast iron wheels on steel axles; *high efficiency* gunmetal cylinders; slip eccentrics for reversing.

Total length 3 feet. Gauge 2½ inches. Ready to run. $250.

Full set of machined parts with finished boiler, $110.

(Requiring the use of hand tools only.)

FREDERICK DEY, Grand Ave., Englewood, N. J.

D-L[11] INDUCTANCE COILS ½ PRICE

Order Now. Best Coils Given Out First. All Are Good. Some Slightly Shop Worn.

They are unmounted, and cover the wave lengths, as follows:

	Wave-Length	
D-L-25,	130-375	83c
D-L-35,	180-515	85c
D-L-50,	240-730	88c
D-L-75,	330-1030	93c
D-L-100,	450-1460	98c
D-L-150,	660-2200	$1.05
D-L-200,	930-2850	1.10
D-L-250,	1300-4000	1.15
D-L-300,	1550-4800	1.23
D-L-400,	2050-6300	1.30
D-L-500,	3000-8500	1.38
D-L-600,	4000-12000	1.53
D-L-750,	5000-15000	1.65
D-L-1000,	6200-19000	1.88
D-L-1250,	7000-21000	1.93
D-L-1500,	1200-25000	2.05

AMERICAN ELECTRO TECHNICAL APPLIANCE CO.

235 Fulton Street **New York, N. Y.**

U. S. Bureau of Standards News

(Continued from page 1318)

the principles of radio communication and which have been apt to surround the whole matter with an air of mystery, most people believe that the principles underlying wireless transmission are not very well known. On the contrary, radio communication is a natural effect following well-known causes.

The Transmission of Music by Radio

Music can be transmitted by wireless in the same manner as speech or code signals. As an incidental result of research work on radio telephony at the Bureau of Standards, it has been shown that music can be transmitted by radio without loss of quality. The possibilities in this direction are great and very interesting. By this means a concert given in one place may be available to those living at a distance. One way of transmitting music has been to place a phonograph so that the sound from it will pass into the radio transmitter. The Bureau of Standards has made an interesting improvement upon this method, which consists of substituting the carbon microphone, which is the mouthpiece of an ordinary telephone, for the vibrating diaphragm ordinarily used on the phonograph. As a result, the phonograph sound record produces direct variations of electric current in the telephone apparatus instead of producing sound; thus while no sound is heard where the phonograph record is being played, the music is easily heard by those at the distant receiving stations.

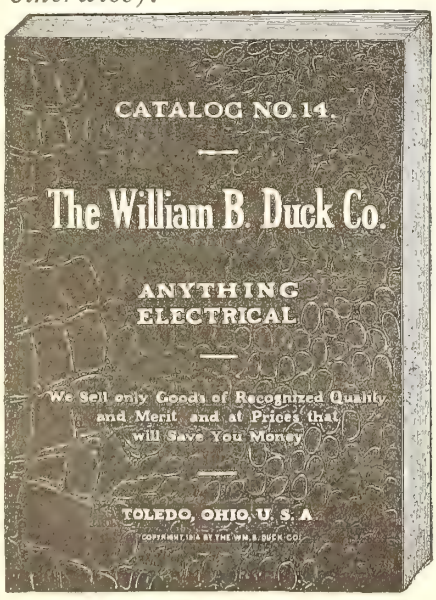
Never in the History of Radio Were These Prices Approached

Improved Navy Type Receiving Transformer again reduced from $27.50 to the startling price of..... **$16.95**

Improved Arlington Receiving Transformer again reduced from $15.00 to the startling price of..... **$7.75**

Substantial reductions on many other radio instruments in our catalog No. 14.
Circular with reduced prices and a large number of new instruments mailed on request.

Mail 12c in stamps or coin (*not sent otherwise*).



"The Greatest Radio Catalog in the World"

The Universal Verdict of Tens of Thousands of Radio Amateurs.

Duck's No. 15 Big 225 Page Wireless Catalog Just Out.

A Veritable Treasure House of Everything Worth While and Dependable in Radio. The largest, most comprehensive, artistic and educational wireless catalog published. The Beacon Light to guide you right in the selection of your radio purchases, and at prices that will command your attention. Every instrument guaranteed with privilege of return if not satisfied.

OTHER SUBSTANTIAL REDUCTIONS ON ITEMS IN CATALOG NO. 14

No. R40 Receiving Set	$22.50
No. R41 Receiving Set	38.50
No. R41a Receiving Set	28.50

THORDARSON TRANSFORMERS

1 K. W. Type R	$40.00
¾ K. W. Type R	28.00
½ K. W. Type R	22.00
1 K. W. Type RS	30.00
½ K. W. Type RS	20.00
¼ K. W. Type RS	15.00
No. A1792 Thord. Condenser	25.00
Nos. 50-51, 52 Switch Contacts, each	.03
No. 1023 Mica Condenser	.60
No. B670 Det.	2.75
No. A862 Det.	2.75
No. A1915 Det.	1.50
No. A367 Murdock Condenser	4.50
No. A1002 Receiving Set	9.75
No. A1916 Condenser	1.65
No. 61x08A Tuning Coil	2.95
No. 61x10 Tuning Coil	$4.95
No. 14 Aluminum Wire per lb	.90
All Binding Posts Reduced	33⅓%

ONLY A FEW OF THE MANY NEW RADIO INSTRUMENTS IN CATALOG NO. 15

Type C-300 Cunningham Bulb	$5.00
Type C-301 " " "	6.50
"UV" 200 Radiotron Bulb	5.00
"UV" 201 " "	6.50
Type C-302 5-Watt Cunningham Power Tube	8.00
Type "UV"-202 5-Watt Radiotron Power Tube	8.00
Type C-303 50-Watt Cunningham Power Tube	30.00
No. A200 Control Panel	7.50
A complete line of new detector regenerative and amplifying sets	
Connecticut Variable Condenser	6.50
Turney Spider-Web Unit	6.00
All the new Murdock Panel Type Variable Condensers	
Burgess "B" Batteries.	

Send 12¢ for Our Big Catalog Today

THE WILLIAM B. DUCK COMPANY, 230-232 Superior Street, TOLEDO, OHIO

Radio "Talk" Relayed to Land Lines

(*Continued from page* 1316)

was this device useful as an aid to navigation, for example during fog, but it automatically served its main purpose of assisting in running down the submarines which then infested the main lines of marine traffic. As soon as a submarine sent a radio message, its direction from one or more destroyers was obtained and the necessary measures taken.

Extreme secrecy was preserved during this training work, even the class rooms being provided with double doors, lest unauthorized persons should catch a glimpse of the special apparatus then employed. In this case, as in others, the unusual equipment, facilities, and willing personnel of the City College enabled it to be of real service to the country.

Radio signals from the great transmitting stations in France, Germany and England were received on the special long distance receivers in one of the Laboratories and the latest methods of recording these in permanent form when necessary, were also made clear.

Another unusual demonstration consisted in showing the way in which the new tubes can be used to *amplify* signals. On another receiving set equipt with such amplifiers of special construction, wireless signals of deafening loudness were obtained. Messages from ships many hundreds of miles at sea rang out with surprising clearness.

Practical Chemical Experiments

BY PROF. FLOYD L. DARROW

(*Continued from page* 1308)

Flame Test for Potassium: If possible obtain a few grams of chemically pure potassium chlorid or some other potassium salt and dissolve in 50 c.c. of distilled water. Preserve this free from contamination in a glass stoppered bottle. Into this solution dip a cleaned platinum wire and as before place in the flame of the Bunsen burner. If the salt is pure a lavender to violet color will appear for a few moments and then disappear. Now observe this flame thru the cobalt-blue glass and note that the color is not cut off.

Testing for Potassium in the Presence of Sodium: Prepare a mixture of solutions of sodium and potassium salts and make the flame test. You will observe that the yellow sodium color completely masks the delicate violet of the potassium and did you not know that the latter element were present you would be totally unable to detect it by direct vision.

Now observe the color of the flame colored by the mixture thru the cobalt-blue glass. The yellow sodium color is thus cut off and the violet of the potassium permitted to pass. In this way we may test for potassium in the presence of sodium.

Other Flame Tests: Prepare solutions of lithium, strontium, calcium and barium salts and make separate flame tests for each one, being careful to clean the wire after making each test. You will find that *lithium gives a beautiful carmine red, strontium a bright red, calcium orange to brick red and barium green.*

Such tests as the foregoing are made in the preliminary examination of unknown substances and as confirmatory tests for substances found in the regular course of qualitative analysis.

Drive Out Aches, Pains

As Well as the Cause of Sickness



Apply thousands of volts of painless, harmless, high frequency electricity without the slightest shock or unpleasant feeling, just an exhilaration of well-being. Aches, pains, soreness, tired feeling, sub-normal conditions depart and the natural joy of good health is restored. You may now do this at home with a

The Vibrant Health-promoting forces of High Frequency electricity, the Violet Ray has accomplished truly wonderful results for others. Learn what it can do for you.

RenuLife

VIOLET RAY HIGH FREQUENCY Generator

Transforms the current from your light socket into this wonderfully effective form of electricity; penetrates deep, saturates entire body; increasing circulation, adding oxygen to the blood, promoting elimination of waste products. The local pain or ache or ailing tissues are directly stimulated while the cause is attacked and the whole system toned and benefited. It's a fundamental treatment working to re-establish normal healthy conditions. That's why it is used and recommended for such a long list of human ills. Get full particulars.

Statement of User

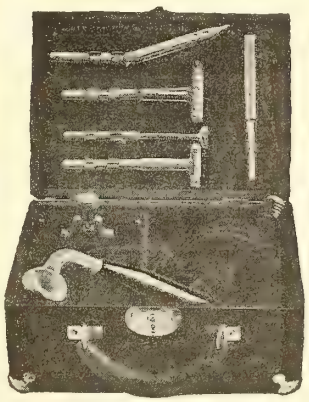
"I had a stroke of paralysis two years ago and spent thousands of dollars seeking a cure but without results. In fact I have derived more benefit from your Violet Rays in three weeks than all other treatments combined. I feel almost certain of a complete cure. My arm and hand are as good as ever and I can walk comfortably and without a cane. I am feeling fine in every way. I cannot express sufficient thanks to you for my wonderful improvement."

NOTE.—Thousands of people, with all manner of ailments, have told us of the benefits, obtained from Renulife self-treatments. If you are in ill-health, learn what relief you may expect from this modern, scientific and simple means.

Liberal Trial Plan

You can determine by actual use at home what benefits you will derive from a Renulife Violet Ray. Send for our book giving full information on the use and success of the Violet Ray. Then decide which model you want to try.

You know that by getting the circulation of pure blood—alive with germ-fighting white corpuscles—flowing through an organ or tissues—that are stagnant or starved—you have started a common sense treatment in the right direction. That's what the *Renulife* does. Learn all about it. Send for full information contained in our book.



SALE DISTRIBUTORS

If you can handle an exclusive territory in a big way, write for attractive proposition.

RENULIFE ELECTRIC CO.

1204 Marquette Bldg., Detroit, Mich.

Netting Bldg., Windsor, Canada

VIOLET RAY BOOK TELLS how the Violet Ray is used for more than 100 different ailments. It is a marvelous story, intensely interesting.

Send For Free Book

Renulife Electric Co. 1204 Marquette Bldg., Detroit, Mich.

Please send me, without obligation, a copy of your

RENULIFE BOOK

Health via Violet Ray.

Name.....

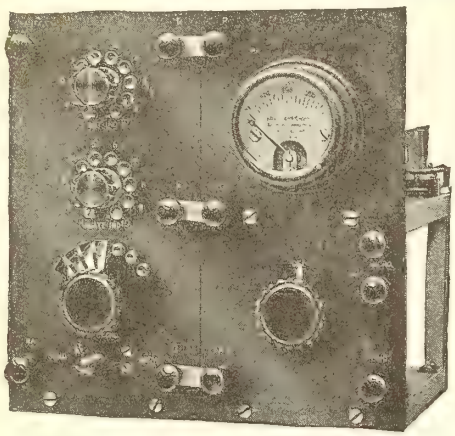
Street.....

City..... State.....

DE FOREST

Talk 30 Miles by "Radiophone"* with this New Midget Transmitter

(Type O T-3)



MOST perfect radio telephone of its size ever made; complete in every respect. Tests show 30 mile range. Works on any source of direct or alternating current. Tuning by tapped switches. One 6-volt storage battery required; for filament, microphone and "B" Battery. Receptifier or Motor Generator Supply may be used. Set mounted on two separate Bakelite panels, each 4½ x 9 in., clamped together as shown. Prices listed are without tubes, microphone or power supply. Get details of this latest development at once. Order now, thru your dealer or direct.

Aerial Oscillating Circuit Panel. Contains all Controls and transfer key switch. This Panel is $55.00.

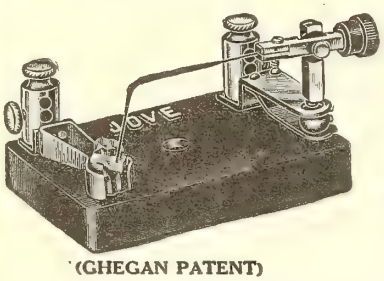
Power Tube Panel. Contains tubes, ammeter and filament rheostat. Price this Panel, $45.00.

* "Radiophone"
Name Copyrighted

Deforest Radio Telephone & Telegraph Co.

Inventors and Manufacturers of High Grade Radio Apparatus.

1399 Sedgwick Ave. New York City



(GHEGAN PATENT)

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

Send stamp for new edition 42E Catalog.

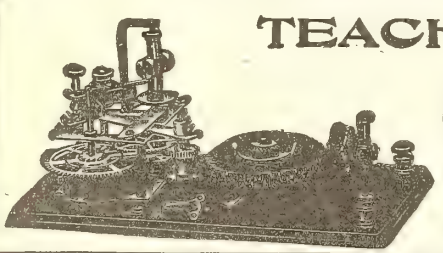
J. H. BUNNELL & CO., 32 Park Place, New York

"THERE'S MONEY IN IT"

AT HOME **LEARN TELEGRAPHY** AT HOME

MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter. THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
26 L. Cortlandt St. New York

PIMPLES

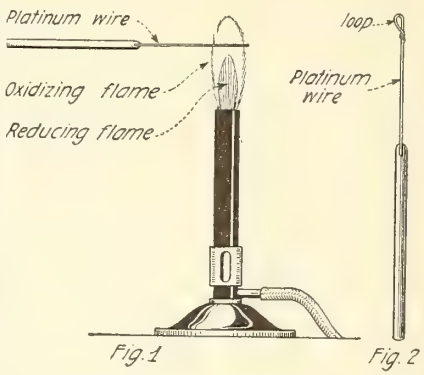
Blackheads—Acne Eruptions

Now Are Easily Removed at Home at a Small Cost!

Banish those unsightly blemishes easily and quickly by using **"CLEAR-TONE"**—a simple home treatment that has cured chronic cases of long years standing. Use like toilet water. Leaves the skin clear, smooth and without a blemish. Has made many friends with both men and women. Elegant for men after shaving. If you have ***Pimples, Blackheads, Acne Eruptions*** on the face or body, ***Enlarged Pores, Oily or Shiny Skin***—never mind how bad—**"CLEAR-TONE"** has cured the worst cases I ever saw. **FREE**—simply send name today for *FREE Booklet,* "A CLEAR-TONE SKIN," telling how I cured myself after being afflicted for 15 years. And I know every embarrassment one has to endure with a bad complexion. **$1,000.00 Cold Cash says I can clear your skin of the above blemishes.**

E. S. GIVENS 168 Chemical Building KANSAS CITY, MO.

Spectroscopic Analysis: The spectroscope is one of the most wonderful instruments at the disposal of the trained



Apparatus Used in Making a Flame Test.

chemist. It places between the eye of the observer and the flame being examined an optical device that increases to a marvelous degree his ability to detect the presence of minute quantities of unknown substances. By its aid he is able to determine the chemical composition and physical state of the infinitely distant stars and nebulae. Every element in the state of incandescent vapor will give by means of the spectroscope a characteristic bright-line spectrum, i.e., a dark background crost at right angles by a series of bright lines separated by intervening dark spaces. By the color of these lines and their position in the spectrum the presence of an element is known with absolute certainty.

An accompanying photograph shows the spectroscope in use. For home laboratory work a small direct vision spectroscope may be had at a very moderate outlay.

Borax Bead Tests: Another series of tests of great value to the chemist are the so-called *borax bead tests.* Borax is a flux, i.e., it is able to dissolve metallic oxides and many of these oxides give to the bead characteristic colors.

Make a small loop on the end of your platinum wire as shown in Figure 2. Heat the wire in the oxidizing flame of the Bunsen burner and quickly thrust it into some borax powder. The powder will cling to the hot wire. Then place the wire again in the flame and the borax will melt into a clear glassy bead which by a repetition of the process may be made to fill the entire loop.

While the bead is still hot touch it very lightly to a small crystal of some cobalt salt such as cobalt nitrat. Upon reheating in the flames the borax will completely dissolve the cobalt compound and become

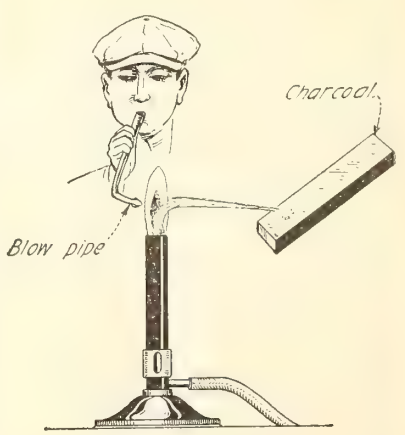


Fig. 3. Heating a Compound on a Stick of Charcoal by Means of the Blowpipe.

a deep blue in color. Therefore should this test be made on an unknown substance and a blue color result, *the presence of COBALT would be proved.*

Because cobalt gives a blue color when fused with vitreous substances, it is used to color glass.

To remove the bead thrust it into cold water while still hot and it may easily be removed with the fingers. Then prepare a fresh bead and if it is still colored remove it and repeat until one that is colorless is obtained. In the same manner as cobalt was tested make tests for compounds of manganese, chromium and iron. After each test make a fresh bead. Each metal will give a characteristic color but in the case of manganese only a very minute particle should be used, or the resulting color will appear to be black. Iron will give a light yellow in the oxidizing flame and a green in the reducing flame when allowed to cool, but the color will be brownish red while hot. Chromium gives green both hot and cold and manganese a wine red if heated in the oxidizing flame. Copper compounds give a green color while hot and a blue when cold. Nickel and bismuth compounds may also be tested with the borax bead. When heated in the oxidizing flame, nickel gives a violet color if hot and a reddish brown if cold. Bismuth is yellowish brown when hot and light yellow when cold.

Cobalt Nitrat Tests: Obtain a small rectangular piece of willow charcoal and a brass blowpipe. Also prepare a solution of cobalt nitrat carrying a stopper fitted with a medicine dropper.

At one end of the charcoal stick hollow out a small cavity and place in it a little of some zinc compound. Moisten it with a drop of water. Then, having adjusted the Bunsen burner flame to rather small dimensions, hold the stick of charcoal in the left hand and direct the flame of the blowpipe upon the zinc compound. You will observe that the zinc residue becomes yellow when hot and white when cold. Now moisten the residue with a drop of cobalt nitrat solution and reheat with the blowpipe. This time you will obtain a green color. See Figure 3.

Clean out the cavity in the charcoal stick and repeat the test using some aluminum compound as alum. After adding the cobalt nitrat and reheating you will obtain a blue color.

With magnesium compounds, as Epsom salts, a delicate rose color appears.

Heating on Charcoal with Sodium Carbonat: Using the charcoal stick and blowpipe as before, heat a mixture of dry sodium carbonat and some copper compound. A metallic globule without any incrustration about the edges of the cavity will result.

A silver compound similarly heated will also give a metallic globule without incrustration.

Compounds of lead and tin heated with sodium carbonate yield incrustrations accompanied by malleable beads of shining metal, while antimony and bismuth give brittle beads.

Iron, cobalt and nickel will give magnetic particles that will be attracted by a magnet.

If you obtain from some unknown compound after heating with sodium carbonat a mass which, when moistened on a silver coin, stains it brown or black, sulfur compounds are present.

Marsh's Test for Arsenic: A somewhat famous test for arsenic, and one which has been used in many cases of arsenic poisoning, is carried out as follows:

First let me say that the gas, *arsine,* which is generated in this test is *exceed-*

(*Continued on page* 1354)

40 Years of Progress with Fine Tools

"--all Richmond turned out."

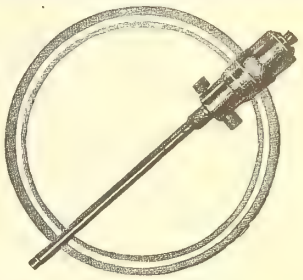
When America's first electric trolley cars were run in the streets of Richmond, Va., in 1887, the whole city turned out to watch them.

Even then, when electric cars were the newest sensation, machinists had already learned that the name of Starrett on a tool meant unfailing accuracy and long service.

The highly-skilled mechanics who build the electrical machinery of today know that they can depend upon Starrett Tools—on the Starrett standard of precision that never varies.

2100 fine tools—with forty years of "knowing how" behind them—are described in the Starrett Catalog No. 22 "L E" Write for a copy. It's free.

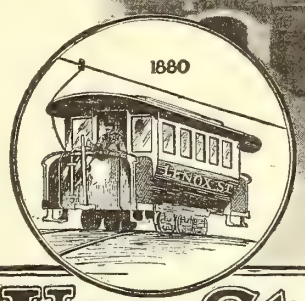
THE L. S. STARRETT COMPANY
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.



1920



1880



Use Starrett Tools

42-124



Free Trial

YOU may have any instrument with complete musical outfit, for a week's free trial at home. No obligation. Return it at our expense after trial if you wish. Outfit includes velvet lined case, self instructor, music and all accessories at factory cost. A tremendous saving.

Convenient Monthly Payments

A few cents a day will pay for instrument and outfit if you decide to keep it. Wurlitzer instruments are known all over the world for artistic quality.

Send Coupon for Beautiful New Catalog

Every instrument known illustrated with price, easy terms and free trial blank. Catalog absolutely free. No obligation. Send this coupon now.

The Rudolph Wurlitzer Co., Dept. 1254
117 E. 4th St., Cincinnati, O.—329 S. Wabash Ave., Chicago
120 W. 42nd St., New York, N. Y.

Send me your new catalog illustrated in color with full details of Wurlitzer Complete Outfits and free trial and easy payment offer.

Name _____

Address _____

(State instrument you are especially interested in.)

Trade Mark *Registered*
WURLITZER
200 YEARS OF MUSICAL INSTRUMENT MAKING
Copyright 1920 Rudolph Wurlitzer Co.

Let

CONTINENTAL

fill all your radio needs — wherever you live—from their wonderfully complete stocks, by mail, with

ACCURACY : SPEED : COURTESY

Order direct from this ad. Send your remittance, preferably by check or P. O. Money Order. Your goods will be shipped the day we receive the order.

PARAGON R. A. TEN

Regenerative Short Wave Receiving Sets. "The weaker the Signal, the stronger the Amplification." Price, Eighty-five Dollars.

TELEPHONES

No. 55 Murdocks 2000 ohms	$4.50
No. 55 Murdocks 3000 ohms	5.50
Brandes "Superior" 2000 ohms	8.00
Brandes "Trans-Atlantic" 2800 ohms	12.00
Brandes "Navy Type" 3200 ohms	14.00
Baldwins Type C Navy Standard	16.50
Baldwins Type E Superior-Sensitive	20.00
Century 2200 ohms. (Govt. Standard)	12.50
Century 3200 ohms. (Govt. Standard)	14.00
Brown 4000 ohm imported super-sensitive double armature	20.00

TRANSFORMERS (Acme new type)

Acme 250 Watt, mounted	16.00
Acme 250 Watt, unmounted	13.00
Acme 500 Watt, mounted	22.00
Acme 500 Watt, unmounted	18.00
Acme 1000 Watt, mounted	33.00
Acme 1000 Watt, unmounted	28.00

VACUUM TUBE SOCKETS

No. R-300 DeForest	1.50
No. M-300 Marconi	1.50
No. 55 Murdock	1.00
No. 156 Gen. Radio	1.75
No. R-400 Inverted Type	2.40

VACUUM TUBES

Radiotron U. V. 202 5 watt transmitting tube	8.00
Radiotron U. V. 200 Detector tube	5.00
Radiotron U. V. Amplifying tube	6.50
Electron relay	6.00
Moorhead Amplifier	7.00
Moorhead extra hard Tubes	7.50
Audiotron	6.00

ROTAY SPARK GAPS

Bell Gaps in stock	55.00
Benwood Gaps	30.00
Benwood Gaps (Bakelite Case)	27.50
Large Murdock Gap	30.00
Grebe Synchronous Gap	140.00

LINE PROTECTORS

No. 379 Murdock line protector	9.00
No. AM888 Dublilier line protector	4.00
No. CD888 Dublilier line protector	6.00

TUNGAR RECTIFIERS

Two Ampere Tungar complete	18.00
Five Ampere Tungar complete	28.00
Two Ampere Extra Lamp	4.00

Our 112-page catalogue, containing tables for quickly figuring all radio calculations, the conventional signals and abbreviations, etc., mailed anywhere in the world for 25 cents.

CONTINENTAL

RADIO & ELECTRIC CORP.

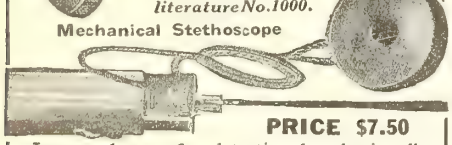
J. DiBlasi, Sec. J. Stantley, Treas.

Dept. A13 6 Warren St. New York



SKINDERVIKEN TRANSMITTER BUTTON

Made in several types for use wherever a transmitter is wanted. *Send for instructions and literature No. 1000.*



Mechanical Stethoscope

PRICE $7.50

Improved type for detecting knocks in all running machinery. Test your automobile motor. Descriptive literature sent on request, *without obligation.*

GENERAL SOUND TRANSMISSION CORP.
Room 507 2 Rector Street New York

Learn to Write

I TEACH BY MAIL

WRITE FOR MY FREE BOOK "How to Become a Good Penman" and beautiful specimens Your name elegantly written on a card if you enclose stamp. Write for it today. F. W. TAMBLYN, 424 Meyer Bldg., Kansas City, Mo.

Scientific Lifting Stunts for Your Parlor

(*Continued from page* 1281)

Fig. 4 shows how the lift is made. One of the committee stands behind the subject and places the index finger of each hand under her arms. One man is placed on either side of her in a stooping position and each places one finger under either foot, while the fourth man stands directly in front of the subject and places one finger sidewise under her chin.

MISS ANNIE ABBOTT, THE "GEORGIA MAGNET," DEFIES FIVE MEN TO LIFT HER.

A surprising fact is that by careful observation and experiments, first instituted by Dr. Leon Lansberg, and publisht in a recent article by Miss Grace Nicholas of the New York *Evening World*—Miss Nicholas was able to duplicate the lifting stunts performed by Miss Abbott—such as defying five men to lift her.

At Figure 5 is shown the best and in fact the only way in which a woman, or man, can be lifted; that is, they must—as Dr. Lansberg pointed out—lock their arms or rather their elbows tight to the body. Try this on your wife, sister, sweetheart or mother, and even if she weighs 140 pounds or more you will be surprised how easily two men, with one hand under either of her elbows and the other hand grasping her hand on either side, can lift her 10 to 12 inches above the floor.

At the offices of the New York *Evening World* where the writer was present and assisted in the demonstrations given by Miss Annie Abbot, Miss Grace Nicholas, an athletic young lady, weight about 130 pounds, successfully resisted the efforts of five muscular men to lift her from the floor.

Now for the secret, as it was pointed out by Dr. Lansberg: The subject who is to be lifted, first permits her arms to be held in (or holds them in tightly against the body) and the lift is at first "allowed" with two or perhaps five men, to show that she *can be lifted* up while the "magnetic power" is switched off.

After a little coaching of your lady subject, and after a few experiments, you will find that the secret of *resisting the efforts* of five husky men to lift her from the floor is accomplisht by allowing her arms to remain flexible and loose from the shoulders, so to speak, and not to tense the muscles.

Another one of Miss Abbott's tricks is to have a number of men stand in a row back of her, while she places her hands against a wall and braces her body and arms.

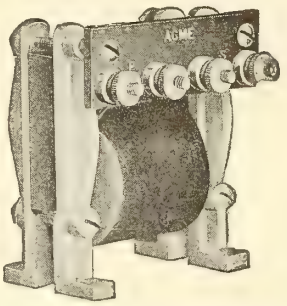
HOW JOHNNY COULON WORKS HIS MARVELS.

Much mystery and secretiveness has surrounded the performances of Johnny Coulon, who has successfully demonstrated to the French public that he cannot be lifted when he "so wills it," by even the most powerful man, including the champion weight lifters of France: Johnny Coulon weighs 110 pounds.

When ready for the lift, Johnny Coulon allows the lifter to raise him by the waist. Of course the hands must come in contact with the bare body. This, according to the investigators, is quite a hindrance, the hands slipping away rapidly due to the velvety skin effect. Coulon now places his right hand upon the wrist of the lifter and the index finger of his left hand upon the jugular vein region in the neck and by pressing upon both points defies the strongest man to lift him.

ACME

AMPLIFYING TRANSFORMERS



GUARANTEED!

The Acme Apparatus Co. has, after much time and expense, developed an amplifying transformer with a guarantee against mechanical defects.

We will replace any coil which open circuits!

When you buy an ACME Amplifying Transformer your costs for this part of your equipment ceases.

ACME APPARATUS CO.

28 Windsor St. Cambridge, 39, Mass.

Transformer and Radio Engineers and Manufacturers

Service-- the Keynote

There is no guesswork about what GREBE RADIO apparatus will do. In design, workmanship and material it is built for the most exacting Service.

GREBE RADIO

apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service.

If your dealer doesn't carry our line, write us—mentioning his name—for catalogue.

A. H. Grebe & Co., Inc.

70 Van Wyck Blvd., Richmond Hill, N. Y.

PITTSCO

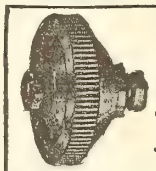
RADIO EQUIPMENT

Our catalog No. 22 illustrates everything in wireless. Send 10 cents in stamps for it.

F. D. PITTS CO.

Boston, Mass.

12 Park Square Dept. D



J. Skinderviken

TRADE MARK

Skinderviken Transmitter Button

U. S. and Foreign Patents

J. SKINDERVIKEN

Inventor and Sole Manufacturer

$1.00 154 W. Randolph St. Chicago, Ill.

LEARN WIRELESS

At the **OLDEST, LARGEST** and **BEST EQUIPPED** school of its kind in New England. Thousands of satisfied graduates all over the world. Splendid opportunities in the Merchant Marine. Day and Evening classes. Start any Monday. Illustrated Prospectus for the asking.

EASTERN RADIO INSTITUTE

899E Boylston St. Boston, Mass.

LIBERTY AUTOMATIC REVOLVER

HIGH QUALITY - RIFLED BARREL - GOOD VALUE

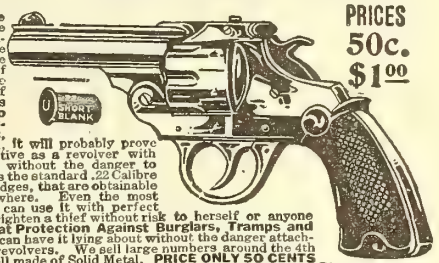
With Shell-Ejecting Device PRICE $9.50



.22 Cal. .32 Cal. .38 Cal.

One of the most powerful and effective weapons made. The shots can be fired rapidly and in succession, as fast as you can count. The ideal weapon for Express Men, Bank Agents, Pay Roll Clerks, Automobilists, and all others where quick action is absolutely essential. Accidental discharge impossible. Another feature is the **Automatic Shell Ejector,** that throws the empty shells out when the barrel is tipped down. The Revolver is exceptionally well made of the very finest of materials and scientifically tested for accuracy. Fitted with fancy rubber handle. .22, .32, or .38 calibre, **PRICE $9.50, postpaid** anywhere; **Cartridges for above Revolvers - by express only, .22 cal. $1.00 per 100. .32 cal., $2.50 per 100; .38 cal., $3.50 per 100.**

BLANK CARTRIDGE PISTOL



PRICES 50c. $1.00

This well made and effective Pistol is modelled on the pattern of the latest type of Revolver, the appearance of which alone is enough to scare a burglar, whilst, when loaded, it will probably prove just as effective as a revolver with real bullets, without the danger to life. It takes the standard .22 Calibre Blank Cartridges, that are obtainable most everywhere. Even the most timid woman can use it with perfect safety and frighten a thief without risk to herself or anyone else. **A Great Protection Against Burglars, Tramps and Dogs.** You can have it lying about without the danger attached to other revolvers. We sell large numbers around the 4th of July. Well made of Solid Metal, **PRICE ONLY 50 CENTS Postpaid. Better make and superior quality for $1.00. Blank Cartridges .22 cal., shipped by express only,** customer paying expressage **50c per 100.**

MELIOR AUTOMATIC PISTOL

SHOOTS .25 CAL. COLT Cartridges



Note Positive Safety Lock Accidental Discharge Impossible

Best value in Automatics in America. Shoots Colt .25 Cal. Automatic Cartridges. **7 Quick Successive Shots.** The Pistol takes seven cartridges at one loading; extra magazines can be kept ready for instant reloading. Each empty shell is automatically ejected immediately after firing. Fixed stationary barrel, ensuring great accuracy. Trigger action is exceptionally light and quick, and must be pulled back for each shot. Never misses fire or jams. Has Safety Lock for disconnecting the pistol when not in use. **LENGTH OVER ALL - less than five inches, 2 in. Barrel.** Material, workmanship and finish of the highest possible grade throughout. A wonderful combination of **ACCURACY** and **RELIABILITY.** Superb shooting qualities; as easy to aim as pointing the finger; works as smooth as an engine; will shoot through four inches of pine wood. Fine for target shooting. Weighs only 12 oz. Sold under postive guarantee to shoot equal to any pistol on the market or money refunded. **PRICE, $15.00 ppd. Cartridges** (express only) **$3.75 per 100.**

MELIOR AUTOMATIC .32 CALIBRE PISTOL

This Pistol may also be had in 32 Calibre, same as above, length of barrel nearly 4 inches, length over all less than 7 in. **PRICE, $20.00 postpaid. .32 Cal. Automatic Cartridges,** (by express only) **$4.50 per 100.**

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures But 4¼ Inches Long. Takes Regular .22 Calibre Cartridges $5.00



The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability.** It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard 22-calibre cartridge obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 9½ ounces. The price of the Baby Revolver is only $5.00. sent by mail, p.pd. to any address.

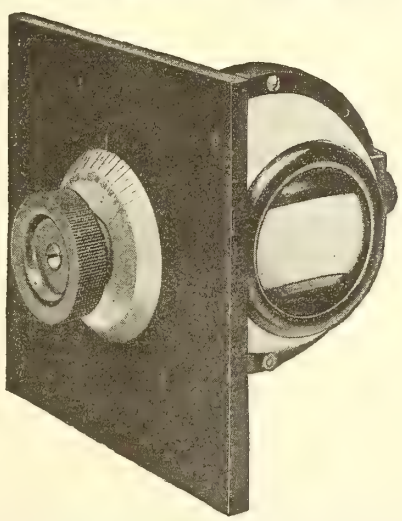
Write For FREE Catalog of Revolvers.

JOHNSON SMITH & COMPANY, Dept. P.M. 72, 3224 N. Halsted St., CHICAGO

THE LATEST **"MURDOCK"** VARIOMETER

No. 345 "MURDOCK" VARIOMETER

$7.50



THE PRICE IS *UNUSUALLY LOW*

THE QUALITY IS *REMARKABLY HIGH*

WINDING FORMS ARE "MURDOCK" MOULDED

No. 55 Head Phone

The continued great demand for these receivers is a wonderful tribute to their extraordinary value, by thousands of satisfied customers. If you are skeptical as to the possibility of so much value at so small a cost, ASK YOUR DEALER. We suggest a trial with the assurance of "satisfaction or your money back."

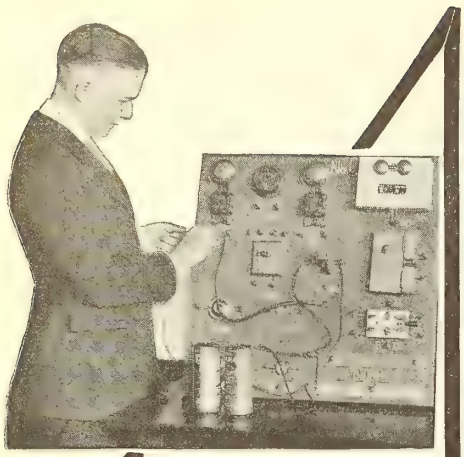
BULLETIN No. 20 Sent anywhere on request.

2000 OHM. $4.50

3000 OHM. $5.50

Wm. J. Murdock Co., 55 Carter St., Chelsea, 50, Mass.

509 Mission St., San Francisco, Cal.



Learn

Electricity

in your own home with

Real Electrical Devices

HERE is a new way to learn the highly paid profession of electricity. You study with and work on laboratory unit boards right in your home in your spare time just as if you were here in this big, world-renowned school with its wonderful equipment. Thus you gain a complete, practical knowledge and experience in less time with less effort than with the older methods of instruction.

Electrical Apparatus For Home Experiments

Wonderful, cleverly constructed units of electrical apparatus are supplied to each student while learning. These home laboratories are not toys, but life-size, expensive instruments and devices which the electrical expert meets with in everyday work. In this way you gain thorough, practical electrical education at home. Thorough, yet simple, tests enable you to work out problems on your instrument boards. You receive the theory as well as the practice of electrical application, which in a short time will enable you to step into a highly paid electrical position.

Big Field—Big Pay

The opportunity for the well trained, electrical man is practically unlimited. Billions of dollars are invested in this great industry. Thousands of men are employed in it, but the demand today is for men who are trained specialists. These men command handsome salaries—$2,500 to $6,000 and up to $10,000 a year and more. You can easily get into this fascinating, highly paid field of work through our thorough method of instruction and the electrical apparatus that is sent to you for home study.

Write Now for Big Free Book

Send the coupon today for full details on our laboratory unit method of home study and information regarding consultation privileges, our free employment bureau and other special services.

Mail the coupon, now, and begin immediately.

Extension Division

SCHOOL of ENGINEERING of Milwaukee

Dept. SI-4, 373 Broadway, Milwaukee, Wis.

Extension Division,
School of Engineering of Milwaukee,
Dept. SI-4, 373 Broadway, Milwaukee, Wis.

Please send your free catalog and details of your laboratory unit method of home study in Practical Electricity. This request obligates me in no way.

Name.....

Address.....

Town..... State.....

Age..... Education.....

Practical Chemical Experiments

(*Continued from page* 1351)

ingly poisonous, and, therefore, the utmost caution must be observed at every point to see that all joints are perfectly tight and that no gas escapes into the room.

The apparatus consists of a hydrogen generator, a calcium chlorid drying tube and a hard-glass delivery tube drawn out somewhat at the end and bent upward. At the middle of the tube is placed a Bunsen burner carrying a fish-tail tip. See Figure 4.

In the generator place zinc and dilute sulfuric acid to generate hydrogen. Collect some of the hydrogen by placing an inverted test tube over the end of the delivery tube and after a few moments present the inverted tube to the flame of a Bunsen burner kept at some distance from the apparatus. If a sharp explosion occurs the hydrogen is still mixt with air. Repeat the test until the gas burns quietly. Then light the escaping gas at the end of the delivery tube.

At the same time have ready a solution of arsenious oxid, ordinary white arsenic,

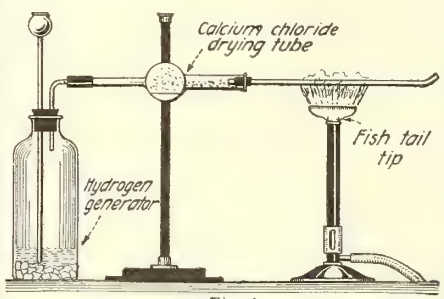


Fig. 4. Making Marsh's Test for Arsenic.

in concentrated hydrochloric acid. Pour down the thistle tube into the generator a *few drops* of this solution. Immediately the colorless hydrogen flame changes to a lavender color and a garlic-like odor is evident.

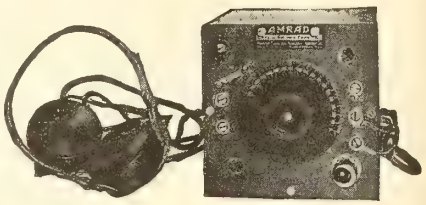
Light the burner with the fish-tail tip and heat the tube strongly. Just beyond the heated portion you will observe a deposit of arsenic which appears as a shining, brownish-black mirror.

Then hold in the flame by means of tongs the lid of a porcelain crucible. A shining deposit of metallic arsenic will at once appear. The nascent hydrogen evolved in the generator unites with the arsenic compound to form the gas *arsine.* Arsine is a very unstable compound and both the heating of the tube and the cooling of the gas by thrusting into it the porcelain crucible lid decomposes it with the deposition of arsenic.

At this point the generator will be full of the *poisonous arsine!* To be safely rid of it carefully pour water down the thistle tube, being careful to keep the tube full so as not to admit any air and thus make an explosive mixture in the generator. As the contents of the generator are forced out the arsine will burn at the end of the delivery tube which must not be allowed to go out.

To determine whether a person has met death from arsenic poisoning the contents of the stomach are pumped out, thoroly extracted, filtered and reduced to small volume. A little of the solution thus obtained is introduced into the hydrogen generator and the test carried out as above.

wireless for everybody



WITH this new Amrad Crystal Receiver you can pick up distant wireless telephone and telegraph messages any time, anywhere.

No elaborate aerial, batteries, license or special knowledge required. Easy to set up. Fascinating to operate.

Portable, compact, convenient. Only 5 x 5 x 7". Wavelength range 180 to 750 meters. Tunes sharply by simply rotating the knob. You can use an indoor antenna or the complete installation we furnish.

How often have you marvelled at the mystery of wireless? This wonderful phenomena has gripped the interest of thousands during the past few years. The Amrad Crystal Receiver brings this constant source of delight to everybody. You can now actually have a real "wireless" in your own home and hear the unseen voices of the air. This outfit is not a toy in any sense,—it is just the most practical and efficient Set a leading manufacturer of quality radio apparatus could build.

Illustrated Bulletin Y gladly sent free on request.

PRICES

Amrad Crystal Receiver.....$23.50
Double Telephone Head Set..... 4.50
Antenna and Ground Equipment... 12.00

Informative operating instructions included free with each set.

AMERICAN RADIO AND RESEARCH CORPORATION

17 PARK ROW, NEW YORK CITY

Factory and Laboratory:

Medford Hillside, Mass.

Address New York

MASTER CONTINENTAL CODE DODGE SHORT CUT ONE HOUR METHOD INSURES SUCCESS

Thousands have. Everybody can.
Testimonials free. Investigate and win.
Costs 50 cents, Saves 50 dollars.
C. K. Dodge, Box 300, Mamaroneck, N.Y.



$12.50

NEW 1920 REDHEAD PHONES

We announce the new model of the famous Red Head Radio Receivers, greatly improved, 3,200 ohms. $12.50 the pair.

THE NEWMAN-STERN CO.
Dept. E. E. Cleveland, Ohio

Distributors for DeForest, Murdock, Signal, Bunnell and other famous lines.

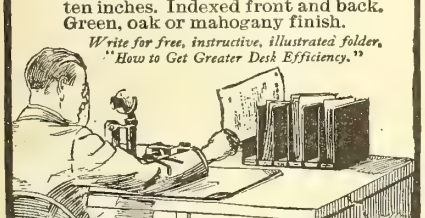
Kleradesk

Saves time—clears your desk. Sorts, classifies and distributes your correspondence, papers, memos, etc. Occupies much less space than wire baskets. No more shuffling through piles of papers many times daily.

A Steel Sectional Device

Each compartment a separate section. Any number of compartments for flat or vertical filing can be added as required. Width of each compartment is adjustable, one to ten inches. Indexed front and back. Green, oak or mahogany finish.

Write for free, instructive, illustrated folder, "How to Get Greater Desk Efficiency."



Ross-Gould 165 N. 10 St. St. Louis.

KNOBS



We have a large stock of knobs as illustrated. This knob is made of "Insulate" and is 1 inch in diameter with a 5/8-inch 3/8 threaded shank. Just the thing for rotary switches.

No. 4 Knob, each 15c; Per dozen $1.50
Shipping weight, each 2 ozs., per doz. 1 lb.

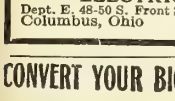
OTHER BARGAINS

Young & McCombs rotary spark gap, shipping weight 4 lbs. $16.00
Young & McCombs saw tooth rotor, shipping weight 1 lb. $4.50
De Forest variable condenser, shipping weight 2 lbs special price $5.75
Skinderviken transmitter button, shipping weight 4 oz. . $1.00
Acme 1-2 K. W. semi-mounted transformer, shipping weight 30 lbs. $22.00

Send 15c for our big illustrated catalogue. This amount may be deducted on your first order for $1.50 or over. High printing costs make free distribution impossible.

ELECTRICAL SPECIALTY CO.
Dept. E, 48-50 S. Front St. Columbus, Ohio
Dept. E, 20 N. 9th. St. Philadelphia, Pa.

CONVERT YOUR BICYCLE INTO A MOTOR CYCLE

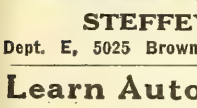


by using a STEFFEY ATTACHMENT
Simple-Reliable-Economical

Fits any ordinary wheel, diamond, double-bar or truss frame. Easy to attach. Send stamp for circulars.

STEFFEY MFG. CO.
Dept. E, 5025 Brown Street, Philadelphia, Pa.

Learn Autos and Tractors



Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O

AGENTS—Auto Free



We need special agents to travel by Automobile introduciug our great line of Nationally-advertised Pure Food Products, Soaps and Household Necessities. Here is an opportunity to earn $6 to $12 a day, all or spare time and obtain an Automobile FREE besides. Write at once for full particulars. Address

AMERICAN PRODUCTS CO.
3018 American Bldg., Cincinnati, O.

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. **Guarantee Bond for 8000 Miles.** (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write

MELLINGER TIRE & RUBBER CO.
901 Oak St., Kansas City, Mo.

You Can Save $50.00



$6.55 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

Flying In Space

By H. GERNSBACK

(*Continued from page* 1292)

explosive charges at the right time and in the right order would be an undertaking that might tax the ingenuity of the best navigator but of course it is not impossible.

Our front cover illustration shows another space flyer imagined by the writer, and this machine contains several new ideas not proposed heretofore. In general principle it is along the lines of the space flyer proposed by the writer in 1915. Generally speaking, the present machine is a sphere about 50 feet or more in diameter and it may be made to rotate at will in a system of rings as shown. These rings crossing at an angle of 60 degrees serve a triple purpose. Firstly, they are used for landing purposes; on them the machine may roll when it reaches its destination, for example, on the moon. Secondly, the rings give the sphere free movement so that it can be turned upon its axis in a manner best suited for landing purposes. Thirdly, these rings contain a wire system which is used to annul gravitation by means of certain currents, not as yet known. By energizing these wires, a counter reaction is set up against the earth's gravitational influences, and the machine will rise to the sky. Upon approaching the moon or other body, the current is again brought into play, and the counter reaction is set up, which gradually decreasing should permit the machine to descend without harmful consequences to the travelers.

It goes without saying that such a machine must be airproof and that the inmates must take cylinders of additional air and oxygen along with them, and purify and renew the air by chemical means by the well-known means carried out today in submarines.

While the idea of the space flyer today may seem extravagant, it is not more impossible than the airplane was thirty years ago, and there is no telling that we all may live to see the day when our present "pipe dreams" become a thing of reality.

MAGNESIUM FROM SEA WATER

According to dispatches from Christiania, Norway, the prominent scientist, Professor Helland Hansen, at a meeting of the Central Committee for Scientific Co-operation in Furtherance of Industry, lecturing on the use of salt water as raw material for Norwegian industry, declared that the new salt works at Bergen, which are now nearly ready, will produce 100 tons of metallic magnesium yearly, the raw materials being only salt water and electric power.

Trip to the Moon

(*Continued from page* 1303)

meteors come unheralded without hiss or noise and bury themselves on the surface of the moon or smash against the rocks, pulverizing the latter as well as themselves instantly. Nothing announces their approach and the traveler only knows of them by the terrific shaking of the rocks or ground on which he stands. In consequence of these meteors, the whole surface of the moon is covered with an impalpable powder made up of iron dust of the meteor and sand caused by rocks being ground to powder thruout the ages.

Illustrations courtesy Bray Studios.

Go to School at Home!



HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competition is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

AMERICAN SCHOOL
Dept. H-426, Drexel Ave. & 58th St., Chicago

American School

Dept. H-426, Chicago, Ill.

Explain how I can qualify for position checked:

.....Architect $5,000 to 15,000	.....Lawyer $5,000 to $15,000
.....Building Contractor $5,000 to $10,000	.....Mechanical Engineer $4,000 to $10,000
.....Automobile Engineer $4,000 to $10,000	.....Shop Superintendent $3,000 to $7,000
.....Automobile Repairman $2,500 to $4,000	.....Employment Manager $4,000 to $10,000
.....Civil Engineer $5,000 to $15,000	.....Steam Engineer $2,000 to $4,000
.....Structural Engineer $4,000 to $10,000	.....Foreman's Course $2,000 to $4,000
.....Business Manager $5,000 to $15,000	.....Sanitary Engineer $2,000 to $5,000
.....Certified Public Accountant $7,000 to $15,000	.....Telephone Engineer $2,500 to $5,000
.....Accountant & Auditor $2,500 to $7,000	.....Telegraph Engineer $2,500 to $5,000
.....Draftsman & Designer $2,500 to $4,000	.....High School Graduate In two years
.....Electrical Engineer $4,000 to $10,000	.....Fire Insurance Expert $3,000 to $10,000
.....General Education In one year	

Name..... Address.....

Do You Use V. Ts?

Then Read This

To get the highest efficiency from a station equipped with vacuum tubes it is absolutely necessary to use a headset of very high impedance. Our High Impedance Navy Type Headset is something new along this line. It has an impedance of 50,000 ohms at 800 cycles, a thing heretofore considered impossible in a commercial headset. We get this high impedance by putting 10,000 turns of wire on each of the four bobbins in the Navy. Ordinary headsets do not have over 7,500 turns to the bobbin and no other develops over 25,000 ohms, whereas the Navy develops 50,000. In spite of this high winding the Navy weighs only 9 oz. complete with headband and cord.

This headset is exceedingly high pitch in tone and is consequently very sensitive to high pitch signals. To anyone wishing to receive trans-Atlantic or Pacific signals it is indispensable.

Its compact, sturdy build insures comfort, reliability and long life. Read our offer below.



50,000 Ohms A.C. Weight 9 oz. Complete with headband and polarity indicating cord. Price $14.00.

BRANDES
MATCHED-TONE
HEADSETS
100% Receiver Satisfaction

While all Brandes Headsets are very light and comfortable they are so sturdily built that there is no danger of them losing their adjustment through hard usage. The shell is made of thick rigid aluminum and the cap of hard, vulcanized rubber. Because the action in our receivers is direct on the diaphragm less current is required to produce audible signals and the space, weight and current consumption of unnecessary amplifying mechanism is eliminated. Our receivers are carefully matched in tone and permanently adjusted at their highest point of efficiency.

They are all equipped with new style woven khaki headbands and polarity indicating cords which eliminate danger of demagnetizing the receivers when used with vacuum valve detectors.

Our Offer

Send us $14 for our High Impedance Navy Type Headset. Try it for ten days. Give it every test you can devise. Make rigid comparisons with the set you are now using. If it isn't a better headset than any you have ever used or seen, or if for any reason whatever you are dissatisfied with your purchase, return the headset to us and we will refund your money immediately.

ALSO MAKERS OF

Trans-Atlantic Headsets, 25,000 ohms A. C.....$12.00
Superior Headsets, 2000 ohms D. C.. 8.00

Send 5c for Catalog E.

C. BRANDES, Inc. Room 814
34 Union Square, New York City

Popular Astronomy

(*Continued from page* 1326)

under the tidal changes produced by the larger body. It follows that within that limit the smaller body would have been disintegrated into small particles, or moonlets, under the tidal strains exerted upon it by the earth and would have been gradually distributed about the earth in the form of a meteoric ring which in the course of ages would be absorbed by the earth, *just as Saturn is right now gradually absorbing its rings.*

The planets differ greatly in density. The more distant and larger planets—Jupiter, Saturn, Uranus and Neptune—have densities equal to or less than that of the sun. The densities of the inner planets—Mercury, Venus, Earth and Mars—are relatively extremely high, the density of the Earth's core being about that of meteoric iron. The densities of Mercury and Venus are slightly less than that of the earth and the densities of Mars and the moon about equal to the density of the earth's crust.

It is conceivable that, if a stream of matter were ejected from the sun under the influence of some external force, such as that exerted by a passing star, the outlying parts of the stream would consist of the lighter elements and the lower parts of the heavier elements, since the lighter solar elements lie at or near the surface of the sun and the heavier elements at greater depths. At the time of ejection the lighter elements would be thrown to great distances and would go to form the less dense outer planets; the heavier elements would go to form the inner planets of high density. It is conceivable that ejection of solar material might have taken place under the influence of certain forces at work within the sun itself, such as *electrical repulsion* or *pressure of light* which under certain conditions more than offset the effect of *gravitation.*

It is known that certain chemical compounds form at the surface of the sun in sun-spot regions which are regions of comparatively low temperature and great magnetic intensity. We know next to nothing about the physical state of matter at great solar depths, where abnormal conditions of temperature and pressure must exist, and where great physical changes and disturbances may have taken place in the past. Even today solar activity goes through a cycle of change coincident with the sun-spot period, and many millions of years ago the sun-spot cycle of solar activity may have been far different from what it is today and a far more potent factor in producing changes in the solar system.

Outbursts of novas indicate that agencies making for peace and order are not the only ones at work among the stars any more than they are upon our own planet. The cause of these outbursts has not yet been satisfactorily explained. The theory that they are caused by the close approach of a passing sun or by the encounter of a star with a dark nebula does not account for all of the circumstances of such outbursts and is by no means beyond criticism. The nebulous matter, seen about a nova after the outburst, is now believed to have been expelled from the star itself at the time of the catastrophe and *may conceivably be the stuff of which planetary systems are made.*

At some epoch in the past our own sun may have undergone some such cataclysmic change and this may, conceivably, have been brought about by disturbances within the sun itself. Elements may have been so formed and distributed within the interior of the sun that friction and internal instability resulted and in time produced an upheaval of solar elements with initial velocities so great that, thru electrical repulsion and light pressure, portions of the ejected streams were permanently detached from the sun *and became the nuclei of future planets.*

BECOME AN EXPERT!

SPECIAL COURSES IN

Radio Telegraphy

We train you in a very short time for a first grade commercial license. Experienced Instructors, Complete Laboratory Equipment, including Arc and Spark Transmitters, Employment Service, Dormitories, Rest Rooms.

Morse Telegraphy

A course invaluable to the radio man who wishes to prepare for shore station work; also trains men for positions with the leading telegraph companies. Experienced Instructors, Employment Service, etc.

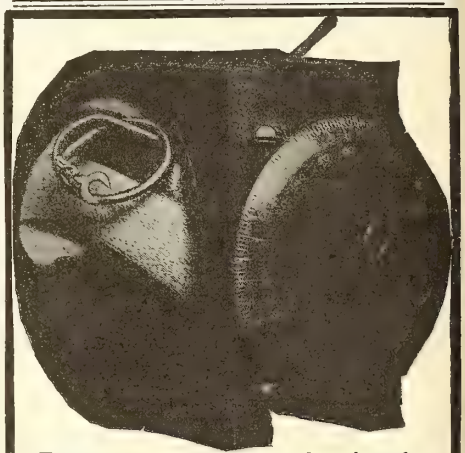
Arc Transmitters

A course which covers the theory and operation of the arc completely. Given separately or in conjunction with regular radio course. Complete in six sessions.

Typewriting

A special course laid out especially for the telegrapher, both commercial and radio. Special instruction in copying telegraph and radio messages. Experienced Instructors, Employment Service, Dormitories, etc.

EAST SIDE Y. M. C. A. RADIO SCHOOL
152 E. 86th Street, New York City
"The Best Radio School in the East"



Z.'R. V. Variometer for $6.50 Short Wave Lengths

Complete catalogs of Radio Apparatus sent for 6 cents in stamps.

CLAPP-EASTHAM COMPANY
131 Main St. Cambridge, Mass.

RADIO CLUB PINS

Special folder of designs and prices in addition to regular School pin catalog free on request. Be sure to see these new numbers which will put new life in your club.

METAL ARTS CO.
Dept. 12 Rochester, N. Y.

CONNECTICUT
RADIO EQUIPMENT

Variable Condensers, Transmitters, Head Bands, Panel Switches, etc.

Connecticut Tel. & Elec. Co., Meriden, Conn.

200 Big Pages,—
chock full of the latest radio equipment—that describes Kelly & Phillip's new radio catalogue. just off the press. Printed on good stock. attractively bound. It lists every reliable make of radio equipment at the lowest prices. Contains valuable information and data that you will use every day. Price 25 cents. refunded on first purchase of $2.50 or over. Send to-day for your copy of the world's largest radio catalogue. **KELLY & PHILLIPS,**
312 Flatbush Avenue, Brooklyn, New York



Printing Cheap

Cards, circulars, labels, book, paper. Press $12. Larger $35 Job press $150. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE, cards, etc. **THE PRESS CO., B-47, Meriden, Conn.**

The Love Machine

By CHARLES S. WOLFE

(*Continued from page* 1300)

"Easily said," jeered the wrathful millionaire.

"Easier done," retorted Parsons, promptly.

"May I ask how you propose to accomplish this miracle?" queried Fennimore, sarcastically.

"I am not telling you what I expect to do, young man," rejoined Parsons, "I am telling you what I am going to do. There is no question whether I am able to get the results I advertise. I know I can. I have the necessary apparatus and the knowledge required to use it."

"Apparatus?" gasped the startled lover, "Do you use machinery?"

"Most certainly," snapt the professor, somewhat nettled, "Did you have an idea that I charmed them with a flute?"

Fennimore ignored the thrust. "When can we begin on this system of yours?" he queried, uncertainly, for the whole thing seemed quite unreal to this lad who had never been accustomed to think of love in terms of ergs or calories.

"We can begin and end just as soon as you can get the object of your affections into my laboratory for a period of two hours."

"Great Scott," gasped Fennimore, "Does one treatment suffice?"

"It does," Parsons replied grimly "Quite."

"Do you guarantee a permanent——er——cure?" Fennimore demanded, determined to go thru with the business, bizarre as it looked.

"I do not," chuckled Parsons, "But I do guarantee it to last long enough to get you past the minister and back from Europe. Say two years. Then if you have any trouble, bring her around for another treatment."

"How am I to get her into your laboratory?" asked Fennimore, satisfied.

"Great Heavens, man," Parsons was exasperated, "If you haven't enough native wit for that task I don't wonder that you have been tagging around without getting anywhere."

"I can't drag her in by the hair of the head, you know," Fennimore interpolated hastily, "It isn't being done at all."

"No, I suppose not," the professor sighed, sarcastically, "And what a pity the fine pointed needle is taboo, too. Well, I suppose I must plan a course of action for you. Convince our young friend that she isn't looking as well as she has been. Tell her that you have heard of some wonderful electric treatments that are getting remarkable results. Tell her that all your wealthy friends are having them. That's the bait she'll raise to. And then offer to pay for a course for her. I think that'll bring her here. Once inside my laboratory, I'll answer for all the rest."

Fennimore arose. "All right, Parsons," he said, "We'll try it. I'll telephone you as soon as I get a definite decision from Violetta."

Parsons smiled quaintly after the departing car. "Before that two year period expires, son," he soliloquised, "You'll be around begging me for the antidote."

It took Fennimore a week to convince Violetta that she needed toning up. Finally, attracted by the price that the young millionaire would have to

CUNNINGHAM Power Tubes



Type C-302
5 watt output
Price $8.00

Demand Cunningham Tubes

The Name is etched on the Tube

C W *Telegraphy and Telephony With Cunningham Transmitter Tubes Offers the Advantages of*

COMPACTNESS — RELIABILITY — LONG RANGE
LOW POWER — SHARP TUNING

Transmitter Tube Specifications

Model	Output Conservative Rating	Filament Amps.	Filament Volts	Plate Voltage	Price	Delivery Date
C 302	5 watts	2.35	7.5	350-400	$8.00	immediate
C 303	50 watts	6.5	10.	1000	30.00	Mar. 10th
C 304	250 watts	15.	12.	4000 Max.	110.00	Mar. 10th

Price of C 303—C 304 fob. New York or San Francisco

C 302 is mounted on the standard four prong receiving tube base. The larger tubes have special bases.

Cunningham Power Tubes

are the latest product of the great Research Laboratory of the General Electric Co. The trade mark GE is the guarantee of their quality. Each tube is built to most rigid specifications. The output ratings are extremely conservative and in actual test deliver greatly in excess of their rated output.

General Electric Quality *plus* Cunningham Service

Address All Communications to

A. T. Cunningham

Trading as
Audiotron Mfg. Company
Dept. S,
35 Montgomery St.
San Francisco, Cal.

WANTED
Railway Mail Clerks
$1600 to $2300
a year in it for you



Men—Boys—Over 17—should write at once

Hundreds of Railway Mail Clerks Needed

Rapid advancement to higher Government Positions. "No lay-offs" because of STRIKES, POOR TIMES, FINANCIAL FLURRIES or the WHIMS OF SOME PETTY BOSS. THE POSITION IS YOURS FOR LIFE.

Country residents and city residents stand the same chance of immediate appointment. Common-sense education sufficient. Political influence NOT REQUIRED.

Write immediately for schedule showing the places and dates of ALL SPRING Government examinations. Don't delay. Every day you lose means the loss of just so much coaching before the rapidly approaching examinations.

FRANKLIN INSTITUTE, Dept. J182 Rochester, N. Y.

FRANKLIN INSTITUTE [The Pathway to Plenty]
Dept. J182, **Rochester, N. Y.**

This coupon filled out as directed, entitles the sender to free specimen questions; a free copy of our book, "Government Positions and How to Obtain Them;" a list of Government positions now open, and to consideration for Free Coaching for the examination here checked.

COUPON

...Railway Mail Clerk	($1600 to $2300)
...Bookkeeper	($1240 to $1440)
...Postoffice Clerk	($1400 to $1800)
...Postoffice Carrier	($1400 to $1800)
...Rural Mail Carrier	($ 720 to $2600)
...Customs Positions	($1100 to $2000)
...Stenographer	($1100 to $2000)
...File Clerk	($1340 to $1640)
...Clerk in the Departments at Washington	($1200 to $1800)

Name ..... Address .....

Use this before you lose it. Write plainly.



"$5,000 Working for Us!"

"I bought another good bond today and tonight Helen and I were figuring up our investments. All told we now have $5,000 saved and invested where it will add $300 to our income every year!

"I used to scrape along in routine work and spend what little I earned. Then one day my employer gave me some advice. He said success depends on two things. First, learn to do some one thing well. Second, save and invest something out of what you earn each month.

'I decided then and there to get some special training. I wrote to Scranton and found I could get just the course I wanted and study at home evenings. So I started, and it wasn't long before the manager gave me more important work—and more money. I kept on studying with three increases the first year. And each pay day I put something aside. So it has been ever since. As I advanced at the office and my salary grew, my savings grew faster and I put them into good securities.

"Helen was happy as a lark tonight when I told her we had five thousand dollars in safe, sound investments working for us! And this is only the beginning. At our present rate of saving, in a few years more we'll have an independent income for life!"

Success is within easy reach for *you* if you'll just follow the simple rules that have made all men successful who have practiced them. First decide what *your* work is, learn everything about it that you can. The easy, convenient way to do that is to let the International Correspondence Schools help you.

More than two million men and women have taken the up road with I. C. S. help. More than 130,000 are now turning their spare time to profit. Isn't it about time for *you* to find out what the I. C. S. can do for you? Then mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6188-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electrician
- ☐ Electric Wiring
- ☐ Electric Lighting
- ☐ Electric Car Running
- ☐ Heavy Electric Traction
- ☐ Electrical Draftsman
- ☐ Electric Machine Designer
- ☐ Telegraph Expert
- ☐ Practical Telephony
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Ship Draftsman
- ☐ Machine Shop Practice
- ☐ Toolmaker
- ☐ Gas Engineer
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREM'N OR ENG'R
- ☐ ARCHITECT
- ☐ Architectural Draftsman
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Navigator
- ☐ CHEMICAL ENGINEER
- ☐ Pharmacy
- ☐ SALESMANSHIP
- ☐ ADVERTISING MAN
- ☐ Window Trimmer
- ☐ Show Card and Sign Paint'g
- ☐ RAILROAD POSITIONS
- ☐ ILLUSTRATOR
- ☐ DESIGNER
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ Business Correspondent
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Pub. Accountant
- ☐ Traffic Management
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ STATIONARY ENGINEER
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ Textile Overseer or Supt.
- ☐ AGRICULTURE
- ☐ Poultry Raising ☐ Spanish
- ☐ Automobiles ☐ Banking

Name_____

Present Occupation_____ Business Address_____ 1-1-21

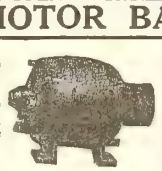
Street and No._____

City_____ State_____

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada

NEW MOTOR BARGAIN

GENERAL ELECTRIC



1/4 HP Motor 110 V. A. C. 60 cycle single phase, 1750 Speed. Complete with Cord, Plug and Grooved Pulley.

Will operate $21.00 Washing Machines, Sewing Machines, Small Lathes, Grinders, Bottle Washers, Etc. Satisfaction guaranteed or money refunded.

Illustrated catalog of motors and supplies FREE

HYRE ELECTRIC CO.
631 T. South Dearborn Street Chicago, Ill.

5 Master Keys

The most wonderful and only set of keys of its kind. They open and test **thousands** of different locks. **They have satisfied thousands** of purchasers, and are used and recommended by locksmiths, janitors, detectives, and other great key users. They are unequalled as a useful, convenient, and household article. Send $1.00 for set and novel key chain.

MASTER KEY CO. 42 Manhattan Bldg. MILWAUKEE, WIS.

pay for her treatments, the fickle young beauty consented, agreeing to place herself in Parson's hands.

When the last curtain fell one evening she hastened to her dressing room and made ready for her first visit to the professor's laboratory. The impatient Fennimore was waiting for her with his big limousine, into which he piloted her as soon as she emerged from the stage door alley. Half an hour later she was shaking hands with Parsons.

"Rotten of us," she drawled, languidly, as the scientist dropt her limp hand, "Rotten of us to keep you working at this hour. But I just can't get up in the mornings. Habit I formed out in the sticks making night jumps. Nothing really the matter with me, is there, Doc?"

"Haven't had a chance to examine you yet, young lady, but off hand I should say there were several things the matter with you," said Parsons, dryly, as he led the way into his laboratory.

Fennimore shot him a sharp look, started to speak, then changed his mind. The girl, who had not caught the hidden meaning of the scientist's remark, rattled on, waxing doubly garrulous as she caught sight of the formidable array of electrical apparatus and switchboards in the sanctum. Had either she or Fennimore been versed in such matters they would have been able to identify several familiar pieces of high frequency apparatus, the brass stripped oscillation transformers and burnished Leyden jars being quite conspicuous in the array.

Parsons wasted no time in useless preliminaries. "You first, Fennimore," he said, curtly.

"I," objected the amazed millionaire, "I'm not here for treatment."

"Heavens, man," interposed the professor, testily, "Don't question my methods. I must have your rate."

Fennimore's teeth snapt shut on his unspoken retort, and submissively he took in each hand the peculiar metal electrodes the scientist proferred. He was finding Parsons a different man in the laboratory from what he had been in his consulting room.

The professor, his eyes watching intently the quivering pointer on a meter face, paid scant attention to his two companions. Finally he made some notes on a pad and relieved Fennimore of the electrodes.

"That will do, thank you," he said, "Now I must figure out your rate."

"My rate of what?" demanded the mystified youth.

"The rate at which you are vibrating per second," replied Parsons, none too graciously, "Let's see. The square root of ——. Ah! There we have it. You vibrate, Fennimore, between the twenty-fifth and twenty-seventh octaves. Thirty-seven million, five hundred and fifty thousand and some odd cycles a second, if figures interest you."

"They don't," replied Fennimore, promptly, his eyes feasting on Violetta, "Not that kind, anyway."

Parsons handed the girl the electrodes, and again studied the quivering needle. Again his pencil was busy. Then he faced the pair, a satisfied look on his face which told plainly that he had found what he sought.

"And you, my friend," he said to Violetta, "Vibrate at the rate of thirty-seven million, five hundred and forty-nine thousand and a few odd hundred. There's only about seven hundred cycles difference between you. You're a fine pair of zincs."



CORWIN DIALS

IT is just as easy to specify "Corwins" when buying dials, and it implies that you have quality apparatus throughout. Dealers acquire respect for those who specify good makes of radio goods.

3" Dial, 75c; with knob, $1.30
3 7/8" Dial, $1.00; with knob, $1.70

At all Radisco Agencies, or sent postpaid anywhere.

A. H. CORWIN & CO.
4 West Park St., Newark, N. J.

SAVE TIME AND MONEY

By forwarding your Mail Orders to us.

Our central location makes it possible for you to do so.

Amplifying Transformer	$5.00	Baldwin Navy Type Receiver	$16.50
Bamboo Spreader, 12 ft.	2.25	Brandes Superior Receiver	8.00
Electrose Insulator, 10 in.	.75	Murdock Receivers, 5,000 Ohms	4.50 and 5.50
Electrose Insulator Ball	.35	Marko Storage Batteries, 6 V., 40 A	16.25
Lightning Switch	4.50	Marko Storage Batteries, 4 V., 40 A	10.75
Antenna Switch	4.50	E. R. Det. Tube	6.00
B. Batteries, 22½ V., 1,200-hour capacity	3.50	Amplifier Tube	7.00
B. Batteries, 4½ V., 200-hour capacity	.40	Transmitter Tube	7.50
Variable Condenser, Conn. .001	6.50	Radistron Det. Tube	5.00
Variable Condenser, C. E. Bal. .001	9.50	Ace V. T. Socket with Grid Leak	1.50
Variable Condenser, Murdock .001	4.75	Wixico Coil Mounting, Table	8.00
		Wixico Coil Mounting, Panel	6.00

Mail orders receive prompt attention. Send 3c in stamps for catalogue.

THE PRECISION EQUIPMENT CO.
Dept. E 2437-2439 Gilbert Ave. Cincinnati, Ohio
"You May Pay More But You Can't Buy Better"



You can Ukulele!

You can easily play quaint, dreamy Hawaiian music or latest songs on the Ukulele. Prof. Harry J. Clarke's latest method enables you now to play the Ukulele in a few weeks. We give you a genuine Ukulele absolutely FREE with complete course of lessons. Write at once for FREE narrative of Hawaiian music and offer. No obligations! Send Now!

Hawaiian Institute of Music, 1400 Broadway, Dept. 5A, New York

TELEGRAPHY

(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.

DODGE'S INSTITUTE A Street, Valparaiso, Ind.

ABC Standardized Radio

Sectional Unit Cabinets

A SERIES of cabinets, all standardized including receiving set, VT Detector, VT and one-step combined, one-step, and two-step amplifiers. You start with the receiver (complete in itself) and add on the other sections without discarding one particle of your original equipment.

ABC sectional unit cabinets *look* like professional equipment, *work* like professional equipment, and sell at prices amateurs can afford. That's the result of standardized, automatic production in the best equipped radio plant in the world!

Backed by the *ABC* Guarantee,—"Your money's worth or your money back." *Send a nickel for complete circular.*

Wireless Equipment Co., Inc.
188 Greenwich Street, New York

EXPERIMENTORS

Attention

¼-HP New General Electric Motors
110 Volt—Single Phase—1725 RPM
$22.50

⅙-HP New Westinghouse Motors
110 Volt—Single Phase—1725 RPM
$18.00

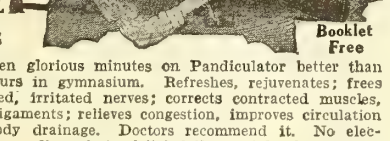
VIM ELECTRIC & MOTOR CO.
Incorporated
66-68 Cortlandt Street
New York City

Write It With a 'Vulcan'



Red or "Vulcan" Ink Pencil Black
The only perfect, non-leakable ink pencils at moderate prices. Long or short.
Absolute necessity to any business man or woman. Promotes efficiency. Unequalled for general writing, billing, ruling and manifolding. Made of pure vulcanized rubber with non-corrosive, durable writing point. Lock-Cap prevents leaking. Extra size, 8 ins. black only, $1.75. *Agents Wanted. Big Profits.*
Order today, Postpaid $1.50
J. F. ULLRICH & CO., 161 Washington St., N.Y.

PANDICULATE FOR HEALTH



BE WELL
YOUNG
STRONG

Booklet Free

Fifteen glorious minutes on Pandiculator better than two hours in gymnasium. Refreshes, rejuvenates; frees impinged, irritated nerves; corrects contracted muscles, spine ligaments; relieves congestion, improves circulation and body drainage. Doctors recommend it. No electricity, no discomfort; delightfully restful. Write now.

PANDICULATOR CO., 332 Prospect Bldg., Cleveland, Ohio



DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my sworn statement of how I recovered my hearing.

A. O. LEONARD
Suite 369, 70 5th Avenue -- New York City

"Fine pair of zincs," echoed Fennimore, "What the devil, Parsons,——"

"Ever see a dry cell, Fennimore?" Parsons asked, calmly, "Carbon and zinc poles, you know? Well, you're a pair of negatives. You couldn't have succeeded in this case in a thousand years."

"See here," broke in the imperious Violetta, "What's all this about a pair of negatives? When do I get those treatments?"

"Don't worry," Parsons assured her, "You'll get them."

Fennimore faced her doggedly. "Look here, Violetta," he said, determinedly, arms folded, jaw squared, "You may as well know the truth. I've told you a thousand times how desperately I love you. Every time you've laughed in my face. I've grown desperate. I had to do something. The professor here thinks he can arouse in you some love for me by means of these treatments. That's why we're here, and that's why he has to take observations of the both of us."

After one startled moment, the girl gave way to uncontrolled laughter. "Make me love you with a bunch of juice," she gasped, "Oh, Lord. This is rich."

Parsons regarded Fennimore with deep disgust. "Fennimore," he said, icily, "You have, in the language of the street, spilled the beans. Now will you kindly keep your mouth shut before you scatter them so hopelessly that I can't pick them up."

"She had to know sometime," retorted Fennimore, stubbornly, "And it might as well be now."

"She didn't have to know before I got these electrodes on her arm," Parsons shot at him, deftly clamping an arm electrode on each wrist of the unresisting girl, who was paying no attention at all to the busy professor. She was regarding Fennimore with contempt.

"Why, you poor simp," she sneered, "I've told you a dozen times, and I tell you again, that if you had a hundred times the money you have, and if you were a hundred times better looking than you are, I wouldn't marry you if you were the last man on earth. Or any other boob in trousers, either. I've got my work to think of. Do you think I'm going to quit being a chorus girl? Not on your life."

Parsons snapt on a switch and grinned at the disheartened millionaire. "How's that for a mouthful, son? he asked, "Think that will hold you for awhile?"

Then the girl turned on him. "And you, Mr. Smart Guy," she demanded, "How do you expect to change my mind with your foolish old treatments?"

Parsons looked at his trembling meters and smiled. "Easily, my dear," he replied, "Oh, quite so. You see, life itself being of an electrical nature, it obeys the laws which govern electrical phenomena in general. To what extent and by just what means we are hardly in position to say as yet. My own researches have carried me beyond the frontiers in certain directions, and the treatment you are undergoing tonight is just one application of the facts that I have unearthed.

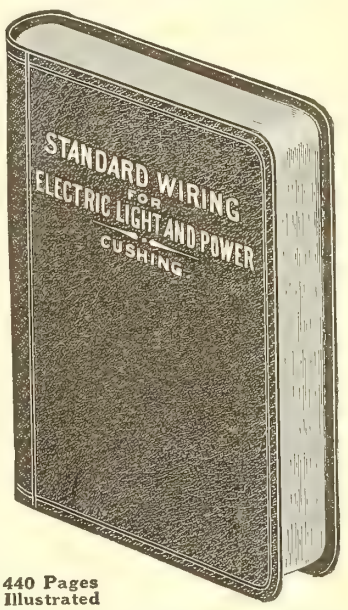
"You young people think that love is a question of good looks, circumstances, and mutual attraction. You have fallen into the common error of mistaking the effect for the cause. No two people will be attracted to each other to any degree—far from sufficiently to love—if their natures aren't tuned properly for the occurrence of the phenomenon. Take your own case, for

LEARN WIRING

AND EARN

$75 a Week

This latest Edition will make you an Expert



440 Pages Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

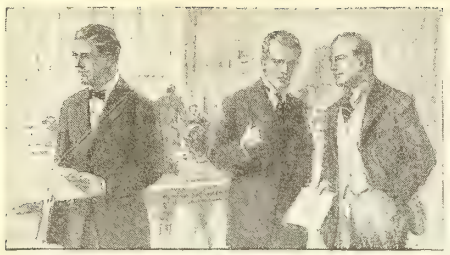
SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. 250 Electrical Units and their Definitions and Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve your wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges. Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.
8 West 40th Street New York



"Watch Bill Brown!"

"He's a comer," said the big boss, "always on the job—courteous, thorough and efficient—never lost a day through sickness since he's been with us. Last winter when two-thirds of the force were home sick with the 'Flu,' Brown did the work of a dozen and pulled us through. He's always in good physical trim. You can depend on him. We want more men like him in this organization. Hereafter don't employ anyone who can't measure up to Brown's physical and health standard. We must have strong, healthy men with lots of pep and vitality—big calibred youngsters with an abundance of physical and mental energy. That kind of a man is worth keeping on the payroll. Put Brown down for another increase in salary and keep him in mind for a bigger job."



STRONGFORT
The Perfect Man

What Does Your Boss Think About You?

Does he think you are an efficient worker—a good producer — a dependable man worthwhile keeping on the payroll, or are you slated for early discharge? If you have neglected your health and failed to measure up to your job, you will soon be a "discarded employee" out on the street with the tail-end failures. Where do you stand?

Your Health Means Your Job!

How do you expect to be mentally efficient with neglected health? Your brain cannot be up to standard when your blood is watery and anemic, loaded with the poisons of Catarrh, Constipation, Indigestion, Biliousness and bad habits and excesses—the results of youthful ignorance. You feel miserably and look twice as badly. You must get strong and healthy or *get out*. It's up to you. What will you do? What will your future be? You can save yourself and your job with

STRONGFORTISM

The Modern Science of Health Promotion

Strongfortism is the Science of Normal Health, Strength, Vigor and Sex Life. It has salvaged thousands of weak, sickly, impotent men out of the bog of miserable failure and despair. It can do the same for you. It will rebuild and rehabilitate you in every part, put new life and ambition into you and make you a success in business, in the home, in society—everywhere. You can be 100% successful with Strongfortism. I guarantee it!

You Want My Free Book

Mark the items on the consultation coupon on which you want special information and send it to me with a ten cent piece (one dime) to help pay postage on my FREE book. **"Promotion and Conservation of Health, Strength and Mental Energy."** This wonderfully instructive book will point your way to a successful, healthy, happy existence. It is a life saver and a job saver. Send for it *right now*.

LIONEL STRONGFORT

Physical and Health Specialist

Department 286, Newark, New Jersey

FREE CONSULTATION COUPON

Mr. Lionel Strongfort,
Dept. 286, Newark, N. J. Personal.

Please send me your book "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH and MENTAL ENERGY," for postage on which I enclose a 10c piece (one dime).

Send me special information on subjects marked X below, without in any way obligating me.

..Colds	..Stomach Disorders	..Despondency
..Catarrh	..Constipation	..Skin Disorders
..Hay Fever	..Biliousness	..Impotency
..Asthma	..Torpid Liver	..Great Strength
..Obesity	..Indigestion	..Falling Hair
..Headache	..Nervousness	..Weak Eyes
..Thinness	..Poor Memory	..Pimples
..Rupture	..Rheumatism	..Blackheads
..Lumbago	..Gastritis	..Round Shoulders
..Neuritis	..Heart Weakness	..Lung Troubles
..Neuralgia	..Poor Circulation	..Female Disorders
..Flat Chest	..Increased Height	..Weak Back
..Deformity (Describe)	..Successful Marriage	..Muscular Development
..Insomnia	..Easy Childbirth	..Advanced Course
..Vital Depletion	..Drug Addicts	..Healthy Children
..Youthful Errors		..Manhood Restored
..Short Wind		
..Flat Feet		

Name.....

Age.....Occupation.....

Street.....

City.....State.....

example. You told the truth when you said that you would not love Fennimore in a million years. Your rates of vibration were so nearly alike that you were, as I said, like poles of a battery."

She regarded him thoughtfully. "Then how, Mr. Man," she asked, "Do you account for the fact that this poor fish is gone on me? Seems to me the rule ought to work both ways to be any good."

"Bravo, little reasoner," exclaimed Parsons, admiringly, "You will be the brains of your household. Well, I account for that quite easily. The simple fact is that HE'S NOT IN LOVE WITH YOU AT ALL."

Fennimore jumped about two feet. The girl looked at the calm scientist in open mouthed amazement. "Say, Parsons, what the ——" burst out the wrathy Fennimore.

"Calm yourself," came the unperturbed reply, "I know what I'm talking about. Bluntly, you've mistaken lust for love. You think you're in love.

"What I'm doing is just this. By a process which I do not choose to reveal, I am changing the rate, or call it natural period, if you like, at which this girl vibrates. When I have changed it sufficiently you will be as far apart as you were together before. In other words, you will be splendidly positive and negative. Then you will love. You won't be able to help yourselves."

Vaguely alarmed at the cool assurance of this man, the girl stirred uneasily in her chair and regarded the quivering meter needles with some apprehension.

Parsons leaned back comfortably against his instrument board and resumed.

"I find that the exact adjustment of these oppositions is quite critical. For maximum manifestation I should have to readjust you to the very cycle. Were I to do that, the attraction would be so violent that you would literally hurl yourselves into each other's arms. That critical state quite frequently occurs naturally, and when it does you see the conventions hurled ruthlessly aside, and every man-made barrier scaled, be it as high as the mountains or as broad as the sea. Let me get the coldest, most haughty beauty of the upper class into this chair, and I can force her to lavish every attention on the dirtiest ash man you can find in the city.

"It is sufficient that we attain a degree of attraction necessary to arouse domestic instincts and impulses." He broke off to study gravely the indication of a large meter. "That state we have about reached now," he said, quietly.

Fennimore started, and regarded the girl intently. For a second she met his gaze. Then her eyes dropt, and she blushed.

Parsons smiled faintly. "I'm a few years ahead of my time, of course," he said, "Within the next few years every couple that applies for a license to wed will have their vibratory rates taken and the corrections necessary to accomplish true affection made. The divorce evil will be wiped out as mis-mating is prevented."

He snapt off the switch and deftly removed the electrodes from the girl's arms. She arose, a trifle unsteadily. Fennimore regarded her anxiously. "How do you feel?" he asked, in some concern.

"A little queer," she replied, dazed, "You'd better take me home, Roderick."

Roderick! The young man's heart pounded within him and a look of exultation came over his features. He faced her squarely. "For the thousand and first time, 'Letta," he said, "Will you marry me?"

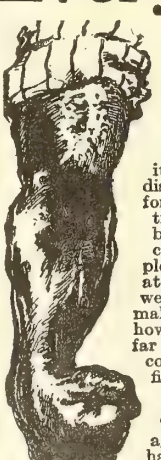
say BAYER Aspirin

Then It's Genuine

Unless you see the name "Bayer" on tablets, you are not getting genuine Aspirin prescribed by physicians for 21 years and proved safe by millions. Always say "Bayer."

Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid.

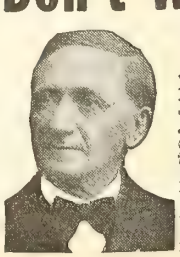
There is Strength in Every Tablet



One dose often helps commence to enrich your blood and revitalize your worn-out exhausted nerves—Nuxated Iron is organic iron, like the iron in your blood and like the iron in spinach. It is so prepared that it will not injure the teeth nor disturb the stomach. It is ready for almost immediate absorption and assimilation by the blood while some physicians claim metallic iron which people usually take is not absorbed at all. If you are not strong or well you owe it to yourself to make the following test: See how long you can work or how far you can walk without becoming tired. Next take two five-grain tablets of Nuxated Iron—three times per day, after meals for two weeks. Then test your strength again and see how much you have gained. Your money will be refunded by the manufacturers if you do not obtain perfectly satisfactory results. At all druggists.

NUXATED IRON
For Red Blood, Strength and Endurance

Don't Wear a Truss



We Guarantee Your Comfort

with every Brooks' Appliance. New discovery. Wonderful. No obnoxious springs or pads. Automatic Air Cushions. **Binds and draws the broken parts together as you would a broken limb.** No salves. No plasters. No lies. Durable, cheap. Sent on trial to prove it. Full information and booklet free.

C. E. BROOKS
203F State St. Marshall, Mich.

"In 1999"

By B. FRANKLIN RUTH

(*Continued from page* 1302)

peculiar nature of the disturbances could only be explained as the result of some human agency capable of exercising extraordinary powers over the physical universe. After the occurrence of several successive manifestations, the latter were immediately identified as radioactive in origin. It was admitted that atomic disintegration had at last been accomplisht, and that the fate of the world was in the hands of its unknown discoverer, who might destroy the planet at his whim. With deep secrecy science kept its knowledge, and waited for the discoverer to make himself known either as the benefactor or destroyer of mankind.

Early in 1925, the great Indian physicist, Signa Beth, announced his discovery of a method of releasing the immense energy stored in the atom, and his intentions of benefiting mankind. Thus the most momentous discovery ever made by science was disclosed.

From that date, science bounded forward. The commercialization of Signa Beth's discovery and its direct application to the immense stores of energy contained in the atoms of the common heavy elements brought unprecedented benefits to mankind. With almost unlimited power waiting to be unleashed by the pressure of a finger, men laid aside their work and took a holiday. It was like the discovery that water could be turned into steam and made to work for us,—multiplied a million times.

Close upon the discovery of atomic disintegration came that of the transmutability of matter. This was the natural sequence of the analysis of the properties of by-products formed during the successive steps of disintegration. The result of this discovery, as we all know today, was the immediate demonetization of gold and all precious metals. In a day the world was threatened with its greatest financial panic.

Fortunately, there was at the head of our government a man of great foresight and ability who saw the threatened disaster and took immediate steps to avert it. At a joint meeting of the representatives of the various governments, measures were taken to meet the crises, and thru pressure brought to bear from certain sources a coalition of nations was formed under a single government. This we know today as the United States of the World. It was in effect a League of Nations similar to the plan advanced by the great Wilson in 1919. It arranged for a semi-annual world congress at Washington, and enforced its decrees by means of an International Police. Paper notes on the World Government were issued as legal currency, and substituted for all outstanding metal currency. Threatened Bolshevik outbreaks in Russia, and labor crises in Europe and America were immediately quelled by the efficient iron hand of the international government. Thus was civilization again saved from destruction.

One of the most apparent effects of the world coalition was the abolishment of war. The United States, as principal creditor of the bankrupt nations, held a unique position in the league, both as its sponsor and guardian. The

Learn Music at Home—

New Way Makes It Easy



Either Playing or Singing — Every Step Made Simple as A B C by Print-and-Picture Lessons That You Can't Go Wrong On.

Try It On Approval

Entire Cost Only a Few Cents a Lesson—and Nothing Whatever to Pay Unless You are Satisfied.

How often have you wished that you knew how to play the violin or piano—or whatever your favorite instrument may be—or that you could take part in singing?

How many an evening's pleasure has been utterly spoiled and ruined by the admission, "I can't sing," or "No, I am sorry, but I can't play."

At all social gatherings, some one is sooner or later sure to suggest music. When the others gather around for the fun, the one who can take no part feels hopelessly out of it—a wall flower—mere listener and looker-on!

Or those long and lonesome evenings at home when minutes seem like hours—how quickly the time would pass if you could spend it at the piano or organ—or in making a violin "talk," or in enjoying some other instrument.

And now—at last—this pleasure and satisfaction that you have so often wished for can easily be added to your daily life.

No need to join a class or pin yourself down to certain hours for lessons or practice. No need to pay a dollar or more per lesson to a private teacher. Neither the question of time nor expense is any longer a bar—every one of the obstacles that have been confining your enjoyment to mere listening have now been removed.

You don't need to know the first thing about music to begin—don't need to know one note from another. My method takes out all the hard part—overcomes all the difficulties—makes your progress easy, rapid and sure.

Whether for an advanced pupil or a beginner, my method is a revolutionary improvement over the old methods used by private teachers. The lessons I send you explain every point and show every step in simple Print-and-Picture form that you can't go wrong on—every step is made as clear as A B C.

For Beginners or Advanced Pupils

Piano	Harmony and Composition
Organ	Sight Singing
Violin	Guitar
Drums and Traps	Ukulele
Banjo	Harp
Mandolin	Cornet
Clarinet	Piccolo
Flute	Trombone
Saxophone	Cello

My method is as thorough as it is easy. I teach you the only right way—teach you to play or sing **by note.** No "trick" music, no "numbers," no makeshifts of any kind.

I call my method "new"—simply because it is so radically different from the old and hard-to-understand ways of teaching music. But my method is thoroughly time tried and proven. Over 250,000 successful pupils—in all parts of the world, and including all ages from boys and girls of 7 to 18 to men and women of 70—are the proof. Largely through the recommendations of satisfied pupils, I have built up the largest school of music in the world.

But I don't ask you to judge my methods by what others say or by what I myself say. You can take any course on trial—singing or any instrument you prefer—and judge entirely by your own progress. If for any reason you are not satisfied with the course or with what you learn from it, then it won't cost you a single penny. I guarantee satisfaction. On the other hand, if you are pleased with the course, the total cost amounts to only a few cents a lesson, with your music and everything also included.

Just now I am making a special short-time offer that cuts the cost per lesson in two—send your name now, before this special offer is withdrawn. Instruments supplied when needed, cash or credit.

MR. DAVID F. KEMP, President
U.S. School of Music, 1334 Brunswick Bldg., New York City

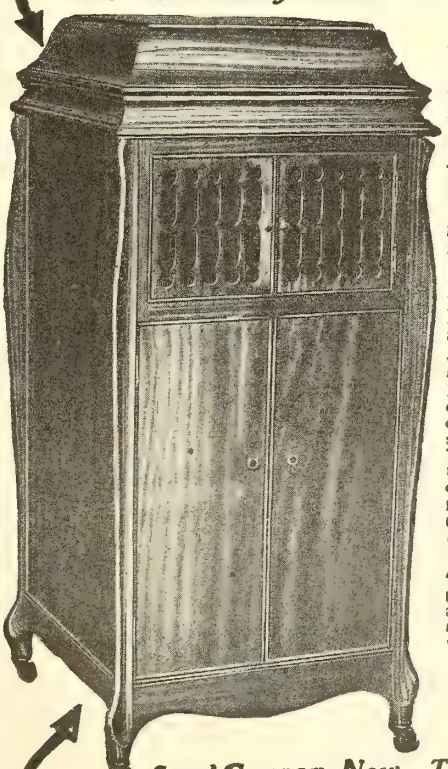
Please send me your free book, "Music Lessons in Your Own Home," and particulars of your Special Offer.

Name .....
Please Print Name.

Address .....

City ..... **State** .....

YOU Can *Easily* BUILD This PHONOGRAPH



TREMENDOUS SAVING IN COST

You don't need to be a cabinet maker. We have made it an easy and pleasant job with

Our Simplified Plans We furnish blue prints, diagrams, motor, ready-built horn, cabinet pieces and all metal parts complete. You do the assembling, **6 models to choose from.** A few hours' work, and you will have as fine a type of phonograph as any produced, and at a price away below what you would pay in a store.

KEEP THE SAVINGS IN YOUR POCKET

Machines play all records, have a wonderful tonal quality, excelled by none. No need now for any family to be without a phonograph because of the cost. THE MAKAFONE solves the problem. BUILD IT YOURSELF AT LESS THAN ONE-FOURTH REGULAR COST, but equal to the high-priced cabinet machines. Free Records with each outfit. SEND TODAY FOR FREE CATALOG and full particulars of our wonderful offer. *Many a manufacturer got his start in this way. Why not you? Build machines and sell to your friends.*

Agents Attention You can make and sell *these* machines from our plans at a profit of $50 to $75 each. Others are selling two and three a week. Here is your opportunity to make big money and become independent. Pleasant and profitable work.

Send Coupon, Now—To-day

MODERN PHONOGRAPH SUPPLY CO.
557 Springer Bldg., 313 So. Clinton Street, Chicago.

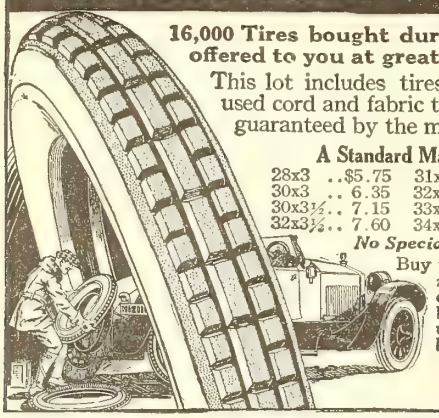
Modern Phonograph Supply Co.
557 Springer Bldg.,
313 So. Clinton St., Chicago, Ill.

Gentlemen: Please send me full particulars of your Makafone Proposition, without obligation to me

Name .....

Address ..... State .....

GUARANTEED MILLER MADE TUBE FREE



16,000 Tires bought during the recent tire panic and now offered to you at greatly reduced prices.

This lot includes tires that are rebuilt throughout, slightly used cord and fabric tires and reconstructed tires that were guaranteed by the manufacturers for 5,000 miles.

A Standard Make Tube Free with Each Tire Ordered

28x3	$5.75	31x4	$9.00	32x4½	$10.25	36x4½	$11.90
30x3	6.35	32x4	9.10	33x4½	10.50	33x5	12.00
30x3½	7.15	33x4	9.50	34x4½	10.70	35x5	12.25
32x3½	7.60	34x4	9.75	35x4½	11.40	37x5	12.75

No Special Discounts to Dealers or Agents

Buy your summer tires now. *Order today and save money.* State straight side or clincher. Send $2 deposit with your order and tire will be shipped balance C. O. D. Orders will be filled promptly until our limited supply is gone, so order today, before it is too late.

Chicago Tire Sales Company
96 Vincennes and 39th St. Chicago

WINDOW SIGNS



AGENTS 500% PROFIT

Gold and Silver Sign Letters

For store fronts, office windows and glass signs of all kinds. No experience necessary. Anyone can put them on and make money right from the start.

$75 to $200 a Week!

You can sell to near-by trade or travel all over the country. There is a big demand for window lettering in every town. Send for free samples and particulars.

Liberal Offer to General Agents

METALLIC LETTER CO.
433Y No. Clark St. CHICAGO, ILL.



Send for a Copy of Our Manual of Wireless Telegraphy

We now have ready for distribution our Manual of Wireless Telegraphy. It contains 200 pages, fully illustrating and describing the many instruments used in Radio. 45 pages cover general instructions, diagrams, station calls, tables, codes and other information identified with the art.

The book is printed on high finished paper with a two-color cover and measures 9x5¾ inches.

Due to the scarcity of paper, the high cost of publication, and in order that the Manual may get into the hands of those most interested in Wireless, we ask 25 cents for it, give a coupon receipt for the amount, which coupon can be applied on a future purchase.

Get Your Copy Before the Edition Is Exhausted

MANHATTAN ELECTRICAL SUPPLY CO. INC.

17 Park Place New York	114 S. Wells St. Chicago	1106 Pine St. St. Louis	604 Mission St. San Francisco

SEND NO MONEY

ALL STANDARD MAKES

These tires are all standard makes, formerly guaranteed for 6,000 to 8,000 miles, many practically new. Do not confuse these exceptional high grade tires with sewed or half soled tires. Thousands of users are getting 6,000 to 8,000 miles easy. Every tire we ship is backed by our satisfaction guarantee.

SIZE	TIRES	TUBES	SIZE	TIRES	TUBES	SIZE	TIRES	TUBES
30x3	$ 6.95	$1.75	33x4	$11.25	$2.50	35x4½	$13.90	$3.15
30x3½	7.95	1.95	34x4	11.90	2.60	36x4½	14.50	3.40
32x3½	8.75	2.15	32x4½	12.25	2.70	35x5	14.90	3.50
31x4	9.45	2.25	33x4½	12.90	2.85	37x5	15.00	3.75
32x4	10.90	2.40	34x4½	13.25	3.00	36x4	15.90	4.00

No money in advance. We ship on approval by Express. See and inspect before you pay. 5 per cent discount if money in full accompanies order. Just write, tell us your size, also whether S.S. or C.L. **Send today.** While these bargain prices last

KLASS-WORTH CO., 3033 Michigan Ave., Dept. 81 Chicago, Ill.

UTTMARK'S NAUTICAL ACADEMY RADIO SCHOOL

SUCCESS OPPORTUNITY

Offers a thorough course in all branches of wireless telegraphy. Radio Operators earn at the start $125.00 per month, and first-class board, etc., free.

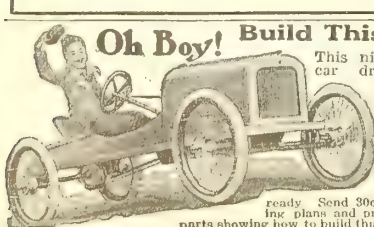
Our school prepares you for your license in three to four months. Positions guaranteed to first-grade licensed operators.

Day and Evening Classes

8 State Street, New York, N. Y.

Phone, Bowling Green 8079

Oh Boy! Build This Car



This nifty little car driven by gasoline motor can be built by any boy. New 1921 plans, bigger, better than ever, now ready. Send 30c for building plans and price list of parts showing how to build this lad's car.

SYRACUSE MFG. CO. 156 Syracuse Bldg. Toledo, Ohio

MATHEMATICS MADE EASY



The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only One Dollar Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah

former president of the United States was elected president of the World Congress. But he also represented the United States.

The reason for the disappearance of war, we are led to believe, was the potential power held by the United States. When the Great War came to an end in 1918, many new and terrible inventions were just nearing completion, and were perfected too late to be used in actual warfare. The possession of these secrets by the United States constituted an effectual curb to the aggressive instincts of any nation inclined to war.

One of the most spectacular inventions resulting from Signa Beth's discovery was that of Thomas Soddy's space navigating apparatus in 1938. By utilization of the terrific recoil developed in a certain method of disintegration, this instrument was able to leave the earth's surface like a sky rocket and travel beyond its gravitational orbit in any direction, at a tremendous rate of speed.

The effect of this invention upon the lay mind at that time can hardly be imagined. Nineteen years before, powerful waves of mysterious but undoubtedly ethereal origin had been received by some of the larger radio stations. The scientific explanations and press exploitations of these unidentified waves created such widespread excitement at the time that when Soddy returned from his epoch-making explorations of Mars and Venus in 1938, and confirmed these attempted Martian communications of 1919, and testified as to the residence on Mars and Venus of highly civilized beings, the people of the earth became wildly excited.

Results followed speedily. Intercourse between the inhabited planets of our solar system was quickly established. Interplanetary laws governing spacial navigation were quickly formulated and ratified, so that today we witness our great interplanetary merchant marine, touching all planets in the solar system, and many of the nearer stars. Trips of exploration are bringing in reports of new discoveries every day. Excursion ships dash thru space at regular hours, bound for other planets.

Soddy's invention truly marks the beginning of this Utopian era of Science. Mankind began to live a life of ease and indulgence, yet governed by sobriety and health.

Due to the congestion of our cities, some of which had a population of fifty-five millions, and to existing agricultural conditions, it was increasingly difficult, during the early sixties, to furnish enough food. The great Browning's discovery of a method permitting the direct conversion of heat into electricity enabled engineers of the period to solve this problem adequately. Thirty-foot tubes were excavated thru the earth's diameter, reaching from a large industrial center on one side to some extensive agricultural area upon the other. Africa, China, Australia, and parts of South America were touched. As these tubes were sunk, they were lined with Browning's electro-heat converting apparatus, which turned the intense heat of the bowels of the earth into an immense voltage, giving an electric current, but left the interiors of the tubes relatively cool and insulated from the fiery medium thru which they passed.

Food, produced easily and in large quantities in the farming countries, was quickly hauled over extensive railroad systems to the mouths of the tubes, and regular consignments dropped thru in specially designed cars. The momentum gained in the four thousand mile drop



Build and Fly Your Own
MODEL AEROPLANE!

Any bright boy can build an IDEAL Model of a real Aeroplane and learn lots about big machines.

It will fly in the air under its own power.

Complete Parts to construct an IDEAL 3-ft. Scale Model of the famous JN4D-2 (shown above), including Plans and Building and Flying Instructions.....$8.00

Ask Your Dealer or Order Direct

Plans and Instructions *only*, with catalogue of Parts needed, postpaid.....25c.

Catalogue alone, listing many other types of Model Aeroplanes, Parts and Supplies, postpaid.....5c.

IDEAL AIRPLANE & SUPPLY COMPANY
Making Model Aeroplanes Continuously for 10 years
159-161 Wooster St., Cor. West Houston St., N.Y.

HB Small Cash Payment Starts You Making Big Profits Charging Batteries



Get an HB Charger—*NOW!*

For only a small cash payment you can get, an H. B. Battery Charger, and make from $1500 to $3000 *clear cash profits!* Almost a year to pay balance on easy monthly terms, easily carried by monthly profits. Sizes to charge 10, 16, 32 or 70 batteries. 10 days' free trial on absolute money-back guarantee. Choose size you need—then write *today* for information.

Hobart Bros. Co.
Box 42E, Troy, O.
Successful Manufacturers Since 1893.

You Can Clear $150 to $300 Monthly

1921 Model Warranted Watch $2.95
to introduce our watches. Thin model, beautifully polished silveroid case. Men's and women's size. Fitted with high grade movement, fully tested. Stem set and stem wind.

EVERY WATCH GUARANTEED

$2.95



C.O.D.
Send us your name and address plainly written at once. We'll send this beautiful watch by return parcel post. Pay postman only $2.95. Test this 1921 timekeeper in every way. If not satisfied return it. We'll refund your money. Send your order TODAY.
Cambridge Watch Co., 350 Cambridge Bldg., Chicago, Ill.

Electrical Engineering In One Year

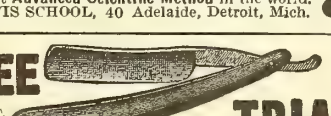
men with training are in demand. For more than a quarter of a century this school has been training men of ambition and limited time for the electrical industries. Condensed course in Electrical enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics. Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete



Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 29th year opens Sept. 28, 1921.
BLISS ELECTRICAL SCHOOL
315 TAKOMA AVE., WASHINGTON, D. C.

***Why continue to* STAMMER?**
Send for (free) illustrated 200-page book. It tells how Stammering and Stuttering can be quickly cured by the most **Advanced Scientific Method** in the world.
THE LEWIS SCHOOL, 40 Adelaide, Detroit, Mich.

FREE TRIAL



Let us send this fine Razor for 30 days free trial. When satisfied after using, send $1.85 or return razor. Order Today. JONES MFG. CO. 136 W. Lake St. Dept. 906 CHICAGO

Be an Artist
Comics, Cartoons, Commercial, Newspaper and Magazine Illustrating, Pastel Crayon Portraits and Fashions. By Mail or Local Classes. Write for terms and List of successful students.
Associated Art Studios,
111 Flatiron Bldg. New York

easily carried the cars past the center of the earth, where gravity began to exert its counterpull, up to within several feet of the opposite surface. The moment they started to fall back, they were caught and held by automatic catches. Giant electric hoists completed their journey to the surface.

It is to these great engineering feats that credit must be given for the comfort of our modern city life. They may easily be regarded as among the most beneficial gifts to mankind that science has produced in the last four decades, for they make possible our present-day existence. Today we are so dependent for food upon these earth-piercing tubes, that if they all should be damaged simultaneously, there would be much suffering and hardship before repairs could be effected. Possibly many deaths might result from starvation. These tubes are indeed the arteries of our daily existence.

Some of the most widely known of Science's improvements have been those of transportation and travel. Speed, as demanded by the ease and luxury-loving internationalite of today, has been furnished by the prolific genius of science. Huge liners of the air, several thousands of feet in length, inflated with helium gas (which is a plentiful end-product of the disintegration processes), driven by powerful atomic engines at several hundred miles per hour, and luxuriously fitted with accommodations for at least a thousand passengers, ply the great Atlantic and Pacific between breakfast time and dinner. Our skies today are filled with wings swiftly propelled by noiseless thorio-actinic motors. Since the helium-filled ship came into general use, more than forty-five years ago, not a life has been lost in aerial transportation. Certainly this is a magnificent record, and a worthy tribute to the science that made it possible.

Progress in Education has been no less rapid. Today we have our great university cities, endowed by a benevolent government, for the free use of all mankind. Free higher-education to any who desire is as much a right of the world citizen of today as liberty was of the American of a century ago. Thousands of investigators in pure science now finish their education in the immense national universities of Mars and Venus, as all learning went to Europe to receive its degree in 1900.

In biology, geology, bacteriology, zöology, engineering, chemistry, and all branches of science there has been rapid advancement. In biology, I understand, the synthetic production of living organisms has been lately accomplished, and promises wonderful achievements. It is no great flight of fancy to say that if we were able one billion years from now to look upon those warm, steamy, cooling, and still lifeless planets, where our interpid space-fliers have recently placed cultures of synthetic Amoeba, we might hope to see a creature occupying a place in that planetary existence comparable to that now filled by the earth's human race.

In medical science there has been such progress that death by sickness and disease is rare, whereas continued pain is hardly known, and certainly avoidable. By observing scientific methods of right living and obeying natural laws, one may expect to live for more than one hundred years. That is a period of existence nearly twice that of the average man fifty years ago.

Gentlemen, I ask you, can the coming century be filled with such an array of achievements? Possibly. Who can tell? Biology holds hopes which some of us may live to see realized.

A BOOK ON PERFECT HEALTH VIA VI-REX VIOLET RAYS

FREE

Amazing New Vitality—Health Can Be Yours



New Kind of Electricity Brings Wonderful Beauty and Health

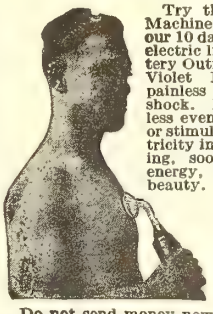
At last! Electricity in its greatest form for the human system.

Wonderful new Violet Ray treatments endorsed by physicians, beauty specialists, hospitals, osteopaths, and thousands of home users. Like a Godsend to sufferers. Like a beauty specialist for making poor complexions beautiful.

VI-REX Violet Rays

Better than gallons of liniment and drugs. Better than a ton of cosmetics. Violet Ray treatments now used at home by thousands. Remarkable records made in cases of **neuritis, rheumatism, asthma, catarrh, deafness, insomnia, obesity, nervousness, lumbago, pains, as well as in cases of skin troubles, sallowness, pimples, blackheads, falling hair.**

10 Days' Trial FREE



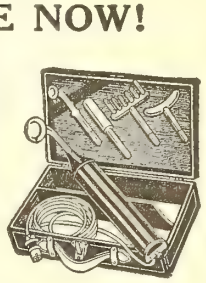
Try the Vi-Rex Violet Ray Machine in your own home on our 10 day offer. Attach to any electric light socket or use Battery Outfit Complete. See how Violet Rays are absolutely painless and harmless. No shock. No vibration. Harmless even to infants. Soothing or stimulating as desired. Electricity in its most helpful, healing, soothing form. Creates energy, strength, vigor and beauty. Write for offer.

Send No Money

Do not send money now. Just write postal or mail coupon for wonderful free 52 Page Book explaining in detail. Read how Violet Rays massage every cell in the body. Read letters from users. See what physicians, sanitariums, home users say.

WRITE NOW!

Why suffer? Why be satisfied with less than your full share of super health and beauty? See what wonderful Violet Rays will do for you. Mail coupon or write postal for free book and 10 days' Trial Offer. Do not miss this offer. Address NOW



VI-REX ELECTRIC CO.
Dept. 43
326 W. Madison St.
Chicago, Ill.

VI-REX ELECTRIC CO., Dept. 43
326 W. Madison St.
Chicago, Ill.

Please send me your free book and particulars of your Trial Offer of the Vi-Rex Violet Ray Machine.

Name .....

Address .....

Opportunity Ad-lets

Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the June issue must reach us not later than April 22.

The Circulation of Science and Invention is over 140,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York City, N. Y.

Aeronautics

Boys fly this model aeroplane. Circular free. Aero Shop, 3050 Hurlbut Ave., Detroit, Mich.

Send for the most remarkable flying novelty ever created. Attains a height from 50 to 100 feet, 25 cents. S. P. Lux, 1582 Pitkin Ave., Brooklyn, N. Y.

Aviation

Learn to Fly. America's oldest and most reliable Flying School. Complete Ground and Flying Instruction. We guarantee to make you an expert Pilot. Third Successful Season. Dozens of satisfied graduates. Classes begin the first of each month. Write now for Literature and Catalogue. The Ralph C. Diggins Co., 140 N. Dearborn St., Chicago, Ill.

Auto Accessories

Blueprints. Automobile Armatures. See ad under "Electrical." Charles Chittenden.

Storage Batteries for Automobiles. We furnish all parts and Moulds for making them. Sample Plate 40c. Foreign Countries 50c. Windsor Specialty Co., 5419 Windsor Ave., Chicago, Ill.

Tire Agents. Exclusive representatives to use and sell the new Mellinger Extra-Ply Tires. (No seconds.) Guaranteed Bond 8,000 Miles. Wholesale Prices. Sample sections furnished. Mellinger Tire Co., 980 Oak, Kansas City, Missouri.

Foul Proof Spark Plugs. Mechanics make Foul Proof Spark Plugs. Absolutely will not foul up. New Idea. Complete Instructions $2. Sample Plug $4. Mechanics Supply Co., Kansas City, Mo., Gateway Station.

Auto Motors Supplies. Buick, Michigan, Stoddard-Dayton, E. M. F. Cadillac, Overland, Continental and Buda Motors. All Types $50 each and up. Special High Tension Magnetos 2 and 4 cylinder $9.50 each. Electric and Gas Head Lamps, Coils, Carburetors, Air Compressors, Generators, Starters, etc. Write for Catalog. Address Motor Sales Dept. 12, West End, Pittsburgh, Penna.

How to make automobile storage battery plates. $1.00 postpaid. H. Deckelman, 7118 Nashville Ave., St. Louis, Mo.

We pay $50 a week taking orders for INSYDE TYRES inner armor for automobile tires. Guaranteed to give double tire mileage. Any tire. Prevents punctures and blowouts. Big demand. Low priced. Write quick for territory. American Accessories Co., B384, Cincinnati, Ohio.

Fords start easy in cold weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene, using our 1921 carburetors. Increased power; styles for all motors; can attach them yourself. Big profits to agents; money back guarantee; 30 days trial. Air Friction Carburetor Co., 1511 Madison St., Dayton, Ohio.

Battery Charging Outfits, all sizes. Absolutely new. Easy monthly terms. Hobart Bros., Troy, Ohio.

Motors, Engines and Dynamos

Special Garage Motors. New, manufactured by General Electric Co. ¼ HP $22.75; 1 HP $88.50; 2 HP $126.50; 3 HP $146.50; 5 HP $188.50. All sizes both single and Polyphase Motors for immediate delivery. Special charging generators all voltages. Write for catalogue. Motor Sales Dept. 12, West End, Pittsburgh, Penna.

Build an Electric Motor. Complete Outfit $2.00. Blue Prints 25c. A. F. Cassell, Box 355, Oradell, N. J.

Motor Bargain. Diehl 1/20 HP Universal 110 V. with pulley. Never used. Price $6.75 prepaid. Alsop Engineering Co., 200 W. 72nd St., N. Y.

Motors, farm lighting generators, battery chargers, new lower prices. Easy monthly terms. Hobart Bros., Troy, Ohio.

Motorcycles, Bicycles

Used Parts for all Motorcycles. Schuck Cycle Co., 1922 Westlake, Seattle, Wash.

Don't Buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 1604, Galesburg, Kans.

Machinery & Tools

Castings and drawings to build sensitive drill press, $10 per set. Particulars on request. C. Swanson, 7826 Coles Ave., Chicago.

American Made Toys

Manufacturers wanted for larger productions and homeworkers on smaller scale for Metal Toys and Novelties, Toy Soldiers, Cannons, Cowboys, Indians, Buffalo Bills, Wild Animals, Whistles, Bird Whistles, Race Horses, Prize Fighters, Religious Statuettes, Puzzles and hundred of other Toys and Novelties. Hundred and more made complete per hour. No experience or tools needed. Bronze Casting forms with complete outfit from $5.00 up. We are buyers of these goods all year, paying fixed prices. Contract orders placed with manufacturers. Exceptional high prices paid for painted goods. An enormous business offers industrious men an excellent opportunity to enter this field. An open market for these goods all over United States, Canada and South America. Write us only, if you mean business. Illustrated catalogue and Booklet mailed free. Toy Soldier Manufacturing Company, Offices and Showrooms. 1696 Boston Road, New York.

Agents Wanted

Agents. Go into permanent business. No capital required. Should net $2,500 to $5,000 first year. Guaranteed products needed in every home. Repeat sales—big profits. Old established concern—products known everywhere. Many make sales of $30 to $50 per day. Practical sales helps, advertising matter furnished. Write today. W. T. Rawleigh Co., 345 Liberty St., Freeport, Ill.

Newest Thing Out. Lithogram initials for automobiles, motorcycles, canoes, golf sticks, tennis racquets etc. Anyone can apply them in a jiffy. Sell to everybody. Set costs 15c.; brings $1.50. Fast sales and big daily profits for agents. Write for catalog. Lithogram Company, Desk 19, East Orange, N. J.

Agents. Sell our accident and sickness policies in your spare time. Pay $5,000 death, $25 weekly benefit. Premium $10 yearly. Permanent income from renewals. Easy seller. Liberal commissions. Insurance Co., Dept. N-5, Newark, N. J.

Perfume Blocks sell everywhere. One Block costing fifty cents, perfumes an entire room for two months. 100% profit. Territory protection. Box 174A, Cleveland, Ohio.

Agents. Our soap and toilet article plan is a wonder; get our free sample case offer. Ho-Ro-Co., 138 Locust, St. Louis.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Agents. Here's the best line of Food Flavors, Perfumes, Soaps, Toilet Preparations, etc., ever offered. No capital needed. Complete outfits furnished Free to workers. Write today for full particulars. American Products Co., 2562 American Bldg., Cincinnati, Ohio.

Signs for Stores and Offices. Entirely new. $50 week easily made. Assorted working samples 25c. Chicago Sign System, E. 326 River St., Chicago, Ill.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Make Big Money. Sell Soldering Solution. No acid. Better than paste. Sample 25c. F. Kossatz, 5th Ave., New Rochelle, N. Y.

Agents. $60 to $200 a week. Free Samples. Gold Sign Letters for Store and Office windows. Anyone can do it. Big demand. Liberal offer to general agents. Metallic Letter Co., 433Z N. Clark St., Chicago, Ill.

Beginners complete Mail Order System. EX. Box 1005, Atlantic City.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Make $30.75 Profit on $2.50 Outfit. Gold Transfer Monograms for Automobiles, etc. Free Samples. National P. O. Box 6-E, Station D, Brooklyn, New York.

Salesmen Wanted

Salesmen. Earn $3,500 to $10,000 a year. City or Traveling. Experience unnecessary. Quickly qualify through our amazing system. Free employment service to members. Send for Salesmanship book, list of lines and full particulars. Nat. Salesmen's Training Ass'n, Dept. 158D, Chicago, Ill.

Help Wanted

Universal Shorthand Course (Pitman) makes stenographic experts in 36 lessons. Efficiency guaranteed or money back. Helps users of other systems increase pay. Easy terms. Write for Booklet 12. Universal Shorthand Course, 6609 Kimbark Avenue, Chicago, Ill.

Stop Daily Grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 48, Marion, Indiana.

Detectives in Great Demand. Men from 18 to 45. Experience unnecessary. Easily learned. Write Earl H. Wilcox, Dept. A, 232 Sheldon Avenue, Grand Rapids, Mich.

Become Automobile Experts. Hundreds wanted. $35 week. Learn while earning. Write Franklin Institute, Dept. J, 806 Rochester, N. Y.

Earn $250 a month, expenses paid as RAILway Traffic Inspector outdoors. Local or traveling. Start at $110 monthly, position guaranteed after 3 months' spare time study. Write for Free Booklet G-57 Stand. Business Training Inst., Buffalo, N. Y.

Hundreds Permanent U. S. Government positions open to men—women—girls, over 17. Commence $135 month. Raise to $190 month. Vacation with full pay. Steady. No layoffs. Inside or outside work. Common education sufficient. Pull unnecessary. Experience unnecessary. List of positions open sent free. Write immediately. Franklin Institute, Dept. J 25, Rochester, N. Y.

Silvering Mirrors, French Plate Taught, Easy to learn, immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

How to Obtain the Position You Want. Remarkable Suggestions! Powerful Letters! $1.00. J. T. O'Neill, 1411 Thomas St., St. Paul, Minn.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Boys—Men! Become Auto Experts. $35 week. Learn while earning. Write Franklin Institute, Dept. H 806, Rochester, N. Y.

Men Wanted for Detective Work. Experience unnecessary. Write J. Ganor, former U. S. Gov't. Detective, 135 St. Louis.

Be a Mirror Expert. $3 to $10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Detectives earn big money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

Men Wanted at $35 to $100 a week to make mechanical drawings. Work is easy, pleasant, and leads to higher positions in Industrial Field at excellent salaries. We furnish set of instruments, train you at home, in spare time, by practical method and help you qualify for position. Write today for particulars. Roy C. Claflin, Pres., Dept. 1368, 14th & T Sts., Washington, D. C.

Be a Detective. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. Write American School of Criminology, Dept. B, Detroit, Mich.

Business Opportunities

Texas Land $6.00 Per Acre. We offer for immediate sale, in tracts of ten, twenty, forty and eighty acres each, patented land, full mineral rights and oil royalty included, located near a railroad in Brewster County, Texas. Warranty deed and opinion by reputable attorney approving the title, furnished with every tract. References: Dunn or Bradstreet, also State National Bank, San Antonio, Texas. H. J. McMullen, Bedell Building, San Antonio, Texas.

If you want to sell or exchange your farm, unimproved land, city property or patent, write me. John J. Black, 194th St., Chippewa Falls, Wis.

We Pay Cash for your spare time. Big money. Easy work. Guaranteed. Wonderful Proposition. Only $1.00 Retail. Standard Safety Razor Corporation, Pittsburgh, Pa.

Advertising, newspapers, magazines, everywhere. We prepare your advertisements, illustrations, form letters, circulars, booklets. Facilities for securing mail or store sales. Information cheerfully given; no charge. Write for catalog. Scott & Scott Advertising Agency, 220 W. 42nd St., New York.

(*Continued on page* 1365)

Electrical Experimenter

233 FULTON STREET, NEW YORK

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer; R. W. DeMott, Sec'y), 233 Fulton Street, New York.



EDITORIAL

The Sun's Heat

EVERY square mile of the earth's surface exposed to the sun's rays receives an average of over 500,000 kilowatts of energy continuously from our luminary. Imagine the sun stationed inside of a hollow sphere, the diameter of this sphere to be as big as the earth's orbit around the sun. Unquestionably every square mile of this unthinkably large sphere, measuring 182,860,000 miles across, would still receive 500,000 kilowatts of energy from the sun or a mere trifle of 52,524,064,195,680,000,000,000 kilowatts continuously. This figure is so tremendously large that the human mind can never grasp it. It is simply unthinkable.

So if we continue and state that recent researches tend to show that the temperature of the sun must be in the neighborhood of 13,500,000 degrees Centigrade, that statement, tremendous as its import is, leaves our imagination unsatisfied. We simply can not comprehend it, even tho we realize that the *hottest* temperature ever produced by man is but a trifling 3500 degrees Centigrade. Now compare the heat of the electric arc—the hottest man-made temperature—*i. e.*, 3500 degrees, with the sun's heat of 13,500,000 degrees. In other words, the sun is 3857 times hotter than our electric arc! Large as this titanic difference is, we fail entirely to grasp it—such are the limitations of the human mind.

Then, if we add that every single point of the sun—which is 852,908 miles in diameter—has been radiating this tremendous amount of heat continuously for millions of years, do we begin to realize that our facilities for grasping such cosmic facts are entirely inadequate.

But how then and thru which agency does the sun derive all this heat? We don't know. We can only speculate and theorize, but in no case can we say that we are sure. Nor can we prove or disprove many of the ingenious theories that have been adduced on the subject in the past.

Perhaps von Helmholtz's theory is the most satisfactory advanced so far, because it is the most difficult to disprove. This famous savant sought to prove that the sun's heat and energy were produced by the shrinkage of the flaming fire-mass. According to Helmholtz, the sun originally was a rather cold nebula, filling our entire planetary system. Gradually this mass assumed motion, becoming a spiral nebula. During this process it shrank gradually from a diameter of 5,491,996,000 miles (orbit of Neptune) to its present size of 852,908 miles diameter. Due to this contracting of the huge mass, unthinkable gravitational stresses were set up which in turn liberated heat, sufficient to account not only for the sun's great present heat, but a much higher temperature. As is well known, the sun has past its zenith some million years ago. It is now past the prime of its life, for if we use von Helmholtz's figures we find that at its hottest period the sun's temperature probably reached between 25 and 30,000,000 degrees Centigrade.

Other scientists in turn dispute the Helmholtz theory and maintain that it is not at all necessary to account for the sun's heat due to its shrinkage and contraction. They point out that the gravitational forces set up in the sun's interior, due to its ponderous mass, are sufficient to produce its great heat, and more. When a mass becomes as tremendous as the sun we may expect altogether different gravitational phenomena, as for instance those produced in a little pebble such as our earth.

Next we have the radium and the atomic theories. The former, namely, that the sun's heat is due to radium, is readily disproved by the spectroscope. The atomic theory cannot be proved nor disproved easily, because man has not produced atomic energy as yet and as a matter of fact we know nothing at all about it. From a purely philosophic standpoint, however, the atomic theory is probably the most plausible one. Time only can tell whether it will hold.

H. GERNSBACK.

Vol. VIII. Whole No. 85 **Contents for May, 1920** **No. 1**

CUTTING THE BOCHE ELECTRIFIED BARBED WIRE 15
By Van Louie Martin

ODDITIES OF SOUND 16
By H. Winfield Secor

A BULLET-PROOF SEARCHLIGHT REFLECTOR 19
By Edwin F. Linder, M.E.

FLOATING SAFE FOR SHIP MAIL 20

ONE-MAN CAR VERSUS THE JITNEY BUS 21
By L. H. Rosenberg

FLYING IN A VACUUM 22

FLASHLIGHTING ANIMALS 23
By Howard Taylor Middleton

NEWTON'S LESS POPULAR LAWS 24
By Professor James S. Stevens

ELECTRICITY GONE TO THE DOGS 25

THE LODESTONE, OR NATURAL MAGNET 26
By Eugene S. Todd, Mineralogist

AIRMEN AND THE DIVINING ROD 28
By Dr. Alfred Gradenwitz

NEW YORK HAS OZONIZED DRINKING WATER 29
By Jos. H. Kraus

ELECTRICITY IN THE "MOVIE" STUDIO 31

THE NEW YORK AERO SHOW 32

ALADDIN'S LAMP—SCIENTIFIC STORY 33
By Charles S. Wolfe

THE DARK SEARCHLIGHT 34
By Louis Yeager

EXPERIMENTS IN PHYSICS 41
By John J. Furia, A.M.

POPULAR ASTRONOMY—FALLING THRU THE EARTH 42
By Isabel M. Lewis, M.A., of the U. S. Naval Observatory

THE AMATEUR MAGICIAN—THE RAPPING HAND 44
By Joseph H. Kraus

"SOME LABORATORY" 45
By Thomas Reed

EXPERIMENTAL CHEMISTRY 46
By Prof. F. L. Darrow

THE ELECTRICAL MACHINIST—No. 7—ERECTING MOTORS 49
By H. Winfield Secor

WRINKLES, RECIPES, AND FORMULAS 53
Edited by S. Gernsback

AMERICAN GIRL'S RADIO STATION 56
By Miss Abby P. Morrison

A ONE-TUBE RADIO TELEGRAPH AND RADIO TELEPHONE TRANSMITTER 57
By Pierre H. Boucheron

The **ELECTRICAL EXPERIMENTER** is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addrest to : Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office.

Copyright, 1920 by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Geoffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London.

Member of the Audit Bureau of Circulation.

ELECTRICITY

as experts know it



This is Terrell Croft and his Library of Practical Electricity, the most popular home study course on electricity in existence



WHEN studying the important subject of electricity, be guided by men who know the field from the ground up. In accepting the guidance of Terrell Croft, you are directly under the instruction of a man who gained his knowledge with his sleeves rolled up. He knows what you should know in order to become a highly paid electrical worker or engineer. He gives you in plain English the facts and knowledge possessed by the men earning $8 per day and up. He tells you in eight compact pocket books that you can master, in a short time, what he has learned in twenty years as apprentice, wireman, draftsman, trouble shooter, central station operator—and then electrical engineer for the Westinghouse Company.

Learn from records of actual practice.

The Croft Library of Practical Electricity teaches you as in practice, and does not leave off until you are an expert. Even the hardest problems are simplified so that you cannot fail to understand them.

Never before in the history of electricity has it been possible for men to earn such high wages. The demand for trained men cannot possibly be met.

Sent to you on ten days' free trial— NOT ONE CENT IN ADVANCE.

The Croft Library of Practical Electricity contains eight flexibly-bound volumes of 3,000 pages and over 2,000 illustrations. The entire set will be sent to you charges prepaid for ten days' absolutely free use.

Merely return the coupon—SMALL MONTHLY PAYMENTS IF PLEASED.

Fill out the coupon now. Send not a cent in advance. If you decide in your own mind that no man interested in any branch of electricity can afford to be without the most popular electrical library in existence, send us the small monthly payments mentioned in the coupon.

If for any reason whatsoever you desire to return the books, do so at our expense.

Read This—

Electricity, from the simplest principles to complete and economical operation of a central station—

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect, in accordance with the National Electrical Code.

Wiring of finishing buildings. Underwriters' and municipal requirements. How to do the complete job, from estimating it to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the short-cuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York

Free Examination Coupon

McGraw-Hill Book Co., Inc.
239 W. 39th St., New York

Gentlemen:—Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions.

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation .....E. 5-20

Electrical Experimenter

233 FULTON STREET, NEW YORK

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer; R. W. DeMott, Sec'y), 233 Fulton Street, New York.

EDITORIAL

Metallic "Paper"

WE have been repeatedly assured by experts that our present visible paper supply will give out in less than 25 years. During the past few years the paper shortage has become worldwide—not because of an actual shortage of the raw materials that go into the making of paper—but because the world is using about 25% more paper than can be manufactured.

Of course, new mills are being built right along, and as it takes from one to two years to build a paper manufacturing plant, thus the present shortage will have disappeared in a few years. But this will not allay the general situation; quite the contrary. The more mills we build and the more paper we use, the quicker do we reach the inevitable point where our raw materials give out.

Ninety per cent of our present day paper is made from wood. Briefly the process consists in reducing the wood to a pulp by a macerating process. Properly digested under steam pressure in a solution of bisulphite of magnesium, washed and bleached, this wood pulp called "sulphite" in trade parlance, forms the base from which nearly all of our paper is derived. While paper pulp can be made theoretically from *any* vegetable fibre, only wood fibre so far has been found economical enough on a large scale.

Alfalfa, straw, grass, seaweed and a host of other substances have been mentioned from time to time as a serious competitor to wood, but so far not one of these have been able to compete, and paper continues to be made of wood pulp.

But as mentioned before, wood will surely not last forever. It can't last while we are daily turning whole forests into newspapers. It simply does not grow fast enough to keep step with the present enormous demand. Besides, wood is used for thousands of other purposes, and all this great demand drives up its cost to such a height, that in a very few years, wood for paper purposes will be unthinkable. The paper on which this is printed cost 3½ cents a pound in 1914. Today it costs from 14 to 18 cents in the open market, and is going higher. Even with new mills to take care of the present excessive demand, paper prices will never recede to their former levels or even anywhere near them. What then? On what will our books and magazines be printed in 25 years? Paper? It is very doubtful. And if it is paper, it will not resemble our present-day paper any more than the latter resembles the *papyrus* of the old Egyptians, or the rag papers first made in 1150 by the Italians.

What substitute our children will use, it is of course impossible to forecast. With modern chemistry and mechanics anything is possible—even synthetic wood pulp with synthetic fibres!

There is one substitute, however, which has not been mentioned much lately, altho it deserves it, particularly now with paper selling at the present fabulous figures.

We refer to metallic foil. Preposterous as the idea appears, it was proposed by no less a man than Edison. During his researches with his storage battery he produced nickel foil by the electrolytic method four to five times as thin as an ordinary sheet of paper. Moreover, this nickel sheeting, tho very much thinner, was stronger and far more durable than paper. Such nickel foil is flexible, strong, uniform in thickness and can be printed upon readily. It will outlast paper for centuries. A thousand-page nickel foil book is less than one-half inch thick. Now nickel is of course not the only metal that can be used. Aluminum, or a correct aluminum alloy, would seem to be ideal, due to its whiteness, its extreme lightness and strength. Aluminum now sells at about 40 cents a pound. If it can be produced cheap electrolytically in foils, only three times thinner than for instance magazine paper, then one pound of aluminum will go about six times as far as a pound of paper. In other words, for about six cents you could print as many pages on aluminum as it would cost you to print the same pages on paper costing fifteen cents.

H. GERNSBACK.

Vol. VIII. Whole No. 86 **Contents for June, 1920** **No. 2**

SEA-GOING FERRIS WHEEL.....Front Cover
From a painting by Howard V. Brown
SIGNAL BUOY FOR OCEAN SHIPS..... 131
By Edwin F. Linder, M. E.
HOW CARTOON MOVIES ARE MADE..... 132
By Joseph H. Kraus
A STEREOSCOPIC "MOVIE" SCREEN..... 134
By John J. Furia, A. M.
INTER-PLANETARY COMMUNICATION..... 135
By Albert V. T. Day
SEARCHLIGHT AND MIRRORS MARK AERO FIELD..... 136
By Edwin F. Linder, M. E.
ODD PHOTO CONTEST..... 138
THE LATEST PLEASURE TORTURES..... 140
A SEA-GOING FERRIS WHEEL..... 142
By H. Gernsback
CHICAGO PROFESSOR GAVE FOUNDATION FOR EINSTEIN'S THEORY..... 144
By Robert H. Moulton
MASTER "MOVIE" THRILLS..... 145
ELIMINATING THE "HELLO GIRL"..... 146
By H. E. Clapham
"NEWSOPHONE" TO SUPPLANT NEWSPAPERS..... 147
By Donald MacGregor
SUB-SEA TALK OVER BARE WIRE..... 148
By Donald MacGregor
TELE-PHOTOGRAPHY ACROSS THE OCEAN..... 149
By Dr. A. Gradenwitz
THE PHANTON ARM..... 151
By Charles S. Wolfe
ODDITIES OF SOUND..... 152
Part Two—By H. Winfield Secor
POPULAR ASTRONOMY—THE EARTH AS A MAGNET..... 160
By Isabel M. Lewis, M. A., U. S. Naval Observatory
A MINIATURE "SKY"..... 162
By Robert H. Moulton
THE AMATEUR MAGICIAN—THE MYSTIC ROULETTE WHEEL 163
By Joseph H. Kraus
THE SECRET OF THE MAGNET POLES..... 164
By Walter E. Keever
PRACTICAL CHEMICAL EXPERIMENTS—EXAMINATION OF WATER—PART 2..... 166
By Professor Floyd L. Darrow
HAVE YOU A BURIED TREASURE?..... 168
By Victor H. Todd
WRINKLES, RECIPES AND FORMULAS..... 175
Edited by S. Gernsback

The **ELECTRICAL EXPERIMENTER** is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be address to : Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office.

Copyright, 1920 by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Geoffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London.

Member of the Audit Bureau of Circulation.

ELECTRICITY

as experts know it



This is Terrell Croft and his Library of Practical Electricity, the most popular home study course on electricity in existence



WHEN studying the important subject of electricity, be guided by men who know the field from the ground up. In accepting the guidance of Terrell Croft, you are directly under the instruction of a man who gained his knowledge with his sleeves rolled up. He knows what you should know in order to become a highly paid electrical worker or engineer. He gives you in plain English the facts and knowledge possessed by the men earning $8 per day and up. He tells you in eight compact pocket books that you can master, in a short time, what he has learned in twenty years as apprentice, wireman, draftsman, trouble shooter, central station operator—and then electrical engineer for the Westinghouse Company.

Learn from records of actual practice.

The Croft Library of Practical Electricity teaches you as in practice, and does not leave off until you are an expert. Even the hardest problems are simplified so that you cannot fail to understand them.

Never before in the history of electricity has it been possible for men to earn such high wages. The demand for trained men cannot possibly be met.

Sent to you on ten days' free trial—NOT ONE CENT IN ADVANCE.

The Croft Library of Practical Electricity contains eight flexibly-bound volumes of 3,000 pages and over 2,000 illustrations. The entire set will be sent to you charges prepaid for ten days' absolutely free use.

Merely return the coupon—SMALL MONTHLY PAYMENTS IF PLEASED.

Fill out the coupon now. Send not a cent in advance. If you decide in your own mind that no man interested in any branch of electricity can afford to be without the most popular electrical library in existence, send us the small monthly payments mentioned in the coupon.

If for any reason whatsoever you desire to return the books, do so at our expense.

Read This—

Electricity, from the simplest principles to complete and economical operation of a central station—

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect, in accordance with the National Electrical Code.

Wiring of finishing buildings. Underwriters' and municipal requirements. How to do the complete job, from estimating it to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the short-cuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York

Free Examination Coupon

McGraw-Hill Book Co., Inc.
239 W. 39th St., New York

Gentlemen:—Please send me the **Library of Practical Electricity** (shipping charges prepaid), for **10 days' free** examination. If satisfactory I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions.

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation ..... E.E. 6-20

Electrical Experimenter

233 FULTON STREET, NEW YORK

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer; R. W. DeMott, Sec'y), 233 Fulton Street, New York.

EDITORIAL

Oil

ONE of the prime requisites of modern civilization is fuel for motive purposes. One hundred years ago, when life was less complex than it is today, commerce moved along at a slow, snail-like pace. If a merchant wished to ship his goods for only one hundred miles, the process took over a month on the average. It took the traveler three days to cover the distance from New York to Philadelphia—less than one hundred miles. It takes two hours by train today and less than one hour by airplane.

Fuel made all this possible. First it was wood that was burned as a fuel. But it was uneconomical, for its thermal output for a given weight was small. Then coal moved to the front and civilization, in less than fifty years leaped ahead farther than it had in fifty centuries. But coal, too, had its limitations. It was not the flexible, nor ideal fuel. It was satisfactory for a locomotive but not for an individual road vehicle such as the automobile, invented less than thirty years ago. The invention of the gasoline engine changed all this, and with its advent civilization and progress took another tremendous leap forward. The automobile, again depended upon a fuel—gasoline—derived from petroleum.

Now it so happens that this comparatively new fuel, petroleum, is not used solely as a fuel, but its by-products are of tremendous value to humanity as well. Of these by-products gasoline is perhaps the most important, being used chiefly in automobiles and gas engines.

Little wonder then that all the nations are drilling wells feverishly all over the world in their race for oil supremacy. For the nation which controls most of the oil may be said to lead the others today. Germany realized this too late and had she had a vast supply of oil at hand at the outbreak of the world war, the outcome might have been different. Fortunately, Germany was a negligible oil producer and could not measure up to the allies who controlled over 95% of the total supply.

Today the United States and Great Britain are the chief producers of the world's oil and both are in a frantic race to gain supremacy. Which of the two will win is problematical.

But what is petroleum? Whence does it come? Petroleum is thought by most geologists to have been derived by the destructive distillation of either animal or vegetable matter contained in the rocks. While oil is a modern fuel, as far as it is used as a prime mover, its history dates back to the Romans. Thus in Roman times petroleum was found in Sicily and it was burned in lamps. But only in comparatively modern times has it found new applications.

It is now thought that during the great upheavals in the earth's early history, when nearly every foot of land was covered with huge primeval forests, the latter were engulfed, while a new crust formed over the old land. These forests with their vast animal life then carbonized gradually, due to the earth's heat, and later by distillation were conveyed into oil and natural gas.

Large as the earth's oil deposits are, it is plain that they cannot last forever. Some day they must give out, as indeed many oil wells are becoming exhausted every year. Authorities as a matter of fact figure that our present oil supply will give out in less than fifty years.

But we need not worry. Four-fifths of the earth's surface is covered with water now, but this condition did not exist when the earth was young. We know now that vast stretches that are ocean today were once above water. By the law of averages then there must be more oil under the lands now covered with water than what is land today.

Some day we will drill oil wells far out in the ocean—that is, if we still need or want oil. This, indeed, is not a visionary scheme. There are already such ocean wells in actual use today along the coast of California as well as along the Gulf of Mexico.

H. GERNSBACK.

Vol. VIII. Whole No. 87 **Contents for July, 1920** **No. 3**

CHICAGO'S NEW MONORAIL.....Front Cover
From a Painting by Howard V. Brown
COMPREST AIR TREATMENT FOR THE SICK..... 251
By George Wall
FOILING THE DIAMOND SMUGGLER..... 252
By H. Gernsback
THE AURORA BOREALIS..... 254
By Prof. Lindley L. Pyle
SHAFTS OF LIGHT REGULATE STREET TRAFFIC..... 256
By Edwin F. Linder, M.E.
NATURE'S JEWELS..... 258
By William M. Butterfield, Illustrated by the Author
TRIPLE CAMERA PHOTOS LIGHTNING FLASHES..... 259
By Dr. Alfred Gradenwitz
NEW SUSPENDED MONORAILWAY 262
DO WE "SEE" ELECTRICALLY?..... 264
By H. Winfield Secor
ALARM NO. 18—A SCIENTIFIC STORY..... 266
By Charles S. Wolfe
MY MESSAGE TO MARS..... 267
By Clement Fezandié
THE STORY OF GLASS..... 268
By Prof. Floyd L. Darrow
OVERCOMING GRAVITATION 272
By George S. Piggott
"HOME ELECTRICS" 274
By G. L. Hoadley, M. E.
"HOME MECHANICS" DEPARTMENT..... 275
Conducted by William M. Butterfield
$50.00 AUTOMOBILE PRIZE CONTEST..... 276
TESLA GASOLINE TURBINE..... 277
By Joseph H. Kraus
IS LIFE ELECTRICAL? 278
By Rogers D. Rusk, M. A.
POPULAR ASTRONOMY—"MOTIONS OF THE HEAVENLY BODIES" 280
By Isabel M. Lewis, M. A., of the U. S. Naval Observatory
PRACTICAL CHEMICAL EXPERIMENTS—"HOMEMADE FIREWORKS" 282
By Prof. Floyd L. Darrow
CARE OF LEAD PLATE STORAGE BATTERY..... 286
By Jesse J. Hipple, Chief Machinist's Mate, U. S. N.
LISTENING FOR SIGNALS FROM MARS..... 295
By Dr. Frederick H. Millener

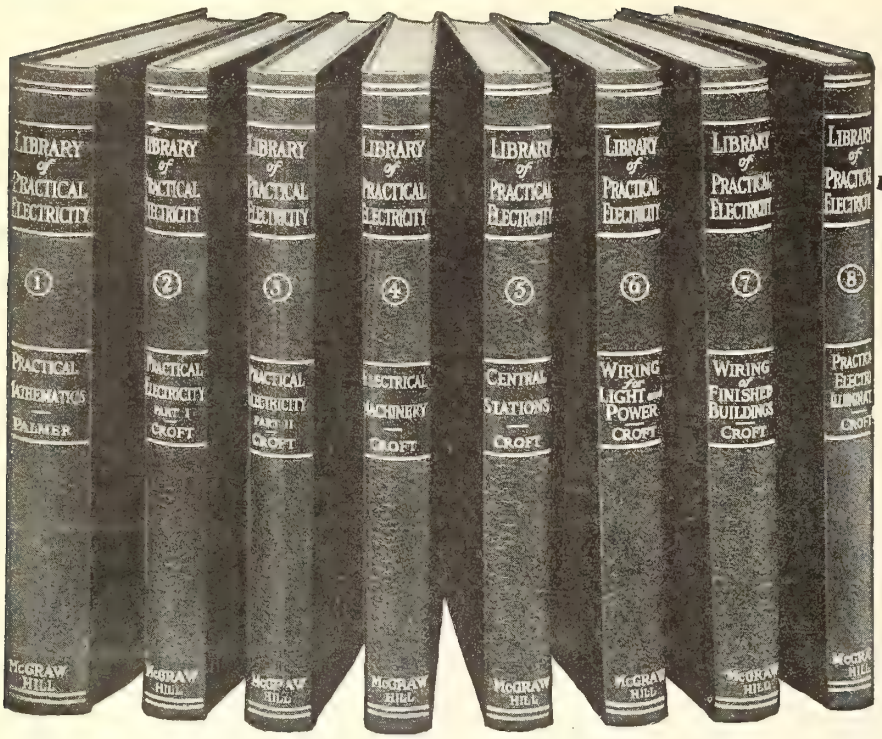
The **ELECTRICAL EXPERIMENTER** is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addrest to: Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1920 by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Geoffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London.

Member of the Audit Bureau of Circulation.



Maintains the lead in Electrical Literature

A Library Of Actual Practice

EVER increasing opportunities are before the man who keeps himself up to date in electrical practice. Electricity now holds out to you the greatest imaginable future.

Thousands upon thousands of dollars are being expended in extension work and improvements. The man who can use his head as well as his hands will be reckoned with in this great revival in the electrical industry. The more you know the more will be your share in the way of increased earnings.

No Useless Theory
No Wasted Space
PRACTICAL—
ACCURATE—
COMPLETE—

Terrell Croft's methods of simplifying electricity are known throughout this country. His books contain the common-sense facts that count, the facts that you need on the job every day. There has never been such a demand for any electrical book or set of books. It has been nearly impossible to keep up with this demand. In these days when men want only the best in electrical literature, this great demand means something to you.

Read This—

Electricity, from the simplest principles to complete and economical operation of a central station—

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect, in accordance with the National Electrical Code.

Wiring of finishing buildings. Underwriters' and municipal requirements. How to do the complete job, from estimating it to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the short-cuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

Three thousand pages clearly written. Two thousand and one hundred illustrations that are an electrical education in themselves. Eight beautifully bound volumes, flexible and pocket size. Dark red and lettered in gold.

Free ten-day test

Put these books to a test. Fill out the coupon below and return to us. We will immediately forward the eight volumes for a ten-day trial. Make every possible use of them in connection with your work for ten full days. Then send them back at our expense, if you think you can afford to be without them.

If your own calm judgment tells you that it is the best investment any electrical worker could make, send us the small monthly payments called for in the coupon.

A sure means of gaining promotion. A direct guide to an expert working knowledge of every branch of electricity.

Make Up Your Mind Today
to Know Electricity as Experts Know It

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York
Publishers of Books for Engineers since 1876

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.
239 West 39th St., New York

Gentlemen: Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions.

Name .....
Home Address .....
City and State .....
Where Employed .....
Occupation .....

Ex. 7-20

Vol. VIII
Whole No. 88

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

August, 1920
No. 4.

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 & 236 Fulton Street, New York.

Science and Invention

THE word *Science,* from the Latin *scientia,* meaning knowledge, is closely related to *Invention,* which, derived from the Latin *inventio,* means, finding out. There is little in Science that did not at one time require some inventive powers, while conversely most of the world's inventions are based upon one or more of the sciences.

But "invention" antedates "science" by thousands of years. When our prehistoric man first fashioned his crude hammer by binding a stone to a stick, by means of reeds, he had made a basic invention in every sense of the word. And when he first applied his stick to a huge boulder he wisht to move, then placing a smaller stone under the stick—he had made another notable basic invention—the lever.

In fact, both of these basic inventions are discoveries, and if they were first made today, would be patentable. Right here we may state that in patent law "discovery" and "invention" are held to be synonymous, tho popularly an "invention" designates one that is new and useful as well as patentable.

Science, or rather the sciences, on the other hand first came into being with the ancient Greeks. Of course, some sciences existed before the Greeks, but they were not recognized as such. At least there is no record of any sciences classified as such by the Phoenicians or the old Egyptians. Even in Grecian times there were comparatively little sciences. Thus the Platonists had their sciences divided into dialectics, physics and ethics.

Even in comparatively modern times there seems to be little agreement as to what the sciences really comprise. Thus Bacon in 1605 has history, poesy, and philosophy as his sciences. As late as 1830 Comte classifies the sciences into six parts in their following orders: Mathematics, astronomy physics, chemistry, physiology and sociology.

Even today there exists no classification of the sciences that would be acceptable to all of our great thinkers.

The general public and "the man in the street" possibly come nearer the actual definition of "science" than most of our philosophers. To the public, the arts, discoveries, inventions—all fall under the term of science. Anything under the sun nowadays becomes a "science"—be it the science of cooking, the science of darning socks, or the science of cleaning streets.

The myriad of inventions and discoveries all tend to make the world more "scientific" and whether we like it or not, one science or another creeps into every one of our homes. We are surrounded with science all day long as well as during the night. Science does this thing for us, and makes us do that. There is no escaping it and the general public has awakened to the fact but yesterday, that science no longer is the sombre book closed with seven seals. Quite the contrary, it is the public that popularizes science—not our scientists. Just at present, for instance, educational scientific films are all the rage and the public clamors for more and heartily applauds them.

But our *real* scientists are as backward as in Galileo's times. The public applauds and instantly believes in anything new that is scientific, whereas the true scientist scoffs and jeers, just as he did in Galileo's times when that worthy stoutly maintained that the earth moved and did not stand still.

Then as now they burn our great discoverers and our great scientists at the stake. Only today the stake is moral and the fire derision.

It matters little that Jules Verne or Nikola Tesla are a hundred years ahead of the times—the scientists scoff and laugh unbelievingly.

But happily, the great public today appreciates the "fantastic dreamer", because it knows from experience that these "fantastic dreams" have a habit of coming true on the morrow.

H. GERNSBACK.

CONTENTS FOR AUGUST, 1920

ELECTROCUTING SHARKS ..... Front Cover
From a Painting by Harold V. Brown
ELECTRIC SAND-HOG TO SALVAGE SHIPS..... 357
By Eric A. Dime
MAN-MADE RUBIES.....By O. Ivan Lee, B. Sc. 358
100 HORSE-POWER VOICE FOR CONVENTIONS..... 360
MOVIES OF THE UNSEEN...By Jerome A. Lackenbruch 361
FIRST ELECTRIC WELDED BUILDING.By H. B. Payne 362
SPERRY SHOAL WATER INDICATOR..... 363
ELECTROCUTING SHARKS.....By H. Gernsback 364
MARVELS OF THE EAR—HOW WE HEAR..... 365
By Joseph H. Kraus
THE ELECTRO-MAGNET IN SCIENCE..... 366
FIRST ELECTRIC LOCOMOTIVE..By Harvey H. Smith 367
JULES VERNE, THE WORLD'S GREATEST PROPHET 368
By Charles I. Horne, Ph.D.
WATER—THE ELIXIR OF LIFE..... 370
By William M. Butterfield
HOUSEHOLD ELECTRIC WRINKLES..By Edna Purdy 371
THE ULTIMATE RAY 372
NEWEST SCIENTIFIC PHOTOS..... 373
THE MASTER KEY.....By Charles S. Wolfe 374
ODD PHOTO CONTEST ..... 375 & 378
FIRELESS FIREWORKS 377
WHAT THEY THINK OF OUR NEW NAME..... 385
"HOME ELECTRICS"—THE VIBRATING BELL..... 386
By G. L. Hoadley, M. E.
AUTOMOBILE STUNTS—$50.00 PRIZE CONTEST..... 388
LITTLE KNOWN X-RAY FACTS.....By Philip A. Wall 389
POPULAR ASTRONOMY—DOUBLE STARS..... 390
By Isabel M. Lewis, M. A., U. S. Naval Observatory
PRACTICAL CHEMICAL EXPERIMENTS..... 392
By Prof. Floyd L. Darrow
ELECTRICITY FROM WATER-POWER..... 394
By H. Winfield Secor
THE CONSTRUCTOR—HOW TO BUILD THE "TESLA" ELECTRIC CLOCK 396
WHY THE TELEPHONE HOWLS..... 397
By Prof. Lindley L. Pyle
$25.00 AUDION POEM CONTEST—ANNOUNCEMENT OF THE WINNER..... 405
WHAT TO INVENT.....By J. G. Hobson 411

SCIENCE AND INVENTION is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be address to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1920, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Geoffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London.

Member of the Audit Bureau of Circulation.

A Direct Route to BIGGER PAY

NO MONEY DOWN

SMALL MONTHLY PAYMENTS

THROUGH ELECTRICITY you can earn more. The salary of the electrical worker is steadily advancing. Especially is this true of those who are educating themselves in the finer points of electrical practice.

Fit yourself for one of the really big jobs by knowing electrical practice complete, including inside and outside work, central stations, and the whole subject. It takes long years to do this in practice only whereas, with the aid of the CROFT LIBRARY OF PRACTICAL ELECTRICITY it takes only months.

No matter how much nor how little you know of electricity, the Croft Library will be found of assistance every day. You will immediately recognize the fact that the author is a practical man. You will immediately see the great difference between these and other books on the subject you possess.

READ THIS—

McGraw-Hill Book Company, Inc.,
239 West 39th Street, New York, N. Y.

Gentlemen: In an attempt to express myself about CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY, I have never seen and do not believe there was ever printed in the English language, a more comprehensive set of books. It is a library that is just as valuable to the novice as to the expert, because it is all practice.

Respectfully,

GUY H. PEIFER,
Chief, Doplan Silk Corporation, Hazelton, Pa.

ELECTRICAL PRACTICE COMPLETE

AND THIS—

McGraw-Hill Book Co., Inc.,
239 W. 39th St.,
New York.

Gentlemen: The CROFT LIBRARY OF ELECTRICITY more than came up to my expectations. I have been in the electrical business for fifteen years, and know the general run of electrical books. Terrell Croft's Library is the best I have had the pleasure of examining.

Yours truly,

EDWARD T. HOFF,
713 3rd Ave.,
Asbury Park, N. J.



The Croft Library adheres closer to actual practice than anything of the kind ever attempted. It is the most complete set of books on electricity ever published. It is clearest in word and illustration. It has no equal in everyday helpfulness. It cannot be compared in any way with other sets of books on this subject.

Just return the coupon—

Fill out the coupon below and return to us. We will immediately send the eight volumes, charges prepaid, for ten days' use in connection with your work. Don't bother to send any money. We do not want a cent from you until you have examined the books and decided that they are a direct route to bigger pay. Then you can send us $2 in 10 days and $3 per month for six months.

McGraw-Hill Book Co., Inc.
239 West 39th St., New York

MAIL THIS COUPON TO-DAY

AND THIS—

Electricity, from the simplest principles to complete and economical operation of a central station.

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect, in accordance with the National Electrical Code.

Wiring of finished buildings, Underwriters' and municipal requirements. How to do the complete job from estimating it, to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the shortcuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

McGraw-Hill Book Co., 239 W. 39th St., New York

Gentlemen:—Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions.

Name.....

Home Address.....

City and State.....

Where Employed.....

Occupation.....S&I 8-20

Vol. VIII
Whole No. 89

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

September, 1920
No. 5.

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 & 236 Fulton Street, New York.

Artificial Diamonds

THE diamond as is well known is a crystallized form of pure carbon. The diamond is not acted upon by the strongest acids or alkalies exactly like carbon. If heated to a high temperature in the presence of oxygen it burns, as does ordinary carbon.

Ever since it became known that the diamond is carbon, chemists and physicists have labored incessantly to produce this precious stone artificially—synthetically in other words. Many precious stones have been actually thus produced, as for instance the ruby, the emerald and the saffire, but as for the diamond, it has so far baffled all our most able researchers.

We might state here that these men who labor so incessantly to produce the diamond realize full well, that the minute the discovery is made, the diamond market will be demoralized, just as happened when artificial rubies were made first. Today not even a jeweler can tell a real ruby from a synthetic one, altho the real one might have cost $5,000, while the artificial one can be had at $10. The same thing will happen in the near future to the diamond—you can be sure of that. What then? Will we continue to adorn ourselves with diamonds? Perhaps. But the greater and larger field will be found for industrial purposes. On account of their remarkable hardness diamonds are used for rock-drilling, glass cutting, wire drawing and hundreds of other uses, far more important than for personal adornment.

Let us now see what has been done to produce the diamond synthetically. Perhaps the greatest authority on the subject is the Frenchman Moissan, who actually produced microscopic diamonds by means of tremendous pressures. Graphite—a pure form of carbon—is usually subjected to extraordinary high pressures running all the way up to 15,000 atmospheres and higher. While under such compression the graphite is treated by means of electric currents as well as high temperatures. Thus Sir Charles A. Parsons used a 200-ton hydraulic press and a current from a storage battery that gave 80,000 amperes! But no diamonds were produced. In some of his experiments Sir Charles actually succeeded in *melting* graphite six times over, but the only result was a slight alteration in the structure of the graphite.

Having found that pressures by means of the hydraulic press had their limitations, Parsons then set about to obtain very much higher pressures on graphite than had ever been thought possible. He simply fired a rifle or gun bullet into a tapered hole drilled into a block of steel. At the bottom of the hole was a small quantity of graphite. By firing a steel bullet into such a hole the net pressure on the graphite was calculated to be 2,000 tons per square inch! So tremendous is such a pressure that the bottom of the hole was enlarged to almost twice its original size! But still the graphite did not change.

Substituting a tungsten steel block tempered glass hard and firing a bullet into a tapered hole by means of a high powered rifle, pressures as high as 5,000 tons per inch were recorded—but still the graphite refused to become a diamond.

It is of high interest to note that Stanley Cook calculated that during such experiments the final pressure must be at least 15,000 atmospheres, while a temperature (caused by the tremendous pressure) of between 15,250° and 17,700° Centigrade must have been reached. In other words, a temperature—tho momentary, of course—as high as that which prevails in the sun!

H. GERNSBACK.

CONTENTS FOR SEPTEMBER, 1920

THE ELECTRICAL MEAL.....Front Cover
From a painting by Harold V. Brown
MOVING PLATFORMS FOR STREET CROSSINGS..... 471
By Edwin F. Linder, M.E.
LIQUID AIR.....By T. O'Conor Sloane, Ph.D. 472
PLANT OR ANIMAL—WHICH?.By William M. Butterfield 475
ELECTRICAL MEALS.....By Jacques Boyer 476
TIMING SUNLIGHT FOR PLANTS..... 477
HOW DO WE TASTE?.....By Joseph H. Kraus 478
WHAT'S WRONG WITH THE MOTOR CAR?..... 479
By H. Winfield Secor
ARCHIMEDES—THE WORLD'S FIRST GREAT INVENTOR 480
UNDERSEA AMUSEMENT PARK...By F. E. Loudy, A.E. 482
THE UNKNOWN AVENGER.By Harold F. Richards, Ph.D. 483
THE AIRPLANE OF THE FUTURE.....By H. Gernsback 484
THE WHIRLING EYE..... 487
By Thomas W. Benson and Charles W. Wolfe
MOVIE CAMERA COPIES BOOKS AND LEGAL PAPERS .....By O. C. Roos 489
THE ROMANCE OF TUNGSTEN.....By E. W. Davidson 492
SYNTHETIC AMMONIA.....By Lucien Fournier 493
ECLIPSES—HOW CAUSED..... 494
By A. M. Harding, Ph.D., University of Kansas
HOME MECHANICS...Conducted by Willam M. Butterfield 496
HOME ELECTRICS—ELECTRIC BELL CIRCUITS..... 497
By G. L. Hoadley, M.E.
MOTOR-HINTS PRIZE CONTEST..... 498
"WHAT TO DO WITH YOUR OLD PHONOGRAPH" Contest 499
POPULAR ASTRONOMY—IF THE EARTH SHOULD STOP! 500
By Isabel M. Lewis, M.A. of the U. S. Naval Observatory
PRACTICAL CHEMICAL EXPERIMENTS—CHEMICAL EFFECTS OF LIGHT.....By Prof. F. L. Darrow 502
BUILDING "YOUR OWN" PHONOGRAPH—PART 1.... 506
By H. Winfield Secor
A GIANT 2000 KW. RADIO CENTRAL STATION ON LONG ISLAND..... 511
HOW TO BECOME A PROFESSIONAL RADIO MAN—PART 1.....By Pierre H. Boucheron 514
WHAT TO INVENT.....By Jay G. Hobson 517

SCIENCE AND INVENTION is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addrest to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1920, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Goeffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London.
Member of the Audit Bureau of Circulation.

$20 for a complete electrical education will soon be ancient history

The price of the CROFT LIBRARY OF PRACTICAL ELECTRICITY must be advanced.



We detest the profiteer. We detest the tactics of the company or individual which raises prices of commodities without just cause.

The new price which must soon be placed on the Croft Library of Practical Electricity finds no favor with us. We have persistently fought against increases in the prices of our books. We have succeeded in keeping these advances down to a minimum. Whereas most other commodities today are sold at advances over former prices of 100% to 500%.

Technical book prices have remained nearly the same. But the present abnormal costs of paper and materials going into the manufacture of the Croft Library compels us to raise the price. Paper is going up daily. It is hard to get at any price. Usually only small quantities are procurable. With the unheard of shortage of wood pulp there can be no drop in prices.

So $20 for a complete electrical education will soon be a thing of history. We must stop publication of the Croft Library—or raise the price.

Still time to act

The advance will take place very soon. You still have an opportunity to procure the meat of up-to-date electrical practice in America at a fraction the cost of the same information procured from any other source. You still have the chance to possess the most vitally important electrical data in print today, at a very low price.

Records of actual electrical practice

Records of actual practice, written by a practical man, written so you can understand, illustrated so that nothing remains a mystery.

The coupon brings the entire set to you

Use the coupon below today. Let us send you for absolutely free examination a set of books, the only aim of which is to place you in a higher paying position, and to make you master of whatever branch of electricity interests you.

Not a cent in advance—small monthly payments if you're pleased

Examine these wonderful books—use them ten days in connection with your work. Then send them back at our expense if you are not satisfied. If wanted, send us $2 in ten days, and then $3 per month for six months.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York
Publishers of Books for Engineers since 1876

Read This—

Electricity, from the simplest principles to complete and economical operation of a central station—

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect, in accordance with the National Electrical Code.

Wiring of finishing buildings. Underwriters' and municipal requirements. How to do the complete job, from estimating it to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the short-cuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.
239 West 39th St., New York.

Gentlemen: Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions.

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation .....

Vol. VIII
Whole No. 90

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

October, 1920
No. 6.

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 and 236 Fulton Street, New York.

A Fortune for You

EVERY day I receive dozens of requests from inventors and would-be inventors asking me what to invent. Many of my correspondents often bemoan their fate that they have been born in an age "when everything worth while was already invented"! What will these good people think twenty years hence? Hundreds of thousands of important inventions—undreamt of today—will have been made in that time. Thousands of fortunes will have been made by the present and next generation from inventions unsuspected to-day. What is the answer to these good people who think everything worth while has been invented?

Just this: *Look about you.* See for yourself how your friends, your brother, your father, your mother, your wife, slave away day in and day out at their chores or their daily work.

We work more strenuously today, more intensely and much harder than our grandfathers and grandmothers. The railroad, the auto, the telephone, all tend to cut down time and distance. Competition everywhere is keener, fiercer than ever before. That means more intense and harder work; it too means that we expend more nervous energy than we ever did before.

Consequently, we must make all of our tasks lighter, and we must save more time every day, if we don't want to go to pieces.

Look about you. Strive to reduce the load from our workers. Take, for instance, your mother, or your wife. Their daily dishwashing task—particularly where there are no servants—is tremendous, if you figure up the time and the hard, unpleasant work.

Dishwasher. What is wanted is a *practical* dishwasher. To be sure, there are some of them on the market today. But I've never seen a good one. To begin with, it must not be too big. It should fit the sink, or be of an equivalent size. *It should have a gas attachment to generate steam.* Hot water alone does not cut the grease from a roasting pan. You must have steam, or steaming hot, *boiling water.* That does the trick, and quickly, too. And the dishes, glasses, forks and knives come out perfectly dry, because the heat from the steam evaporates the water, drying everything. The big hotels use such dishwashers—why don't we make one for our mothers and wives that we can sell for $35? Here is a fortune for you if you go about it right.

Envelope-Letter. Down in the office we still use our prehistoric letters and envelopes. We first write a letter, then an envelope. In a busy office—unless they use the expensive "open face" envelope, it happens dozens of times that Jones receives Smith's letter, and vice-versa. Why not combine letter and envelope? To be sure, many patents exist on such, but the ideas were not good because we recall few firms using such an envelope-letter. Your fortune is made if you invent one that, *when opened does not mutilate the letter, and looks respectable after opening.*

Letter Opener. Big firms receive thousands of letters in every mail. Such letters are not opened by hand any more today. Machines are used. But there are few that fit the bill. And they all get easily out of order, and mutilate the contents of a letter. Here's your chance, and a small machine for the small firm would find a good market. Why not combine a letter opener and an envelope sealing machine? Here's a real idea for you.

Pencil Sharpener. Ah, for the genius who will bless our stenographers with a REAL pencil sharpener. There is, as yet, none in captivity. They all break more pencils and chew them up faster than you can feed them. A simple sandpaper-wheel, correctly constructed, should be better than anything containing funny knives and foolish cutters. Here is your chance.

Paper Collars. Now for a cheap white paper collar that you can't tell apart from a linen one. Sells for five or ten cents apiece. Used once only, then thrown away. But it must be stiff and non-wilting—*a man's collar.*

H. GERNSBACK.

CONTENTS FOR OCTOBER, 1920

SCIENCE EXPLAINS THE GREAT FLOOD.....Front Cover
From a Painting by Harold V. Brown
HOW WERE THE PYRAMIDS BUILT?..... 599
A "PROPELLER-LESS" AIRPLANE..... 600
By H. Winfield Secor
X-RAY "MOVIES" AT LAST!..... 601
AN AERIAL SANATORIUM.....By F. E. Loudy, A.E. 602
A UNIVERSE IN MINIATURE..... 603
NEW LANDING SHIP FOR AIRPLANES..... 604
NEW TYPE OF COMIC MOVIES.....By Eric A. Dime 605
WHAT CAUSED THE GREAT FLOOD?..... 606
HOW WE BALANCE OURSELVES..... 608
By William M. Butterfield
WHY BUTTERFLIES' WINGS ARE COLORED..... 609
By Dr. E. Bade
TREPHINING THE SKULL—HOW BLOOD PRESSURE IS RELEASED BY SURGERY..... 610
"MOVIES" OF FLYING BULLETS..... 611
By Pierre H. Boucheron
POPULAR ASTRONOMY—GIANTS AND DWARFS AMONG THE STARS..... 614
By Isabel M. Lewis, M.A., of the U. S. Naval Observatory
HOME MECHANICS..Conducted by William M. Butterfield 616
THE "LOADED" LINE.....By Charles S. Wolfe 617
SOLVING THE HOUSING PROBLEM...By H. Gernsback 618
SCIENCE IN PICTURES..... 620
AN AMERICAN JULES VERNE..... 622
THE ELECTRIC SHOES.....By J. Mac-Richard 624
PRACTICAL CHEMICAL EXPERIMENTS..... 626
By Prof. Floyd L. Darrow
HOW WE SMELL.....By Joseph H. Kraus 628
HOW TO MAKE A SIMPLE STEREOSCOPE..... 629
By Dr. E. Bade
BUILDING "YOUR OWN" PHONOGRAPH—PART 2.... 630
(Conclusion)
HAMMERING ELECTRONS OUT OF MATTER..... 633
By Harold F. Richards, Ph.D.
$10.00 "PERPETUAL MOTION" PRIZE CONTEST..... 635
WRINKLES, RECIPES AND FORMULAS..... 636
Edited by S. Gernsback
RADIO TRANSMISSION OF POWER..By Samuel Cohen 637
REPORTING YACHT RACES VIA RADIO..... 638
By Donald McNicol
SIMPLEST LONG WAVE RECEIVER..... 641

SCIENCE AND INVENTION is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addrest to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

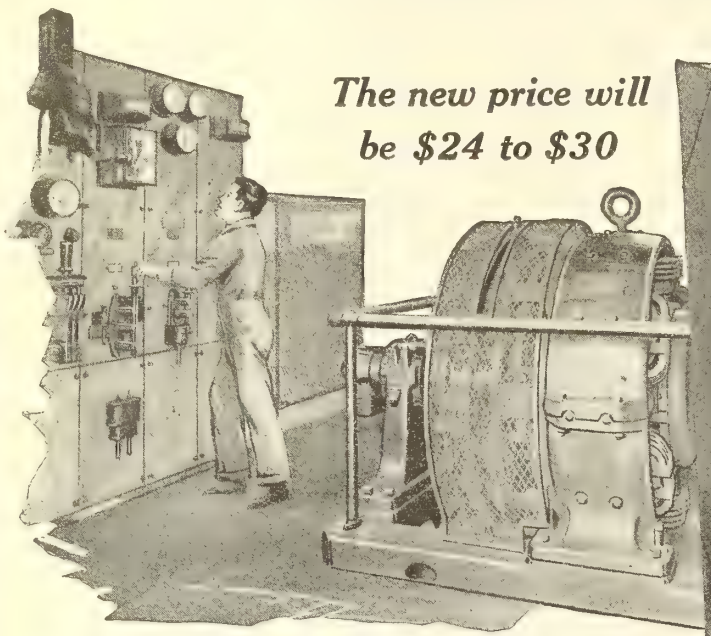
SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1920, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Goeffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London.

Member of the Audit Bureau of Circulation.

The price goes up

After the present printing of the CROFT LIBRARY OF PRACTICAL ELECTRICITY is exhausted it will be impossible to sell the books at $20



The new price will be $24 to $30



ELECTRICITY COMPLETE

AT $50 or $100 the information contained in the Croft Library would be a good investment. But despite the fact that paper and other material going into these books have advanced about 300%, we have kept the selling price down.

After the present printing is exhausted, it will never again be possible to sell the most popular electrical set in America at the present low price.

Save money by ordering now

You can realize a substantial saving by returning the coupon below today. At the same time you will start to acquire a knowledge that will advance you to the higher positions in the world of electricity.

Earn $9 per day or more

Electrical workers are earning $9 per day and over, and there are many more needed than are available. Terrell Croft is a practical man. He tells you in concrete language how to get ready to earn $9 per day and over. His methods are never-failing. The information is in simplest language and simplest arithmetic.

He is proving every day that he can teach a man as much about electrical work in six months as can be learned in five years' practice.

No money to be paid in advance—merely return the coupon

Fill out the coupon below today. This is your opportunity to procure a complete, practical electrical education at a very low price. Many resident courses costing $200 to $300 do not contain as valuable first-hand data as is embodied in these books.

If satisfactory, pay $2 in ten days and $3 per month for six months. Return the books at our expense if you are not thoroughly pleased.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York
Publishers of Books for Engineers since 1876

8 flexible pocket books — over 2,000 illustrations, the best illustrated and most easily understood electrical library in existence.

Read This—

Electricity, from the simplest principles to complete and economical operation of a central station—

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect in accordance with the National Electrical Code.

Wiring of finishing buildings. Underwriters' and municipal requirements. How to do the complete job, from estimating it to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the short-cuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.
239 West 39th St., New York.

Gentlemen: Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions.

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation .....

S.&I. 10-20

Vol. VIII
Whole No. 91

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

November, 1920
No. 7.

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 and 236 Fulton Street, New York

Keeping Warm

AS fall and winter approach each year, we become much concerned about our heating facilities. If we own a house, the coal problem becomes a momentous question, and just now, a very expensive one as well.

But if you were to tell a man that out of twenty tons of coal he uses a season to heat his house, some sixteen or seventeen are a total unnecessary waste, he probably would doubt your sanity.

The trouble, you see, lies not in the coal or in the heating apparatus, but in the *house* itself, or rather in our low intelligence. We build houses to live in, and to have a roof over our heads, or to provide a place for our furniture, but with no forethought to keep warm in winter, and cool in summer. If an ice-box manufacturer built his ice-boxes like we build our houses, he would soon go out of business.

Now let us see what is wrong. On a nice summer's day with a temperature of 70° outdoors, close all doors and windows of your house. Start your furnace with a few pounds of coal and it won't take but a few minutes to warm the house up to 75°. With less than five pounds of coal you can keep up this temperature for a whole day or longer. The reason of course is that as it is 70° outdoors you loose practically no heat to the outside temperature, which is almost as high as the interior of the house. But let the outside temperature drop to zero, your five pounds of coal will have given up their heat thru the *good conducting* walls of your house in less than five minutes.

Evidently the moral is: *Don't heat your house and all outdoors,* but just *heat the air* of your house, and KEEP the heated air indoors.

That is what a Canadian engineer thought last year, when he built his house up in Alberta. Here the temperature drops to 20° below zero for weeks at a time and zero weather is the rule rather than the exception. So he built his house on the ice-box plan. The entire house is built of cement, with double walls, double ceilings, double roof, and double floors. Between the double walls is an airspace about two to three inches wide. This airspace alone would be a great improvement to keep out the cold, but our engineer went further. He filled in every bit of space between the walls with cork dust. This is both cheap and one of the very worst conductors of heat. By doing so he effectively insulated his entire house against the outside temperature.

The windows were double and triple panes of glass with air spaces between the panes. The doors leading outside are all of the revolving kind and they too serve as the only means for ventilation, as all windows must be kept closed hermetically.

Now comes the astonishing part. The house is entirely heated by a few electrical heaters. No steam is used at all. The owner figures that his electric heaters consume an equivalent of *three tons of coal a season,* were he to use a furnace. And this too in steady zero weather.

Another example of what a little intelligence plus science will do.

Of course this is all good advice if you are to build a new house, but how about your present one? Naturally you cannot build double walls now; it is too late for that, without doing the house over. But you can do this. The source of the greatest loss of heat lies without question in the window panes. Your house walls may be two to four inches thick, while the glass panes measure but an eighth of an inch thick. Suppose you build a wooden frame one inch thick inside of the present window frame. On top of this frame place a second pane of glass and putty it in place. This gives you an airspace of one inch between the two panes.

It will also reduce your coal bill over one-third.

H. GERNSBACK.

CONTENTS FOR NOVEMBER, 1920

WHAT MAKES A MAGAZINE COVER.....Front Cover
THE BELIN SYSTEM OF TELEPHOTOGRAPHY..... 717
SHOOTING UP HOUSES WITH A CEMENT GUN.... 718
By Robert H. Moulton
SUPER-SILKWORMS AND SUPER-SILKWORM FOOD 719
By Richard Hoadley Tingley
LEONARDO DA VINCI—THE EDISON OF THE MIDDLE AGES. By Prof. T. O'Conor Sloane, Ph.D., LL.D. 720
SCIENCE IN PICTURES..... 722
TAPPING THE EARTH'S HEAT..... 724
By Prof. T. O'Conor Sloane, Ph.D., LL.D.
DR. PRINGLE DISCUSSES LIFE.....By John DeQuer 726
AWAKENING DE LUXE.....Photos by Edna Purdy 727
WHEN THE "SUB S-5" SANK—WHY SCIENCE FAILED TO INDICATE THE PLIGHT OF THE S-5 729
WHAT MAKES A MAGAZINE COVER..... 730
By Charles A. Grotz
MAKING LIFE-LIKE ANIMATED CARTOONS..... 732
By E. G. Lutz
WHAT YOUR HANDS REVEAL..By Dr. W. de Kerlor 735
"MOTOR HINTS" PRIZE CONTEST..... 736
POPULAR ASTRONOMY—HAS THE EARTH AN UNDISCOVERED MOON? 738
By Isabel M. Lewis, M.A.
"PHONOGRAPH CONTEST" PRIZE AWARDS..... 740
HOME ELECTRICS—TELEPHONE WIRING..... 743
By G. L. Hoadley, M. E.
BLIND NOW READ BY MUSICAL SOUND..... 744
CONEY'S NEW "TOPSY TURVY" WHEEL..... 745
By I. Kuttner
SCIENCE "STARS" IN NEW PLAYS..... 746
"APPLIED CHEMISTRY"—A SCIENTIFIC STORY.... 748
By Charles S. Wolfe
PRACTICAL CHEMICAL EXPERIMENTS—FIRE AND HIGH TEMPERATURES....By Prof. F. L. Darrow 749
THE ELECTRICAL MACHINIST—No. 12, CONSTRUCTION WORK DETAILS.....By H. Winfield Secor 754
WRINKLES, RECIPES AND FORMULAS..... 756
Edited by S. Gernsback
HOW TO BECOME A PROFESSIONAL RADIO MAN—PART 3—CONCLUSION....By Pierre H. Boucheron 760

SCIENCE AND INVENTION is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addrest to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

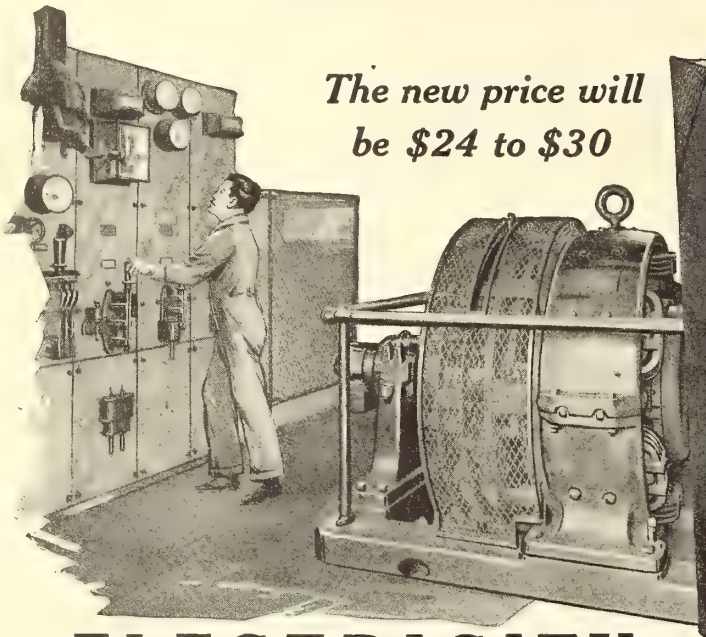
SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1920, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Goeffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London.

Member of the Audit Bureau of Circulation.

The price goes up

After the present printing of the CROFT LIBRARY OF PRACTICAL ELECTRICITY is exhausted it will be impossible to sell the books at $20



The new price will be $24 to $30



ELECTRICITY COMPLETE

AT $50 or $100 the information contained in the Croft Library would be a good investment. But despite the fact that paper and other material going into these books have advanced about 300%, we have kept the selling price down.

After the present printing is exhausted, it will never again be possible to sell the most popular electrical set in America at the present low price.

Save money by ordering now

You can realize a substantial saving by returning the coupon below today. At the same time you will start to acquire a knowledge that will advance you to the higher positions in the world of electricity.

Earn $9 per day or more

Electrical workers are earning $9 per day and over, and there are many more needed than are available. Terrell Croft is a practical man. He tells you in concrete language how to get ready to earn $9 per day and over. His methods are never-failing. The information is in simplest language and simplest arithmetic.

He is proving every day that he can teach a man as much about electrical work in six months as can be learned in five years' practice.

No money to be paid in advance—merely return the coupon

Fill out the coupon below today. This is your opportunity to procure a complete, practical electrical education at a very low price. Many resident courses costing $200 to $300 do not contain as valuable first-hand data as is embodied in these books.

If satisfactory, pay $2 in ten days and $3 per month for six months. Return the books at our expense if you are not thoroughly pleased.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York
Publishers of Books for Engineers since 1876

8 flexible pocket books — over 2,000 illustrations, the best illustrated and most easily understood electrical library in existence.

Read This—

Electricity, from the simplest principles to complete and economical operation of a central station—

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect in accordance with the National Electrical Code.

Wiring of finishing buildings. Underwriters' and municipal requirements. How to do the complete job, from estimating it to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the short-cuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.
239 West 39th St., New York.

Gentlemen: Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions.

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation .....

S.&I. 11-20

Vol. VIII
Whole No. 92

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

December, 1920
No. 8.

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 and 236 Fulton Street, New York

Ice Boiling-Hot

DID you ever hear of five different kinds of ice? Perhaps not. The only kind of ice that you have ever seen or heard of before is the good old-fashioned, common, ordinary ice. But of late, many new things are happening in the world of science and the discovery of the existence of five different kinds of ice is one of them.

In his recent researches, Professor P. W. Bridgman, of the Carnegie Institute at Washington, has made some very remarkable discoveries due entirely to extraordinary high pressures. He investigated a great many substances which he subjected to tremendous pressures and under such conditions a number of surprising things happen. Take, for intance, water. If we subject it to a pressure of about 300,000 pounds to the square inch, water first becomes solid, turning into ice, *altho it is nearly boiling hot!*

At ordinary atmospheric pressures water turns to ice at about 32° Fahrenheit. But as we compress it to very high figures, we find that water is indeed a highly compressible substance—a thing that was not known before. Thus Dr. Bridgman has *comprest water to 80 per cent. of its volume!* During such compression the water turns to ice at all sorts of temperatures, and the four new and different kinds of ice that were discovered are all considerably denser than water. In other words, such a cake of ice *would sink in water,* instead of floating as ordinary ice does.

Water, however, is only one of the substances that behaves strangely under high pressures. Take phosphorus, for example. Ordinarily this substance is known in two forms, namely, the ordinary yellow or white phosphorus and the red, allotropic variety, both, however, having practically the same general physical characteristics White phosphorus is highly oxidizable and cannot be left in the open air without danger of ignition. It is a non-conductor of electricity and as soft as wax. If, however, we subject this phosphorus to the enormous pressure of some 175,000 pounds per square inch we obtain an entirely new substance which is neither the usual nor the allotropic red phosphorus, but something entirely different. We obtain *black phosphorus* which is very hard and which only oxidizes at a very slow rate. It is also 15 per cent. denser than the white variety. It can be handled with the fingers with impunity and *the material is a good conductor of electricity.*

Dr. Bridgman found that at high pressures, paraffin became more rigid than soft steel; soft rubber became as brittle as glass. Another noteworthy feature was discovered in the course of these experiments and that is that nearly all metals such as metallic wires subjected to tremendous pressures become slightly more conductive to the electrical current.

There is no doubt that thru these researches we will learn much about the nature of the atom as well as about the electron if we subject materials to still higher pressures. This field is practically virgin and we may say that only the surface has been scratched so far. What will happen, for instance, if many of our well-known substances are subjected to pressures of say two or three million pounds per inch, or higher, is difficult to conceive today. Of course today we have no control of such pressures because there exist no materials sufficiently hard to resist such titanic compression. But science will surely find a way to obtain some alloys unknown today that will lend themselves to such pressures. It is even thought possible in some quarters that in high pressures we have the key to our alchemist's dreams of changing one metal into another, from base to precious, or vice versa. Although this may sound extreme and while the theory is not given credence by most scientists, still the example of phosphorus is pointed out as to what may happen, given sufficiently high pressures.

H. GERNSBACK.

CONTENTS FOR DECEMBER, 1920

WATER CURTAIN PROTECTS FIREMEN.....Front Cover
From a Painting by Howard V. Brown
FLOATING SUNKEN SHIPS..... 839
EINSTEIN AND THE FOURTH DIMENSION..... 840
By H. Gernsback, Member of the American Physical Society
SCIENCE IN PICTURES..... 842
SCIENTIFIC CHRISTMAS TOYS..... 844
A PROPHET OF SCIENCE..... ....By John De Quer 845
LIFE OR DEATH.....By Charles S. Wolfe 847
VON GUERICKE—THE WIZARD OF ATMOSPHERIC PRESSURE 848
By Prof. T. O'Conor Sloane, Ph.D., LL.D.
WATER CURTAIN PROTECTS FIREMEN..... 850
THE LIGHT RAY PHONOGRAPH....By Eric A. Dime 851
WHAT ARE DREAMS?..... By William M. Butterfield 852
LAMP FACTS FOR THE HOUSEHOLDER..... 853
THE SUBMACHINE GUN..... 854
MOVIE MODELS SHOW HOW MACHINES WORK.. 859
By Esther Lindner
POPULAR ASTRONOMY—HAS THE EARTH'S ROTATIONAL PERIOD CHANGED?..... 860
By Isabel M. Lewis, M.A., of the U. S. Naval Observatory
MOTOR HINTS PRIZE CONTEST..... 863
HEAT FOR THE HOUSEHOLD...By H. Winfield Secor 864
"LANDING LAKES" FOR AIRCRAFT..... 866
By R. T. Carabin, Ex-Lieut. A. E. F.
THE BRITISH MYSTERY TOWERS..... 867
DIVING BELL RECLAIMS DIAMONDS..... 868
THE AMATEUR MAGICIAN.....By Joseph H. Kraus 870
PRACTICAL CHEMICAL EXPERIMENTS—SOME METALS AND THEIR PROPERTIES..... 871
By Prof. Floyd L. Darrow
XMAS ELECTRIC AMUSEMENTS..... 872
FASCINATING CHEMICAL EXPERIMENTS..... 879
By O. Ivan Lee, B.Sc.
TRANSMITTING PHOTOGRAPHS BY RADIO..... 883
By Pierre H. Boucheron
WHAT TO INVENT.....By Jay G. Hobson 885

SCIENCE AND INVENTION is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addrest to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1920, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Goeffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London. Member of the Audit Bureau of Circulation.

DEC 9 - 1920



An Amazingly Easy Way to Earn $10,000 a Year

Let Me Show You How Free

TO the average man the $10,000 a year job is only a dream. Yet today there are a surprising number of men earning five figure salaries who were merely dreaming of them a short while ago. The secret of their success should prove a startling revelation to every ambitious man who has ever aspired to get into the $10,000 a year class.

There is nothing fundamentally "different" about the man whose salary runs into five figures. He is made of the same stuff as you and I. It is not necessary that he must enjoy the privilege of some influential connection or "pull." For example take J. P. Overstreet, of Dallas, Texas. A few short years ago he was a police officer earning less than $1,000 a year. To-day his earnings are in excess of $1,000 a month—more than $12,000 a year. C. W. Campbell, Greensburg, Pa., was formerly a railroad employee on a small salary—last month his earnings were $1,562.

Why Salesmen Earn Such Big Pay

Just stop a moment and think over the successful men of your acquaintance. How many of them are connected with some form of selling? If you will study any business organization you will see that the big jobs go to the men who sell, for upon their efforts depend the profits a company makes. Without trained men to place a product on the market, the finest goods are worth no more than so much clay. Salesmen are the very nerve centers of a business. Is it any wonder that they earn big pay?

The man who starts working as a bookkeeper or clerk for $25.00 a week, never increases his value to the firm. Any advance in pay is merely a reward for length of service. At the end of ten years he is no more essential to the life of the organization than he was at the end of ten weeks. He is only a necessary liability—drawing his pay because somebody must be found to work at the unimportant, routine jobs. Once established in the rut, he becomes a cog in the machine—when he is worn out, he can be easily and cheaply replaced.

Why Don't You Get Into the Selling Field?

Mr. Overstreet, Mr. Campbell and the others whose letters you see on this page are all successful salesmen. They realized their ambitions by landing $10,000 jobs in an amazingly simple way, with the help and guidance of the National Salesmen's Training Association. Sometime—somewhere back in the past, each one of them read of this remarkable course of Salesmanship training and Employment Service just as you are reading of it to-day. Each one of them was dissatisfied with his earning capacity—as perhaps you are—and each one cast his lot with the N. S. T. A. To-day they are important factors in the business world—enjoying all the comforts and luxuries money can buy. And yet they are not exceptions, for there are thousands of N. S. T. A. trained salesmen who are making big money, as we will be only too glad to show you if you will mail the coupon.

We Train You and Help You Land a Job

The National Salesmen's Training Association is an organization of top-notch salesmen and sales managers formed for the express purpose of training men in the science of successful selling. You do not need to know the first thing about selling—for the N. S. T. A. trains you from the ground up—gives you a complete insight into selling methods—in your spare time without making it necessary to give up your present position until you are ready to begin actual selling.

In addition to this remarkably efficient course of training, the N. S. T. A. maintains a Free Employment Service to help its Members to jobs in the lines for which they are best suited. This in itself is of incalculable value for it allows the prospective salesman to make a complete survey of the selling field and to select the work which most appeals to him.

Read These Amazing Stories of Quick Success

Earned $524 in Two Weeks

I have never earned more than $60 a month. Last week I cleared $306 and this week $218. You have done wonders for me.—Geo. W. Kearns, 107 W. Park Place, Oklahoma City, Okla.

I Now Earn as High as $100 a Day

I took your course two years ago. Was earning $16 a week clerking. Am now selling many of the largest firms in the U. S. I have earned more than $100 in a day. You secured me my position. Our Sales Manager is a graduate of yours.—J. L. DeBonis, 1628 S. Crawford Ave., Chicago, Ill.

Earns $1,562 in Thirty Days

My earnings for the past thirty days are $1,562, and I won Second Prize in March although I only worked two weeks during that month.—C. W. Campbell, Greensburg, Pa.

Earned $1,800 in Six Weeks

As soon as I received a letter from you and your literature, I knew that I was on the right track and very soon after I applied for a position as a Salesman to one of the firms whom you informed me were in need of a Salesman and to whom you had recommended me. As soon as they received my application, which was by mail, they wired me to come for an appointment which I did, with the result being that I sold my services to them in about thirty minutes, took a territory in Illinois and Wisconsin and made a success of it from the very first week.

From that time on I have been what might be termed as a "high pressure" Salesman, selling lines where nine out of ten Order Takers would fail. I have sold goods in a highly successful manner in nine or ten States, both North and South. My earnings for March were over $1,000 and over $1,800 for the last six weeks, while last week my earnings were $356.00. I travel eleven months out of the year, working five days each week.

The N. S. T. A. dug me out of a rut where I was earning less than $1,000 a year and showed me how to make a success.—J. P. Overstreet, Dallas, Texas.

Salesmen Are Needed—Now!

Get out of that rut! Work for yourself! Salesmanship is the biggest paid of all professions. Just because you have never sold anything is no sign that you can't. We have made Star Salesmen of men from all walks of life, with no previous selling experience. These men have jumped from small pay jobs to big selling positions and handsome incomes. The same training on which they founded their success is open to you. You can follow in their footsteps. Why don't you get in a class with men who make real money? Never before have the opportunities been greater. At least you cannot afford *not* to investigate the great field of Selling and see what it offers *you*. It will only cost you a 2 cent stamp and the facts and proof you will receive will surprise you.

Free Book on Salesmanship

Just mail the coupon or write for our free illustrated Book, "A Knight of the Grip," which we will be glad to send without any obligation on your part. Let us prove to you that regardless of what you are doing now, you can quickly become a Star Salesman. Let us show you how you too can step into the ranks of these big money makers of business. See how easily you can learn this fascinating, big pay profession at home in your spare time. Learn what we have done for others and what we stand ready to do for you. Don't put it off until to-morrow—write us to-day. Every hour lost keeps you that much farther from success. Mail the coupon at once.

National Salesmen's Training Association
Dept. 42-W, Chicago, Ill., U. S. A.

National Salesmen's Training Association
Dep. 42-W, Chicago, Ill., U. S. A.

Please send me, without any obligation on my part your free Book, "A Knight of the Grip," and full information about the N. S. T. A. system of Salesmanship training and Employment Service. Also a list showing lines of business with openings for salesmen.

Name.....

Street.....

City..... S. I. 12-20

Vol. VIII
Whole No. 93

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

January, 1921
No. 9.

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 and 236 Fulton Street, New York

Cold Light

WE have pointed out before in these columns how utterly wasteful our present methods for obtaining light are. We have mentioned the fact that the coal which we burn to obtain electricity is nearly all wasted, and that we realize less than one per cent in light, of the energy contained in coal.

What then are our prospects of producing "cold light" in the near future? There are three so-called sources of cold light of which we know today. These sources are purely physical, and do not include cathode-ray effects of the Geissler tube type or Cooper Hewitt light variety. These latter are not to be classed in the "cold light" category because the light produced in either of these tubes is not really cold in the true sense of the word.

The three sources that can give rise to cold light are the following: Luminescence, Fluorescence and Phosphorescence. Luminescence can be derived from a large number of substances which become luminous under the influence of light, also due to ignition, etc. In nearly all cases luminescence occurs with a simultaneous rise of temperature, and for this reason it really cannot be termed "cold light." When we take a diamond and heat it moderately, it becomes luminous. This fact has been known for a long time, and this is one variety of luminescence. Calcide, too, when heated becomes luminous and remains so in the dark for hours, even if the heat has been discontinued.

In contra-distinction to luminescence we have fluorescence. Fluorescence is a lighting phenomenon which takes place only as long as the source of light is directed upon the substance. The fluorescence disappears immediately when the original lighting source is discontinued. Fluorescence for that reason is due to the absorption of certain light rays. A peculiar phenomenon of many fluorescent substances is that they give out rays of light of a different color than the substance itself. For instance certain green crystals of fluorspar give off blue light, etc.

Next in order we have phosphorescence, in contra-distinction to fluorescence. The difference between the two is that phosphorescence persists after the source of light has been removed. Thus for instance calcium sulphide gives off light after it has been exposed to sunlight and continues to do so for some time in the dark. Many substances such as barium sulphide, strontium sulphide, etc., when exposed to ultra-violet rays or X-rays, will continue to emit a soft light for hours in the dark.

Phosphorescence is also found to a very large extent in many living organisms such as are found in sea water; they very often cause the sea to become phosphorescent for miles. It is now thought also that the fire-fly and many other insects such as the glow-worm, etc., all owe the origin of their luminosity to phosphorescence. Recent researches also tend to show that the photogenic apparatus of these insects contain certain fats, which latter contain free phosphorus. Oxygen in the air when coming in contact with this fat produces the characteristic phosphorescent flashes or glow.

It should be noted that with the possible exception of the phosphorescence, the other sources of cold light would be just as difficult to exploit economically as coal is today. From this it will be seen that not much progress has been made towards the ultimate realization of cold light commercially.

H. GERNSBACK.

CONTENTS FOR JANUARY, 1921

ELECTRIC ARCS MELT SNOW.....Front Cover
From a Painting by Harold V. Brown
ELIMINATING DANGER FROM X-RAY MACHINES.. 961
ELECTRIC LIGHTS FROM SPIGOT..... 962
TORCH-LIT PLANE LANDS AT NIGHT..... 963
A FAIRYLAND OF BUBBLES.....By Joseph H. Kraus 964
AIRPLANE VARIES WING SPREAD IN FLIGHT.... 965
WONDERFUL EXPERIMENTS IN HIGH PRESSURE. 966
TELEGRAPHING PHOTOS BY CODE..... 967
SCIENCE AND THE WEATHERMAN..... 968
ELECTRIC SNOW AND ICE MELTERS..... 970
By H. Gernsback
ELECTRICAL MARVELS STARTLE DELEGATES..... 974
THE LIMITATIONS OF SIGHT..... 976
By William M. Butterfield
FREIGHT LOADER FOR AIRSHIPS.....Rotogravure 977
By George Wall
MAN-MADE FALLS DEVELOP 100,000 H.P.—AN ARTIFICIAL WATERFALL HIGHER THAN NIAGARA. 980
THE ELIXIR OF LIFE.....By H. L. Johnstone 982
THE MAKING OF COPPER ARTICLES AND STATUARY BY ELECTROLYSIS.....By Samuel Wein 985
POPULAR ASTRONOMY—KEEPING TRACK OF THE MOON 986
By Isabel M. Lewis, M.A., of the U. S. Naval Observatory.
MOTOR HINTS—$50.00 AUTOMOBILE PRIZE CONTEST 988
HOME MECHANICS.Conducted by William M. Butterfield 989
EXPERIMENTAL CHEMISTRY—METALS AND THEIR ALLOYS..... 990
By Prof. F. L. Darrow
BUILDING A SMALL AUTOMOBILE..... 991
By H. Winfield Secor, E.E.
BENCH DRILL FROM PIPE FITTINGS By R. E. Nelson 993
PERPETUAL MOTION "PRIZE WINNER"..... 995
HOW-TO-MAKE-IT PRIZE CONTEST..... 996
RADIO DEPARTMENT..... 997

SCIENCE AND INVENTION is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

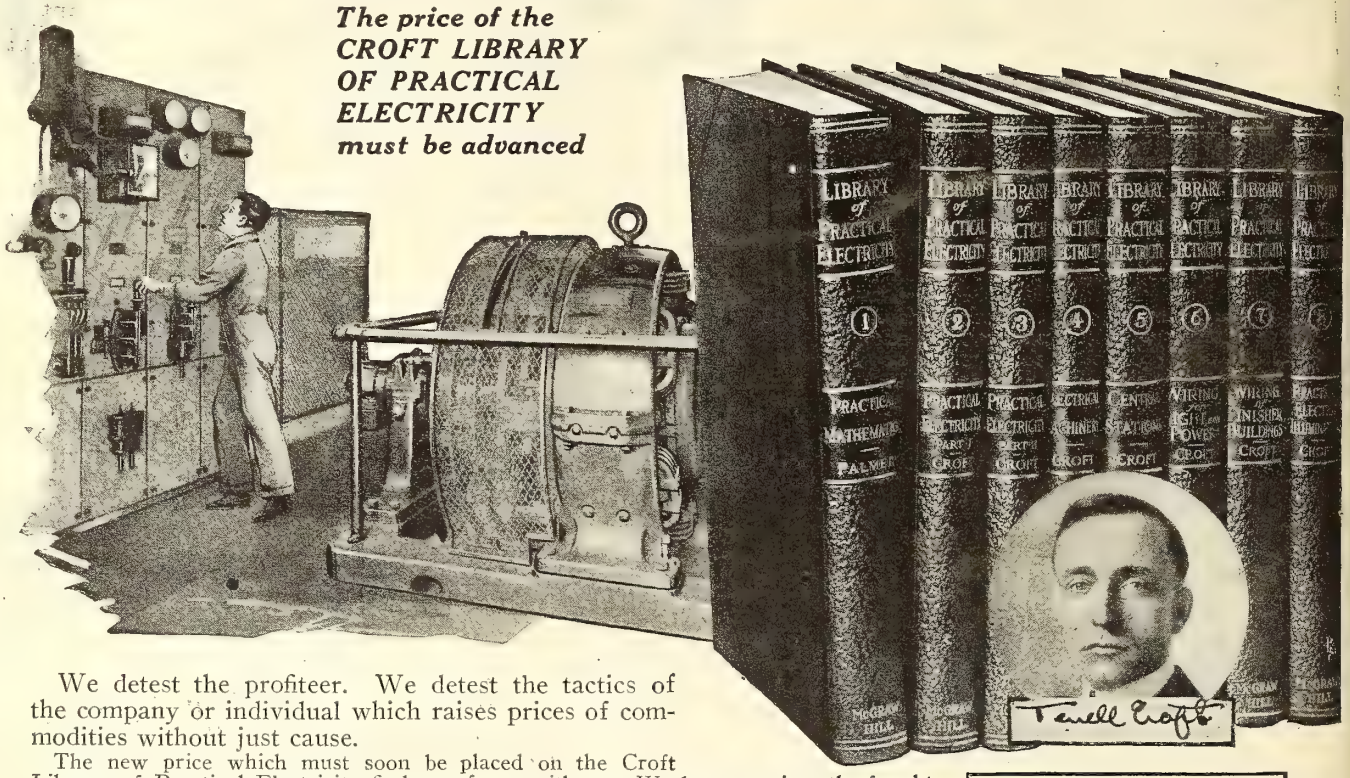
All communications and contributions to this journal should be addrest to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1920, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Goeffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London. Member of the Audit Bureau of Circulation.

$20 for a complete electrical education soon will be ancient history

The price of the CROFT LIBRARY OF PRACTICAL ELECTRICITY must be advanced



We detest the profiteer. We detest the tactics of the company or individual which raises prices of commodities without just cause.

The new price which must soon be placed on the Croft Library of Practical Electricity finds no favor with us. We have persistently fought against increases in the prices of our books. We have succeeded in keeping these advances down to a minimum. Whereas most other commodities today are sold at advances over former prices of 100% to 500%.

Technical book prices have remained nearly the same. But the present abnormal costs of paper and materials going into the manufacture of the Croft Library compels us to raise the price. Paper is going up daily. It is hard to get at any price. Usually only small quantities are procurable. With the unheard-of shortage of wood pulp there can be no drop in prices.

Still time to act

So $20 for a complete electrical education will soon be a thing of history. We must stop publication of the Croft Library—or raise the price.

The advance will take place very soon. You still have an opportunity to procure the meat of up-to-date electrical practice in America at a fraction the cost of the same information procured from any other source. You still have the chance to possess the most vitally important electrical data in print today, at a very low price.

Records of actual electrical practice

Records of actual practice, written by a practical man, written so you can understand, illustrated so that nothing remains a mystery.

The coupon brings the entire set to you

Use the coupon below today. Let us send you for absolutely free examination a set of books, the only aim of which is to place you in a higher paying position, and to make you master of whatever branch of electricity interests you.

Not a cent in advance—small monthly payments if you're pleased

Examine these wonderful books—use them ten days in connection with your work. Then send them back at our expense if you are not satisfied. If wanted, send us $2 in ten days, and then $3 per month for six months.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York
Publishers of Books for Engineers Since 1876

Read This—

Electricity, from the simplest principles to complete and economical operation of a central station—

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect, in accordance with the National Electrical Code.

Wiring of finishing buildings. Underwriters' and municipal requirements. How to do the complete job, from estimating it to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the short-cuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.
239 West 39th St., New York.

Gentlemen: Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions. (Price subject to advance.)

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation ..... S & I 1-21

Vol. VIII
Whole No. 94

Science and Invention

FORMERLY

ELECTRICAL EXPERIMENTER

233 FULTON STREET-NEW YORK

February, 1921
No. 10.

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 and 236 Fulton Street, New York

A New Giant

THE year 1919 has not been a very prolific one in great discoveries. But the greatest scientific achievement of the year 1919 and perhaps a decade, doubtless, was Professor Michelson's discovery of a method for measuring the size of stars.

Fixt stars are so far removed from us, that even the nearest one, *Alpha Centauri,* is so distant, that if we imagine a wire stretched to this star, it would take our voice four and one-third years to travel over this wire until the man at the other end of the telephone receiver would hear the first sound; altho we know that electricity travels at the rate of 186,000 miles per second. Professor Michelson succeeded in measuring the size of some of these stars, altho they are billions of miles distant from us. *Alpha Centauri* just mentioned is over four light years distant from us, meaning thereby that it takes light or electricity, both traveling 186,000 miles per second, over four years to bridge this tremendous chasm. While we know that all fixt stars are suns like our own, and for that reason are of tremendous proportions, the imagination is overwhelmed when we try to grasp the size of Betelgeuse, in the constellation of Orion, which Professor Michelson's researches recently made it possible to measure accurately. Betelgeuse, which is about 150 light years distant from the earth, is 40,000,000 times as large as the sun. In other words, if we were to place about 350 suns side by side, we would then have a star of the diameter of this new giant, Betelgeuse.

Figures of this kind, while tremendous, mean nothing to our imagination, because our microscopic minds simply fail to grasp them. The writer therefore wishes to give a few illustrations which will make the enormous size of Betelgeuse more apparent.

A man on the earth, let us say, weighs 150 pounds. Transported to the sun the same man would weigh 4,146 pounds, or over two tons. This is due to the greater gravitational attraction, just as on the moon the same man would weigh less than 25 pounds, the moon being much smaller than the earth. But on Betelgeuse the same man would weigh 2,494,146 pounds, or 1,242 tons, if we estimate that Betelgeuse has the same density as the sun, *which, by the way, it has not.*

Suppose you live on Betelgeuse and you have a friend living on the other side of that globe. You call him up on the telephone, and it takes your voice exactly 42¼ minutes to travel half way around Betelgeuse, altho electricity as we know travels 186,000 miles per second. In this case you would speak your message into the telephone receiver, go out and have lunch for over an hour, and when you returned the words from your friend would just begin to pour from your receiver.

A train traveling 60 miles an hour speeding along the equator without stopping would take 419 hours or a little over 17 days to complete the circle on our own globe. The same train on Betelgeuse running at the same speed would take 1,792 years to cover the trifling circumference. In other words, a train which had started during the downfall of the Roman Empire would just now arrive at its destination!

Betelgeuse is 52,630,000,000,000 times the size of our earth. This means nothing to our mind. If, however, we asked you to count these billions of globes that you could tack away into Betelgeuse, at the rate of 100 per minute, it would take one million years to count them all, not forgetting that each globe is the size of our earth.

H. GERNSBACK.

CONTENTS FOR FEBRUARY, 1921

CAN WE MAKE OURSELVES INVISIBLE?...Front Cover
From a Painting by Harold V. Brown
A FLOATING CITY..... 1063
SWIFTEST THINGS ON EARTH..... 1064
A NIAGARA OF BUBBLES..... 1065
PIPING COAL FROM MINE TO CITY..... 1066
By Reginald Pelham Bolton
SCIENCE IN PHOTOS..... 1068
A RADIOGENES.....By Charles S. Wolfe 1070
NEW YORK SUBWAYS A CENTURY HENCE..... 1071
By H. Winfield Secor, E.E.
THE RADIUM INSTITUTE OF PARIS—THE REMARKABLE WORK OF MADAME CURIE..... 1072
CAN WE MAKE OURSELVES INVISIBLE?..... 1074
By H. Gernsback, Member of American Physical Society.
SCIENCE MEASURES THE ATHLETE..... 1075
THE X-RAY FLUID.....By Jules H. Stean, Ph.D. 1076
TALKING ON A "THREAD"..... 1077
THE DIVINING ROD—IS IT A FAKE?..... 1080
By Prof. T. O'Conor Sloane, Ph.D., LL.D.
IS ELECTROCUTION HUMANE?..... 1081
By Joseph H. Kraus
THE SUN'S UNKNOWN RAYS..... 1086
By Rogers D. Rusk, M.A.
"MOTOR HINTS" PRIZE CONTEST..... 1087
HOME ELECTRICS—READING THE HOUSEHOLD ELECTRIC METER.....By G. L. Hoadley, M.E. 1089
POPULAR ASTRONOMY—THE MAGNETISM OF THE SUN..... 1090
By Isabel M. Lewis, M. A., of the U. S. Naval Observatory.
CHARGING IGNITION BATTERY AT HOME..... 1092
By H. C. Petzwal
THE HALL JET RELAY FOR RECORDING RADIO SIGNALS.....By Prof. Ralph D. Doner 1099

SCIENCE AND INVENTION is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO, Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

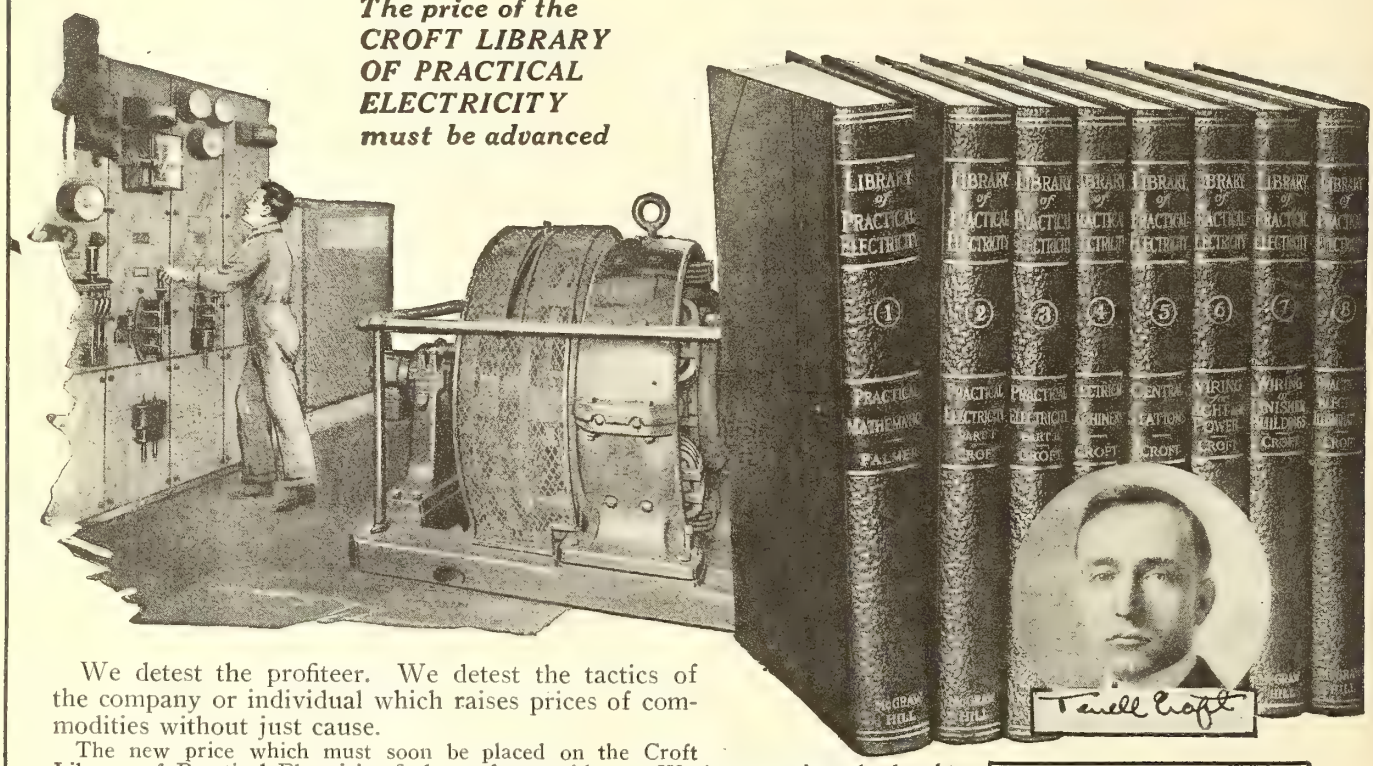
All communications and contributions to this journal should be addrest to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1921, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Goeffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London. Member of the Audit Bureau of Circulation.

$20 for a complete electrical education soon will be ancient history

The price of the CROFT LIBRARY OF PRACTICAL ELECTRICITY must be advanced



We detest the profiteer. We detest the tactics of the company or individual which raises prices of commodities without just cause.

The new price which must soon be placed on the Croft Library of Practical Electricity finds no favor with us. We have persistently fought against increases in the prices of our books. We have succeeded in keeping these advances down to a minimum. Whereas most other commodities today are sold at advances over former prices of 100% to 500%.

Technical book prices have remained nearly the same. But the present abnormal costs of paper and materials going into the manufacture of the Croft Library compels us to raise the price. Paper is going up daily. It is hard to get at any price. Usually only small quantities are procurable. With the unheard-of shortage of wood pulp there can be no drop in prices.

Still time to act

So $20 for a complete electrical education will soon be a thing of history. We must stop publication of the Croft Library—or raise the price.

The advance will take place very soon. You still have an opportunity to procure the meat of up-to-date electrical practice in America at a fraction the cost of the same information procured from any other source. You still have the chance to possess the most vitally important electrical data in print today, at a very low price.

Records of actual electrical practice

Records of actual practice, written by a practical man, written so you can understand, illustrated so that nothing remains a mystery.

The coupon brings the entire set to you

Use the coupon below today. Let us send you for absolutely free examination a set of books, the only aim of which is to place you in a higher paying position, and to make you master of whatever branch of electricity interests you.

Not a cent in advance—small monthly payments if you're pleased

Examine these wonderful books—use them ten days in connection with your work. Then send them back at our expense if you are not satisfied. If wanted, send us $2 in ten days, and then $3 per month for six months.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York
Publishers of Books for Engineers Since 1876

Read This—

Electricity, from the simplest principles to complete and economical operation of a central station—

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type, installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect, in accordance with the National Electrical Code.

Wiring of finishing buildings. Underwriters' and municipal requirements. How to do the complete job, from estimating it to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the short-cuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.
239 West 39th St., New York.

Gentlemen: Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $2 in ten days and $3 per month until $20 has been paid. If not wanted, I will write you for return shipping instructions. (Price subject to advance.)

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation ..... S & I 2-21

Vol. VIII
Whole No. 95

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

March, 1921
No. 11.

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 and 236 Fulton Street, New York

The Mysterious Rays

WHEN Röntgen first discovered the X-rays, the discovery provided a sensation not only in scientific circles, but it caught the popular fancy as well. When these mysterious rays were first discovered, the outstanding facts about them were of course their penetration thru the human tissue, and it gave us the means to view the bones in the human body, a thing which before that time had appeared fantastic of accomplishment.

Altho it is now twenty-five years since X-rays have been discovered, we still know very little about them. In some quarters it is maintained that X-rays are not a wave motion of the ether similar to light, but that on the contrary, the rays are really streams of matter shot off at the speed of light. This view, however, does not seem to be upheld lately, mainly for the reason that it has been discovered that X-rays can be refracted in certain crystals similar to light rays, which latter can be refracted by means of prisms and lenses. As time wore on many new wonders became possible by means of the X-ray. It was early found that these rays have the property to ionize, *i.e.*, making electrically conductive the air thru which the rays pass. This quality is shared by radium in a similar manner.

Every day we behold new wonders which are accomplisht by the X-ray in one way or another. Certain diseases for many years have been treated by means of X-rays and cures have been effected on cancerous tissues by these rays as well. Metal castings which have invisible flaws need no longer endanger human life; for instance, our automobile axle may look perfect from the outside, but it may have invisible fissures hidden inside. The X-ray reveals these faults today. Certain insects which infect tobacco are now killed by X-rays. The crates containing the tobacco are subjected to the rays and the insects are killed off in short order. One of the greatest scourges of humanity, insanity, is now indirectly cured by the X-ray. Teeth containing pus were hitherto unsuspected of creating insanity, but they do just that. The X-rays show at once such defective teeth. There are now thousands of recoveries if the teeth are either treated or extracted properly.

By rubbing the finger over metallic powder and taking an X-ray picture, the French police recently found this to be a valuable adjunct to ordinary finger printing. Not only do we thus get the true picture of the skin's lines and whorls, the same as if ink were used, but we get the structure of the bones as well, and these were found to vary just as much as the finger prints themselves.

Oil paintings by old masters are now readily proven genuine or spurious by means of X-rays giving us immediately the true condition of the painting.

Recently X-ray moving pictures have been proposed whereby audiences may witness the most fantastic spectacles ever seen. Instead of seeing the human beings or animals in the flesh, we see only the bones as well as the outlines of the body.

We may safely say that we have only scratched the surface with the X-ray. Every day brings forth new wonders—new applications. It is impossible to draw a line limiting what can be accomplisht by these mysterious rays in their own field, and much is to be hoped for from them during the next few years.

H. GERNSBACK.

CONTENTS FOR MARCH, 1921

AND NOW X-RAY MOVIES.....Front Cover
From a Painting by Harold V. Brown
ELECTRICAL POWER FROM TIDAL ENERGY..... 1169
THE MOVIE THEATER OF THE FUTURE..... 1172
By H. Gernsback, Member of American Physical Society.
X-RAYS EXPOSE COUNTERFEITED "OLD MASTERS".....By Jacques Boyer 1174
THE ANATOMY OF CRYSTALS..... 1177
With Special Illustrations by William M. Butterfield.
X-RAY MOVIES—WHY NOT?..... 1178
By Prof. Harold F. Richards, Ph.D.
HOW WE FEEL—THE SENSE OF TOUCH..... 1179
By Joseph H. Kraus
WHY WE GROW BALD..By David J. Calicchio, M. D. 1180
MOTOR HINTS—$50.00 PRIZE CONTEST..... 1181
POPULAR ASTRONOMY — MEASURING THE GIANTS OF THE UNIVERSE..... 1182
By Isabel M. Lewis, M.A., of the U. S. Naval Observatory.
EARLY STEAM ENGINES FROM HERO OF ALEXANDRIA TO JAMES WATT..... 1184
By Prof. T. O'Conor Sloane, Ph.D., LL.D.
THE DEVIL'S UNDERSTUDY—SCIENTIFIC FICTION.....By Charles S. Wolfe 1188
DR. PRINGLE DISCUSSES MIND....By John Dequer 1190
IF NEW YORK CITY WERE THE SNOWIEST PLACE ON EARTH..... 1195
HOW ROTOGRAVURE PICTURES ARE MADE..... 1197
By Oswald R. Schultz
THE VELOCITY OF LIGHT..... 1198
By Prof. James S. Stevens, Dept. of Physics, University of Maine.
HOME MECHANICS..... 1199
Conducted by William M. Butterfield
PRACTICAL CHEMICAL EXPERIMENTS—CRYSTALLIZATION.....By Prof. Floyd L. Darrow 1201
THE CONSTRUCTOR DEPARTMENT..... 1202
WRINKLES, RECIPES AND FORMULAS—INTERESTING CHEMICAL EXPERIMENTS..... 1206
By O. Ivan Lee

SCIENCE AND INVENTION is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries, $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be address to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

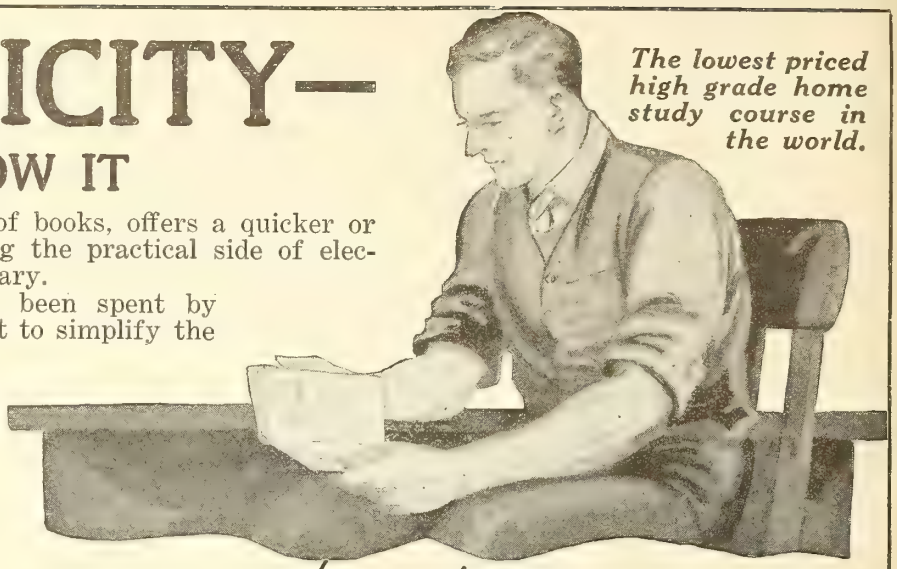
SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1921, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Member of the Audit Bureau of Circulation.

ELECTRICITY—

AS EXPERTS KNOW IT

The lowest priced high grade home study course in the world.



NO course, no book, no set of books, offers a quicker or surer method of mastering the practical side of electricity than the Croft Library.

A quarter of a century has been spent by writers and teachers in an effort to simplify the principles of electrical practice.

The pinnacle in self-help educational literature has been reached in the Croft Library.

It is different from any other literature of the kind in existence. It is founded purely on work as it is done. It is built by a practical man. It is practice itself. It will actually save any man about 90% of the usual apprenticeship period.

Even the beginner can understand it. And it is the daily guide of thousands of highly paid electrical workers and engineers.

Whether you are experienced or not, you can entrust your entire electrical education to the Croft Library.

"Know electricity as experts know it."

Don't be content with $38 to $50 per week

Don't be content with just a fair knowledge of electricity. Don't be satisfied with the average electrical worker's salary of $38 to $50 per week. Know electricity as experts know it. Terrell Croft will tell you how.

Learn while you earn

NOT ONE CENT IN ADVANCE

Merely fill out the coupon below and return to us for ten days' absolutely free examination of the CROFT LIBRARY OF PRACTICAL ELECTRICITY. Use the books in connection with your work for ten full days. See how the hundreds of problems in electrical practice are cleared up in simple language and illustration. If thoroughly convinced that the books will enable you to know electricity as experts know it, send us the small monthly payments mentioned in the coupon below. Return the books at our expense if not entirely pleased.



8 Volumes
Flexibly bound
Pocket Size
3000 pages
2100 illustrations
Everything you must know about electricity at the finger's end

A letter that means something to YOU—

McGraw-Hill Book Co., Inc.
239 W. 39th St., New York, N. Y.

Gentlemen:—In an attempt to express myself about CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY, I have never seen, and do not believe there was ever printed in the English language, a more comprehensive set of books. It is a library that is just as valuable to the novice as to the expert, because it is all practice. Respectfully,

GUY H. PEIFER,
Chief, Doplan Silk Corporation,
Hazleton, Pa.

McGRAW-HILL BOOK CO., Inc.

239 West 39th Street, New York

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.
239 W. 39th St., New York

Gentlemen:—Please send me the Library of Practical Electricity (shipping charges prepaid), for ten days' free examination. If satisfactory I will send $3 in ten days and $3 per month until $27.50 has been paid. If not wanted, I will write you for return shipping instructions.

Name .....

Home Address .....

City and State .....

Where Employed .....

S & I 3-21

Vol. VIII
Whole No. 96

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

April, 1921
No. 12

Publisht by Experimenter Publishing Company, Inc., (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y) 233 and 236 Fulton Street, New York

Scientific Paradoxes

THE more we learn, the less we know—is a true saying, particularly true today. Every new discovery, every new fact opens new labyrinths to our knowledge, without end to the number to be entered in the future. Take for instance light and heat, i. e., radiant energy as originated in our sun. When on a hot summer's day we sit in a broiling sun, out steps an aviator from his airplane. He is swathed in furs and wears an electrically heated suit. His face and fingers are not thawed out yet, due to the terrific cold he experienced only four miles above your head, ten minutes ago. Your thermometer registered 120 degrees in the sun, his 30 degrees below zero in the same sun! And he was actually four miles nearer to the sun than you. Of course science tells us the reason for this paradox. The dense atmosphere charged with watery vapor and perhaps with clouds near the earth, along with the solid and liquid matter of the earth's surface, easily retains and accumulates the heat received from the sun's rays. But four miles up the air is very rarefied and very diathermic, and the heat is no longer retained but passes through to mother earth with little effects on the thin atmosphere. Heat and the earth's atmosphere in this instance act analogously to water and a sponge. Water (heat) is eagerly absorbed by the sponge (atmosphere) and is retained by the latter. Now take the same size sponge which has big holes all thru it (rarefied atmosphere). It is evident that such a sponge cannot retain as much water as a perfect one. The more water you pour in it, the quicker it runs out.

But let us go a bit further. We actually know that all heavenly bodies gravitate in a perfect vacuum. Thus we know that if we were to rise only 500 miles above the surface of the earth, we would find ourselves in an absolute vacuum. We furthermore know that out in space the temperature in this vacuum is −459.4 degrees, i. e., absolute zero. We can also demonstrate by experiment that heat cannot be propagated in a vacuum by conduction or by convection. An ordinary thermos bottle readily proves this. Fill the latter with boiling water, and the outside will stay cold, due to the vacuum separating the inside and the outside of the bottle.

The case of the sun and the earth is analogous. Heat proper cannot flow between these bodies immersed in a perfect vacuum and besides separated some 92 million miles. So we see that we *do not* and cannot receive radiant heat rays from the sun.

Paradoxically enough we know for sure that we get heat *somehow* in spite of our logic. How? Scientists have a vague notion about it, but they are not too sure. They now think that when the ether waves, devoid of all temperature coming from the sun at a speed of 186,000 miles a second strike our dense atmosphere, the terrific impact results in heat; it is analogous to a meteor, which at a temperature of absolute zero, striking our atmosphere, goes up in metal vapor, due to the enormous friction set up. So we see that after all we do not get heat from the sun at all, merely ether waves, which by shock or impact are turned into heat.

Another paradox not so readily explained is the revolution of the earth around the sun. The earth with the sun at its center swings around the latter at the frightful speed of over 65,000 miles an hour. One would think that the titanic centrifugal force set up would make the earth fly off its orbit into infinite space. It can even be calculated that in order to keep the earth from being whipt off we would require a steel cable fastened to it and reaching to the sun. The thickness of this cable would have to be almost as great as the diameter of the earth! But there is no cable as we know and the earth does not fly out of its orbit. We talk merrily about mutual gravitation holding the earth to its course, but there are many objections, logical and otherwise. The plain truth is, we don't know.

H. GERNSBACK.

CONTENTS FOR APRIL, 1921

CAN WE VISIT THE PLANETS?.....Front Cover
From a Painting by Harold V. Brown
200-MILE-PER-HOUR AIR-PROPELLED RAILWAY..... 1279
ELECTRIC POWER FROM THE AIR..... 1280
SCIENTIFIC LIFTING STUNTS FOR YOUR PARLOR..... 1281
TYPEWRITING AND STENOGRAPHIC MACHINES FOR THE BLIND..... 1282
ODDITIES OF PHYSICS.....By H. Winfield Secor 1284
HOW BIG ARE MOLECULES?....By Rogers D. Rusk, M.A. 1286
PECULIAR BEETLE LOCOMOTION.....By Dr. E. Bade 1288
FLYING IN SPACE.....By H. Gernsback 1290
MOTOR HINTS PRIZE CONTEST..... 1293
POPULAR ASTRONOMY—THE ORIGIN OF THE EARTH 1294
By Isabel M. Lewis, M.A., of the U.S. Naval Observatory
HOW ROCKS GROW.....By William M. Butterfield 1297
THE "LOVE MACHINE"—SCIENTIFIC FICTION..... 1300
By Charles S. Wolfe
"IN 1999"—SCIENTIFIC FICTION....By B. Franklin Ruth 1302
A TRIP TO THE MOON..... 1303
RECENT WORK OF THE BUREAU OF STANDARDS..... 1305
HOME ELECTRICS—"WHEN THE FUSE BLOWS OUT".. 1306
By G. L. Hoadley, M.E.
HOME MECHANICS....Conducted by William M. Butterfield 1307
EXPERIMENTAL CHEMISTRY..By Prof. Floyd L. Darrow 1308
A MODEL ELECTRIC RAILWAY DE LUXE..... 1309
By Earl Christmas
IS OHM'S LAW VALID?.....By C. A. Briggs 1312
RADIO "TALK" RELAYED TO LAND LINES..... 1315
THE AUDIO-FREQUENCY AMPLIFIER IN FRANCE..... 1317
By Robert E. Lacault
"LATEST PATENTS" DIGEST..... 1319
WHAT TO INVENT.....By Jay G. Hobson 1320

SCIENCE AND INVENTION is publisht on the 25th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addrest to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

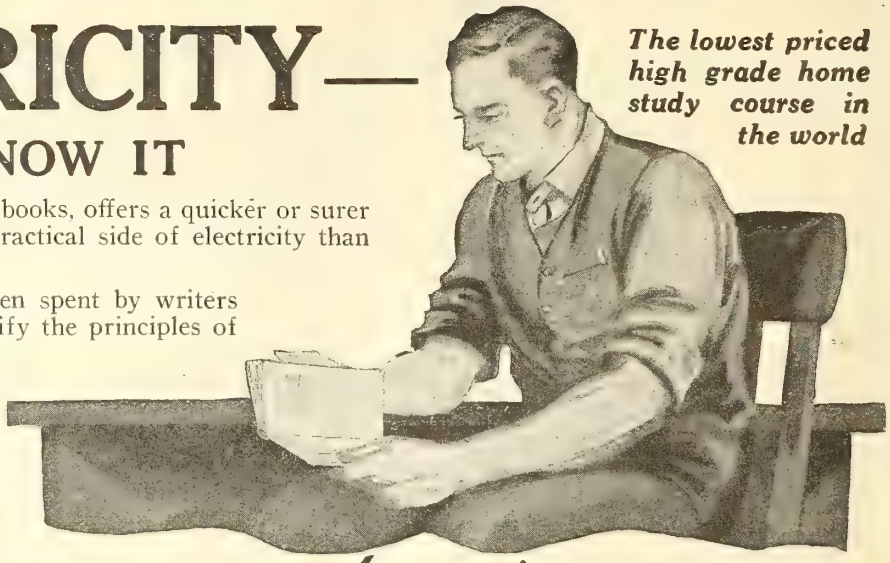
SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1921, by E. P. Co., Inc., New York. The Contents of this Magazine are copyrighted and must not be reproduced without giving full credit to the publication.

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Member of the Audit Bureau of Circulation.

ELECTRICITY—

AS EXPERTS KNOW IT

The lowest priced high grade home study course in the world



NO course, no book, no set of books, offers a quicker or surer method of mastering the practical side of electricity than the Croft Library.

A quarter of a century has been spent by writers and teachers in an effort to simplify the principles of electrical practice.

The pinnacle in self-help educational literature has been reached in the Croft Library.

It is different from any other literature of the kind in existence. It is founded purely on work as it is done. It is built by a practical man. It is practice itself. It will actually save any man about 90% of the usual apprenticeship period.

Even the beginner can understand it. And it is the daily guide of thousands of highly paid electrical workers and engineers.

Whether you are experienced or not, you can entrust your entire electrical education to the Croft Library.

"Know electricity as experts know it."

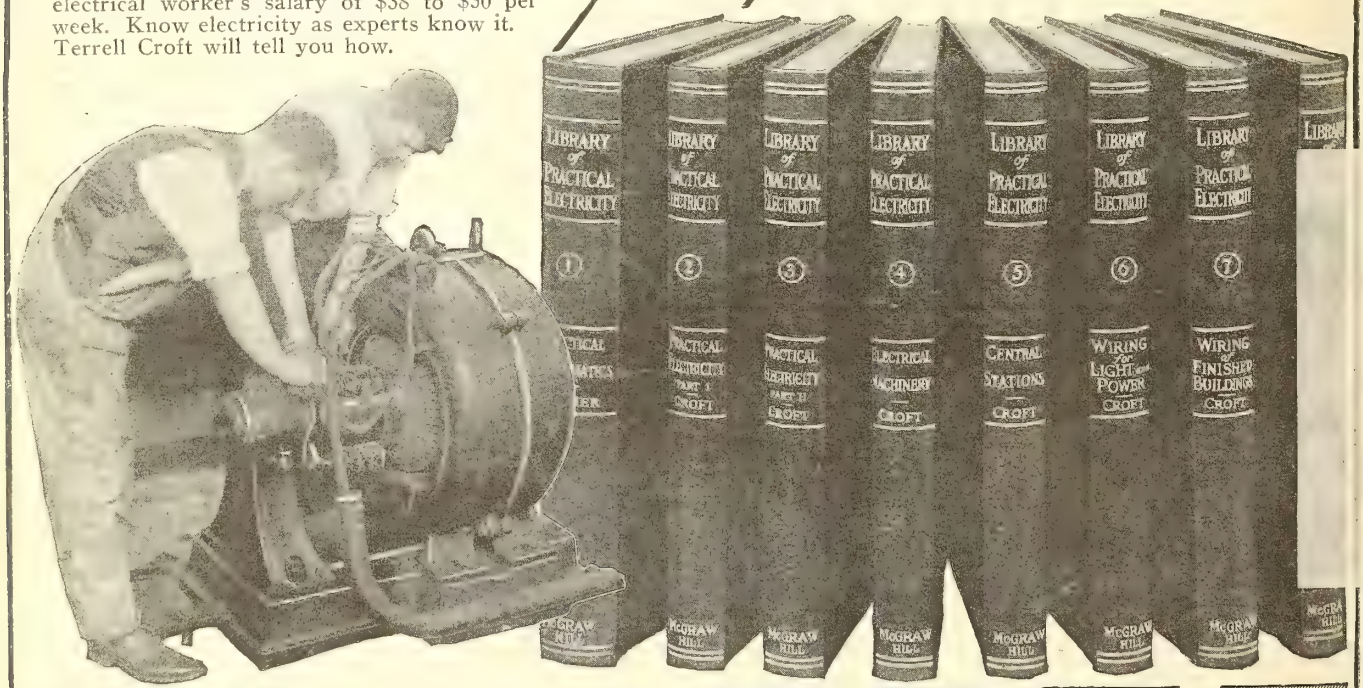
Don't be content with $38 to $50 per week

Don't be content with just a fair knowledge of electricity. Don't be satisfied with the average electrical worker's salary of $38 to $50 per week. Know electricity as experts know it. Terrell Croft will tell you how.

Learn while you earn

NOT ONE CENT IN ADVANCE

Merely fill out the coupon below and return to us for ten days' absolutely free examination of the CROFT LIBRARY OF PRACTICAL ELECTRICITY. Use the books in connection with your work for ten full days. See how the hundreds of problems in electrical practise are cleared up in simple language and illustration. If thoroughly convinced that the books will enable you to know electricity as experts know it, send us the small monthly payments mentioned in the coupon below. Return the books at our expense if not entirely pleased.



8 Volumes
Flexibly bound
Pocket Size
3000 pages
2100 illustrations
Everything you must know about electricity at the finger's end

A letter that means something to YOU—

McGraw-Hill Book Co., Inc.,
370 7th Ave., New York, N. Y.

Gentlemen:—In an attempt to express myself about CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY, I have never seen, and do not believe there was ever printed in the English language, a more comprehensive set of books. It is a library that is just as valuable to the novice as to the expert, because it is all practice. Respectfully,

GUY H. PEIFER,
Chief, Doplan Silk Corporation,
Hazleton, Pa.

McGRAW-HILL BOOK CO., Inc.
370 7th Ave., New York

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.,
370 7th Ave., New York.

Gentlemen:—Please send me the Library of Practical Electricity (shipping charges prepaid), for ten days' free examination. If satisfactory I will send $3 in ten days and $3 per month until $27.50 has been paid. If not wanted, will write you for return shipping instructions.

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation ..... S & I-4-21

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 90014 6689